THE GENUS ASTROLOBA UITEWAAL.

(LILIACEAE)

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SUMMARY.

The present work was undertaken to provide a much needed taxonomic revision of the genus Astroloba Uitew. Type material of all previously described species appears to be completely lacking.

This revision was based almost entirely on living material collected by the author. Studies were made of morphological variation, geographical distribution, cytology and ecology.

The morphological studies were based on field population samples. As a result of these studies, seven species and three subspecies were established, of which three species and one subspecies are new : A. rugosa Roberts, A. hallii Roberts, A. smutsiana Roberts and A. foliolosa subsp. robusta Roberts. One new combination is made : A. foliolosa subsp. congesta (Salm-Dyk) Roberts. A new key to the species is given.

Because this genus is so little known, a large number of plates are included.

A new hybrid genus, X Astroworthia Roberts, was established for hybrids between the genera Astroloba and Haworthia Duval. This consists at present of one species, X Astroworthia bicarinata (Haworth) Roberts comb. nov.

THE GENUS ASTROLOBA UITEW.

INTRODUCTION AND APPROACH TO THE PROBLEM.

Astroloba Uitew. (1947), (formerly known as Apicra Duval) is a small genus of succulent plants confined to the South central, Southern and Eastern karoid areas of the Cape Province. Since Berger's work on the Aloinae (1908), the only work on the genus to date, has been done by overseas succulent enthusiasts who have been unable to study populations in the field.

The similar facies of all members of this genus makes the delimitation of species a difficult problem. Early type descriptions, as will be shown later, were in most cases inadequate, seldom accompanied by an illustration, and taken from living plants which were not preserved as herbarium specimens. This has resulted in considerable confusion over interpretation of the described species.

The present author found it necessary to begin this revision of the genus by establishing, de novo, what she herself considered to be taxa of at first unspecified status. Succulent plants make poor herbarium specimens and herbarium material of Astroloba, apart from being scant, is no exception to this rule. Accordingly, this revision has been based almost entirely on living material collected by the author.

In the field, plants of Astroloba do not occur singly but in varying numbers over limited areas where they are numerically conspicuous components of the vegetation. With a few exceptions, these populations are uniform. Groups of them have sufficient characters in common to justify the recognition of each group as a taxon of unspecified status. These groups of related populations were used by the present author as a working basis for her reassessment of the specific concept in Astroloba. In the text they are referred to as <u>entities</u>, and, until their taxonomic position has been established, they are indicated by an underlined epithet, e.g.: <u>bullulata</u>.

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Detailed knowledge of these entities made it possible to associate certain of them with previously described taxonomic categories. These are bullulata, spiralis, herrei, congesta, foliolosa and rugosa, (which was erroneously named Aloe aspera by Salm-Dyk (1836-63)). Other entities recognised by the present author are hallii, smutsiana and robusta.

Grounds for the superficial recognition of these entities are given below.

The entities spiralis and herrei are distinguished by the fact that both have an inflated perianth, and are separated by the presence of fine striations on the leaves of herrei, which are absent from the leaves of spiralis, and by the fact that the perianth in spiralis is very markedly transversely rugose.

The nature of the leaf surface divides the remaining entities into two groups.

The entities foliolosa, congesta and robusta have leaves with a glossy sheen. Of these three, the entity robusta has characteristically thick peduncles, long floral bracts and predominately sessile flowers. The leaves of the entity foliolosa tend to be shorter and more rounded than those of the entity congesta, as well as more patent and imbricate in arrangement.

The remaining entities have leaves with a matt sheen of these, the entities bullulata, hallii and rugosa have some or all individuals with tuberculate leaves. The leaves of the entity rugosa are the smallest of the three, and have apices of the true marginate type (see page 14). Both the entities bullulata and hallii have the majority of leaves with keeled-marginate apices. The leaves of bullulata tend to be broader than hallii, and with the tubercles transversely arranged. In hallii the tubercles tend to be in longitudinal series, and further there are fine striations on the under surfaces of most leaves.

The remaining entity, smutsiana, has no tubercles and leaves with true marginate apices, but sometimes the leaves do have fine striations on their under surfaces towards the apex.

A short account of the plan of this thesis now follows. First a survey of the morphology and anatomy in the genus as a whole is given. It is hoped that this will confirm for the reader the recognition by the author of the groups of populations referred to as entities. From this survey, similarities between certain entities are established and various groups are recognised.

A detailed discussion of the distribution of the entities then follows.

Because of the ease with which leafy shoots strike root, cytological material was readily available, and as far as possible a cytological survey was also made. An account of the cytology of the entities follows the account of entity distribution.

Then, a more detailed examination of the various groups of related populations is given. From this it is possible to assess their taxonomic position. This is followed by a survey of the literature and taxonomic history of the genus.

The thesis concludes with a key to, and descriptions of, the species according to the present author, accompanied by their synonomy and citation of specimens examined.

Note on representation of numerical data.

The actual measurements of the various characters are given in the appendix. In the text these are expressed in a more compact and comprehensive form in tables.

In each table the range covered by the measurement is divided into appropriate classes, and the number of individuals occurring in each class is shown. The range of classes and the number of individuals in each class are shown under the heading: "Class range of measurements." in the tables. These tables gives more information than the histograms usually used to demonstrate the same point, and, in the author's opinion, are easier to assess visually, especially when taking into consideration the unevenness of sample size often met with in a survey of a taxonomic nature. Also included is the range of actual measurements for each sample. In the text the class or classes including the greatest number of individuals is, for the sake of brevity, sometimes referred to as the "majority range".

It is felt that this gives an adequate picture of the variation patterns within each group. From these tables, the taxonomic significance of the various measurements may be determined by inspection of the data thus presented. It is felt that in this case there is no need for a further assessment by statistical methods.

ASSESSMENT OF CHARACTERS IN THE GENUS AS A WHOLE

Note. Throughout this survey, population samples collected by the author are described by a collecting number and preceded by the letter "R".

A. VEGETATIVE CHARACTERS.

1. PLANT HABIT AND GROWTH

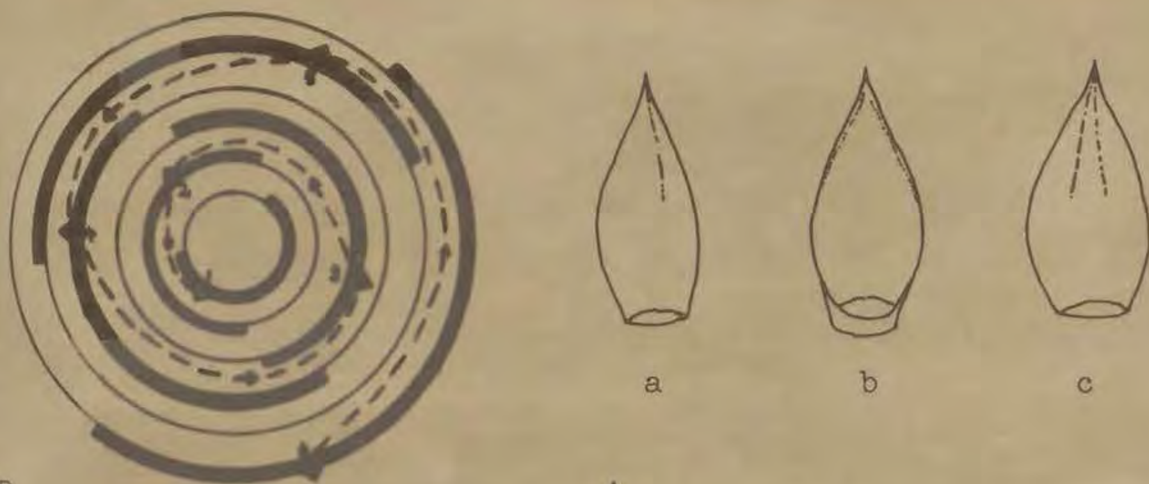
All the species of Astroloba have a caulescent habit, with adventitious roots at the base of the stem, and crowded mucronate leaves, the bases of which completely encircle the stem. The number of stems constituting a single plant varies - up to fifty have been recorded. Stem lengths of up to 60 cm. have been recorded in plants growing supported by bushes, notably in the entity rugosa, but leafy shoots growing unsupported in the open are generally less than 30 cm. in height. As the leafy stem increases in length, the basal portion comes to lie on the ground and develops adventitious roots.

It has been observed that all species for the most part only flower once a year, producing usually a single raceme. The peduncles are persistent, and thus a count of leaves between them gives an estimate of the number of leaves produced annually. This is found to be between five and eight, indicating growth to be quite slow.

2. LEAF ARRANGEMENT.

Because of crowding of leaves at the growing apices and because the developing leaf tends to be triangular in shape, the under surface of a fully developed leaf is keeled, the keel extending from the leaf apex for about two-thirds of the leaf length. (See Figs. 1A, and 2A and B.)

The leaves are alternate and spirally arranged with the keel always slightly to one side of the leaf depending upon the direction of the genetic spiral. If this is acropetally anti-clockwise, then the keel is situated to the left of the leaf undersurface (see Fig. 1B) and vice versa.



B A

Fig.1.A: Leaves from a plant of the entity robusta (R67) X1; a lower side of leaf showing keel; b upper side of leaf; c lower side of leaf with two keels.

B: Diagram of phyllotaxy of six successive leaves from the apex of a shoot of the entity herrei (R46).

Plants of the entity rugosa from Dobbelaars Kloof (R21), with leaves in five straight ranks. (The spiral angle is $0-10^{\circ}$).

Plants of the entity smutsiana from the Ladismith-Barrydale Karoo. Here the five ranks of leaves are spirally twisted. In the specimen on the right, the leaves are so spirally twisted, that they appear imbricate.

PLATE 1.

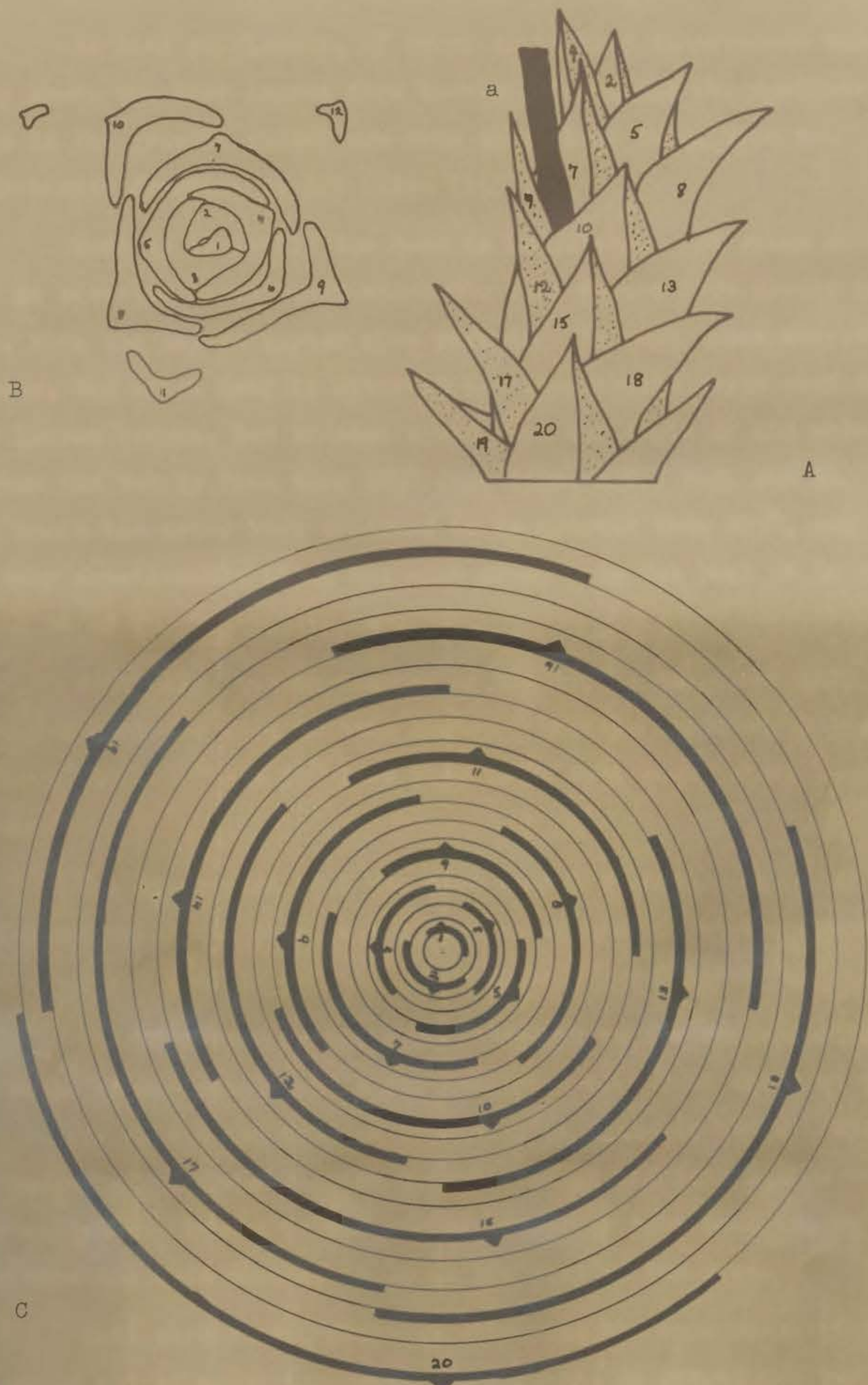


Fig.2.A: Apex of shoot of the entity robusta (R67), showing the leaf arrangement (X $1\frac{1}{2}$). The keel side is shaded; a old peduncle base. B: Section through apex of shoot from same plant (X 3). C: Diagram of phyllotaxy of shoot A. The leaf numbers in A and C correspond.

In leaf phyllotaxy, if every sixth leaf is situated directly above the leaf formed five leaves before, and two complete turns of the genetic spiral are made to achieve this, then the phyllotactic fraction is 2/5 (Esau 1953).

Such is basically the case in Astroloba. If every sixth leaf is situated immediately above the leaf formed five leaves before, then the leaves appear five ranked. In most cases observed, however, the sixth leaf is situated not immediately above that formed five leaves before, but in such a way that the angle of the spiral between the two is less than 720° (See figs. 1.B., 2.C. and 3). This angle has never been observed to be greater than 720°, and may very considerably along the same stem. In the text it is referred to as the "spiral angle".

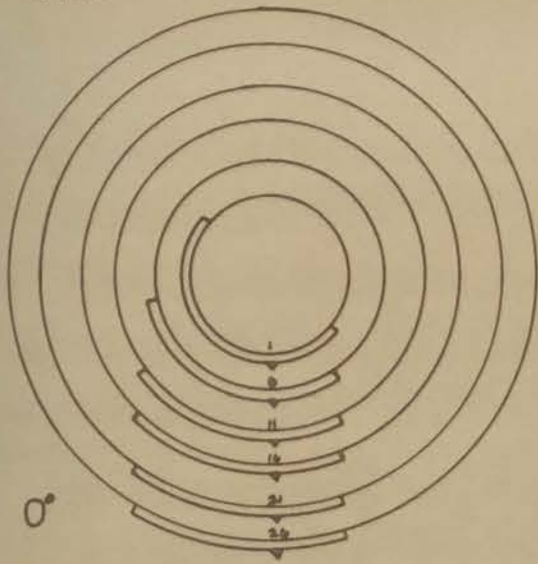
Naturally, the appearance of the leaf arrangement will vary depending upon the size of this angle. This is depicted in Figure 3, for 0°, 10°, 20° and 30° less than 720°; only every sixth leaf is shown. (See also Plate 1).

The divergence from the five ranked condition is partly due to a twisting of the stem in a direction apparently always counter to that of the genetic spiral.

The direction of the genetic spiral varies amongst different stems of one plant, and a few instances have been observed where the genetic spiral had changed direction on a single stem. This was indicated by the change in orientation of the leaf keels. In some cases, the leaves in the region of change were smaller, in others they were the same size as those on the rest of the stem.

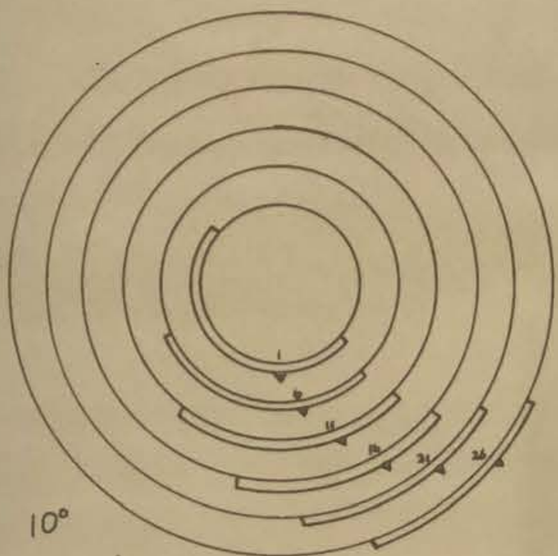
Leaf phyllotaxy, although affecting the appearance of the shoot, is not of great taxonomic significance in Astroloba, but the matter is dealt with in some detail because of the considerable emphasis placed on it by early taxonomists, as expressed in the descriptive phrases "five ranked","five ranked spirally twisted" and "so twisted as to appear imbricate", and in the specific epithets "spiralis" and "pentagona".

°<720°



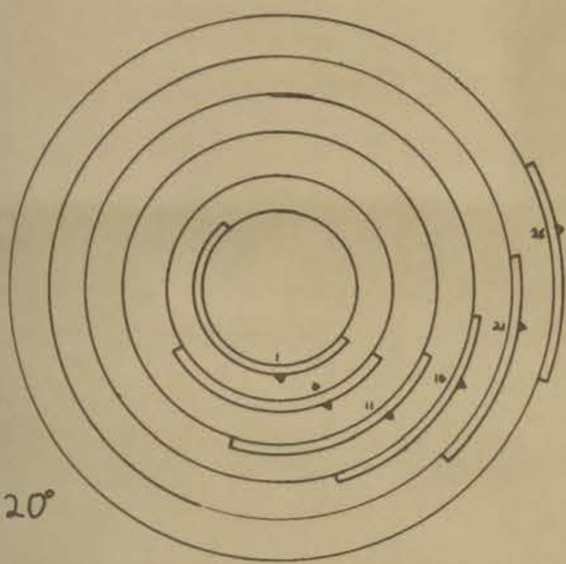
0°

Spiral angle 0°, leaves in five straight rows.



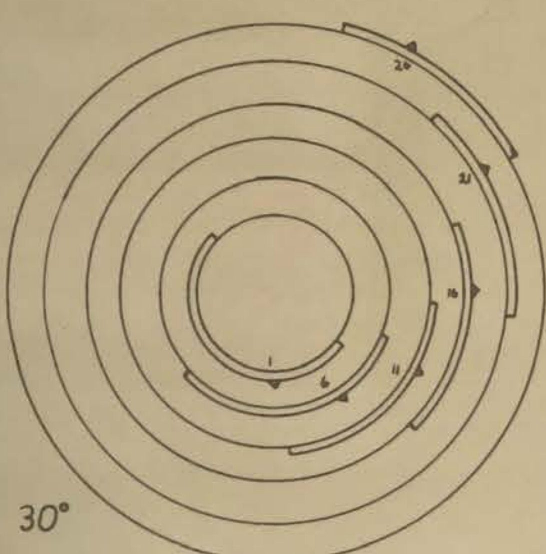
10°

Spiral angle 10°, leaves five-ranked, the rows in a slight spiral.



20°

Spiral angle 20°, leaves five-ranked, but the rows in a marked spiral.



30°

Spiral angle 30°, the five ranks of leaves so spiralled that leaf arrangement appears imbricate.

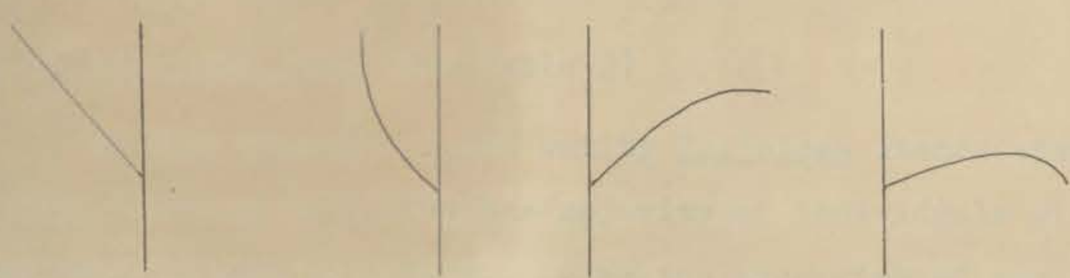
Fig.3. Diagram showing the effect of the size of the spiral angle on the leaf arrangement.

Approximate measurements were made of the angle by which the spiral of successive sixth leaves was less than 720°. A mean value of this spiral angle in each case was obtained by measuring the angle between a number of successive sixth leaves and dividing this by the number of spiral angles involved.

The angle the leaf makes with the stem and the curvature of the leaf apex, both of which also effect the appearance of the leafy shoot, show some slight differences depending upon species. In all samples, therefore, measurements obviously only approximate, were made of this angle, and the curvature of the leaf apices was noted.

Angle of leaf axil	30°	30-50°	50-70°	70-90°
Descriptive term	Erect	Suberect	Patent-erect	Patent

POSSIBLE CURVATURE OF LEAF APICES:-



Following angle of leaf with stem. Curving upward. Curving outward. Curving downward. (In the case of some very patent leaves)

TABLE 1. Showing the possible angles made by the leaves with the stem, the curvature of the leaf apices and the associated descriptive phraseology. (See also Plate 2).

A number of previous authors give the diameter of the stem including the leaves. Some of the accounts, notably that of Baker (1896-97) indicate that the measurements were made from leaf tip to leaf tip, in which case the diameter would vary according to the curvature of the leaf apex, as well as according to leaf size. Here the diameter of leafy stems is omitted for this reason.

NUMERICAL ASSESSMENT OF LEAF ARRANGEMENT.

(See Appendix Table 1.)

All these measurements were made with an ordinary protractor and are therefore, considering the bulky nature of the objects measured, somewhat approximate.

Spiral angle (See Table 2)

As is shown in Table 2, the total range of values is quite extensive in all entities, being least in hallii (0-20°) and widest in foliolosa (0-50°).

The entities hallii, bullulata and rugosa, with a majority range of 0-10°, have most individuals with leaves in 5 straight or very slightly spirally twisted rows. With increase of the spiral angle, the leaves become more spirally twisted. In the entities robusta and congesta the majority of individuals have a spiral angle of 0-20°. The entity smutsiana, with a majority range (see page 3) of 10-30° has spirally twisted or imbricate leaves in most individuals, while the entity foliolosa has the greatest number of individuals with imbricate leaves. In the entities spiralis and herrei there is an even distribution of individuals with all types of leaf arrangements.

Angle of leaf with stem (See Table 2)

In this character, the entity foliolosa stands apart from the other entities in having the majority of individuals with leaves either patent-erect or patent. With the exception of one specimen of the entity robusta, no individuals from samples of other entities extend into the patent class.

In the other entities, the majority of individuals have suberect leaves.

Curvature of leaf apices (See Table 2)

Here, the entities bullulata and hallii stand apart in that in most individuals the leaf apices curve upwards. The entity bullulata is further distinguished by the fact that most of the leaf apices not only curve upward but to one side, - the side on which the keel is situated. The leaf apices also curve upwards in a few individuals of the entities, spiralis and congesta, but in the majority of individuals of these entities the leaf apices follow the angle the leaf makes with the stem. In the entities smutsiana, rugosa, foliolosa and robusta the majority of individuals have the leaf apex curving outward. The entity herrei has an even distribution of in-

Entity.	Class range of measurements. *						Total no. indiv.	Range actual measurements.
	SPIRAL ANGLE. Class Interval 10°.							
	0	10	20	30	40			°
Bullulata	1	20	2	1	-	-	24	0 - 21
Hallii	3	18	3	-	-	-	24	0 - 16
Smutsiana	-	8	16	15	7	-	46	2 - 40
Spiralis	1	7	5	8	2	-	23	0 - 36
Herrei	-	6	8	5	-	-	19	10 - 30
Rugosa	1	13	6	2	-	-	22	0 - 25
Foliolosa	-	6	13	29	18	2	68	7 - 45
Congesta	-	18	27	9	3	2	59	1 - 41
Robusta	1	28	20	7	7	-	63	0 - 40

ANGLE OF LEAF WITH STEM. Class Interval 20°

	Erect	Sub-Erect. (30°)	Patent Erect. (50°)	Patent. (70°)	Total no. indiv.	Range actual measurements.
Bullulata	-	24	-	-	24	35 - 50
Hallii	6	18	-	-	24	20 - 50
Smutsiana	1	38	7	-	46	30 - 60
Spiralis	7	17	-	-	24	25 - 60
Herrei	-	18	1	-	19	35 - 60
Rugosa	-	21	1	-	22	40 - 60
Foliolosa	-	-	40	32	72	55 - 85
Congesta	3	45	17	-	64	30 - 70
Robusta	1	53	10	1	65	30 - 55

CURVATURE OF LEAF APICES.

	Upward andto one side	Upward	Following angle of leaf with stem.	Curving Outward	Curving outward and downward.	Total no. indiv.
Bullulata	19	5	-	-	-	24
Hallii	-	21	3	-	-	24
Smutsiana	-	-	16	30	-	46
Spiralis	-	1	16	7	-	24
Herrei	-	5	5	9	-	19
Rugosa	-	-	4	18	-	22
Foliolosa	-	-	10	54	8	72
Congesta	-	5	40	19	-	64
Robusta	-	-	15	49	1	65

Table 2 VARIATION IN LEAF ARRANGEMENT IN GENUS AS A WHOLE

* i.e. the whole range covered by the measurements, which has been divided up into appropriate classes, the number of individuals in each class being shown.

Fig. 4. Leaves seen from upper side of a : hallii (R26); b: bullulata (ex hort); c: smutsiana (R3), (X 1). Note keeled marginate apex in a and b and true marginate apex in c.

Leafy shoots of the entity bullulata; with the leaf apices curving upwards and sideways; the sideways curvature is less marked in the specimen on the right.

Leafy shoot of the entity robusta with the leaf apices following the angle made by the leaf with the stem.

Leafy shoot of the entity smutsiana, with the leaf apices curving outwards.

(All scales in cm.)

PLATE 2.

dividuals with leaf apices curving upwards, following the angle of the leaf with the stem, or curving outwards.

A note on the shape of the leaf apex

In the entities hallii and bullulata, all of the plants examined had most or all of the leaves with apices in which, when viewed from the upper side of the leaf, the margin on the side to which the keel was situated, lost its identity as an edge towards the apex, the keel itself then "functioning as a margin". (See Fig. 4). Such an apex is referred to as "keeled marginate". In both these entities, the leaf apex is often "shouldered" just below the mucro.

In all other members of the genus, the margin of the leaf on the side towards which the keel was situated, retained its identity as an edge. This is referred to as a "true marginate" apex. In these entities the leaf apex varies from acute to acuminate below the mucro.

Summary.

From the foregoing it is seen that several entities do emerge with a distinctive leaf arrangement. These are the entities hallii and bullulata with the majority of individuals with leaves in 5 straight or slightly spirally twisted rows, and their apices curving upwards in the case of the entity hallii and upwards and to the side in bullulata; and the entity foliolosa, with the majority of individuals having patent leaves with apices curving outward. The entities hallii and bullulata are further rendered distinct by the shape of their leaf apices.

The remaining entities have intermediate forms of leaf arrangement, which at their extremes embrace the condition found in these three, with the notable exception of the curvature of the leaf apices in the entity bullulata, and the very patent angle of 46% of the leaves of the sample of the entity foliolosa.

3. LEAF SHAPE.

In all species, the leaf shape is basically the same, that is roughly deltoid and keeled, with an acute acuminate apex ending in a short mucro. The base of the leaf forms a complete sheath around the stem, a few mm. wide at its narrowest part (See Fig. 1A), but excluding the thin sheathing part, the widest fleshy part of the leaf is generally found approximately half way along the length of the leaf. A few cases were found where two keels were present on the leaf under surface, a feature of no significance, although considered of some importance by early writers and expressed in the name Apicra bicarinata Haw.

For the record, imprints of leaf shapes, as viewed from the upper surface were made using an endorsing ink pad.

There is, on the whole, little difference in size between mature leaves in a single plant. This is seen in the following table (Table 3), for leaves from the stem of a specimen of the entity robusta (R64). As indicated by keel orientation, the genetic spiral changed direction nine mature leaves from the apex in this specimen.

	Leaf Length	Width at widest part	Orientation of keel
	cm.	cm.	
Apex	3.4	2.0	Right
	3.5	2.0	Right
	3.4	1.9	Right
	3.4	1.8	Right
	3.4	1.7	Right
	3.3	1.7	Right
	3.4	1.6	Right
	3.3	1.5	Right
	3.4	1.6	Right
	3.6	1.9	Left
	3.4	1.8	Left
	3.4	1.9	Left
	3.5	2.0	Left
	Leaf Broken		Left
	3.4	2.0	Left
	3.4	1.9	Left
Base	3.3	1.9	Left

Table 3 Size of mature leaves taken in succession from a single stem of a plant of the entity robusta from Prince Albert (R64)

For purposes of study two, sometimes more, mature leaves were taken at random from each plant and measurements of the folowing were made :-

i) Leaf length.

ii) Leaf width at the widest fleshy part, See under (v).

iii) The length breadth ratio was estimated.

iv) Distance of widest part from base and hence position of widest part in relation to the longitudinal half-way mark of the leaf.

These measurements proved to be of some taxonomic significance. For the sake of completeness, other measurements were made, but were found to be unimportant.

v) Basal leaf width (excluding sheathing part) and hence difference between basal width and maximum width.

vi) Length of keel. The orientation of the keel was also noted.

vii) Length of mucro (difficult to measure accurately).

In the Appendix the mean of these measurements is given for each plant.

NUMERICAL ASSESSMENT OF LEAF DIMENSIONS.
(See Appendix Table 2)

The length of the leaf, the length breadth ratio, and the place along the length of the leaf at which the widest point occurs contribute to the appearance of the leaf.

Leaf Length (See Table 4)

As can be seen in the table, the majority ranges are distinctive, but in most cases the total class range is wide with consequent overlap of measurements between the entities.

The entities with the longest leaves are bullulata and hallii both with a majority range of 3.0-3.5 cm., and the entity congesta with a wider majority range of 2.5-4.0 cm. The shortest leaves are found in the entities foliolosa and rugosa where most individuals have leaves between 1.5 and 2.5 cm. long. The remaining entities have most individuals with leaves of intermediate length.

Entity.	Class range of measurements.										Total no. indiv.	Range actual measurements.
		1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5		cm.

LEAF LENGTH. Class interval 0.50 cm.

Entity.		1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	Total no. indiv.	Range actual measurements. cm.
Bullulata	-	-	3	6	13	4	-	-	-	-	26	2.3 - 4.0
Hallii	-	-	-	3	14	2	6	-	-	1	26	2.7 - 5.8
Smutsiana	-	9	31	21	7	2	-	-	-	-	70	1.8 - 3.9
Spiralis	-	1	11	11	3	2	1	-	-	-	29	1.9 - 4.2
Herrei	-	1	15	4	1	-	-	-	-	-	21	1.8 - 3.2
Rugosa	1	35	21	-	-	-	-	-	-	-	57	1.4 - 2.5
Foliolosa	8	49	36	1	-	-	-	-	-	-	94	1.4 - 3.0
Congesta	-	1	1	18	21	14	6	3	-	-	64	2.0 - 4.7
Robusta	-	1	18	29	19	13	-	-	-	-	80	1.8 - 4.0

GREATEST WIDTH OF LEAF. Class Interval 0.25 cm.

Entity.		1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	Total no. indiv.	Range actual measurements. cm.
Bullulata	-	-	5	3	7	6	4	1	-	26	1.3 - 2.6
Hallii	-	-	7	10	8	1	-	-	-	26	1.3 - 2.1
Smutsiana	2	7	35	17	9	-	-	-	-	70	1.0 - 2.0
Spiralis	4	9	16	-	-	-	-	-	-	29	1.0 - 1.5
Herrei	3	6	11	1	-	-	-	-	-	21	0.9 - 1.6
Rugosa	-	6	38	12	1	-	-	-	-	57	1.1 - 1.8
Foliolosa	3	25	44	16	4	2	-	-	-	94	0.9 - 2.1
Congesta	-	-	3	20	17	15	6	2	1	64	1.4 - 2.8
Robusta	-	1	19	19	32	7	2	-	-	80	1.1 - 2.4

LENGTH/BREADTH RADIO OF LEAF. Class Interval 0.25

Entity.		1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	Total no. indiv.	Range actual measurements.
Bullulata	-	-	6	15	2	2	-	1	-	-	26	1.28 - 2.72
Hallii	-	-	-	2	3	13	6	1	-	1	26	1.72 - 3.14
Smutsiana	-	2	15	26	16	9	2	-	-	-	70	1.14 - 2.31
Spiralis	-	-	-	3	9	5	7	3	2	-	29	1.57 - 2.90
Herrei	-	-	2	4	8	4	3	-	-	-	21	1.44- 2.42
Rugosa	1	12	28	14	2	-	-	-	-	-	57	1.00 - 1.83
Foliolosa	-	17	51	22	3	1	-	-	-	-	94	1.06 - 2.14
Congesta	-	-	10	26	20	6	2	-	-	-	64	1.35 - 2.33
Robusta	-	1	11	35	28	5	-	-	-	-	80	1.25 - 2.20

Table 4 VARIATION IN LEAF DIMENSIONS IN GENUS AS A WHOLE.

Leaf width at widest part and length-breadth ratio (See table 4).

The width of a leaf at its widest part affects the appearance of the leaf when considered in relation to the length. The greater the length-breadth ratio, the narrower the leaf. In a Astroloba, the values of this ratio range from 1.00 where the leaf width is equal to the length, to just over 3.00, where the width is roughly a third that of the length.

As the tables show, there is considerable overlap of both measurements in the various entities. However, the entities foliolosa and rugosa, with a majority range of 1.25 - 1.50 for the length-breadth ratio tend to have the broadest leaves, while the entity hallii, with a length-breadth ratio of 2.0 - 2.25, in the majority of individuals, tends to have the narrowest leaves. The entity spiralis, with a wider majority range of 1.75 - 2.50 for the length-breadth ratio also tends to have narrow leaves. The remaining entities have leaves with intermediate length-breadth ratios, but, as examination of the table shows, the majority ranges tend to differ slightly for the different entities.

Position of widest part of leaf in relation to longitudinal halfway mark. (See Table 5)

This character, estimated from the distance from the base of the widest part of the leaf, also determines the shape of the leaf. In the entities hallii, spiralis, congesta and robusta, the majority of individuals have the widest part of the leaf occuring 0.25 - 0.50 cm. below the halfway mark. In the entities smutsiana, herrei, rugosa and foliolosa, the majority range is 0.00 - 0.25 cm. below the halfway mark, while for bullulata it is wider being 0.00 - 0.50 cm.

Difference between maximum and basal width of leaf (See Table 5)

This is another factor determining leaf shape. As the table shows, the greatest difference between maximum and basal width is found in the majority of individuals of the entity bullulata, while the least difference between these measurements is found in the majority of individuals of the entities spiralis and herrei.

Entity.	Class range of measurements.								Total no. indiv.	Range actual measurements.

POSITION OF MAXIMUM LEAF WIDTH IN RELATION TO LONGITUDINAL * HALF WAY MARK. Class interval 0.25 cm.

	Above 0	Below Half way mark 0	0.25	0.50	0.75	1.00	1.25			cm.
Bullulata	-	1	11	13	1	-	-	-	26	0.0 -0.6bel
Hallii	-	-	1	14	7	3	-	1	26	0.2 -0.6bel
Smutsiana	-	5	43	19	3	-	-	-	70	0.0 -0.6bel
Spiralis	-	-	7	17	2	2	-	-	28	0.1 -0.9bel
Herrei	1	-	14	6	-	-	-	-	21	0.1ab -0.5bel
Rugosa	11	23	22	1	-	-	-	-	57	0.2ab -0.3bel
Foliolosa	2	21	68	3	-	-	-	-	94	0.1ab -0.3bel
Congesta	1	-	23	35	5	5	-	-	64	0.1ab -0.7bel
Robusta	3	3	26	46	2	2	-	-	80	0.2ab -0.7bel

DIFFERENCE BETWEEN MAXIMUM AND BASAL WIDTH OF LEAF. Class Interval 0.25 cm.

	.25	.50	.75	1.00	1.25			
Bullulata	1	5	8	8	1	3	26	0.20 - 1.30
Hallii	1	6	15	4	-	-	26	0.20 - 0.90
Smutsiana	-	25	37	4	1	-	67	0.30 - 1.10
Spiralis	3	24	2	-	-	-	29	0.20 - 0.60
Herrei	5	10	5	1	-	-	21	0.10 - 0.80
Rugosa	-	21	30	6	-	-	57	0.40 - 0.90
Foliolosa	-	17	62	15	-	-	94	0.35 - 0.93
Congesta	-	3	48	13	-	-	64	0.40 - 1.00
Robusta	-	7	39	29	5	-	80	0.25 - 1.00

LENGTH OF KEEL. Class Interval 0.50 cm.

	1.0	1.5	2.0	2.5	3.0			
Bullulata	-	5	15	5	1	-	26	1.3 - 2.7
Hallii	-	1	12	9	3	1	26	1.4 - 3.2
Smutsiana	6	47	15	2	-	-	70	0.9 - 2.2
Spiralis	-	10	14	4	1	-	29	1.2 - 2.9
Herrei	1	17	3	-	-	-	21	1.0 - .18
Rugosa	37	20	-	-	-	-	57	0.8 - 1.5
Foliolosa	27	66	1	-	-	-	94	0.8 - 1.8
Congesta	-	3	35	20	6	-	64	1.1 - 2.8
Robusta	-	27	40	12	-	-	79	1.1 - 2.3

MUCRO LENGTH. Class interval 0.05 cm.

	.05	.10	.15			
Bullulata	1	18	4	1	24	.03 - .20
Hallii	1	12	12	-	25	.05 - .15
Smutsiana	13	53	4	-	70	.03 - .13
Spiralis	2	18	8	1	29	.04 - .16
Herrei	-	13	6	2	21	.07 - .18
Rugosa	31	25	-	-	57	.04 - .10
Foliolosa	9	61	24	-	94	.04 - .15
Congesta	5	50	8	-	63	.05 - .13
Robusta	21	35	21	3	80	.03 - .20

Table 5 VARIATION IN LEAF DIMENSIONS IN GENUS AS A WHOLE. Contd.

* (ab = above half-way mark, bel = below half-way mark.)

Keel length (See Table 5)

On the whole this depends partly upon leaf length and partly upon the distance of the widest part of the leaf from the base. The longest keels are found in the entities bullulata, hallii, spiralis congesta and robusta, the shortest in the entity rugosa.

Mucro length (See Table 5)

In a leaf with an acuminate apex, mucro length is somewhat difficult to measure as the mucro is not sharply distinct from the rest of the leaf.

As can be seen in the Table, there is little variation in the different members. The entity hallii, with a majority class of 0.05 - 0.15 cm. tends to have the longest mucros, while the entity rugosa, with the majority of individuals with mucros less than 0.05 cm. long, tends to have the shortest mucros.

Summary.

From this introductory survey of leaf characters in the genus as a whole, two entities with the shortest and broadest leaves stand out from the rest, namely rugosa and foliolosa, while the entity hallii is recognisable by having the longest and narrowest leaves of the whole genus. The remaining entities are intermediate in size and shape and, although the majority ranges for each entity may be slightly different, the overlap of measurements between entities is considerable. The characters of leaf size and shape, apart from the nature of the leaf apex, are thus not of primary taxonomic importance or value.

4. LEAF COLOUR AND ORNAMENTATION.

Colour of leaf as a whole

Leaf colour is difficult to describe and quite variable within different populations, often depending upon whether the plant grows in the open or under a thick bush.

The author has attempted to associate the colours with the Royal Horticultural Society colour charts, and these colours are quoted. It is felt, however, that with regard to greens, these colour charts are inadequate.

The basic colours of leaves of the entities <u>hallii</u> and <u>smutsiana</u> are similar, and may be likened to Agathia green (60/2, 60/3), Pod green (061/2 061/3), Veronese green (660/2, 660/3), and Sap green (62/2, 62/3).

The entities <u>bullulata</u>, <u>rugosa</u> and <u>spiralis</u> have similar but sometimes darker shades, including Scheeles green (860), and the entities <u>bullulata</u> and <u>rugosa</u> often have a garnet brown (2240) overtone.

The entity <u>herrei</u> has leaves of the colour of Paris green (58/3), Cyprus green (59/2, 59/3), Veronese green (660/2) and Pod green (061/1, 061/2).

In the entities <u>congesta</u> and <u>foliolosa</u>, the basic leaf colours are darker and may be likened to Scheeles green (860), Lettuce green (861), Fern green (0862) and Spinach green (0960). In the entity <u>robusta</u>, the leaves are of a whole range of shades, including all those mentioned, but they often have a greyish tint similar to Willow green (000862/3).

<u>Colour of margins and keels, and striations.</u>

In the entity <u>hallii</u>, the margins and keels of the leaf are a darker green, usually becoming reddish brown towards the apex of the leaf. The top third of the leaf itself may have a pale reddish brown or Garnet brown tinge. This appears to be correlated with degree of exposure to sunlight, as in plants growing in fairly thick bushes the reddish tinge is absent.

Faint longitudinal lines, up to 0.5 mm. broad and about 1.0 mm. apart, corresponding to the bundle caps of the vascular strands are visible on the lower side of the leaf, and sometimes also on the upper, either for the whole length of the leaf or only extending a short distance from the apex. In some leaves they may be absent, but they are always present on some leaves of any one plant. In colour these vein lines are darker than the rest of the leaf, (Paris green (58/1) and Cyprus green (59/1), and often have a reddish tinge.

In the entities <u>bullulata</u> and <u>rugosa</u>, no bundle cap lines are apparent, and the margins and keels are usually concolorous.

In the entity <u>smutsiana</u>, the margins and keels are concolorous or a darker green, and as in the entity hallii, the apices of the leaf may have a pale reddish brown or garnet brown tinge. Of the 50 plants examined, 42 had some or all leaves in which longitudinal bundle cap lines were visible towards the apices on the underside of the leaf.

In the entity <u>spiralis</u>, the margins and keels are as in the entity <u>smutsiana</u>, and leaves with a reddish tinge towards the apex were observed in 8 of the 28 plants examined, and in 12 of them darker longitudinal bundle cap lines were faintly visible on the leaf underside.

In the entities <u>hallii</u>, <u>smutsiana</u> and <u>spiralis</u>, the mucro is often reddish brown even when the rest of the leaf does not have a reddish tinge.

In the entity <u>herrei</u>, fine darker bundle cap lines are always present either just visible or projecting as extremely fine ridges, on the leaf underside. The margins are generally concolorous or paler and very rarely is the tip of the leaf reddish.

In the entity <u>robusta</u>, margins and keels are usually paler or white, and in 42 out of 70 plants observed, faint darker green bundle cap lines were visible. In the entity <u>congesta</u>, margins and keels are concolorous, or paler, rarely whitish, and in 15 out of 63 specimens examined, faint darker bundle cap lines were apparent. In the entity <u>foliolosa</u> the margins and keels are similar to those of the entity <u>congesta</u>, and in 7 of the 75 plants examined, faint bundle cap lines were visible.

<u>Tubercles and maculae</u>:

In most leaves, the margins of the top half of the leaf have a double row, the keel a single row, of small tubercles. Measurements of tubercle dimensions were made using a micrometer eyepiece. However, this was not very satisfactory because in many instances the tubercles tend to coalesce into groups, or rise gradually from the surface of the leaf so that it is difficult to measure their true diameter or height.

In the entity <u>rugosa</u> all leaves of all 57 plants examined had concolorous shiny tubercles on the under surface of the exposed top part of the leaf. Sometimes tubercles were present on the upper side towards the apex as well. The degree of tuberculation varied from about 5 per sq. 4 mm. to 30 per sq. 4 mm. These tubercles tend to be arranged in longitudinal series, up to 6 coverging in a single longitudinal group. The degree of tuberculation tends to be the same for all the leaves on any one plant. Where the leaves are sparsely tuberculate, the tubercles are generally less prominent.

In the entity bullulata, all the plants examined had some or all of the leaves with tubercles on them and 6 out of 26 plants had some leaves with no tubercles. The tubercles may be irregularly scattered or more usually aggregated into groups of up to five which are often transversely elongated. These groups for the most part tend to be arranged in irregular, but distinct, transverse rows, with usually up to 4 such rows per leaf, and these rows are usually 0.2 to 0.5 cm. apart. In colour the tubercles may be concolorous, paler or whitish.

In the entity hallii, tubercles were found in some cases to be present on the underside of the leaf and very rarely on the upper side. When present, they generally occur longitudinally associated with the vein lines, and arise as small individual protuberances or converge in irregular longtudinal rows. The greatest number of tubercles per leaf observed was up to 12 longitudinal groups of tubercles per leaf, with up to 9 tubercles in the largest group. Not all the leaves of any one plant are tuberculate. Out of 25 plants examined, 13 had leaves with no tubercles, of these, 10 had a few whitish spots, sometimes slightly raised, on some of theleaves, and these were usually, but not always, associated with the vein lines. The remaining 12 plants had some or all of the leaves tuberculated to a greater or lesser degree. In colour the tubercles may be whitish, paler, concolorous, reddish or darker than the rest of the leaf.

In the entity smutsiana, none of the plants examined had any leaves with tubercles but 8 of the 50 specimens, were seen to have one or more leaves with, on the underside, up to about four very slightly raised, (0.05 mm. or less high), elongated shiny patches, darker in colour, about 0.5 mm. wide and up to 3.0 mm. long. Sometimes these longitudinal areas had several longitudinally arranged minute projections.

In the entity congesta, similar longitudinal patches were observed in some of the leaves of 13 out of 64 specimens. Here, up to seven per leaf were observed, up to 5.0 mm. long and 1.0 wide. In the entity foliolosa, one out of 94 plants had leaves with similar elongated patches.

In the entity robusta, 20 out of the 70 plants examined had leaves with one to 15 whitish flecks up to 1.0 mm. in diameter on the undersurface of some of the leaves.

In the entity spiralis, no plants were observed in the field to have any such markings on the undersurface, but, under cultivation one specimen from Calitzdorp, R47, developed whitish flecks on some of the leaves, 0.05 to 0.10 mm. in diameter and somtimes very slightly raised, but of a height of less than 0.05 mm. (See Plate 25).

In the entity herrei, no markings of any sort were observed on plants in the field or under cultivation.

Tubercles of margins and keels:

As can be seen from the Table below, there is some variation in dimensions between the different entities.

Those entities with tuberculate leaf undersides, tend to have more prominent tubercles on the margins and keels.

Entity.	Diam. Tubercles mm.	Height Tubercles mm.
	Tubercles from underside of leaf	
Rugosa	0.10 - 0.50	0.10 - 0.30
Bullulata	up to 2.00	0.10 - 0.35
Hallii	0.05 - 0.50	0.10 - 0.25
	Tubercles of margins and keels	
Bullulata	up to 1.00	0.10 - 0.35
Hallii	0.10 - 0.50	0.10 - 0.25
Smutsiana	0.10 - 0.25	0.10 - 0.20
Spiralis	0.10 - 0.20	0.10 - 0.10
Herrei	0.10 - 0.15	0.10 - 0.10
Rugosa	0.10 - 0.50	0.10 - 0.25
Foliolosa	0.10 - 0.45	0.10 - 0.20
Congesta	0.10 - 0.30	0.10 - 0.15
Robusta	0.10 - 0.35	0.10 - 0.15

Table 6 VARIATION IN DIMENSIONS OF TUBERCLES FROM THE LEAVES OF ALL ENTITIES OF THE GENUS.

Summary

Thus it can be seen that the presence of tubercles on the undersides of the leaves tends to distinguish the entities rugosa, bullulata and hallii from the other members of the genus. These three entities are themselves distinguished by the transverse arrangement of tubercles in the entity bullulata and the longitudinal arrangement in the entities hallii and rugosa. Unlike the entities bullulata and rugosa, hallii has leaves with striations on the underside. These striations are always found on the undersurfaces of leaves of the entity herrei, often present as fine ridges, while they are also visible, but not as fine ridges in a large number of specimens of the entities smutsiana and robusta.

Leaf ornamentation is consequently of some taxonomic significance.

5. LEAF ANATOMY (See Plate 3).

Gross Astroloba leaf anatomy is similar to that of some species of Gasteria and Haworthia* and Poellnitzia rubriflora (L.Bol) Uitewaal. Certain anatomical details, notably the shape of epidermal cells, and the size and degree of lignification of bundle cap cells are of some taxonomic significance, as will be shown.

In all cases, leaves a comparable distance from the shoot apex were examined. Transverse sections cut half way along the length of the leaf were used, except in certain cases where sections were taken a few millimetres from the apex.

In transverse section, because of the keel, the leaves appear in outline as flattened, slightly curved triangles.

Epidermis

The epidermal cells in surface view are isodiametric or elongate, depending upon their situation, and five or six sided (See Fig. 5C). In longitudinal section, they are seen to be taller than broad, with a heavy thickening of cutin**impregnated cellulose on the outer part of the radial walls and outer tangential walls,

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* Species examined were G. stayneri von Poell., G. beckeri Schönl., G. stayneri Schönl., and H. margaritifera (L) Haw.

** Schultz's solution was used to stain the epidermal cells.

which result in a gourd-shaped cell lumen. In some sections the demarcation between cutin impregnated thickening and original cellulose wall is clear cut, in others there is an infiltration of the one by the other. (See Fig. 8A). In most sections, the layers in which the thickening was laid down are visible as fine strata.

The outer faces of the epidermal cells may be almost flat to extremely convex to papillate, and this feature is of taxonomic importance (See Figs. 6, 7 and 8). It is best seen in epidermal cells from the lower epidermis of the upper half of the leaf. Towards the margins and keel, the epidermal cells become elongated, thd cell lumen now resembling a long-necked gourd, and the outer faces become flattened. (See Plate 3). Towards the base of the leaf, the thickening of the outer epidermal cell walls and the resultant gourd shaped lumina become less marked.

The stomata are sunken, (See Fig. 5B), the numerous supra-stomatal depressions appearing as minute puncticula over the surface of the leaf. The epidermal cells surrounding the guard cells do not differ from other epidermal cells and thus are not of the nature of subsidiary cells (Esau 1960). In shape, the guard cells are of the common crescent type, with very noticeable rims of wall material impregnated with cutin above and below the stomatal aperture. (See Figs. 5B and C).

Tubercles

Where tubercles occur, when these are only very slightly raised, they are formed by groups of elongated epidermal cells with flat faces. When the tubercle is more prominent, however, it is formed by a mound of colourless or chlorophyll containing parenchyma enclosed by epidermal cells whose outer faces are often flatter than those adjacent to the tubercle. (See Plate 3). Tubercles generally do not have stomata, and this increases their shiny appearance.

Internal anatomy

Immediately below the epidermis is a layer of chlorenchyma, the component cells of which may be round to elongate,

Fig. 5.

A. Diagram of transverse section of leaf of the entity robusta (R1) x 6½: a stoma seen in perfect section; b vascular strands with centri-petal xylem; c chlorenchyma; d central water storage parenchyma.

B. Section through epidermis showing sunken stoma: e cellulose part of cell wall; f outer thickening of cutin impregnated cellulose; g cuticle; h and i rims of cutin impregnated wall material below and above stomatal aperture; k guard cells.

C. Surface view of epidermal cells surrounding supra stomatal depression s, e and f seen in optical section, also t the neck of gourd shaped lumen.

D. Epidermal cells with guard cells seen from below. B, C and D are also from the entity robusta.

E. Transverse section of vascular strand from a leaf of the entity congesta (R40).

F. Fibre-sclereid from leaf of the entity smutsiana (R5) .

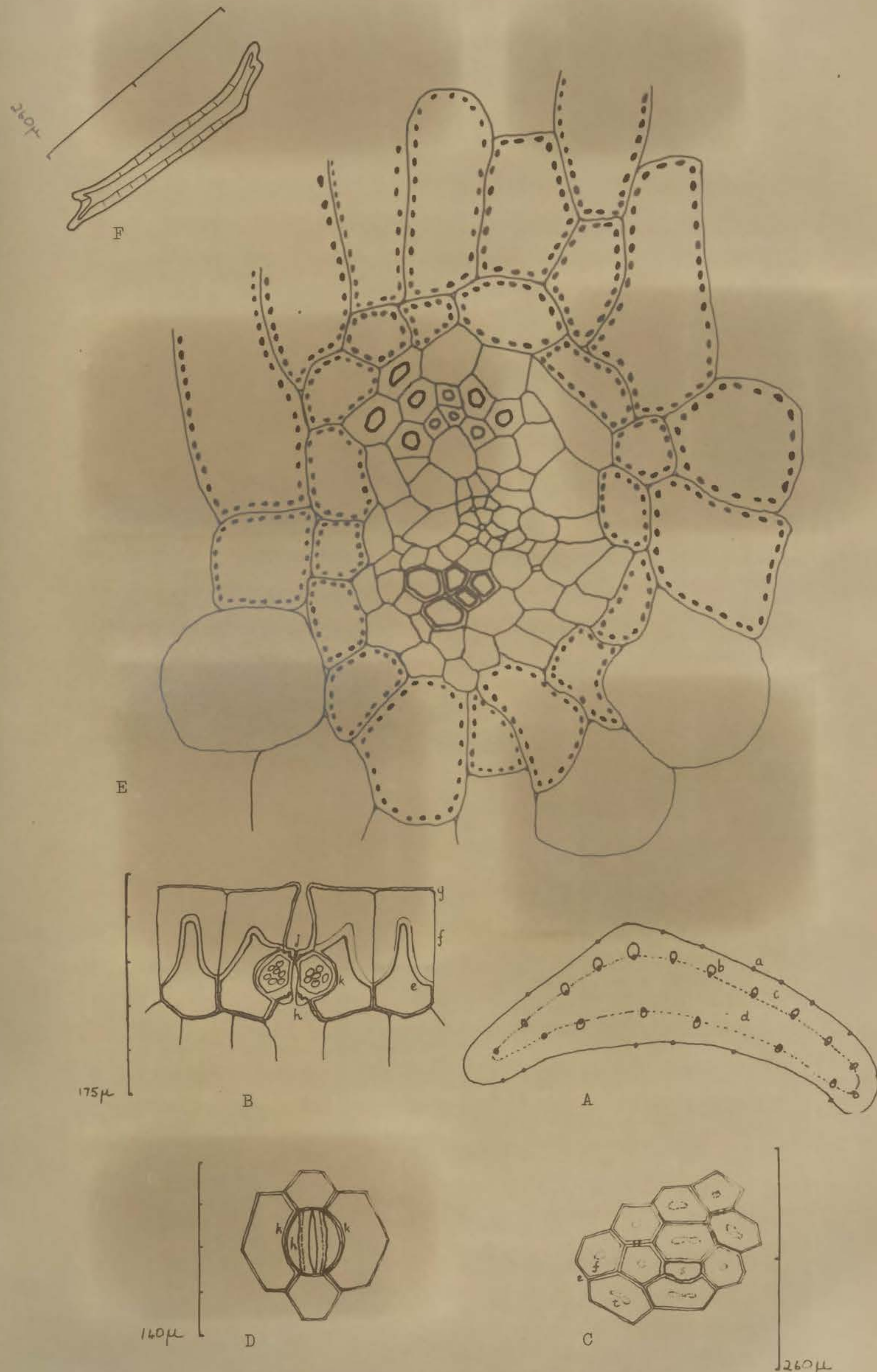


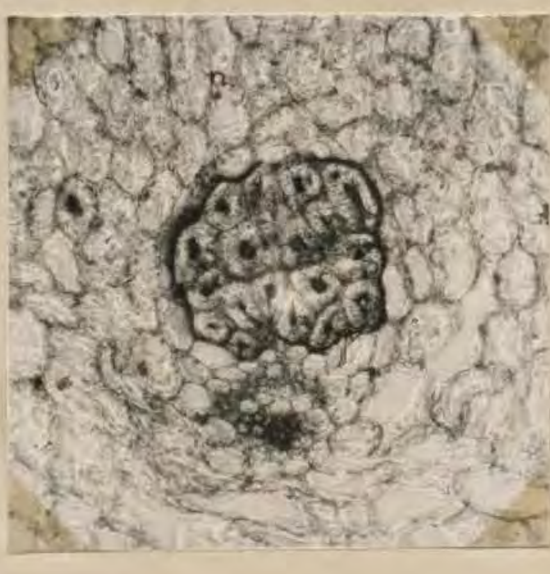
Fig. 5.

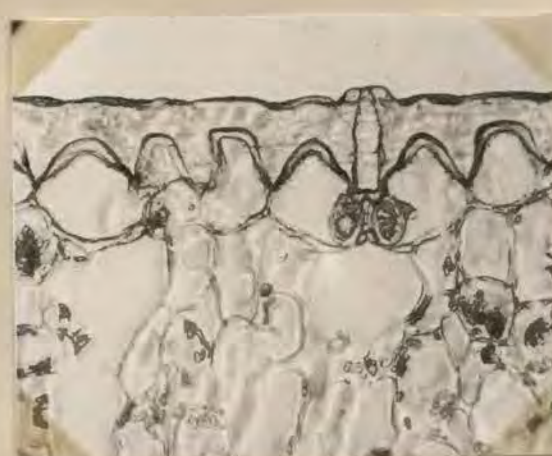
A. B.

T.S. Leaf of the entity rugosa showing: A, papillate epidermal cells; B, a section through a tubercle.

A. B.

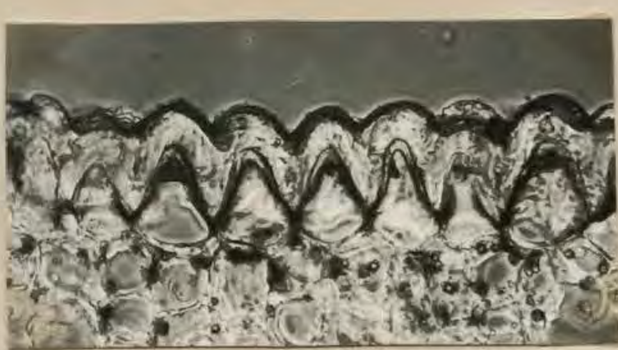
T.S. Leaf of the entity congesta showing: A, epidermal cells of keel; B, cells from the lower epidermis.





A. B.

T.S. Leaf of the entity robusta showing: A, vascular bundle with heavily lignified fibre sclereids of the bundle cap; B, stomata from the upper epidermis.



T.S. Leaf of the entity smutsiana showing cells from the lower epidermis.

PLATE 3.

and in some instances, slightly lobed. There may be a few smaller, round or oval colourless cells between the chlorenchyma and the epidermal cells of the margins and keel.

The vascular strands are arranged in a flattened triangle at the junction of the chlorenchyma and the central mass of large colourless water storage parenchyma cells. (See Fig. 5A).

Details of xylem and phloem anatomy were not investigated, but, like other members of the Liliaceae, the xylem lacks the large conspicuous metaxylem vessels typical of the Glumiflorae. To the outside of the phloem in each strand (See Fig. 5E), is a cap of cells which vary in size, but for the most part are of quite a large diameter, and longitudinally elongated. These bundle cap cells may lignify as fibre-sclereids. The degree of lignification will be shown to be of some taxonomic importance, and in the text these cells are referred to as bundle cap cells rather than fibre-sclereids. Surrounding the vascular tissue and bundle cap is a sheath of chlorophyll containing parenchyma cells.

The vascular strands, including bundle caps, become smaller towards the leaf margins where some of the strands may lack bundle caps. The largest strands with bundle caps occur on the underside of the leaf near the keel.

In a number of species, the vascular strands including bundle caps affect the external character of the leaf in that they are seen externally as faint lines extending from the leaf apex for about a third to a half of the leaf length, or sometimes for the entire length of the leaf. In some instances a red pigment is associated with these "vein lines".

The number of vascular strands per unit leaf width, the size of the bundle caps and degree of lignification of bundle cap cells will be shown to be also of taxonomic significance in some instances.

Assessment of Significance of Anatomical Characters

Epidermal Cells

Examination of the surface of the top half of leaves of entities of Astroloba reveals two types of leaf - those with a glossy sheen and those with a dull sheen or a matt surface.

The entities congesta, foliolosa and robusta all have leaves with a glossy sheen, while the remaining entities have leaves with a dull sheen. A reason for this is found on examination of the epidermal cells in longitudinal section. In the leaves with a glossy surface, the outer surfaces of the epidermal cells are flush with one another, or only very slightly convex. In the matt leaves, the outer surfaces of the epidermal cells are markedly convex. A large number of transverse sections of leaves was examined and in all instances this was found to be the case, although it was not very marked in certain members of the entity smutsiana, (See Fig. 7C), but the leaves of these specimens still had a dull, not a glossy sheen.

Entities	Populations examined
bullulata	Matjiesfontein R2.
hallii	Koup R26; Rietvlei R48.
smutsiana	Ladiesmith/Barrydale R3 and 5.
spiralis	Oudtshoorn R7; Calitzdorp R47; Ladismith/Barrydale R6.
herrei	Hoekplaas R16; Prince Albert R46.
rugosa	Montagu R17, 22.
foliolosa	Waterford R10; Steytlerville R14.
congesta	Cradock R32; Adelaide R38 and 39; Dikkop Vlakte R40.
robusta	Klaarstroom R27; Nelspoort R28; Miller R8; Steytlerville R15; Molteno pass (leg. Hall).

Table 7. Population samples of Astroloba in which leaf anatomy was investigated.

It can be seen in Figures 6, 7 and 8, that size and degree of development of the cutinised part of the cell wall varies considerably. In two sections of epidermal cells from leaves of a plant of the entity congesta (Fig. 6A. 1,2), the cutinised part of the wall had a thin outer layer which stained up a much darker colour.

In the entity rugosa, the concave outer wall of the epidermal cells is in some instances papillate (See Fig. 8A).

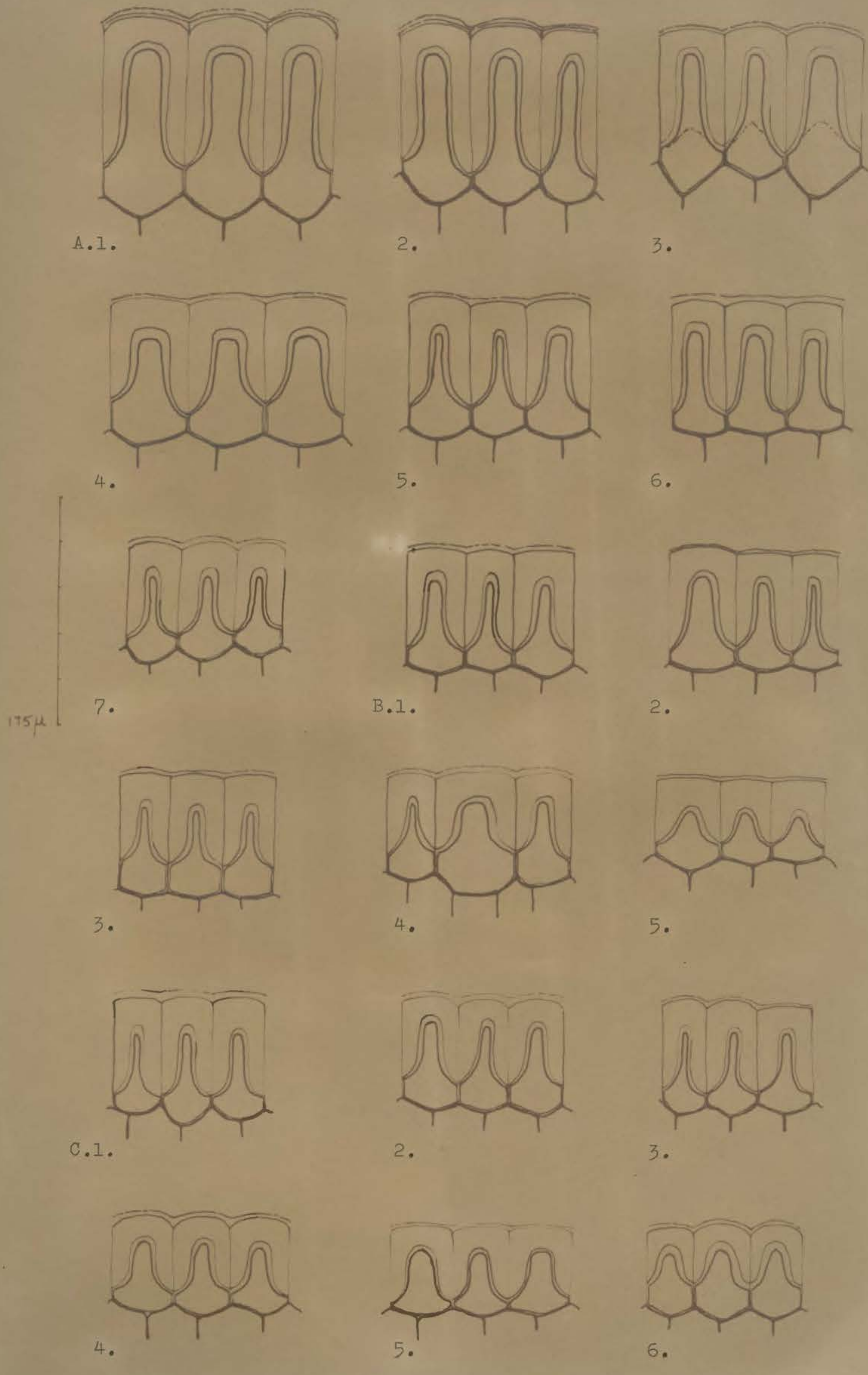


Fig.6. Cells of lower epidermis from top half of leaf seen in longitudinal section. Epidermal cells shown of: A the entity congesta; B the entity robusta; C the entity foliolosa.

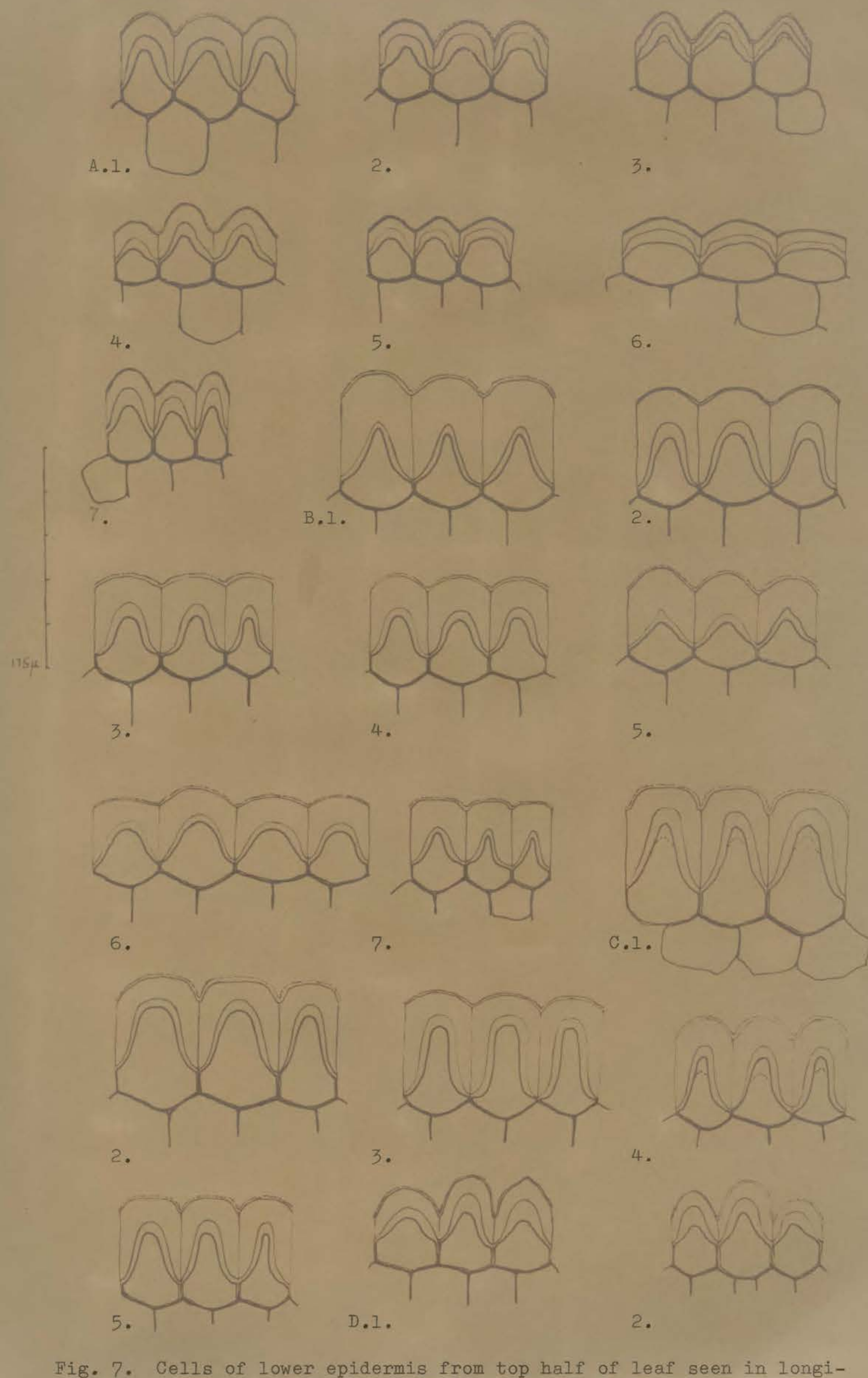


Fig. 7. Cells of lower epidermis from top half of leaf seen in longitudinal section. Epidermal cells shown of: <u>A</u> the entity <u>herrei</u>; <u>B</u> the entity <u>spiralis</u>; <u>C</u> the entity <u>smutsiana</u>; <u>D</u> putative hybrid, between members of the entities <u>smutsiana</u> and <u>rugosa</u>.

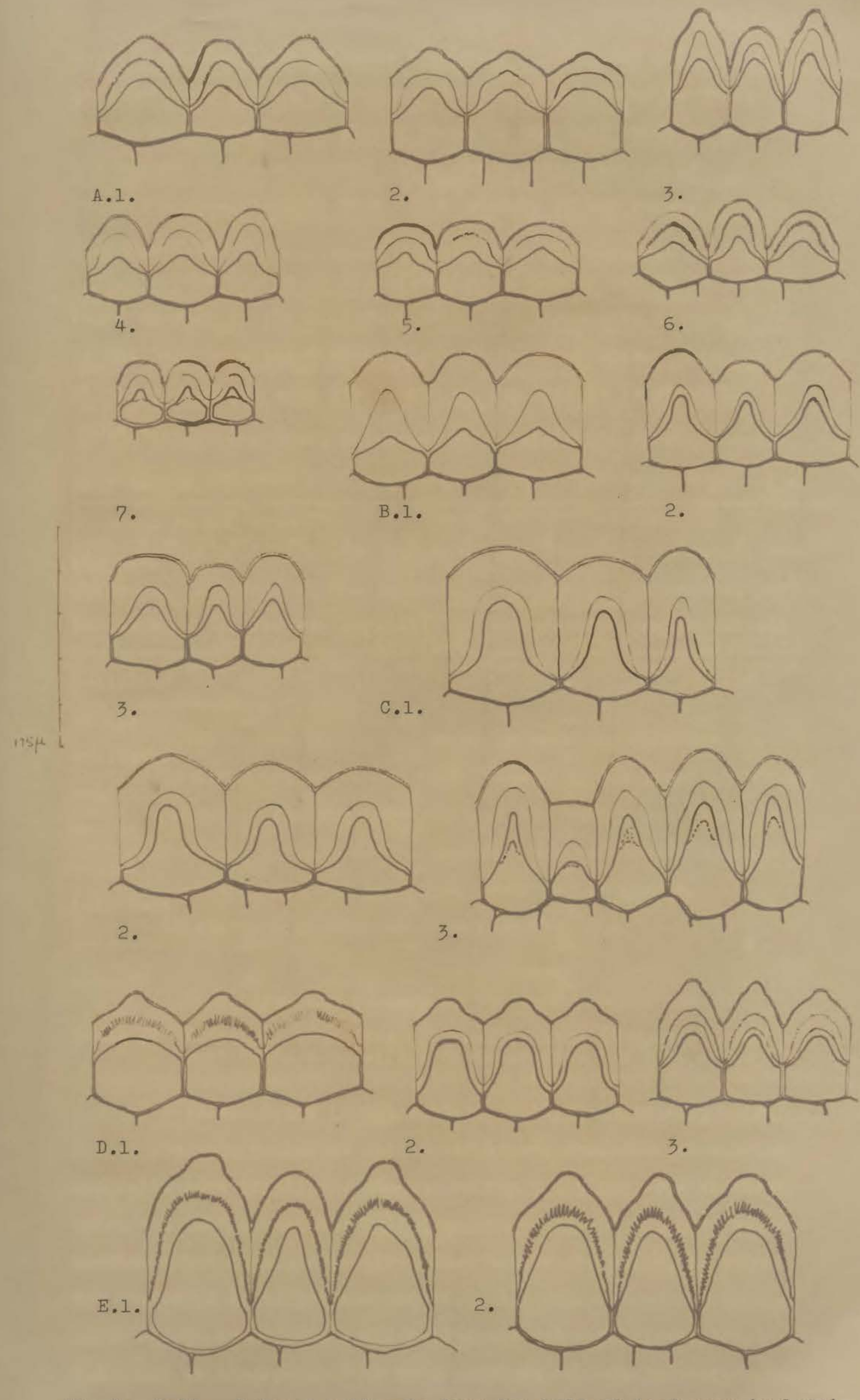


Fig.8. Cells of lower epidermis from top half of leaf seen in longitudinal section. Epidermal cells shown of: A rugosa; B hallii; C bullulata; D Astroworthia X bicarinata E Haworthia margaritifera.

As will be seen, the entities congesta, robusta and foliolosa have perianth and inflorescence characters in common as well, and it is felt that the glossy sheen to the leaf surfaces and the nature of the epidermal cells are of significance in rendering them distinct from other members of the genus.

Bundle Cap Cells

The degree of lignification of bundle cap cells was found to vary in the different entities. Transverse sections of the leaf were cut a short distance from the apex. This distance depended upon the length of the leaf as is shown in Table 8.

Leaf Length	1.5	2	2.5	3	3.5	4	4.5	
Distance in mm. from apex at which section was cut.	3	4	5	6	7	8	9	10

Entities	No. leaves examined	Bundle Cap Cells: All lignified	Partly lignified	All un-lignified
bullulata	20	-	-	20
hallii	20	20	-	-
smutsiana	20	20	-	-
spiralis	20	20	-	-
herrei	20	20	-	-
rugosa	20	20	-	-
foliolosa	10	-	5	5
congesta	30	-	22	8
robusta	30	-	30	-

Table 8. Variation in degree of lignification of bundle cape cells a specified distance from the leaf apex, (for all bundle caps).

It was found in the entities hallii, smutsiana, spiralis, herrei and aspera that at this level in the leaf, all the bundle cap cells were lignified. In the entity bullulata none of them were, and in the entities foliolosa, congesta and robusta, some specimens had completely unlignified bundle cap cells, in others the degree of lignification varied.

In leaves where the bundle cap cells are incompletely lignified at the apex, it is found that at the base of the leaf all bundle cap cells are lignified. The size of the bundle cap itself varies but this is not of prime importance.

It is of some interest that leaves with lignified bundle caps often dry with these strands forming a series of ridges. This is sometimes of use when dealing with herbarium material. Dry ridged leaves are found in the entities hallii, herrei and aspera and sometimes in smutsiana and robusta.

It was hoped that this character and bundle cap size would help to distinguish the entity smutsiana from the entity spiralis when they are not in flower, as, although the leaves of the latter are often narrower, it is difficult to distinguish between the two when only vegetative material is available.

A small sample of leaves of the entities herrei, spiralis and smutsiana were sectioned one third of the length from the apex. The area of the largest bundle cap in the ventral part of the leaf was roughly estimated in micrometre eyepiece units, and the shortest distance of this bundle from the lower epidermis was also measured.

The entity herrei was found to have the most and the largest bundle caps, which are also closest to the lower epidermis and this accounts for the appearance of the bundle cap lines as very fine ridges in many of the leaves. The difference between the entities sprialis and smutsiana howev er, is slight. This is sh own in a scatter diagram (See Fig. 9).

Summary

Thus, from the texture of the leaf surface and the shape of the walls of the outer epidermal cells, the entities congesta, foliolosa and robusta tend to be separated from the rest.

The entities hallii and bullulata with characteristic keeledmarginate apices in common, are further separated from one another on the grounds of bundle cap cells lignified at the leaf apices of the former, as opposed to unlignified bundle cap cells at the leaf apices of the latter.

The size of the bundle caps and their proximity to the lower epidermics tend to separate the entity herrei from the entity spiralis, although both have in common an inflated perianth tube.

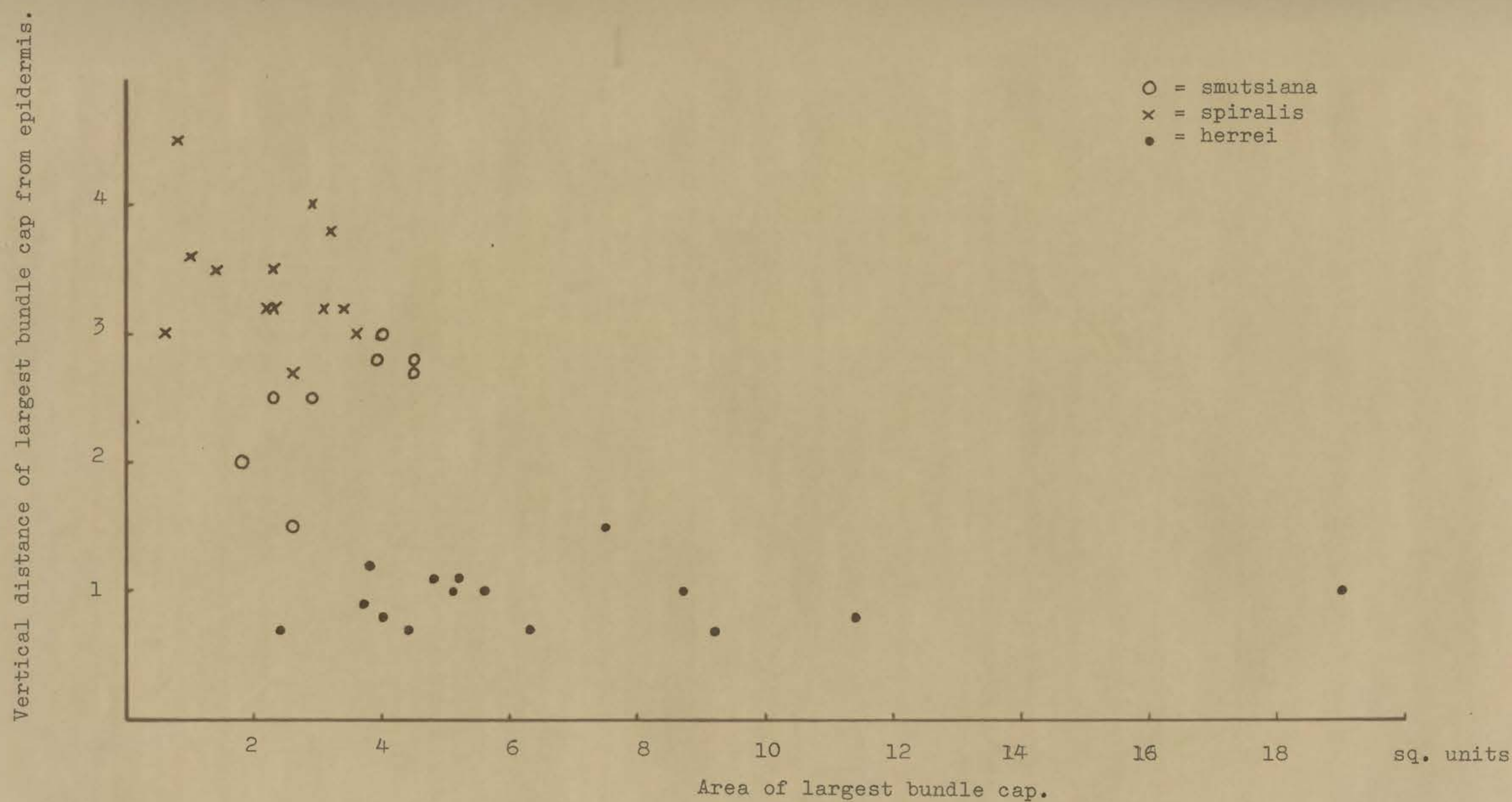


Fig. 9. Variation in the size of the largest bundle cap from the ventral side of the leaf and its distance in from the cuticle of the lower epidermis in the entities smutsiana, spiralis and herrei. (1 unit = 130µ). Leaves sectioned one third of the length from the apex.

In conclusion then, populations of the various entities can be recognised on a summation of their vegetative characters. Of these, however, only the shape of the leaf apex, the presence or absence of tubercles, and the nature of the outer wall of the epidermal cells as affecting the texture of the leaf, are of major taxonomic importance.

B. INFLORESCENCE AND FLORAL CHARACTERS

1. INFLORESCENCE MORPHOLOGY

In all species of Astroloba, the inflorescence is racemose with shortly pedicellate flowers. Each flower arises in the axil of a small bract and there are usually a few "sterile" or empty bracts on the peduncle below the raceme. Sometimes lateral racemes or unexpanded inflorescence buds are to be found in the axils of these bracts.

The peduncle is usually of the same length as, or slightly longer than the raceme, and while there is some variation in this measurement among different entities, it is not always a reliable taxonomic character, because growth in length may be influenced by external conditions. Further, specimens are often collected when the raceme is not fully expanded.

The base of the peduncle is flattened, owing to its origin in the axil of one of a number of crowded leaves. This flattened portion extends for about a centimetre and is expanded on either side into a thin wing of tissue with a width of 1 to 2 mm. and a margin which may be smooth, wavy, slightly serrated or crenellated, within the same entity. In the closely related monospecific genus, Poellnitzia, this wing is, however, rather distinctive.

Bract characters.

Sterile and fertile bracts are deltoid in shape, that is, widest at the base, and membranous with one to several central veins. Acropetally, these midrib veins decrease in thickness and number, so that at the apices of most inflorescences, the bracts become leathery and are thickened with chlorophyllous tissue about the midrib. In one instance, as will be shown, the number of midrib veins in the bracts is of some significance.

Bract length is a character which shows some variation in the different entities, and, as will be shown, is of some importance.

Pedicel length

Pedicel length generally decreased acropetally, but a few cases were seen in which pedicels some way from the base of the raceme were longer than those below them, or the pedicel second from the base was longer than the basal one. With the development of fruit there is an increase in pedicel thickness which may or may not be accompanied by an increase in length. Pedicel length too, will be shown to be of some significance.

In most instances the lowest flowers open in acropetal succession, but sometimes those from higher up are the first to do so. The successive opening of the flowers takes place one or two flowers at a time.

Measurements of inflorescence characters were made to include the following:-

i) Length of peduncle and length of flower bearing part, here termed "raceme".

ii) The number of "sterile" bracts below the raceme was noted, and this included those subtending axillary buds.

iii) Number of side branches or undeveloped buds found in axils of "sterile" bracts below raceme.

iv) Peduncle width at widest part of base and immediately below the raceme, where it is still slightly oval in section. In both instances, the wider diameter was measured. In the case of branched inflorescences this latter measurement was taken below the raceme terminating the main stem.

v) Dimensions of lowest "sterile" and "fertile" bracts. These included length, basal width and sometimes middle width. On a single inflorescence, there was little difference in these measurements amongst the lowest fertile bracts and so, where the lowest one was damaged, measurements were made of the one immediately above it.

vi) The lengths of the lowest pedicel or the one immediately above it, and one from the middle of the raceme, when it was fully expanded and flowering, were measured. In the case of fruiting racemes, the length of the lowest pedicel was noted. Sometimes it was possible to record the length of a lowest fruiting pedicel and a flowering pedicel from the middle of the same raceme.

Measurements of herbarium specimens are also given in the appendix, but consideration was given to the fact that in some instances these were no longer reliable due to shrinkage through drying, and where this was so, they were excluded in the assessment of the characters of the different groups.

Measurements of peduncle width and pedicel length were made with a vernier gauge, and those of bracts with a micrometer eyepiece.

Numerical assessment of inflorescence characters

(See Appendix Table 3)

Degree of branching of inflorescence (See Table 9)

Entity	Individuals with one or more branches to inflorescence.	Individuals with unexpanded infl. buds in the axils of sterile bracts.	Total number individuals.
bullulata	0	2	14
hallii	1	11	35
smutsiana	0	2	45
spiralis	1	4	45
herrei	0	0	22
rugosa	0	0	68
foliolosa	5	2	69
congesta	22	28	69
robusta	0	7	97

Table 9. VARIATION IN DEGREE OF BRANCHING OF INFLORESCENCE IN GENUS AS A WHOLE.
(Herbarium specimens included).

In most cases the inflorescence is unbranched. A very notable exception is the entity congesta which has a large number of individuals with branched inflorescences or unexpanded axillary raceme buds in the axils of the sterile bracts. A fair number of such buds are also found in the entity hallii.

Length of peduncle and raceme (See Table 10)

In all cases there is considerable overlap of these measurements in the different entities. The shortest peduncles are found in the entity robusta, (majority range 5 - 15 cm.) which also tends to have the largest number of individuals with racemes under 10 cm. in length.

The entity with the longest peduncles is spiralis (majority range 20 -35cm.)which also has the longest racemes, together with bullulata and hallii.

Peduncle width (See Table 10)

There is an overlap of this measurement between the different entities. The widest peduncle base is found in the entity robusta (majority range 0.45 - 0.75 cm.) and in the entities bullulata, hallii and herrei, all of which have a majority range of 0.45 - 0.60 cm. The entity rugosa has the narrowest peduncle base with a majority range of 0.15 - 0.30 cm. Measurements for the other entities are intermediate.

The width of the peduncle below the raceme is greatest in the entity robusta, where the majority range is 0.30 - 0.45 cm. For the other entities with the exception of the entity hallii, where it is 0.15 - 0.45 cm., the majority range is 0.15 - 0.30 cm.

Number of sterile bracts. (See Table 11A).

The number of sterile bracts below the raceme is quite variable. The entities with the least number of sterile bracts are herrei and rugosa, which have the majority of individuals with 1 - 4 bracts. The other entities have the majority of individuals with 2 - 6 bracts.

Length of lowest sterile bract (See Table 11A).

The range of variation of this measurement is wide in most entities, and again there is overlap between the different entities. The longest sterile bracts are found in the entity

Entity.	Class range of measurements.									Total no. indiv.	Range actual measurements.
	PEDUNCLE LENGTH. Class Interval 5.0 cm.										
	5	10	15	20	25	30	35	40			cm.
Bullulata	-	-	2	7	1	3	-	-	-	13	14 - 30
Hallii	-	2	4	11	7	8	5	-	-	37	8 - 32
Smutsiana	-	3	11	14	6	4	-	-	-	38	8 - 29
Spiralis	-	-	-	5	12	16	10	5	-	48	16 - 39
Herrei	-	1	1	9	8	2	-	-	-	21	10 - 30
Rugosa	-	1	7	9	24	11	4	-	1	66	10 - 43
Foliolosa	-	3	24	30	11	1	-	-	-	69	9 - 28
Congesta	-	2	6	26	26	12	1	-	-	73	6 - 31
Robusta	2	34	44	15	2	-	-	-	-	97	5 - 21
	RACEME LENGTH.										
Bullulata	-	-	4	1	4	4	-	-	-	13	11 - 29
Hallii	-	1	7	14	12	1	2	-	-	37	8 - 32
Smutsiana	-	6	15	14	2	-	-	-	-	37	8 - 25
Spiralis	-	3	15	10	15	-	2	1	-	48	8 - 36
Herrei	-	-	5	4	3	2	-	-	-	14	13 - 28
Rugosa	1	14	19	11	1	2	-	-	-	48	5 - 27
Foliolosa	-	6	26	16	1	-	-	-	-	49	6 - 24
Congesta	-	2	31	27	7	-	-	-	-	67	8 - 25
Robusta	1	29	45	14	4	2	1	-	-	96	6 - 33

Entity.	WIDTH OF PEDUNCLE BASE. Class Interval 0.15 cm.								Total no. indiv.	Range actual measurements.
	0.15	0.30	0.45	0.60	0.75	0.90	1.05			
Bullulata	-	-	1	8	-	1	-	-	10	0.44 - 0.80
Hallii	-	-	4	22	7	3	-	-	36	0.39 - 0.90
Smutsiana	-	15	22	-	-	-	-	-	37	0.22 - 0.42
Spiralis	-	6	19	5	-	-	-	-	30	0.26 - 0.56
Herrei	-	-	4	12	-	-	-	-	16	0.40 - 0.60
Rugosa	-	37	18	-	-	-	-	-	55	0.22 - 0.40
Foliolosa	-	7	43	5	-	-	-	-	55	0.26 - 0.50
Congesta	-	-	22	29	11	2	-	-	55	0.32 - 0.80
Robusta	-	-	1	22	29	8	5	4	69	0.42 - 1.10
	PEDUNCLE WIDTH BELOW RACEME.									
Bullulata	-	7	2	-	-	-	-	-	9	0.24 - 0.32
Hallii	-	18	16	-	-	-	-	-	34	0.17 - 0.44
Smutsiana	6	33	-	-	-	-	-	-	39	0.11 - 0.27
Spiralis	5	25	-	-	-	-	-	-	30	0.14 - 0.25
Herrei	-	17	1	-	-	-	-	-	18	0.20 - 0.32
Rugosa	6	49	-	-	-	-	-	-	55	0.14 - 0.28
Foliolosa	2	54	1	-	-	-	-	-	57	0.15 - 0.35
Congesta	-	47	16	-	-	-	-	-	63	0.20 -0.40
Robusta	-	14	38	19	7	-	-	-	78	0.28 - 0.73

Table 10 VARIATION IN DIMENSIONS OF PEDUNCLE AND RACEME IN GENUS AS A WHOLE (HERBARIUM MATERIAL INCLUDED.)

Entity.	Class range of measurements.							Total no. indiv.	Range actual measurements
NUMBER OF STERILE BRACTS. Class Interval 2 bracts.									
	2	4	6	8	10	12			cm.
Bullulata	-	5	6	3	-	-	-	14	3 - 7
Hallii	-	7	17	7	3	-	1	35	3 - 14
Smutsiana	1	12	20	5	1	-	-	39	2 - 10
Spiralis	-	15	23	7	-	-	-	45	3 - 8
Herrei	9	12	1	-	-	-	-	22	1 - 6
Rugosa	19	49	2	-	-	-	-	70	1 - 6
Foliolosa	1	26	32	8	1	-	-	68	1 - 10
Congesta	20	28	22	3	-	-	-	73	1 - 8
Robusta	9	49	32	8	1	-	-	99	1 - 10

LENGTH LOWEST STERILE BRACT. Class Interval 0.20 cm.

	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0			
Bullulata	-	8	6	-	-	-	-	-	-	-	14	0.42 - 0.73
Hallii	-	9	21	3	-	-	-	-	-	-	33	0.43 - 0.93
Smutsiana	-	13	17	5	1	-	-	-	-	-	36	0.42 - 1.05
Spiralis	-	2	15	15	4	3	-	-	-	-	39	0.52 - 1.40
Herrei	-	-	8	12	3	-	-	-	-	-	23	0.70 - 1.10
Rugosa	11	20	6	-	-	-	-	-	-	-	37	0.40 - 0.80
Foliolosa	-	4	32	23	6	2	-	-	-	-	67	0.56 - 1.30
Congesta	-	-	9	22	3	1	-	-	-	-	35	0.70 - 1.27
Robusta	-	-	4	11	28	25	17	6	4	1	96	0.75 - 2.15

LENGTH LOWEST FERTILE BRACT. Class Interval 0.20 cm.

Bullulata	8	7	-	-	-	-	-	-	-	-	15	0.35 - 0.53
Hallii	11	23	-	-	-	-	-	-	-	-	34	0.30 - 0.54
Smutsiana	20	15	-	-	-	-	-	-	-	-	35	0.30 - 0.60
Spiralis	3	25	12	1	-	-	-	-	-	-	41	0.32 - 0.86
Herrei	-	4	21	4	1	-	-	-	-	-		0.68 - 0.10
Rugosa	52	14	-	-	-	-	-	-	-	-	66	0.23 - 0.50
Foliolosa	2	41	34	4	-	-	-	-	-	-	81	0.40 - 0.90
Congesta	-	10	32	8	-	-	-	-	-	-	50	0.45 - 0.95
Robusta	-	2	20	30	36	7	1	-	-	-	96	0.43 - 1.50

Table 11A VARIATION IN DIMENSIONS OF INFLORESCENCE BRACTS IN GENUS AS A WHOLE (HERBARIUM MATERIAL INCLUDED) robusta, (majority range 1.0 - 1.6 cm), the shortest in the entity rugosa, (majority range 0.2 - 0.6 cm). In the other entities the basal sterile bracts are intermediate in length, with varying majority ranges, as can be seen from the table.

Length of lowest fertile bract (See Table 11A)

This is somewhat shorter than the lowest sterile bract, and tends to vary in length with it.

Basal width of sterile bracts (See Table 11B)

Sterile bracts with the widest bases are found in the entities congesta and robusta, both with a majority range of 0.45 - 0.60 cm. The entities bullulata, smutsiana, spiralis and rugosa have sterile bracts with the narrowest bases (majority range 0.15 - 0.30 cm) and the remaining entities have the majority of individuals with intermediate measurements.

Basal width of fertile bracts (See Table 11B)

This measurement tends to be slightly less than that for the sterile bracts. Fertile bracts with the widest bases are again found in the entity robusta (majority range 0.30 - 0.60 cm) and in the entity congesta (0.30 - 0.45 cm). With the exception of the entity herrei which has a majority range of 0.15 - 0.45 cm., the remaining entities have most fertile bracts 0.15 - 0.30 cm. wide at the base.

Middle width of lowest sterile and fertile bracts (See Table 11B)

The lowest fertile bracts are, on the whole, narrower than the lowest sterile bracts, but the pattern of variation tends to be the same in both types of bracts. The entities robusta (majority range 0.2 - 0.3 cm) and congesta (majority range 0.1 - 0.3 cm) have the broadest bracts, while the most tapering bracts are found in the entities smutsiana and spiralis, both with a majority range of less than 0.1 cm.

Pedicel length (See Tables 12A and B)

The entities with the longest basal flowering pedicels are herrei, with a majority range of 0.4 - 0.8 cm, and bullulata, hallii and rugosa all with a majority range of 0.4 - 0.6 cm. The shortest basal flowering pedicels are found in the entities

Entity.	Class Range of measurements.									Total no. Indiv.	Range actual measurements.

BASAL WIDTH OF LOWEST STERILE BRACT. Class Interval 0.15 cm.

0.15 0.30 0.45 0.60 0.75 0.90 1.05 1.20 cm.

Bullulata	-	7	2	-	-	-	-	-	-	9	0.25 - 0.40
Hallii	-	18	13	2	-	-	-	-	-	33	0.19 - 0.47
Smutsiana	1	31	2	-	-	-	-	-	-	34	0.15 - 0.37
Herrei	-	7	11	4	-	-	-	-	-	23	0.28 - 0.50
Rugosa	-	22	3	-	-	-	-	-	-	25	0.18 - 0.36
Foliolosa	-	34	29	5	-	-	-	-	-	68	0.20 - 0.60
Congesta	-	-	9	17	8	-	-	-	-	34	0.35 - 0.75
Robusta	-	2	2	46	22	11	1	-	1	95	0.30 - 1.30

BASAL WIDTH OF LOWEST FERTILE BRACT. Class Interval 0.15 cm.

Bullulata	-	10	-	-	-	-	-	-	-	10	0.20 - 0.30
Hallii	-	31	2	-	-	-	-	-	-	33	0.19 - 0.40
Smutsiana	1	32	1	-	-	-	-	-	-	38	0.14 - 0.34
Spiralis	3	37	1	-	-	-	-	-	-	41	0.14 - 0.35
Herrei	-	10	19	2	-	-	-	-	-	31	0.30 - 0.50
Rugosa	-	31	-	-	-	-	-	-	-	31	0.20 - 0.30
Foliolosa	-	62	15	-	-	-	-	-	-	77	0.18 - 0.45
Congesta	-	3	42	4	-	-	-	-	-	49	0.28 - 0.58
Robusta	-	1	33	49	13	1	-	-	-	97	0.30 - 0.80

MIDDLE WIDTH OF LOWEST STERILE BRACT. Class Interval 0.10 cm.

0.10 0.20 0.30 0.40 0.50

Bullulata	2	5	2	-	-	-	9	0.08 - 0.23
Hallii	7	15	-	-	-	-	23	0.08 - 0.22
Smutsiana	24	12	-	-	-	-	36	0.05 - 0.15
Spiralis	27	8	-	-	-	-	35	0.05 - 0.15
Herrei	4	16	2	-	-	-	22	0.08 - 0.30
Rugosa	7	17	1	-	-	-	25	0.06 - 0.23
Foliolosa	14	41	9	-	-	-	64	0.08 - 0.36
Congesta	-	11	12	4	3	-	30	0.14 - 0.48
Robusta	-	21	49	20	4	1	95	0.17 - 0.52

MIDDLE WIDTH OF LOWEST FERTILE BRACT. Class Interval 0.10 cm.

Bullulata	3	6	-	-	-	-	9	0.08 - 0.16
Hallii	16	7	-	-	-	-	23	0.07 - 0.14
Smutsiana	30	5	-	-	-	-	35	0.07 - 0.13
Spiralis	39	1	1	-	-	-	41	0.04 - 0.23
Herrei	5	24	2	-	-	-	31	0.08 - 0.24
Rugosa	16	15	-	-	-	-	31	0.07 - 0.17
Foliolosa	34	41	1	-	-	-	76	0.06 - 0.22
Congesta	-	23	18	4	-	-	45	0.11 - 0.40
Robusta	-	27	58	12	-	-	97	0.14 - 0.40

Table 11B VARIATION IN DIMENSIONS OF INFLORESCENCE BRACTS IN GENUS AS A WHOLE. Contd. (HERBARIUM MATERIAL INCLUDED.)

Entity.	Class range of measurements.						Total no. indiv.	Range actual measurements.
	LOWEST FLOWERING PEDICEL IN FIELD SPECIMENS.							
	0.2	0.4	0.6	0.8	1.0			cm.
Bullulata	-	1	8	-	-	-	9	0.37 - 0.53
Hallii	-	7	20	6	-	-	33	0.35 - 0.75
Smutsiana	3	31	3	-	-	-	37	0.14 - 0.48
Spiralis	4	11	2	2	-	-	19	0.17 - 0.80
Herrei	-	2	6	6	2	-	16	0.25 - 0.95
Rugosa	-	9	26	15	2	-	52	0.30 - 0.90
Foliolosa	23	22	-	-	-	-	45	0.09 - 0.38
Congesta.	16	15	-	-	-	-	31	0.07 - 0.40
Robusta	62	-	-	-	-	-	62	0.00 - 0.18
	MIDDLE FLOWERING PEDICEL IN FIELD SPECIMENS.							
Bullulata	-	5	4	-	-	-	9	0.30 - 0.47
Hallii	-	21	12	-	-	-	33	0.28 - 0.59
Smutsiana	11	27	1	-	-	-	39	0.09 - 0.60
Spiralis	21	10	1	-	-	-	32	0.08 - 0.43
Herrei	-	2	8	4	-	-	14	0.23 - 0.70
Rugosa	-	21	20	4	1	-	46	0.28 - 0.92
Foliolosa	45	8	-	-	-	-	53	0.08 - 0.32
Congesta	37	4	-	-	-	-	41	0.06 - 0.28
Robusta	67	-	-	-	-	-	67	0.00 - 0.07
	BASAL FRUITING PEDICEL IN FIELD SPECIMENS.							
Bullulata	-	-	2	-	-	-	2	0.39 - 0.42
Hallii	-	-	4	-	-	-	4	0.41 - 0.53
Smutsiana	-	10	1	-	-	-	11	0.24 - 0.43
Spiralis	3	11	2	-	1	-	17	0.17 - 0.82
Herrei	-	-	-	-	-	-	1	2.00
Rugosa	-	-	2	-	1	-	3	0.52 - 0.89
Foliolosa	2	15	-	-	-	-	17	0.14 - 0.38
Congesta	19	23	-	-	-	-	42	0.06 - 0.38
Robusta	35	-	-	-	-	-	35	0.02 - 0.15

Class Interval 0.20 cm.

Table 12A VARIATION IN PEDICEL LENGTH IN GENUS AS A WHOLE.

foliolosa and congesta, both with a majority range of 0.2 - 0.4 cm, and robusta with a majority range of <0.2 cm.

Pedicels become shorter acropetally and the entities with the longest pedicels from the middle of the raceme are again herrei (majority range 0.4 - 0.6 cm) and bullulata and rugosa, both with a majority range of 0.2 - 0.6 cm. The shortest pedicels from the middle of the raceme, which are <0.2 cm in length are found in the majority of individuals of the entities spiralis, foliolosa, congesta and robusta.

Unfortunately the samples of fruiting pedicels are small, but the variation pattern does not differ much from that of the lowest flowering pedicel.

The table showing range of variation in dried and herbarium material tallies with that for fresh material. Of interest is the very wide range of length of pedicel found in flowering and fruiting material of the entity herrei - from 0.25 - 200 cm.

Summary

In conclusion it can be seen that in all cases there is an overlap of the ranges of measurements of the various inflorescence parts for the different entities. Inflorescence characters cannot thus be considered to be of primary taxonomic importance. However, in a number of instances, the majority ranges do differ, and accordingly, certain inflorescence characteristics are discernable.

Long slender unbranched peduncles, long pedicels and small bracts tend to characterise the entity rugosa, while long stout unbranched peduncles, medium sized to large bracts and very long pedicels are typical of the entity herrei.

Very short pedicels tend to distinguish the entities foliolosa, congesta and robusta from the rest, lending support to the suggestion that these three entities be regarded as a distinct group because of their glossy sheen leaves. Congesta and robusta are further distinguished from the other entities by the high percentage of branched inflorescences in the former, and by short peduncles with wide bases and long bracts in the latter.

Entity.	Class range of measurements.						Total no. Indiv.	Range actual measurements.
	o.2	0.4	0.6	0.8	1.0			cm.
	LOWEST FLOWERING PEDICEL IN HERBARIUM SPECIMENS.							
Bullulata	-	3	1	-	-	-	4	0.30 - 0.45
Hallii	-	1	-	-	-	-	1	0.33
Spiralis	1	9	1	-	-	-	11	0.20 - 0.42
Herrei	-	-	1	4	1	2		0.60 - 1.68
Rugosa	1	3	6	2	-	-	12	0.20 - 0.74
Foliolosa	9	5	-	-	-	-	14	0.08 - 0.29
Congesta	7	-	-	-	-	-	7	0.14 - 0.18
Robusta	12	-	-	-	-	-	12	0.00 - 0.08
	MIDDLE FLOWERING PEDICEL IN HERBARIUM SPECIMENS.							
Bullulata	-	3	-	-	-	-	3	0.23 - 0.33
Spiralis	3	9	-	-	-	-	12	0.10 - 0.31
Herrei	-	1	4	-	2	1	8	0.39 - 1.10
Rugosa	2	9	1	-	-	-	12	0.18 - 0.58
Foliolosa	8	-	-	-	-	-	8	0.07 - 0.20
Congesta	7	-	-	-	-	-	7	0.07 - 0.15
Robusta	12	-	-	-	-	-	12	0.00 - 0.04
	BASAL FRUITING PEDICEL IN HERBARIUM SPECIMENS.							
Spiralis	-	4	-	-	-	-	4	0.30 - 0.39
Herrei	-	-	-	-	1	-	1	0.83
Rugosa	-	-	2	-	-	-	2	0.53
Foliolosa	1	-	-	-	-	-	1	0.20
Congesta	1	-	-	-	-	-	1	0.15 - 0.33
Robusta	1	-	-	-	-	-	1	0.02 - 0.10

Table 12B VARIATION IN PEDICEL LENGTH IN GENUS AS A WHOLE. Contd.

2. FLORAL MORPHOLOGY

In Astroloba and the related genus Haworthia Duval, the six tepals of the perianth are loosely fused to form a tube, usually about a centimetre long and with a mean diameter of about 3 mm. The expanded free apical parts of the tepals, here referred to as lobes, vary in length from 1 to 3 mm. in Astroloba and 3 to 5 mm. in Haworthia. An inner tepal is in the posterior position.

In Haworthia, the lobes in addition to being longer than in Astroloba, open in such a way that the three anterior lobes are strongly up curved, resulting in a secondarily zygomorphic,* bilabiate flower. (See Plate 4). This feature is not strongly marked in some species such as H. margaritifera (L.) Haw and H. albicans Haw.

In Astroloba, the open arrangement of the lobes is much more regular, although sometimes the anterior outer lobe

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* The term "Zygomorphy" implies a morphological asymmetry in the flower while "secondary zygomorphy" covers the situation in which there is an apparent lack of radial symmetry due to grouping of floral parts, themselves perfectly symmetrical, in the open flower.

tends to be out-curved through an angle greater than that formed by the two outer lateral lobes. (See Plate 4). The inner lobes tend not to open out as much as the outer ones and they are often somewhat hooded. The inner posterior lobe generally opens out more than the remaining inner lobes.

In Poellnitzia von Poellnitz, the third and mono-specific genus associated with this group of the Aloinae, the perianth tube is longer and bright orange-red in colour with connate yellow lobes, the side margins of which are revolute. The placing of P. rubriflora (L. Bol.) Uitew. in a separate genus on account of its unusual perianth is quite justified.

The colours of Astroloba flowers are indistinct, generally pale colours, difficult to describe - beige, olive green, pea green, glaucous green, yellow, sulphur yellow, cream and white. In cultivation under glass at Kirstenbosch, the perianth colours may become slightly paler, but on the whole do not differ very much from colours observed in the field.

Perianth characters do indicate certain trends in the genus, and the most obvious character is that which distinguishes the entities herrei and spiralis from the other entities. Each tepal has a midrib of three central veins which converge to form an inverted V in the lobes, and the tissues surrounding these veins is pigmented. In the outer tepals, on either side of the midrib, there is an inflation of loosely packed parenchyma tissue, which may be white or faintly pigmented, the colouring becoming more intense towards the base of the tube. Save for the entities spiralis and herrei, this inflation is slight, (See Fig. 10). In these two, however, it is considerable (See Fig. 11). They may further be distinguished by the fact that in the entity herrei this inflation is generally smooth or undulating in appearance, while in the entity spiralis it tends to be transversely rugose. This will be discussed in more detail later.

Numerical Analysis of Perianth Characters in the Genus as a whole.

The measurements of perianth characters of individual populations are given in the Appendix Table 4. Whether the flowers

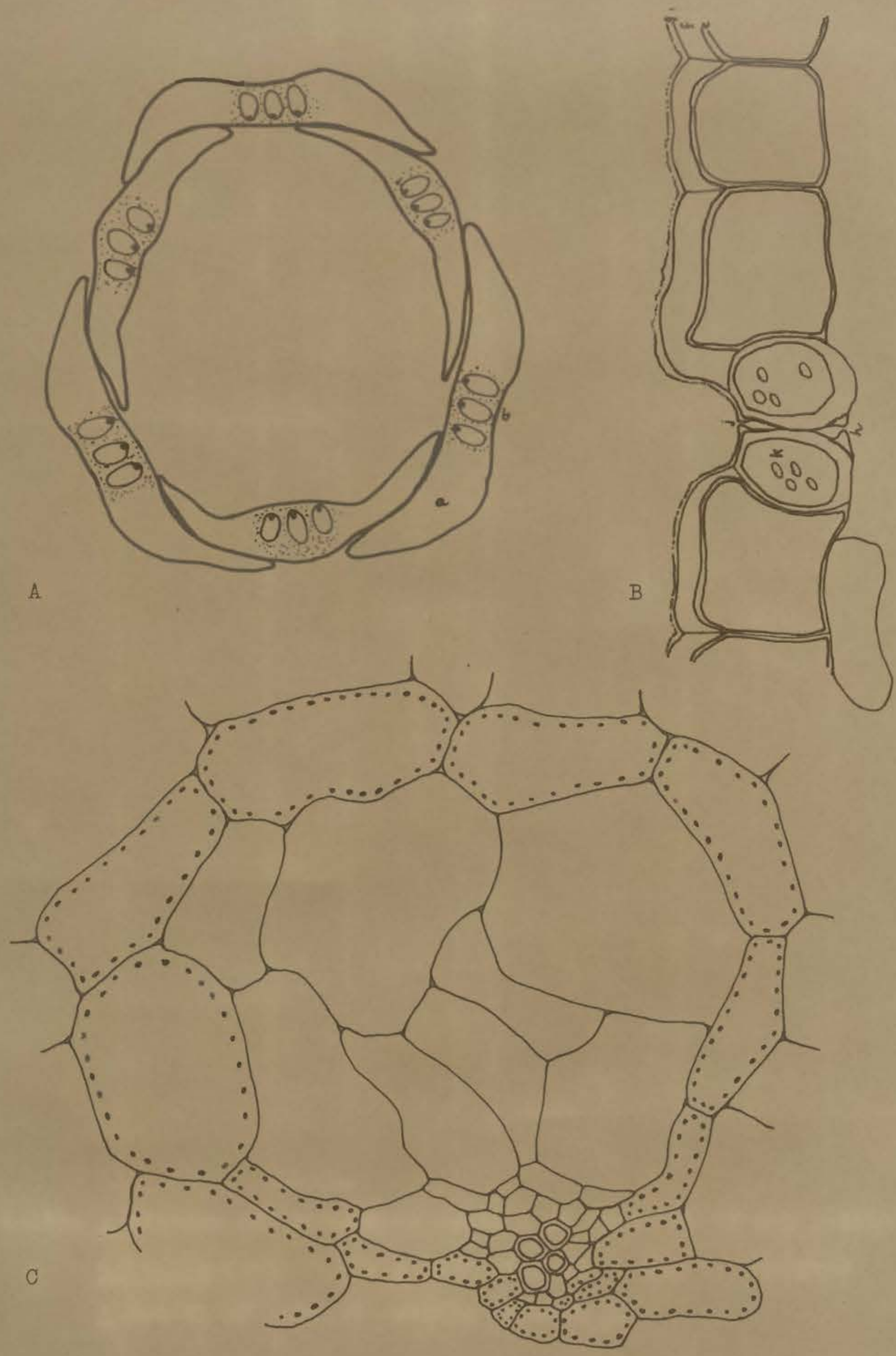


Fig. 10 A Diagram of transverse section of perianth of the entity rugosa (R17) X 30: a spongy parenchyma causing very slight inflation on either side of midrib in outer tepal, b midrib composed of three vascular strands, extent of pigmented tissue shown by stippling; B section through epidermis of perianth of same specimen showing stoma, labelling as for Fig.4.B; C transverse section of vascular bundle from midrib of tepal; note thin walled cells of bundle cap.

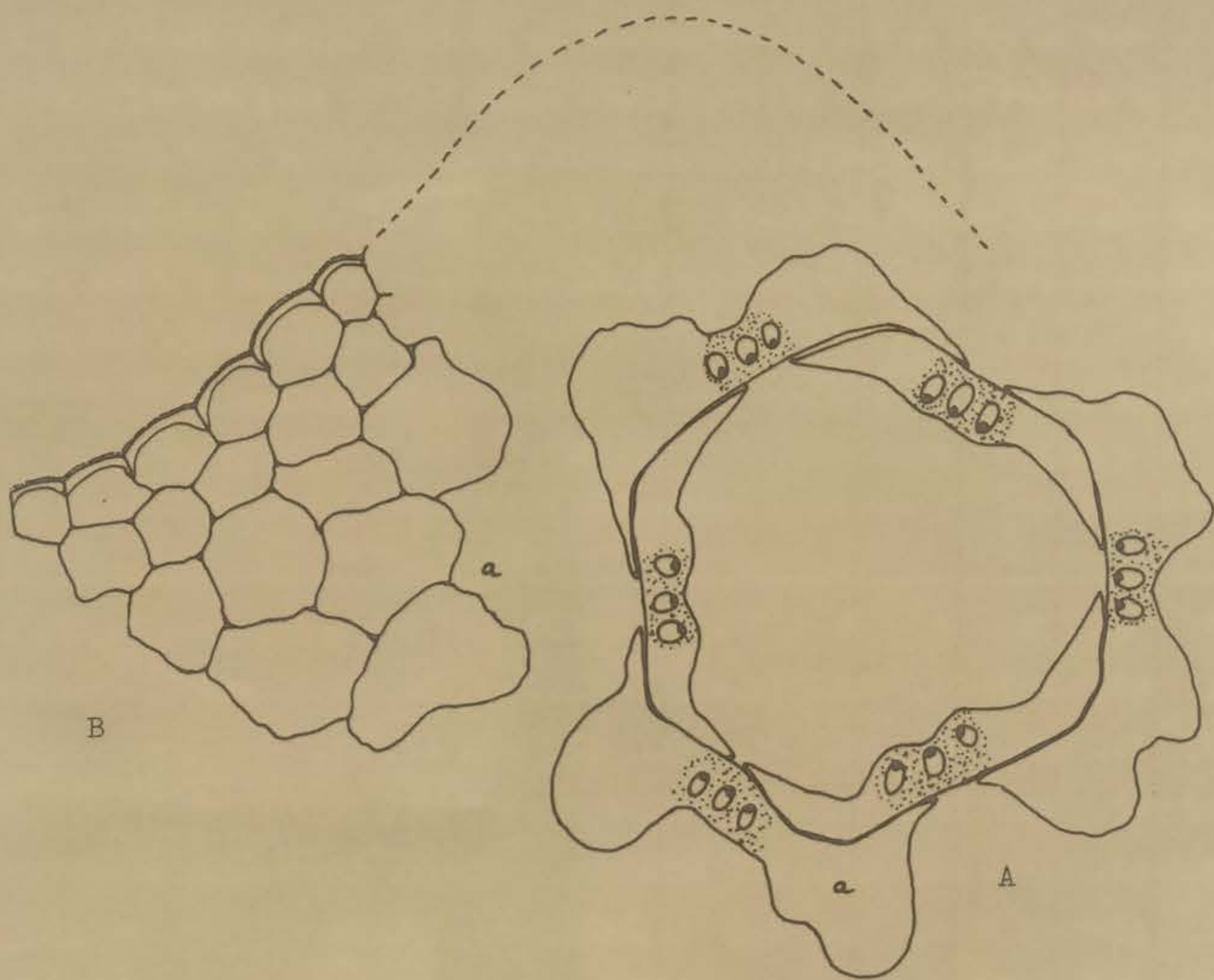


Fig.11. A Diagram of transverse section of perianth of the entity spiralis (R61) X 30: a inflation of spongy parenchyma; B detail of part of section through a.

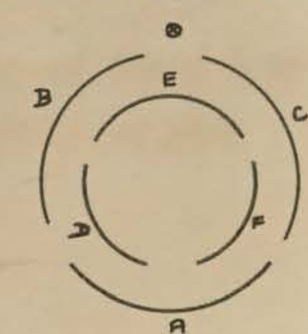
were measured from inflorescences growing in the field or from inflorescences which developed under cultivation is indicated in the table.

Perianth lobes. These are dealt with first. In colour, they are yellow, pale or whitish, in the open flower; the V of the vein endings usually with the same pigmentation as the midribs of the outer tepals. Apices of unopened buds are a deep salmon pink. The margins of the lobes are generally somewhat ragged or serrated, this being on the whole more marked in the inner lobes. Measurements of the length and width of inner and outer lobes were made using a micrometer eyepiece. The width of a lobe was measured half way along its length.

Dimensions of individual lobes vary slightly as is shown in Table 13 below.

Entity	Lobe length in cm.						Lobe width in cm.					
	A	B	C	D	E	F	A	B	C	D	E	F
robusta (R 43)	.23	.28	.30	.32	.32	.31	.30	.20	.20	.30	.31	.30
	.30	.30	.28	.37	.37	.36	.30	.30	.28	.40	.40	.40
	.28	.30	.30	.33	.32	.32	.19	.20	.20	.30	.32	.30
smutsiana (R62a)	.18	.15	.15	.15	.15	.14	.10	.13	.14	.15	.15	.15
	.14	.13	.13	.15	.15	.15	.10	.12	.13	.15	.15	.14
	.15	.16	.15	.15	.15	.15	.12	.13	.14	.14	.15	.13
hallii (R 54)	.19	.17	.17	.18	.19	.18	.12	.13	.15	.17	.18	.18
	.17	.16	.15	.18	.17	.18	.10	.13	.13	.18	.17	.18
	.20	.20	.20	.20	.20	.20	.15	.16	.16	.18	.20	.18

Table 13 showing variation in length and width of individual lobes taken at random from original measurements. The lobes are lettered as shown in the adjacent diagram.



These measurements are somewhat approximate in view of the fact that it is difficult to determine the exact extent of the length of a lobe. In the Table 4 of the Appendix, the mean of the measurements for each whorl are given and it is these which are used in the analyses below.

Length of Perianth lobes (See Table 14)

There is little difference in length between the inner and outer perianth lobes throughout the genus.

Entities with the longest outer lobes are herrei (majority range 2.0 - 3.0 mm) and robusta (majority range 1.5 - 3.00 mm), while the shortest lobes are found in the entities smutsiana and spiralis, both with a majority range of 1.0 - 1.5 mm. The other entities have the majority of plants with outer lobes of intermediate length.

A similar pattern of variation is found for the length of the inner lobes. However it is of interest to note that about a third of the individuals of the entities foliolosa and congesta have inner perianth lobes 2.0 - 2.5 mm long, while for the entity robusta the majority range is 2.5 - 3.0 mm.

Width of perianth lobes (See Table 14)

In general, the inner perianth lobes are wider than the outer ones.

The broadest outer perianth lobes are found in the entity herrei, with a majority range of 1.5 - 2.5 mm, and the entities congesta, foliolosa and robusta, all with 1.5 - 2.00 mm as the majority range. The other entities have narrower lobes, the majority range in each case being 1.0 - 1.5 mm.

The broadest inner perianth lobes are found in the entities robusta (majority range 2.5 - 3.0 mm), herrei and congesta, (both with a majority range of 2.0 - 3.0 mm) and foliolosa, with a majority range of 2.0 - 2.5 mm. The narrowest perianth lobes are found in the entities smutsiana and spiralis, both with a majority range of 1.0 - 1.5 mm.

Thus in dimensions of perianth lobes, herrei, an entity with an inflated perianth stands apart with robusta, an entity with a smooth perianth, in having the longest and broadest lobes in the genus. The entities foliolosa and congesta, are distinguished from the remaining members of the genus by the possession of wider, if not longer lobes.

Entity.	Class range of measurements.							Total no. indiv.	Range actual measurements.
	1.0	1.5	2.0	2.5	3.0	3.5			mm.
	LENGTH OF OUTER PERIANTH LOBES.								
Bullalata	-	2	7	-	-	-	-	9	1.5 - 1.9
Hallii	-	3	22	1	-	-	-	26	1.4 - 2.1
Smutsiana	-	30	4	-	-	-	-	34	1.2 - 1.8
Rugosa	-	12	12	-	-	-	-	24	1.4 - 1.8
Herrei	-	-	2	5	4	-	-	11	1.8 - 3.0
Spiralis	-	15	5	-	-	-	-	20	1.4 - 1.9
Congesta	-	-	22	8	1	-	-	31	1.6 - 2.8
Foliolosa	-	3	32	1	-	-	-	36	1.4 - 2.3
Robusta	-	-	7	7	10	-	-	24	1.7 - 3.0
	LENGTH OF INNER PERIANTH LOBES.								
Bullulata	-	1	8	-	-	-	-	9	1.4 - 2.0
Hallii	-	4	20	2	-	-	-	26	1.5 ÷ 2.2
Smutsiana	2	27	5	-	-	-	-	34	
Rugosa	-	13	11	-	-	-	-	24	1.4 - 1.8
Herrei	-	-	2	4	4	1	-	11	1.6 - 3.2
Spiralis	-	16	4	-	-	-	-	20	1.2 - 1.9
Congesta	-	-	18	10	3	-	-	31	1.8 - 2.8
Foliolosa	-	1	24	10	1	-	-	36	1.4 - 2.7
Robusta	-	-	-	5	12	4	3	24	2.3 - 4.0
	WIDTH OF OUTER PERIANTH LOBES.								
Bullulata	-	7	2	-	-	-	-	9	1.3 - 1.8
Hallii	-	16	9	1	-	-	-	26	1.2 - 2.1
Smutsiana	6	24	4	-	-	-	-	34	1.0 - 1.9
Rugosa	-	22	2	-	-	-	-	24	1.2 - 1.7
Herrei	-	1	5	4	1	-	-	11	1.5 - 3.0
Spiralis	2	17	1	-	-	-	-	20	1.0 - 1.6
Congesta	-	1	28	2	-	-	-	31	1.5 - 2.2
Foliolosa	-	12	24	-	-	-	-	36	1.2 - 2.0
Robusta	-	-	9	2	3	-	-		
	WIDTH OF INNER PERIANTH LOBES.								
Bullulata	-	-	9	-	-	-	-	9	1.6 - 2.0
Hallii	-	-	18	8	-	-	-	26	1.6 - 2.5
Smutsiana	-	20	14	-	-	-	-	34	1.2 - 1.9
Rugosa	-	2	22	-	-	-	-	24	1.5 - 2.0
Herrei	-	-	1	5	5	-	-	11	2.0 - 3.0
Spiralis	-	12	8	-	-	-	-	20	1.3 - 2.0
Congesta	-	-	1	17	12	1	-	31	2.0 - 3.2
Foliolosa	-	1	4	22	8	1	-	36	1.5 - 3.5
Robusta	-	-	-	3	17	2	2	24	2.2 - 4.0

Class Interval 0.50 mm.

Table 14 VARIATION IN DIMENSIONS OF PERIANTH LOBES IN GENUS

AS A WHOLE.

The entities smutsiana and spiralis have the smallest lobes, while for the entities rugosa, bulluta and hallii, the lobe dimensions are of intermediate size.

Although the samples of herrei and bullulata are small, it is felt that in this case the measurements are sufficient to be indicative of the variation pattern of lobe dimensions within these entities. (See Plate 4).

The position of the lobes in the open flower (See Table 15)

The figures obtained by estimating with a protractor the angle (Fig. 12) through which the lobes curve outward from a projection of the line of the perianth tube,are very approximate.

It was found that the two lateral outer lobes open at roughly the same angle and so do the two inner laterals. In the appendix, then, four measurements, of the open angles made by the anterior outer lobe, outer laterals, posterior inner lobe, and inner laterals, are given.

Of all measurements made of perianth character these are the least reliable because both in the field and under cultivation the lobes do not always open to their fullest extent. Nevertheless, as is seen in Table 15 slight differences between the entities are apparent. Because of the fact that these measurements are only approximations a wide class interval of 30^{o} is given in this Table.

Angle made by the outer anterior lobe

Reference to Table 15 shows that the most open anterior lobes are found in robusta (majority range 90 - 120^{o}), and foliolosa and congesta, (both with a majority range of 60 - 90^{o}). Entities with the least open anterior lobes are rugosa, herrei and spiralis, all with a majority range of 30 - 60^{o}. The remaining entities have a majority range of 30 - 90^{o}.

Angle made by outer lateral lobes

Table 15 shows that in some instances, the outer lateral lobes are less open than the outer anterior lobe. The most open outer laterals are also found in the entities congesta, foliolosa and robusta.

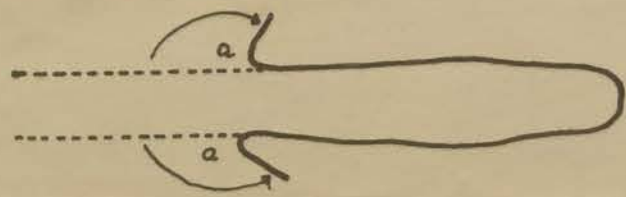


Fig. 12. Diagram showing angle _a_ measured to indicate position of lobes in the open flower.

Flowers of the entity robusta, showing broad perianth lobes, which open out in a wide angle. In one of the flowers below, the anterior outer lobe curves back through an angle of 180°.

(X 1)

(X 1)

Flowers of the entity bullulata with smaller perianth lobes which do not open out as much as is found in the entities foliolosa, robusta and congesta.

PLATE 4.

Entity.	Class range of measurements.						Total no. indiv.	Range actual measurements.
	30° 60° 90° 120° 150°							°
	ANGLE MADE BY OUTER ANTERIOR LOBE.							
Bullulata	-	3	3	1	-	-	7	30 - 90
Hallii	2	10	8	2	-	-	22	5 - 90
Smutsiana	3	9	8	-	-	-	20	10 - 80
Rugosa	4	9	4	-	-	-	17	0 - 70
Herrei	-	6	2	-	1	-	9	40 - 125
Spiralis	2	10	3	1	-	-	16	10 - 90
Congesta	-	3	13	6	2	1	25	30 - 180
Foliolosa	-	7	16	8	-	1	32	30 - 180
Robusta	-	3	3	8	3	2	19	40 - 180
	ANGLE MADE BY OUTER LATERAL LOBES.							
Bullulata	1	2	4	-	-	-	7	20 - 80
Hallii	1	15	4	2	-	-	22	0 - 90
Smutsiana	3	8	9	-	-	-	20	10 - 70
Rugosa	11	6	-	-	-	-	17	10 - 55
Herrei	3	4	1	1	-	-	9	0 - 90
Spiralis	4	11	1	-	-	-	16	0 - 70
Congesta	-	5	12	7	-	1	25	30 - 180
Foliolosa	4	8	17	3	-	-	32	10 - 100
Rébusta	-	4	4	6	4	1	19	30 - 170
	ANGLE MADE BY INNER POSTERIOR LOBE.							
Bullulata	-	6	1	-	-	-	7	30 - 70
Hallii	9	8	5	-	-	-	22	0 - 80
Smutsiana	2	13	5	-	-	-	20	10 - 70
Rugosa	16	1	-	-	-	-	17	0 - 30
Herrei	9	-	-	-	-	-	9	0 - 10
Spiralis	8	8	-	-	-	-	16	0 - 50
Congesta	9	9	5	2	-	-	25	0 - 110
Foliolosa	2	16	10	4	-	-	32	0 - 90
Robusta	-	5	6	5	3	-	19	30 - 130
	ANGLE MADE BY INNER LATERAL LOBES.							
Bullulata	3	4	-	-	-	-	7	10 - 45
Hallii	20	2	-	-	-	-	22	0 - 45
Smutsiana	14	6	-	-	-	-	20	0 - 45
Rugosa	16	1	-	-	-	-	17	0 - 30
Herrei	9	-	-	-	-	-	9	6 - 10
Spiralis	15	1	-	-	-	-	16	0 - 30
Congesta	11	7	5	2	-	-	25	0 - 110
Foliolosa	5	23	4	-	-	-	32	0 - 70
Robusta	-	6	8	2	3	-	19	30 - 130

Class Interval 30°.

Table 15 VARIATION IN POSITION OF PERIANTH LOBES IN OPEN FLOWER IN GENUS AS A WHOLE.

Angle made by inner posterior lobe

For all entities there is a tendency for this to be less open than the outer lobes. The entities with the most open inner posterior lobe are robusta and foliolosa, while the entities with the least open inner posterior lobe are aspera and herrei. The remaining entities are intermediate.

Angle made by inner lateral lobes

The inner lateral lobes tend to open out least of all the lobes. Again the entities robusta and foliolosa have the most open lobes. The entities congesta and bullulata are intermediate, while the remaining entities all have the majority of inner lateral lobes opening at an angle of 30^{o}.

Thus the entities robusta and foliolosa, and to a lesser extent congesta appears to have the most open perianth lobes in the genus.

Perianth tube (See Table 16)

Dimensions and shape of the perianth tube vary slightly and measurements were made, using a vernier gauge, of the following:-

(i) Basal diameter of perianth tube.

(ii) The diameter of the perianth tube half way along its length.

(iii) The diameter of the perianth neck - the point at which the lobes begin to diverge.

The perianth tube is in general slightly oval in section, the broadest diameter being along the anterior posterior axis, and measurements were made in this plane.

(iv) The length of the perianth tube was measured from the base to the neck.

Length of perianth tube

Entities with the longest perianth tubes are hallii and smutsiana, both with a majority range of 9 - 11 mm, while the shortest perianth tube is found in the entity herrei with a majority range of 5 - 7 mm. The remaining entities have perianth tubes intermediate in length.

Entity.	Class range of measurements.				Total no. indiv.	Range actual measurements.

LENGTH OF PERIANTH TUBE. Class interval 2.0 mm.

	7.0	9.0	1.1			mm.
Bullulata	-	4	5	1	10	8.0 - 12.0
Hallii	-	7	22	1	30	7.8 - 11.3
Smutsiana	-	8	21	5	34	8.3 - 12.1
Rugosa	-	13	6	8	27	7.3 - 12.5
Herrei	8	3	-	-	11	5.7 - 8.0
Spiralis	-	13	6	3	22	7.3 - 11.9
Congesta	16	15	-	-	31	5.8 - 9.0
Foliolosa	3	31	2	-	36	7.0 - 9.9
Robusta	9	14	1	-	24	5.8 - 9.6

DIAMETER OF PERIANTH NECK. Class interval 0.5 mm.

	2.0	2.5	3.0	3.5			mm.
Bullulata	-	10	-	-	-	10	2.3 - 2.5
Hallii	-	15	15	-	-	30	2.1 - 3.0
Smutsiana	15	17	2	-	-	34	1.9 - 2.8
Rugosa	12	14	1	-	-	27	1.9 - 2.6
Herrei	1	6	4	-	-	11	2.0 - 3.0
Spiralis	15	5	1	-	-	21	1.7 - 2.8
Congesta	-	7	19	4	1	31	2.3 - 3.6
Foliolosa	2	15	17	2	-	36	2.0 - 3.4
Robusta	1	4	17	1	-	23	2.2 - 3.2

MIDDLE DIAMETER OF PERIANTH TUBE. Class interval 0.5 mm.

	2.5	3.0	3.5	4.0	4.5	5.0	5.5			mm.
Bullulata	-	2	4	-	2	-	-	-	8	2.9 - 4.1
Hallii	- -	5	10	7	1	-	-	-	23	2.8 - 4.1
Smutsiana	-	17	12	4	1	-	-	-	34	2.8 - 4.1
Rugosa	1	18	4	1	-	-	-	-	24	2.5 - 3.7
Herrei	-	-	-	6	3	2	-	-	11	3.7 - 5.0
Spiralis	-	7	11	-	2	-	-	-	20	2.6 - 4.3
Congesta	-	8	12	10	1	-	-	-	31	2.8 - 4.3
Foliolosa	-	10	15	9	1	-	-	-	35	2.6 - 4.3
Robusta	1	11	10	2	-	-	-	-	23	2.4 - 3.8

BASAL DIAMETER OF PERIANTH TUBE. Class interval 0.5 mm.

Bullulata	-	1	6	1	2	-	-	-	10	3.0 - 4.4
Hallii	-	4	17	5	4	-	-	-	30	2.8 - 4.3
Smutsiana	-	20	10	4	-	-	-	-	34	2.7 - 3.7
Rugosa	1	9	15	2	-	-	-	-	27	2.5 - 3.8
Herrei	-	3	3	2	2	-	-	1	11	2.9 - 5.6
Spiralis	2	8	6	4	1	-	-	-	21	2.4 - 4.2
Congesta	5	20	4	2	-	-	-	-	31	2.2 - 3.7
Foliolosa	3	20	10	3	-	-	-	-	36	2.4 - 4.0
Robusta	2	15	6	-	-	-	-	-	23	2.3 - 3.3

Table 16 VARIATION IN DIMENSIONS OF PERIANTH TUBE IN GENUS AS A WHOLE.

Diameter of perianth neck

Entities with the widest neck are congesta and robusta, both with a majority range of 2.5 - 3.00 mm, while the entity spiralis, with a majority range of 1.5 - 2.0 mm has the most constricted perianth neck. The remaining entities have necks intermediate in diameter.

Middle diameter of perianth

The broadest mid diameter is found in the entity herrei, with a majority range of 3.5 - 4.0 mm, while in spiralis, the other entity with a marked inflation of the outer tepals, the majority range is 2.5 - 3.5 mm.

Of the entities with a smooth perianth, the broadest mid diameter is found in congesta and bullulata, (majority range 3.0 - 4.0 mm), while the narrowest mid diameter occurs in the entity rugosa with a majority range of 2.5 - 3.0 mm. Measurements for the remaining entities are intermediate.

Basal diameter of perianth

Entities with the broadest perianth bases are bullulata, hallii and rugosa, all with a majority range of 3.0 - 3.5 mm. The majority ranges for the entity spiralis, (2.5 - 4.0 mm), and the entity herrei, (2.5 - 4.5 mm) are more extensive. The remaining entities have the majority of individuals with perianth bases 2.5 - 3.0 mm in diameter.

Difference between diameter of base and diameter of middle of perianth. (See Table 17)

The middle diameter of the perianth is for the most part less than or equal to the basal diameter in the entities bullulata, hallii and rugosa. In the entity smutsiana the majority of individuals have the middle diameter equal to or greater than the basal diameter. In the other entities, the middle diameter of the perianth tube is greater than that of the base in the majority of individuals, this difference being most marked in the entity herrei.

Difference between diameter of middle and diameter of neck of the perianth tube. (See Table 17)

In all cases the neck of the perianth tends to be narrower than the middle. The greatest difference in diameter is

Entity.	Class range of measurements.									Total no. indiv.	Range actual measurements.
		-1.5	-1.0	-0.5	0		0.5	1.0	1.5		mm.
DIFFERENCE BETWEEN DIAMETER OF MIDDLE AND DIAMETER OF NECK OF PERIANTH TUBE.											
Bullulata	-	-	-	-	-	-	6	-	2	8	0.6 - 1.7
Hallii	-	-	-	-	-	2	12	9	-	23	0.5 - 1.4
Smutsiana	-	-	-	-	-	5	19	7	3	34	0.4 - 1.7
Rugosa	-	-	-	-	-	5	17	1	1	24	0.4 - 1.7
Herrei	-	-	-	-	-	-	-	6	5	11	1.1 - 2.0
Spiralis	-	-	-	-	-	-	5	11	4	20	0.7 - 2.0
Congesta	-	-	-	-	-	18	12	1	-	31	0.1 - 1.4
Foliolosa	-	-	-	-	-	7	23	4	1	35	0.3 - 1.9
Robusta	-	-	-	-	3	16	4	-	-	23	0.0 - 0.8
DIFFERENCE BETWEEN DIAMETER OF BASE AND DIAMETER OF MIDDLE OF PERIANTH TUBE *											
Bullulata	-	-	-	-	1	7	-	-	-	8	0.0 - 0.3
Hallii	-	-	-	6	5	12	-	-	-	23	-0.3 - 0.4
Smutsiana	-	-	-	14	12	8	-	-	-	34	-0.4 - 0.4
Rugosa	-	-	-	-	3	21	-	-	-	24	0.0 - 0.5
Herrei	-	-	6	3	1	-	1	-	-	11	-1.0 - 0.6
Spiralis	-	-	1	11	3	5	-	-	-	20	-0.7 - 0.3
Congesta	1	-	7	22	1	-	-	-	-	31	-1.6
Foliolosa	-	-	6	22	5	2	-	-	-	35	-0.9 - 0.2
Robusta	-	-	2	10	7	4	-	-	-	23	-0.8 - 0.3

Class interval 0.50 mm.

Table 17 SHOWING VARIATION IN SHAPE OF PERIANTH TUBE IN GENUS AS A WHOLE

* A negative value indicates that the base of the perianth is less in diameter than the middle.

found in the entities with inflated perianth tissue , namely herrei (majority range 1.0 - 2.0 mm) and spiralis (majority range 1.0 - 1.5 mm). The entities with the least difference in diameter between middle and neck of perianth are congesta and robusta, both with a majority range of 0 - 0.5 mm. The other entities are intermediate.

The varying diameter of the base, middle and neck of the perianth tube do tend to affect its appearance.

The entities bullulata and hallii have perianths similar in character in that they tend to be the longest in the genus, with the base of the tube for the most part being broader than the middle.

The entity rugosa, it is seen, has a perianth in general shorter in length than bullulata and hallii, but also with a similar basal diameter and a middle diameter narrower than the basal diameter. Here, howev er, the middle diameter is less than in the two other entities. The appearance of the perianth as a whole is consequently somewhat different.

In the entity smutsiana, the basal diameter tends to be less than in the entity rugosa, while the middle diameter is more or less the same, so that the middle part may be greater than, equal to, or in a few cases, less than the diameter of the base.

The entities herrei and spiralis, both with inflated perianth tissue have somewhat dissimilar perianth tube dimensions, the perianth tube being shorter and broader in herrei.

The entities congesta and robusta tend to have perianths with the widest necks, while these and the entity foliolosa tend to have the middle diameter larger than the basal diameter.

Length of stamens, ovary and style

In general these are too variable to be of any taxonomic significance but for the sake of completion ovary and style lengths are included in Table 4 of the appendix.

The length of the stamen varies within one flower since they do not all mature at the same time, and generally the three anterior stamens are slightly longer than the three posterior ones.

On the whole, the length of the longest stamen is roughly equivalent to or a fraction shorter than the length of the perianth tube.

Stamen length is not included in the Appendix Tables, but the variation in stamen length in flowers of two population samples is shown in Table 18.

Entity	Length of perianth tube	Length of stamens Anterior			Posterior		
bullulata (R55)	.92	.82	.97	.85	.82	.80	.85
	.86	.75	.70	.73	.65	.72	.70
	.80	.80	.82	.78	.75	.75	.72
	.83	.80	.75	.75	.77	.73	.70
	1.00	.90	.80	.86	.75	.85	.75
	.98	.85	.70	.82	.80	.75	.75
	.94	.86	.90	.85	.70	.80	.70
	.89	.75	.80	.80	.70	.80	.70
robusta (R42)	.79	.70	.65	.70	.57	.65	.55
	.77	.60	.70	.70	.65	.65	.70
	.70	.70	.65	.70	.65	.60	.70
	.66	.65	.80	.75	.60	.60	.65
	.70	.70	.60	.60	.63	.70	.65
	.90	.70	.80	.85	.50	.70	.60
	.70	.65	.70	.70	.60	.60	.65
	.80	.70	.80	.70	.70	.65	.65
	.85	.70	.65	.70	.60	.60	.60

Table 18. VARIATION IN LENGTH OF STAMENS IN TWO POPULATION SAMPLES OF ASTROLOBA (THE CENTRAL FIGURE IN THE MEASUREMENTS OF ANTERIOR STAMEN LENGTH APPLIES TO THE ANTERIOR STAMEN FROM THE OUTER STAMINAL WHORL, WHILE THAT IN THE MEASUREMENTS OF THE POSTERIOR STAMENS IS THE LENGTH OF THE POSTERIOR STAMEN FROM THE INNER WHORL OF STAMENS.)

<u>Perianth Colours</u> (See Plate 5).

The colours of the perianth are hard to define but do vary somewhat in the different entities. Mention has been made earlier of the greatly swollen tissue on either side of the midrib in the three outer tepals of the entities <u>spiralis</u> and <u>herrei</u>.

In these two, the midribs of the tepals are a pale green, with a bluish or a beigey tinge, the inflated tissue on either side of the outer tepal midribs is white, and the lobes are a clear yellow, which may be bright or pale, but is always definitely yellow.

In the entities congesta, foliolosa and robusta, the colours of the perianth are similar for all three. The veins of the tepals are green with a slightly blue, beige or yellowish tinge, the vein endings in the lobes being of the same colour, but sometimes with a pinkish tinge. The rest of the lobe is white or pale cream, but never yellow. The tubular part of the outer tepals on either side of the midrib is greenish white or pale cream, becoming greener towards the base.

In the entity hallii, the colours of the perianth tube are similar to those of the above three, same that the tissue on either side of the midrib of the outer tepals often has a greenish, beige or greenish yellow tinge. The lobes may be a bright yellow, or more often a pale yellow or yellowish cream, and in a few instances, cream. When the lobes are yellow, the vein endings tend to be a reddish brown otherwise they are greenish, greenish beige or beige.

In the entity bullulata, the lobes in most cases are a bright yellow, or a pale yellow, and very rarely yellowish cream. No specimens with cream or whitish lobes were observed.

In specimens with bright yellow lobes, the midribs of the tepals are often green with a reddish brown tint.

In the entity smutsiana, the colour of the perianth is much the same as in the entity hallii, save that the lobes are white or cream.

In the entity rugosa, the midribs of the tepals are green with a beige or pinkish tinge. The three outer tepals of the perianth tube may be very slightly inflated on either side of the midrib. This tissue is white, cream or with a very faint pinkish or greenish tinge and it tends to be more distinct from the midrib than in the entities hallii, bullulata or smutsiana.

Summary

Thus on grounds of perianth characters, the entities herrei and spiralis stand apart from the other entities in the possession of markedly inflated tissue on either side of the midribs of the outer tepals, and the fact that the lobes are always yellow. However, the lobes of herrei tend to be longer and broader than those of spiralis, and the perianth tube tends to be shorter in length and broader than in spiralis.

The entities congesta, robusta and foliolosa tend to be distinguished from the remaining entities on the grounds of having the broadest and most open lobes which are never yellow in colour, and a perianth tube which is for the most part broader at the middle than the base.

The entities hallii and bullulata tend to have, in the majority of cases, a yellow tinge to the perianth tube and yellow lobes, and the width of the base of the perianth tube is for the most part equal or greater than the width of the middle.

The entity rugosa tends to have the least open lobes, which may have a pinkish or yellowish tinge, and a perianth tube in which the middle diameter is in nearly all cases less than the basal diameter, and this middle diameter tends to be less than that of the entities hallii and bullulata. Also the tissue on either side of the midribs of the outer tepals is sometimes slightly inflated.

The entity smutsiana tends to have a perianth tube with the middle diameter greater than the basal diameter and short lobes which never have a yellowish tinge.

But, with the exception of the inflated perianth of the entities herrei and spiralis, these variations in perianth character while tending to have slightly different peaks of expression in the different entities, cannot be used as taxonomic delimitants.

Left: inflorescence of the entity foliolosa, showing open flowers with white lobes, tips of unopened buds are a salmon pink. (X 1).

Right: inflorescence of the entity herrei, showing open flowers, with yellow lobes, and the three outer tepals of the tube with an inflation of parenchyma tissue. (Approx. X $1\frac{1}{5}$).

Left: Flowers of the entity smutsiana with smooth perianth tubes and cream lobes, and flowers of the entity spiralis with yellow lobes and perianth tubes with a marked inflation of the outer tepals, which is transversely rugose. (Approx X 2).

PLATE 5.

DISTRIBUTION OF ENTITIES.

In this account, Acock's classification of veld types (1953) is cited because a reference to his lists of species gives some idea of the vegetation with which Astrolobas are associated. Further, Acock's work is the only comprehensive survey to date on South African veld types, and his terminology is at present that most widely used.

The present author however, does not necessarily agree with all of Acock's classification of karoid types. It is felt that his use of the term "False" implies encroachment of karoid vegetation at an artificial rate which is by no means proven in all cases. Inaccuracies are to be found in the only listing of Astroloba species in the work, under "26 Karoid Broken Veld (b) The Little Karoo .... Apicra foliolosa, A. deltoidea and A. rubriflora." Poellnitzia rubriflora (L. Bol.) Uitew. occurs chiefly in the Robertson Karoo and the other two entities are found in the eastern part of the Great Karoo and marginal karoid - grassveld areas.

The map used to illustrate entity distribution is taken from that of the Botanical Provinces of South Africa, by R.S. Pinker, 1930 in Marloth's Flora (1932) See Fig. 13. In the distribution maps, only the position of the mountain ranges is shown, and the broken line indicates the approximate boundary between karoid areas and grassveld.

To permit assessment by the reader of adequacy of data on distribution, the distribution of the various entities is discussed at some length, and localities visited by the author are given in detail. It can be seen that herbarium records are few, and although the author attempted a comprehensive collection of the entities, the record cannot be regarded as complete. Collecting in karoid areas has its physical limitations, for one is more or less confined to areas which are not a great distance from roads.

Spelling and identification of localities in this text is taken from the Topographical Edition of the 1:500,000 map of South Africa. (1950-1958).


THE BOTANICAL PROVINCES
OF
SOUTHERN SOUTH AFRICA
ATLANTIC OCEAN
INDIAN OCEAN
KARROID PLAINS
GREAT KARROO
CAPE REGION
BUSHMAN LAND
GREAT NAMAQUA LAND
KALAHARI
LITTLE NAMAQUALAND
ROGGEVELD
Approximate boundary between Karroid Areas and Grassveld
Southern limit of Aloe dichotoma
Southern limit of Euphorbia
Bloemfontein
Cape Town
Port Elizabeth

Figure 13.

THE ENTITY CONGESTA. (See Fig.14).

Of all Astrolobas, this entity has the Eastern most distribution, occurring in areas transitional between karoid veld and grassveld.

The most Northerly record is from Rosmead (Bruwer s.n. No. 27629 in Herb. Bol. (BOL)), but the present author failed to find any populations of Astroloba in the vicinity of Rosmead.

Further South there are a number of records along the Fish River valley North of the Suurberg, where, according to Acocks, the vegetation is False Karoid Broken Veld (37). (The numbers in brackets are those given by Acocks for his different veld types.) Personal records of the author are: 19 miles North of Cradock, where the population consisted of a few plants growing under bushes over a small area of about 50 yards square, on a gentle North facing shaley slope; a prominent shaley hill just outside Cradock where the entity congesta was a dominant member of the community, growing alone or under bushes of Rhigozum obovatum; and Rayners Kop, where the locality was a stony North East facing slope and the plants were again locally very common, growing alone or with low shrubby bushes less than a foot in height.

To the West of this part of the Fish River valley lie the Tandjiesberg and Bruintjieshoogte, and to the East, the western part of the Winterberg, North of which the vegetation is bush or grassveld.

South of this part of the Fish River valley, topography and vegetation are varied, but, where patches of karoid broken veld occur, congesta populations may occur, as the author found along the road to Grahamstown, South of Adelaide, where, over small areas, the entity congesta was common, growing mostly under Rhigozum obovatum bushes on gentle North facing shaley slopes.

Further South, near Dikkop Vlakte a population of the entity congesta was found growing under somewhat different conditions, on a silty vlakte with low bushes of the karoid broken veld type - chiefly composites and shrubby mesems. (The word "mesem" is used in this context in the widest sense).

An extremely interesting locality was a North facing slope at the poort near Helspoort, where there was a very small patch of karoid broken veld which merged into a mixture of Succulent Mountain Scrub or Spekboomveld (25) and Valley Bushveld of the Fish River Scrub type (23(c)). In this small area, the entity congesta was extremely common, being a dominant member of the community and growing on its own in dense clumps. There are a number of herbarium records of congesta from this locality.

The easternmost record for congesta is "the top of Brakkloof", (Acocks 12049 PRE). The author visited the area, without success, but conditions under which plants of congesta might be found appeared to be similar to those near Helspoort. There are few records for congesta to the South of Helspoort, the southernmost one probably being from near Alicedale.

THE ENTITY FOLIOLOSA. (See Fig.14). (See plates 6 and 7).

This entity is found in the lower lying flat karoid areas between the Baviaanskloof - Groot Winterhoek ranges and the line made by the more arid Grootriverhoogte, Wolvefonteinberg, Klein Winterhoekberg and the Suurberg, and to the North of these as far as the Koudeveldberg, Sneeuberg and Tanjiesberg.

Following Acocks' classification, the vegetation types with which the entity foliolosa is associated are Great Karoo Karoid Broken Veld (26(a)) and Central Lower Karoo (30).

The most northerly record for foliolosa appears to be that of the author, 10 miles North of Graaff Reinet on the Middleburg Road. Around Graaff Reinet, the topography is extremely varied with resultant variations in vegetation. Near the town itself, a large population of foliolosa was found at the turn off to the Valley of Desolation. This locality had the appearance of having been an old flood plain, as it was flat and silty. Over an area of about a square mile, foliolosa was a dominant member of the vegetation, the plants growing in the open as compact tussocks, of up to 50 shoots, not more than about 20 cm. in height, often less. Vegetation was sparse, the other components being low shrubby composites and mesems.

The Tandjiesberg and Grootbruintjieshoogte seem to set the North Eastern limits to the distribution of foliolosa, while the known Eastern limit appears to be along a line from Pearston to Voëlrivier.*

To the immediate North of the Klein Winterhoekberg - Suurberg ranges, a number of foliolosa populations were found by the author near Waterford and around Lake Mentz, in flat silty areas similar to those near the Valley of Desolation. Although the author did not find any specimens in these localities, there are herbarium records of the entity robusta from Lake Mentz, and East of Waterford. To date there are no records of plants of foliolosa to the East of this.

To the immediate North of the Grootrivierhoogte, the author found foliolosa populations in flat silty areas around Mount Stewart. From this locality too, but not found here by the author, is a record of the entity robusta. South East from Mount Stewart runs a silty flat bottomed valley, also possibly a former flood plain, between the Klein Winterberg and Eastern part of the Grootrivierhoogte and Wolvefonteinberg, along which populations of foliolosa occur.

South of this, to the North of the Groot Winterhoekberg is a record from Springbokvlakte, (NBg 171/59, in hort. Kirstenbosch) and the southernmost record south of the Suurberg, appears to be from Addo Bush. Two early records from unplaceable localities, but probably from this area are "Zwartkops Sundays River", Zeyher 4184 (GRA) and "Koegakammaskloof", Zeyher 1054 (GRA).

Acocks describes the vegetation around Addo as Valley Bush Veld, Addo Bush and Sundays River Scrub (23 (d) i & ii).

South of the Grootrivierhoogte lies a flat silty plain, the Steytlerville Flats, the vegetation of which Acocks typefies as Succulent Karoo, Steytlerville Karoo type (31(c)), possibly False Succulent Karoo derived from Central Lower Karoo.

Just outside Steytlerville on the Willowmore road, over an area of several square miles the author found a mixed population of the entities foliolosa, and robusta. The area is flat and silty rising to a low shale ridge to the South.

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* Mr. Acocks has a record of localities of species of a large number of genera identified on the spot and not collected. The author obtained a copy of his records for Astroloba, which were most unfortunately later mislaid.

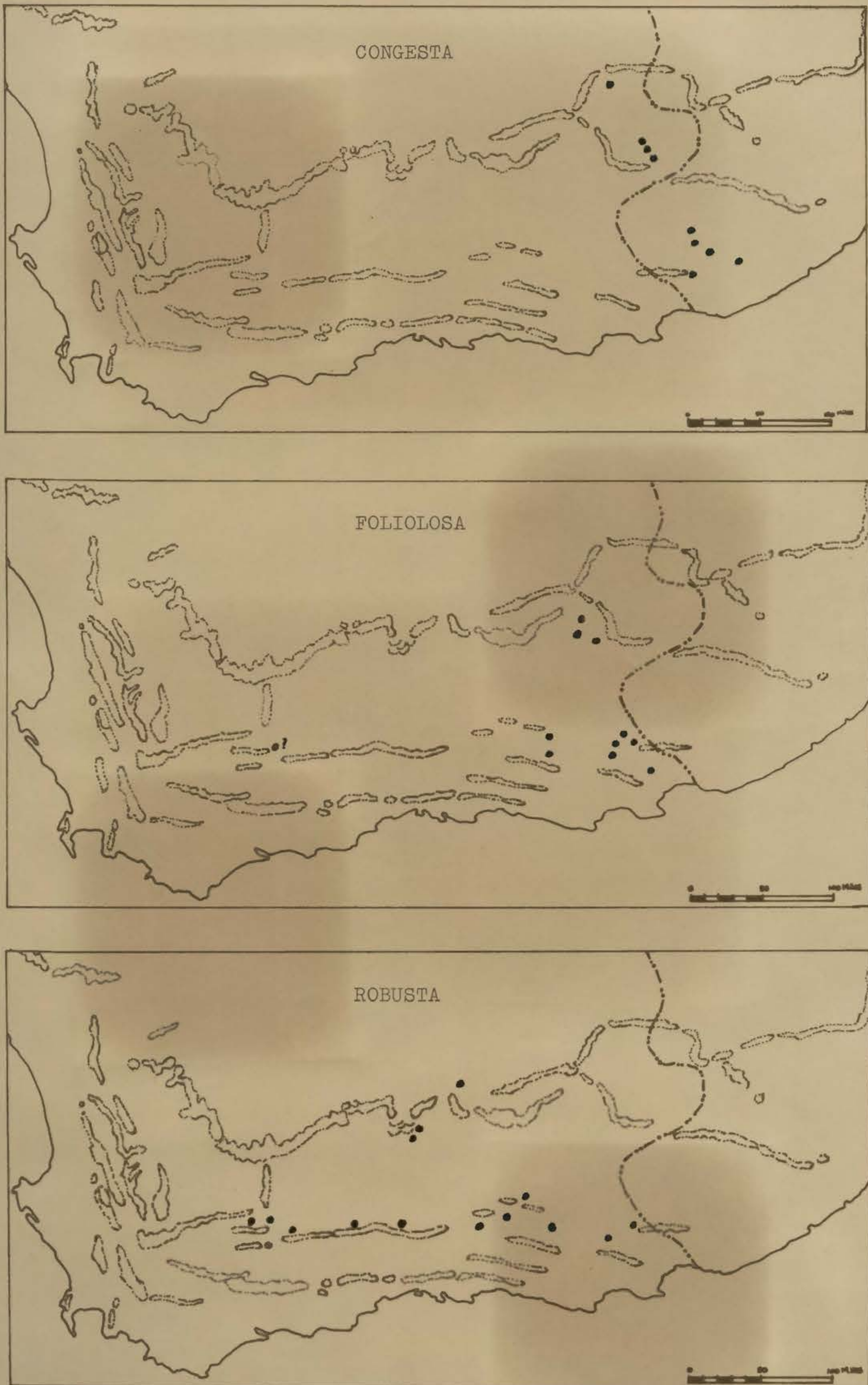


Fig.14. Showing the distribution of the entities congesta, foliolosa and robusta.

The vegetation of a shale ridge near Miller on which a few plants of the entity <u>robusta</u> (R8)were found.

A plant of the entity <u>robusta</u> from the above population growing with a bush of Rhigozum sp.

A population of the entity <u>foliolosa</u> (R10) on the farm Toekomst near Waterford.

Showing the habit of a plant of the entity <u>foliolosa</u> growing with a Rhigozum bush from the above population.

PLATE 6.

A general view of the sandy vlakte just outside Steytlerville showing the mixed population of the entities foliolosa (R14) and robusta (R15).

A single clone of the entity foliolosa (R14) from the same population. As the stems elongate so their bases come to lie on the ground and develop adventitious roots. These bases can be seen in the vicinity of the matchbox.

Showing the sparse vegetation on the ridge south of the sandy vlakte shown above.

PLATE 7.

Plants of both entities grew, not under bushes, both on the flat area and the slopes of the ridge, forming a conspicuous part of the sparse vegetation, other components being low bushes of mesems and composites on both vlakte and shale ridge, and in addition, creeping mesems on the vlakte.

Steytlerville and Mount Stewart appear to be the western-most records for the entity <u>foliolosa</u>, apart from an extremely discontinuous locality: "between Ladismith and Laingsburg" N.S. Pillans 877 (in Herb.H.Bolus) (BOL). This specimen was pressed after flowering in Mr. Pillans' garden. Examination of likely localities along the Graaff Reinet-Willowmore road was fruitless, and fairly extensive collecting in the Northern foothills of the Swartberg, and in places along the Ladismith Laingsburg road, revealed populations of other entities, but not of <u>foliolosa</u>.

It is of interest to note that Acocks, (loc.cit.p.115) considers a large part of the area between Aberdeen and Adelaide, to be False Karoid Broken Veld (37) or False Central Lower Karoo (38), having been previously marginal grassland. North of the Grootrivierhoogte, <u>foliolosa</u> occurs, according to existing records, only in these areas. If Acocks' theory is to be considered, then has there been a shift in <u>foliolosa</u> distribution with encroaching karoid vegetation or was <u>foliolosa</u> there previously with the former marginal grassveld types?

<u>THE ENTITY ROBUSTA</u>. (See Fig. 14). (See plates 6 and 7).

Of what may be termed the foliolosa group, (consisting of the entities <u>congesta</u>, <u>foliolosa</u> and <u>robusta</u>), and indeed of all Astrolobas, the entity <u>robusta</u> has the widest distribution.

The eastern-most records, near Lake Mentz, Mount Stewart and Steytlerville, have already been mentioned. It seems likely that in all these cases the plants were growing with or near plants of the entity <u>foliolosa</u>, and that the localities included flat silty areas.

The next recorded localities to the West of this are low lying shale ridges near Miller, where the plants were locally frequent growing under Rhigozum bushes in vegetation of the

Karoid Broken Veld type. This area lies to the North and North East of the Witteberg and Grootrivierhoogte, where the topography and consequently the vegetation, is more varied. An herbarium record, "Between Oudtshoorn and Willowmore", Stell. Univ.Gdns. 7859 (BOL), is the only record to date of a possible locality for robusta South of the Eastern Swartberg - Slypsteenberg series.

There are a number of records from the Northern foothills of the Swartberg where the vegetation is karoid broken veld, being more of the Great Karoo type (26(a)) East of Sevenweekspoort, and to the West, more related to the Little Karoo type (26(b)). Near Prince Albert, plants of robusta were a dominant feature of the vegetation over a small area, growing on undulating ground, the other components of the very sparse vegetation being Rhigozum obovatum, Pentzia sp. and other low shrubby composites and mesems.

To date, the southernmost record appears to be between the Witteberg and the Western end of the Klein Swartberg.

The author found plants further West near Laingsburg, on a shale ridge where only two plants were found growing alone not under bushes; and near Whitehill, and Matjesfontein where the plants were locally frequent growing in shaley undulating areas with vegetation of the Karoid Broken Veld type. At the Matjesfontein locality, the robusta population occurred next to a population of the entity bullulata on shale outcrops, members of each occurring over an area of about an acre, the margins of which overlapped.

To the North of this, are records from Beaufort West, and the foot of Molteno Pass, (H.Hall.2284). The Northernmost exact record to date appears to be a collection of the author 10 miles East of Nelspoort along the Murraysburg road. Here again the plants were locally frequent, either under bushes or alone, on a shaley North facing slope, associated with low bushes, up to a foot in height, of species of Pentzia, Eriocephalus and bushy mesems.

It is quite possible that populations of robusta do occur further North in similar areas.

THE ENTITY BULLULATA. (See Fig. 15).

The entity with the most westerly distribution is bullulata. It is found in the eastern part of the Tanqua Karoo, being recorded from karoid areas North of Ceres, and in the vicinity of the Roggeveld mountains.

The Western part of the Tanqua Karoo and the Succulent Karoo of the Namaqualand Coast Belt have been extensively surveyed by Mr. H. Hall of Kirstenbosch, who has found no plants of Astroloba in this area. Examination of possible localities along the Grootrivierhoogte - Blinkbergpass Road which runs along the eastern karoid foothills of the Cedarberg, also failed to reveal any Astroloba populations.

The author collected plants of the entity bullulata at a locality 35 miles North of Ceres on the Sutherland road, where the vegetation was intermediate between Succulent Karoo, Tanqua Karoo type (31(b)) and Great Karoo Karoid Broken Veld (26(a)). The area consists of a series of low shaley ridges with low shrubby mesems as the commonest bushes, and plants of bullulata growing with them, or, for the most part alone, and forming a fairly common constituent of the vegetation over a small area.

According to Acocks' typefication, the vegetation of the Roggeveld foothills is Western Mountain Karoo (28) rising to Mountain Rhenosterbosveld (43).

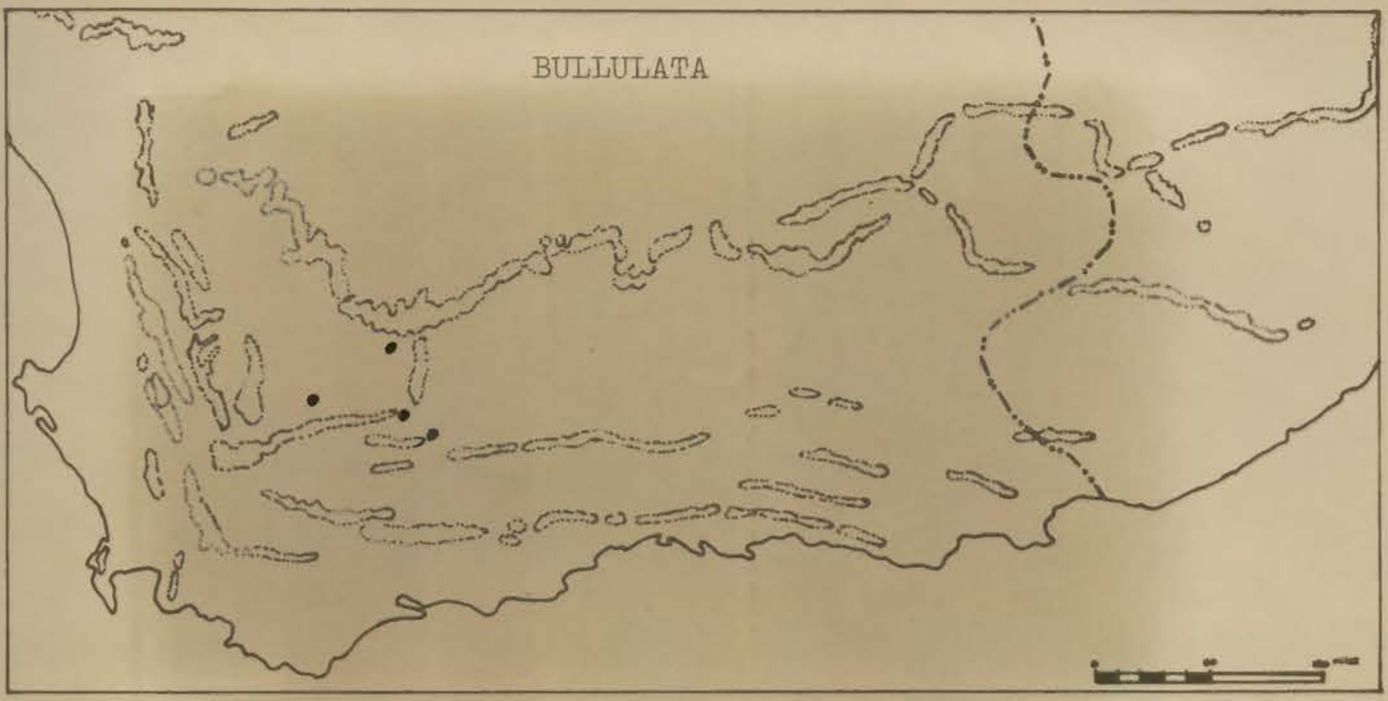
A more easterly record is near Matjesfontein where the author found bullulata plants again on shaley outcrops and growing adjacent to a population of robusta as described earlier.

The easternmost record is between Ladismith and Laingsburg, (No. 9363 in Herb. H. Bolus, BOL).

THE ENTITY HALLII. (See Fig. 15). (See plate 8).

The entity hallii, to date has only been found in two areas: near Koup, the type locality where it was first collected by Mr. H. Hall of Kirstenbosch, and on shaley ridges along the road from Laingsburg to Sevenweekspoort.

The Koup locality, was a low shale ridge to the West of the National road almost opposite the railway station. The



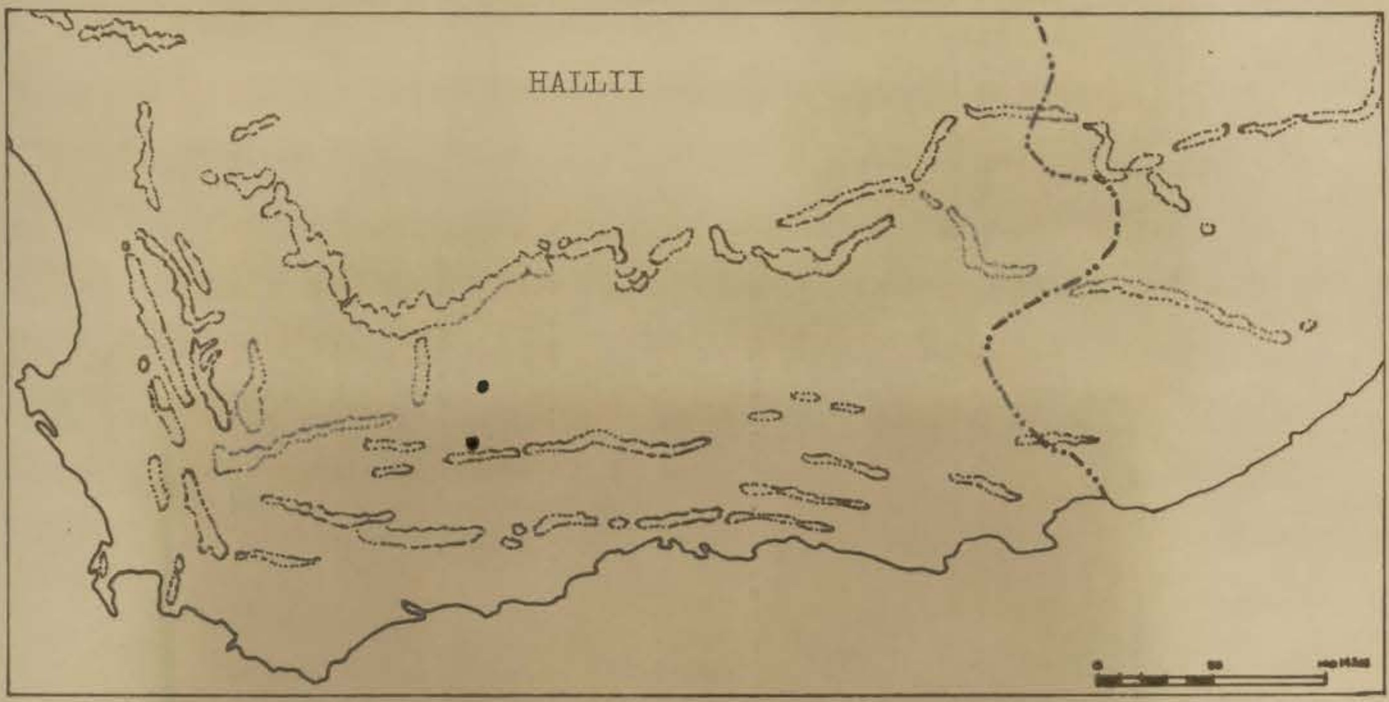


Fig.15. Showing the distribution of the entities bullulata, hallii and smutsiana.

The habit of a plant of the entity <u>hallii</u> from the population R42 near the farm Rietvlei in the Northern foothills of the Swartberg.

A plant of the entity <u>hallii</u> growing under a bush of <u>Rhigozum obovatum</u> from the population R26 on the shaley ridge near Koup.

PLATE 8.

vegetation was very sparse, and of the Great Karoo Karoid Broken Veld type (26(a)) with Rhigozum obovatum the dominant shrub, and a few trees of Euclea undulata and Carissa haemotocarpa. Hallii was locally very common occurring along the top and slopes of the ridge, with greater numbers on the Northern aspect. Most of the plants were growing under Rhigozum bushes, where they attained a height of 30 cm. or more.

South of the Sevenweekspoort-Laingsburg Road, along the shale outcrops,(which sometimes include quartzite and sandstone) and join with the northern foothills of the Klein Swartberg, the vegetation is more of the Little Karoo Karoid broken veld type. Euclea undulata, Carissa haematocarpa, Crassula rupestris, Euphorbia mauretanica, Galenia africana, Pteronia and Pentzia spp. and Cotyledon paniculata were common species in the localities where two populations of hallii were found by the author on northern aspects of shaley ridges. The plants were not as common nor as vigorous in habit as those from Koup. Here they were growing in rocky crevices unprotected by bushes, and averaging a height of under 20 cm.

THE ENTITY RUGOSA. (See Fig.16). (See Plate 9).

The entity rugosa appears to have the most southerly distribution of all Astrolobas. It is most common in the dry hilly areas around Montagu, where it is locally frequent on shaley North East facing slopes, associated with karoid broken veld of the Little Karoo type. In this area, the karoid broken veld vegetation merges into Renosterbosveld (43) with change of aspect or increase in rainfall.

The vegetation associated with rugosa in the Montagu Karoo is denser than that found in the shaley hills South of Laingsburg, although the constituent species are much the same. Here however more succulents are found and Dodonaea thunbergiana, which is apparently associated with karoid vegetation transitional between karoid broken veld and rhenosterbos, is a fairly common low tree. The entity rugosa does not occur in true Rhenosterbos-veld, although scattered Elytropappus rhinocerotis may be found in the proximity of rugosa populations.

The area was quite extensively collected by the author along the Upper Baden, Pietersfontein, Rietvlei No. 2 and Dobbelaars Kloof roads. Plants of the entity rugosa grew alone in the open or under bushes; in several cases where the shade and protection afforded by a bush was considerable, leafy shoots of up to 50 cm. were observed.

No other entities of Astroloba were found in this area. Very locally, (two verified localities being known to the author), an intergeneric hybrid between rugosa and Harworthia margaritifera.

Apart from a dubious record "Bonnievale" Jan. 1937, N.J.S. van der Merwe 226 (BOL), there are no records of rugosa South of the Langeberg. The locality of this specimen, which consists only of a flowering spike is doubted, because there is another specimen, consisting only of a leafy shoot, "Montagu ex hort Bonnievale", Jan. 1937 N.J.S. van der Merwe 227 (BOL).

The north-western most record for rugosa is South East of Touws River, while to the North of the Montagu area lie the Waboomsberg, and to the North East the Warmwaterberg, where, with and increase in altitude, the vegetation changes to Rhenosterbos and Macchia.

Apart from a specimen, "Graaff Reinet", s.leg.4202 in herb. Marloth (PRE); the northernmost records for rugosa appear to be in the northern foothills of the Klein Swartberg under conditions similar to those for the hallii populations.

All other records come from the Little Karoo South of the Swartberg. The author found a population 23 miles South of Ladismith on the old Barrydale road, on a shaley knoll. Here the entity rugosa was locally common, growing for the most part in the open, over an area of about 40 square yards, associated with a sparse, much goat-eaten type of Karoid Broken Veld. About 200 yards away, for the extent of which distance there were no Astroloba plants, was a large population of plants of the smooth leaved entity smutsiana growing on an adjacent ridge. Amongst these was one plant with slightly tuberculate leaves and flowers intermediate in character between those of rugosa and smutsiana.

A general view of the vegetation found at the head of the Baden-Baden valley, near Montagu. Populations of the entity rugosa in this area are associated with this type of vegetation. A shrub of Dodonaea thunbergiana is in the left foreground.

A plant of the putative intergeneric hybrid between the entity rugosa and Haworthia margaritifera growing in situ next to a plant of the entity rugosa on the farm Rietvlei No. 2. near Montagu.

PLATE 9.

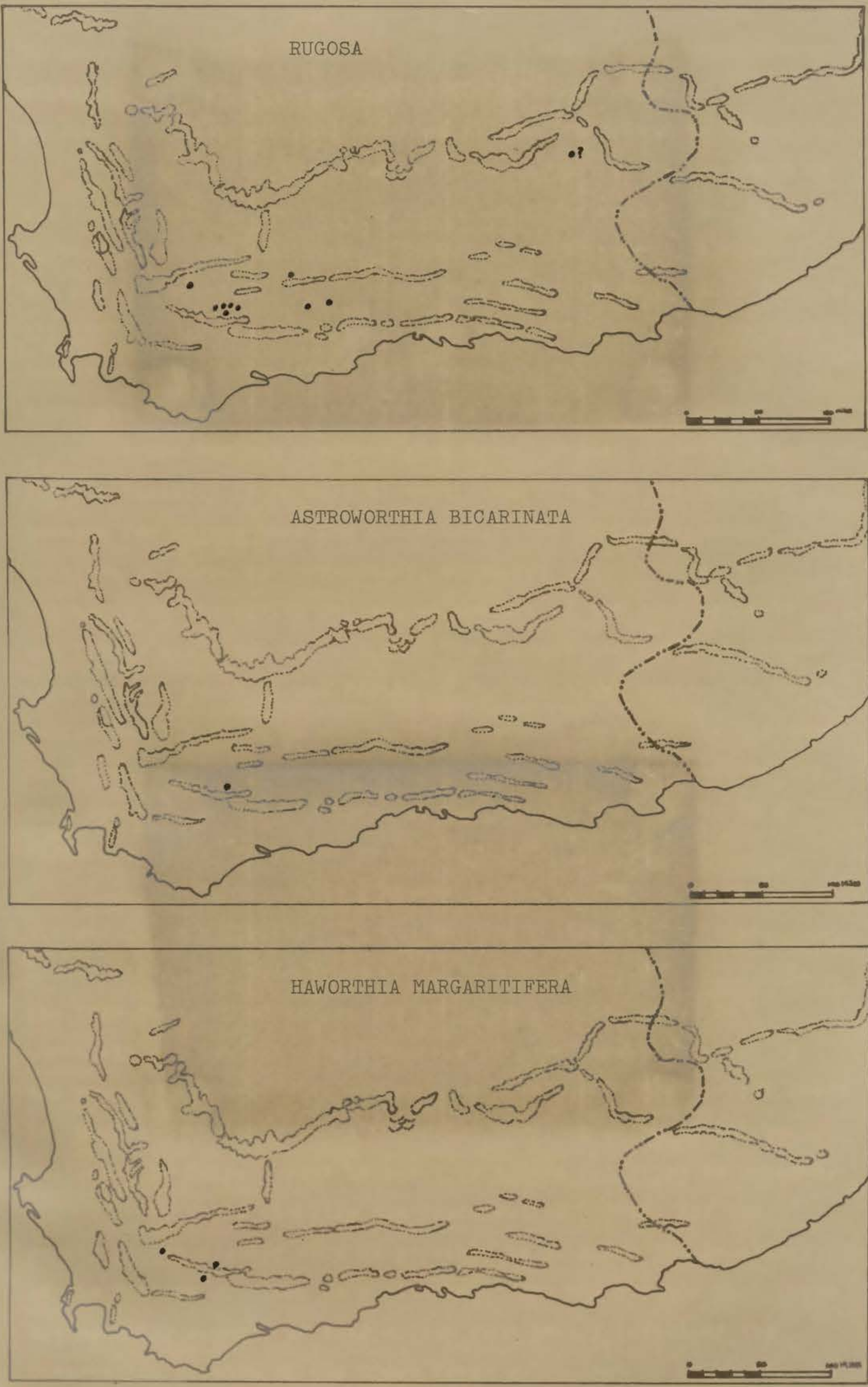


Fig.16. Showing the distribution of the entity rugosa, Astroworthia X bicarinata, (a hybrid between rugosa and Haworthia margaritifera), and Haworthia margaritifera. (Only the distribution of the parental form of Haworthia margaritifera is shown).

It is very likely that this plant is a hybrid between these two entities, but as yet no successful PMC squashes of meiotic pairing have been obtained which might confirm this cytologically.

The Ladismith Barrydale Karoo is bounded in the South by the Langeberge, in the East by the Groot river valley, and in the North East by the Rooiberge. The easternmost record, excluding the Marloth specimen, is "7 miles East of Vanwyksdorp" A.J. Joubert 111 (BOL). Around Vanwyksdorp, the vegetation changes from Karoid Broken Veld to Spekboomveld (25); where Portulacaria affra is dominant, no Astrolobas have yet been found.

The Marloth specimen from Graaff Reinet presents a problem, for its locality is so very discontinuous from the distribution pattern for rugosa thus far described. The Marloth specimen consists of three inflorescences, which are identifiable as belonging to the entity rugosa, on account of the long pedicels and fairly small bracts, although the racemes are somewhat longer than usually found in the field. The labelling appears to be in Schlechter's hand and there is no collectors number. On the same sheet, ruled off presumably indicating that it is not part of the same specimen is a leafy shoot of rugosa with the caption in a different hand: "collected by Dr. J. Muir".

Dr. J. Muir made a survey of the vegetation of the Riversdale area (1921). In the section on the Little Karoo, listed under leaf succulents are Apicra foliolosa and A. aspera, the latter described as growing in partial shade, which is certainly not typical of all members of populations observed by the present author. The rather poor specimen on the Marloth sheet is, however, the only known herbarium specimen of an Astroloba collected by Muir. What he meant by Apicra foliolosa is unknown.

It would simplify the distribution pattern for the entity rugosa greatly were it possible to consider the labelling of the Marloth specimen as a mistake. Are the grounds that there are no other records of this entity from Graaff Reinet or the intervening portion of the Great Karoo sufficient to do this? It is of interest to note that Berger (1908) writing of Apicra foliolosa cited amongst other specimens examined Marloth 4204.

Professor Jordaan of Stellenbosch, an authority on Marloth was unable to give any information about the numbers 4202 and 4204 in the Marloth collection.

THE ENTITY SMUTSIANA. (See Figs. 15 and 17).

Mention has already been made of the occurrance of the entity smutsiana in the Ladismith - Barrydale Karoo, where it has been found by the author to be locally frequent, growing on shaley ridges along the old Ladismith Barrydale road. Here the vegetation was sparse consisting chiefly of shrubby mesems and composites, notably Pentzia sp., so that for the most part the plants occurred alone, not associated with bushes. In some areas the shale ridges sloped down into flat silty areas, where creeping mesems were common. The easternmost records to date in this area are two localities between Adamskraal and Ockertskraal, along the Muiskraal - Ladismith road where the plants were locally frequent over small areas. The westernmost record is "Anysberg", Nbg, 784/63 Kirstenbosch hort.

Aspect did not seem to affect occurrance of the entity smutsiana in the Little Karoo, but on the shaley ridges along the Laingsburg - Sevenweekspoort road, no smutsiana populations were found facing the South.

A number of locally frequent populations of smutsiana were found in this area, between the farm Rietvlei and the Rooineck pass, of which only one collection was made, (Roberts 49). Mention has already been made of populations of the entities rugosa, hallii and robusta occurring in this area, and the associated vegetation described. Towards the Rooineck pass, however, on some shaley ridges, Rhigozum obovatum occurs as a dominant member of the vegetation. A population of smutsiana was found in such an area, where all the plants grew under Rhigozum bushes. One specimen had a leafy stem of 40 cm., the support of the Rhigozum branches enabling it to reach this length. At Rooineck Pass the vegetation consisted of very sparse shrubby mesems and composites, all six inches or less in height, and here smutsiana plants for the most part grew in the open.

To date, these are the only records for smutsiana. Save for a search along the Prince Albert-Leeu Gamka road, which failed to reveal any plants of Astroloba, the area to the immediate North of the Laingsburg Sevenweekspoort road was not examined.

THE ENTITY SPIRALIS. (See Fig. 17)

Plants from the smutsiana localities along the Ladismith Barrydale road were planted at Kirstenbosch, where most of them flowered at the end of the year producing inflorescences with smooth perianths.

In December of the following year, 1960, a plant (Roberts 6) from the population (Roberts 5) which had not previously flowered, produced a raceme of flowers with the rugose perianth typical of the entity spiralis. The locality was visited the following February to collect flowering material of both entities, but no other plants of spiralis were found. (At this locality plants of smutsiana were in full flower as at the same time were spiralis plants from Oudtshoorn).

This is the only record of the author for the entity spiralis in this part of the Little Karoo, and to date, is the westernmost precise locality for this entity.

Proceeding eastwards the next locality for spiralis found by the author was approximately 5 miles South of Calitzdorp on a shaley hill to the West of the Rooiberg Pass road. This hill rose from a silty vlakte, strewn with quartzite pebbles on which creeping mesems were common, notably Glottophyllum and Opthalmophyllum spp. Vegetation on the shaley hill consisted of low shrubby composites and mesems together with spiralis plants which were locally frequent over a small area, growing alone or with bushes.

Between Calitzdorp and Ladismith, the vegetation is largely Spekboomveld (25) with Portulacaria afra dominant along the Huisrivier pass, and no plants of Astroloba were found here. South of this area rise the Rooiberge and North, the Swartberge.

The road from Calitzdorp to Oudtshoorn runs through cultivated land, the natural vegetation of which Acocks describes as Karoid Broken Veld Little Karoo type (26(b)). North and South of this extending to the foothills of the Swartberg and Outeniquas, and East-West from Ladismith to Uniondale Road, he considers the vegetation to be Spekboomveld or Succulent Mountain Scrub with a patch of succulent Karoo (31) to the immediate South of the

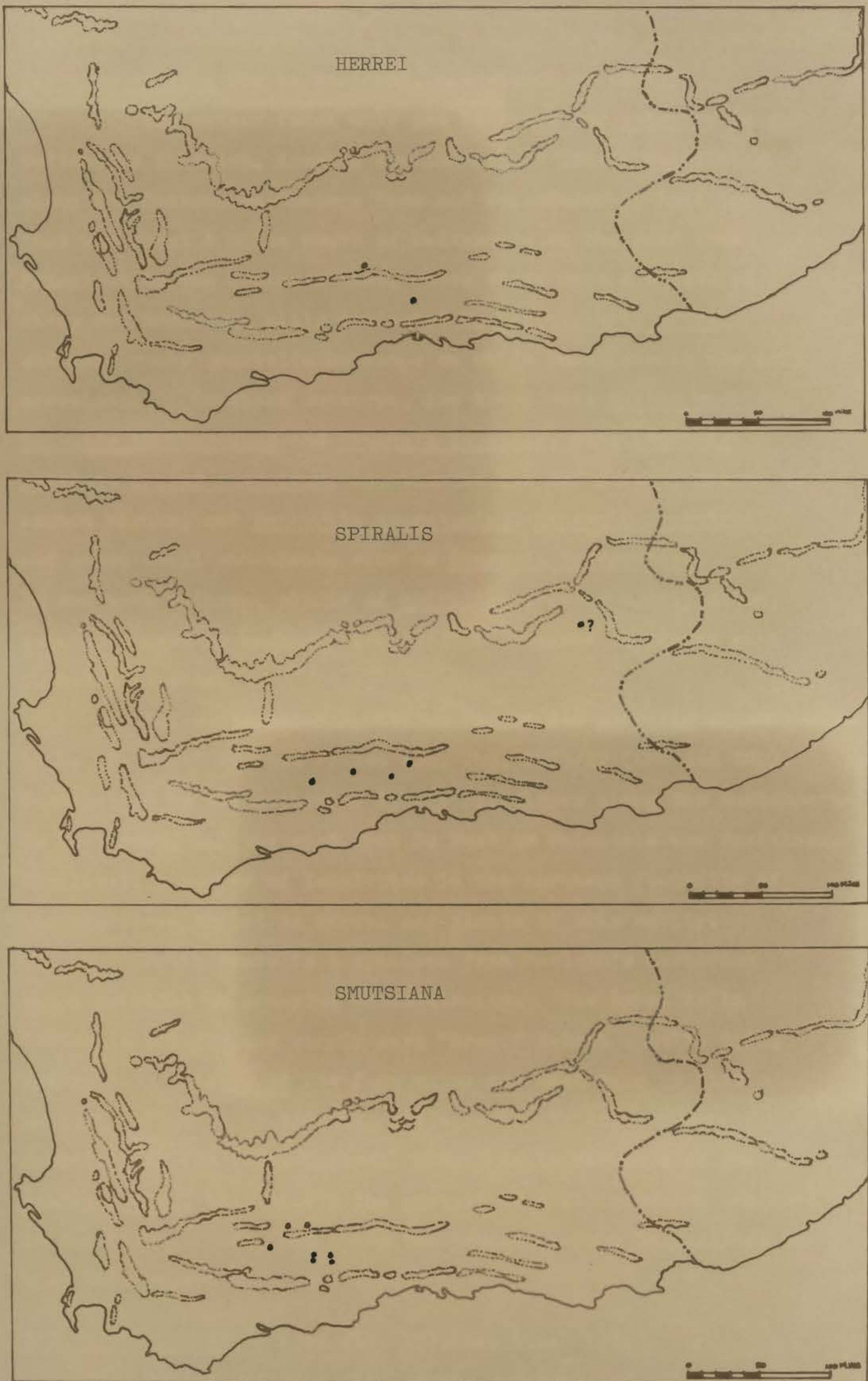


Fig.17. Showing the distribution of the entities herrei, spiralis and smutsiana.

Calitzdorp-Oudtshoorn Karoid Broken Veld. In the Spekboomveld, Portulacaria afra may be dominant, occasional or absent.

The author found only one locality for spiralis in the Oudtshoorn district, despite examination of likely localities along the Oudtshoorn-Montagu Pass and Oudtshoorn-De Rust Roads. This was about 4 miles South of Oudtshoorn on the road from Friesland to the Robinson Pass, where there were a series of steep red sandstone hills dominated by Portulacaria afra, and more rocky quartzite outcrops on which Portulacaria was only occasional. On these outcrops, low trees were Euclea undulata, Dodonaea thunbergiana and Hymannia capensis, with Pteronia pallens, Lycium austrinum, Acanthopsis sp. and shrubby mesems as common shrubs, and Euphorbia mauretanica, Crassula rupestris and other small succulents such as Crassula lycopodides. On one such outcrop, plants of spiralis, growing mostly alone, sometimes next to bushes, were locally frequent on slopes with northern aspects.

The westernmost herbarium record for spiralis appears to be "De Rust" P. Ross Frames s.n. Nbg. 2525/27 (NBG and BOL). Examination by the author of likely hillslopes along the Oudtshoorn-De Rust road, and the road from De Rust to Uniondale was fruitless. Similarly, a number of localities in the northern foothills of the Swartberg failed to reveal any plants of this entity.

Again there is a specimen from Marloth's herbarium which provides an annoying discontinuity. The label is in Marloth's writing and simply says "Graaff Reinet , coll: 5112," and nothing else. At its face value one must take it that Marloth collected it himself, and accordingly cite it as Marloth 5112 (in Herb. Marloth) PRE. As in the case of the entity rugosa, this upsets the picture of a distribution confined to the Little Karoo, but again the present author is inclined to view this record with some doubt.

THE ENTITY HERREI. (See Fig. 17).(See Plate 10).

Of the entities with convex outer walled epidermal cells, herrei, apart from the discontinuities of the Marloth specimens, has the easternmost distribution. To date, only two localities for this species are known.

The Hoekplaas locality for the entity herrei (R16). Note bushes of Pteronia, Pentzia and Eriocephalus spp, with plants of *Aloe ferox*, Carissa sp and *Euclea undulata* in the background. In the distance are the Kammanassie mountains.

The habit of a plant of the entity herrei from the population (R16). Tops of shoots appear to have been grazed. The plant is growing under a bush of Eriocephalus sp.

PLATE 10.

The first is about 10 miles West of Uniondale, near the farm Hoekplaas. To the West, South and East of Uniondale lie the Kamanassie, Outeniqua and Kouga mountains. Around Uniondale, the vegetation is Rhenosterbosveld (43), while to the North West towards De Rust it becomes Succulent Mountain Scrub, and North East towards Willowmore, Karoid Broken Veld.

The Hoekplaas locality was a shaley "vlakte" with vegetation of the Karoid Broken Veld type - low growing bushes of composites such as Eriocephalus, Pteronia and Pentzia spp. and shrubby mesems, with a few bushes of Euclea undulata and Carissa sp., and occasional plants of Aloe ferox. Here, over a small area the entity herrei was occasional, mostly under bushes.

The other known locality for herrei is 5 miles South East of Prince Albert along the Prince Albert Klaarstroom road. Acocks described the vegetation to the North of the Swartberg, East and West of Prince Albert as a narrow band of succulent Mountain Scrub (25). Near Prince Albert itself, there is quite a large area where Portulacaria affra is dominant, and where no Astrolobas were found, but in the kloof where the entity herrei grew the vegetation was more typical of the karoid broken veld type, with low shrubby mesems and composites, some succulents notably Crassula rupestris, and occasional low trees of Euclea undulata. The author found herrei growing on both sides of the kloof, i.e. with North and South aspect, where the plants were occasional growing alone or under bushes.

RAINFALL AND DISTRIBUTION OF ENTITIES

Rainfall statistics were taken from the publication by the Weather Bureau (W.B.20). Mean, maximum and minimum annual rainfall figures for selected weather stations near Astroloba localities are given in Table 21.

In some instances these figures may be considered to apply to the locality in question, in other instances the rainfall of the weather station is probably higher. An example is afforded by the figures for weather stations near localities for the entity bullulata. (See Table 21). Nuwe Dam is more or less in Verlatenkloof, and Spes Bona is very near the locality on the Ceres Sutherland road (Roberts 24), so that figures for these stations may be taken as being very similar to those for the actual localities. However, there is a locality described as "between Ladismith and Laingsburg", (No. 9363 in herb. H. Bolus BOL). For the sake of completion figures are given for Laingsburg, Prinsrivier (between Ladismith and Laingsburg) and Ladismith, but the Ladismith figures are nearly 100 mm. higher than any of the other weather stations for bullulata localities. Sutherland is included because its rainfall is similar to that of Nuwe Dam and there are additional figures for this station of seasonal rainfall, expressed as a percentage per quarter, over a period of 30 years.

MEAN ANNUAL RAINFALL

In an attempt to give a rough visual picture of the average annual rainfall associated with localities of entities, for each entity a diagram was constructed indicating at the same time, along the horizontal axis: frequency of rainfall classes, the class interval being 50 mm, and along the vertical axis: the actual measurements of the selected stations within each class. (See Fig. 18). Stations far from the actual localities, such as Sutherland and Uniondale, which are included in Table 21 because of their seasonal variation records, are omitted. In the case of towns for which there is more than one average annual rainfall figure, the average of these is given, with the exception of Laingsburg, (104.4 and 135.1 mm).

The resultant picture is only approximate but it does show that most localities for the entities foliolosa and congesta are associated with the highest rainfall of all entities, of between 250-400 and 300-450 mm. respectively. The three records for the entity foliolosa in the 100-150 mm. class are included on account of the dubious locality between Laingsburg and Ladismith, (Pillans 877 BOL). For the third member of the foliolosa group, the entity robusta, most localities are associated with a rainfall of 150-250 mm.

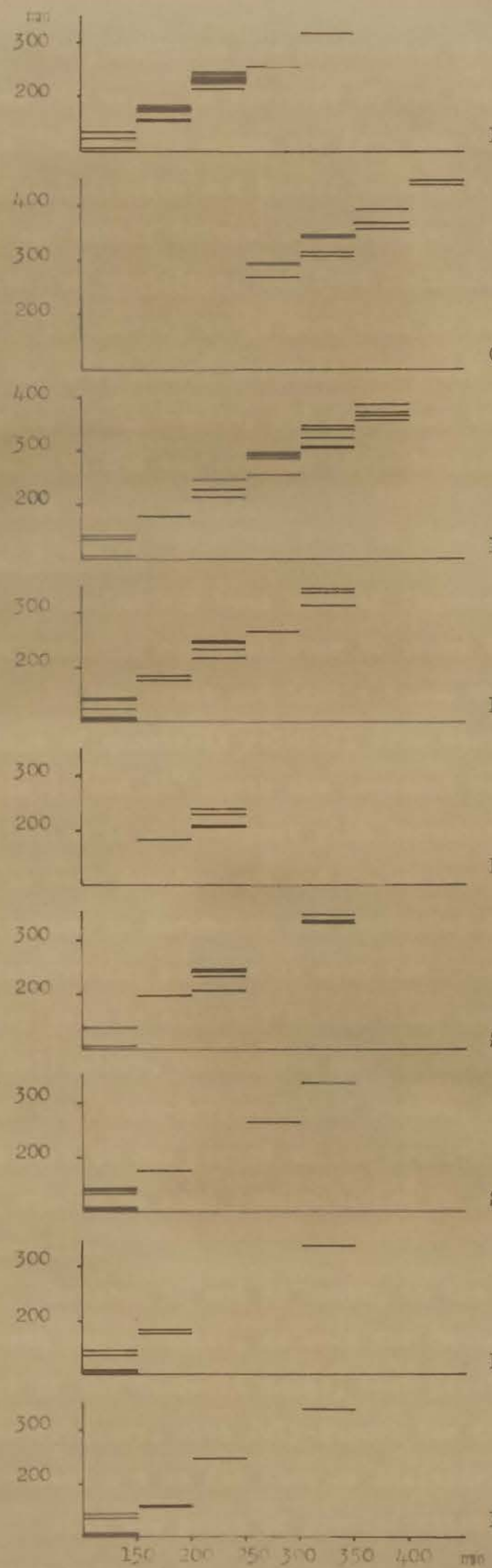


Fig.18. Showing the average annual rainfall for weather stations nearest localities for each entity. Each horisontal stroke denotes the average annual rainfall for a single station. On the vertical axis the actual measurement is indicated, along the horisontal axis, the measurements are grouped in classes with a class interval of 50 mm.

No localities are associated with an annual rainfall of less than 100 mm. In the case of the remaining entities, records of above 250 mm. per annum are from the towns of Montagu, Barrydale, Ladismith and Graaff Reinet, for rugosa; from Ladismith, De Rust and Graaff Reinet for spiralis; from Barrydale and Ladismith for smutsiana; and from Ladismith for hallii and bullulata.

In general it is seen that in the Great and the Little Karoo, the mean annual rainfall decreases southwards from the northern mountain ranges, and from East to West and thus the entities with the easternmost distribution are associated with the highest annual rainfall.

SEASONAL RAINFALL

Mention has been made of figures for quarterly percentages of rainfall obtained over 30 years for some stations.

In the Great and Little Karoo there are changes in the percentage of quarterly rainfall from West to East. Between latitudes 33°and 34° South the seasonal rainfall changes from most precipitation in July-August with December-February the driest months as seen for Montagu and Touwsriver, to two peaks of precipitation in March-May and September-November, with two drier intervening periods as seen for Prince Albert, (where the March-May peak is slightly higher than the September-November peak), Calitzdorp, Oudtshoorn and Uniondale. Still further East, North of the Kouga-Baviaanskloof ranges, the seasonal precipitation reverts back to one period of low precipitation, now between July-August, rising to most precipitation in December-March, as at Steytlerville.

Between 32°and 33°South, to the West, most precipitation is between March-August, as seen for Sutherland and Spes Bona, but East of the Nuweveld range, most precipitation occurs in December-February, with July-August the driest months as seen for Beaufort West and as far East as Adelaide.

With two peaks of precipitation, the percentage difference between wet and dry periods is somewhat less than when there is only one precipitation peak. But in all cases, with the exception of the Cradock station, where it reaches 25%, this difference is less than 20%.

For each entity, graphs of percentage seasonal variation in precipitation for the nearest weather stations were drawn (See Figs. 19, 20, 21). From these it is seen that, apart from the doubtful foliolosa locality "between Ladismith and Laingsburg", Pillans 877 BOL, the entities congesta and foliolosa occur in areas with maximum precipitation in summer. The entity robusta occurs in areas with all three patterns of precipitation, while the remaining entities have the maximum precipitation in winter, or two precipitation peaks, with the exceptions of the doubtful Graaff Reinet localities for the entities rugosa and spiralis, (respectively Nos. 4202 and 5112 in Herb. Marloth PRE).

FLOWERING TIMES

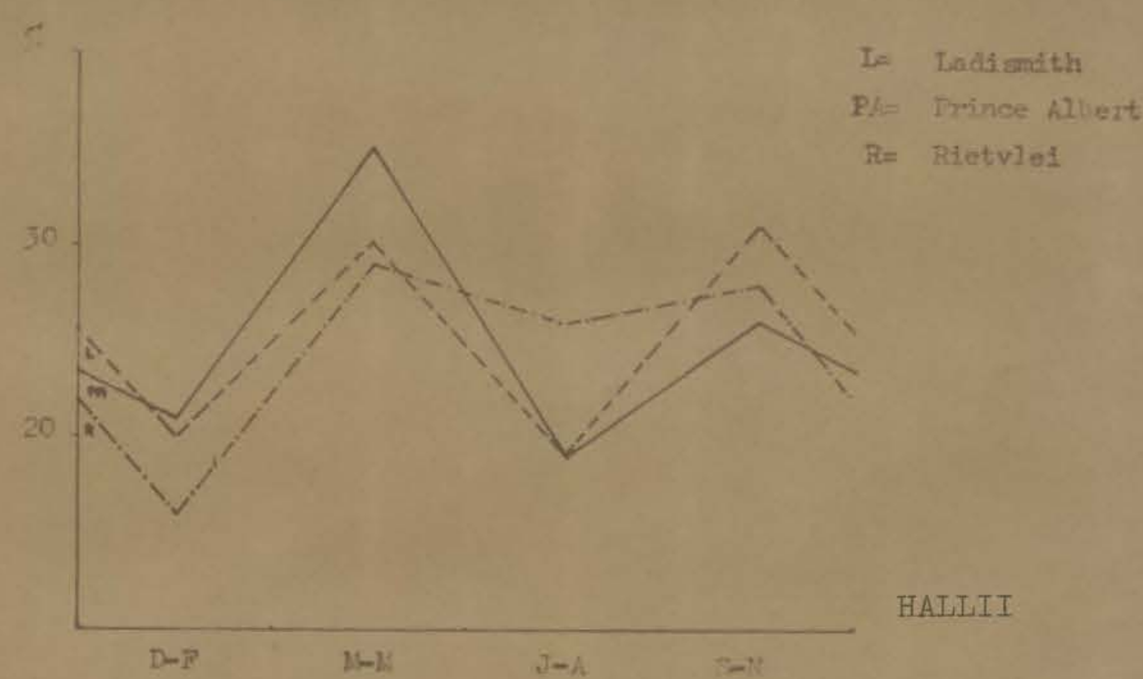
The flowers take about six weeks to develop from when the inflorescence buds are first visible to the opening of the lowest flowers. It may be a fortnight before the topmost flowers are open, and another month before all the fruits are mature. The flowering period may thus be considered as covering three months.

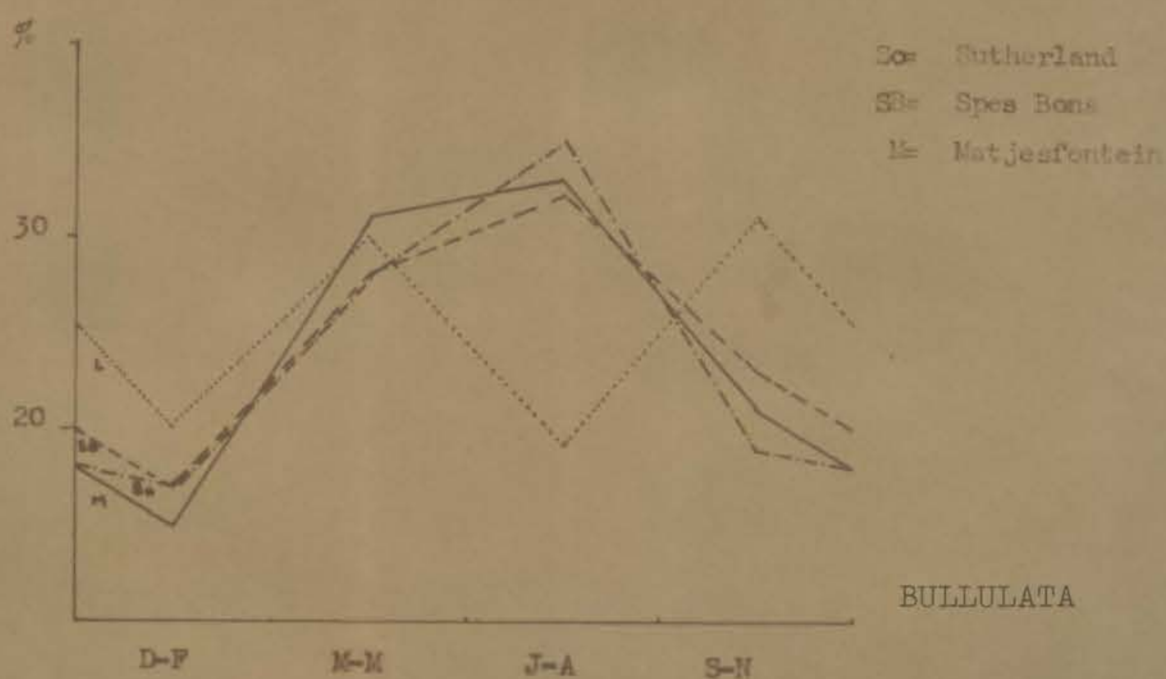
Histograms showing the extent of the flowering period were constructed separately for specimens flowering in the field and under cultivation in the following way. If the specimens were collected in bud, then the two months subsequent to the date of collecting are included in the histogram; if the specimens were in flower, then the month before and the month after are included, and if in fruit then the two preceding months. This data for all localities was included in one histogram. (See Fig. 22).

Of the foliolosa group, the flowering period for the entity foliolosa in the field starts in August and ends in March with peak blooming time in November and December, in the rainy season. The only two records of flowering under cultivation correspond to behaviour in the field.

The entity congesta in the field has peak blooming periods in September and January, just before and during the rainy season, with only one record of flowering in the dry season from Mortimer (June 1915 Davison Nbg 187/15 BOL). As is shown in

Fig.19. Showing quarterly precipitation expressed as a percentage for weather stations nearest localities of the entities hallii and bullulata.





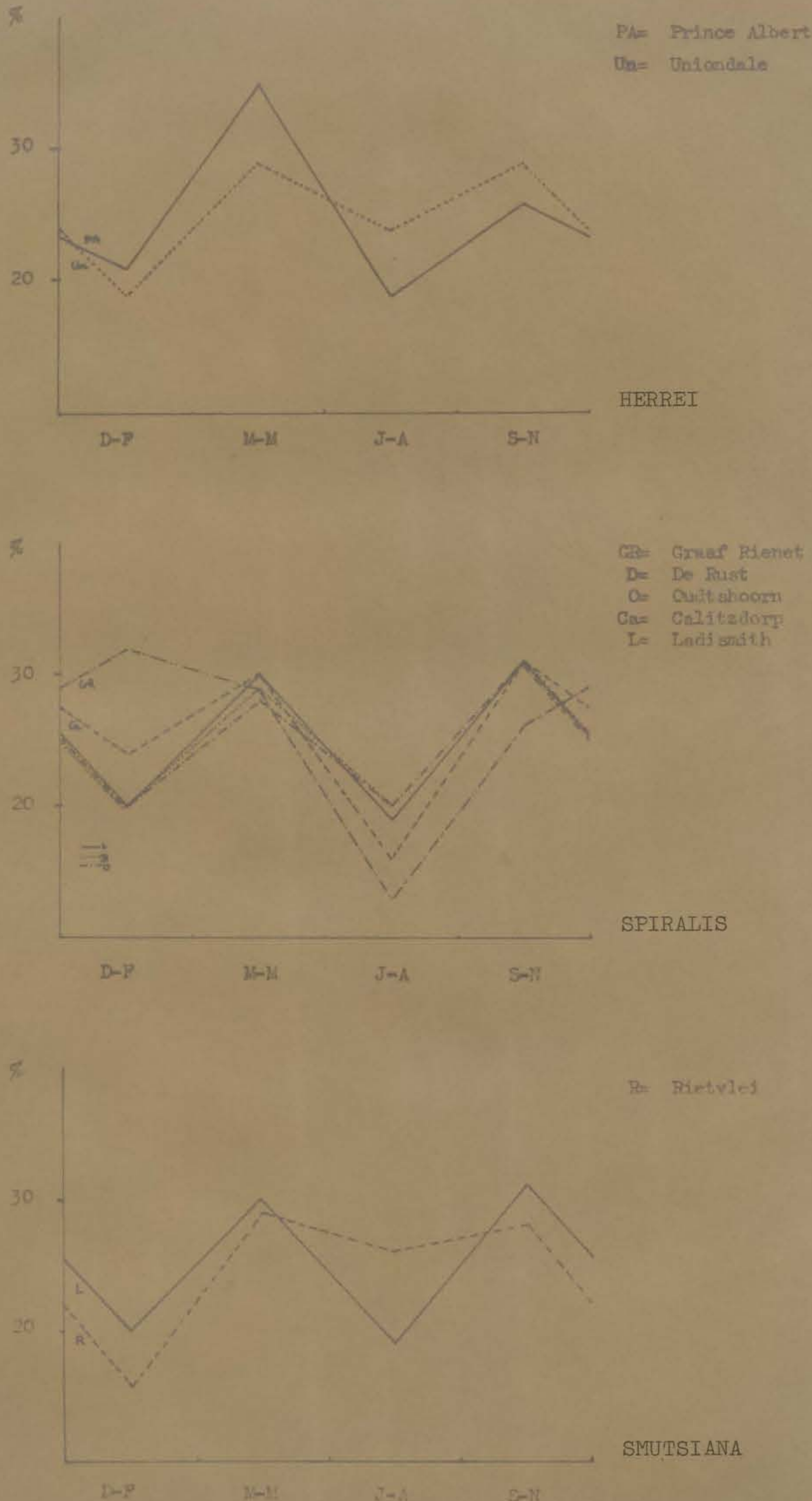


Fig. 20. Showing quarterly precipitation expressed as a percentage for weather stations nearest localities of the entities herrei, spiralis and smutsiana.

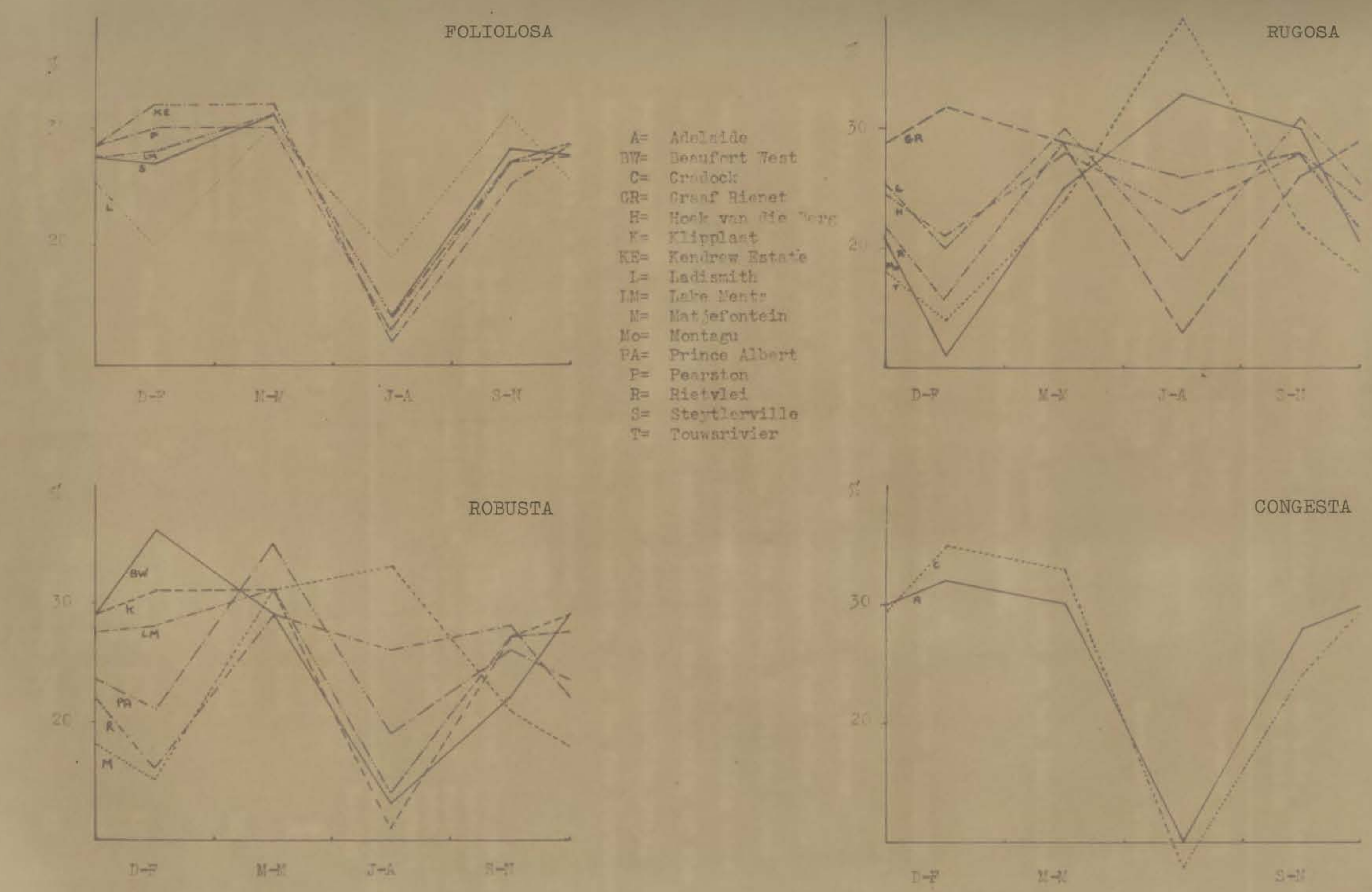


Fig.21. Showing quarterly precipitation expressed as a percentage for weather stations nearest localities of the entities rugosa, foliolosa, robusta and congesta.

Table 19, flowering months for the same locality varied from year to year.

Locality	Flowering and Fruiting	No buds, flowers or fruits
Helspoort	Jan., Feb. 1874 Aug. 1927 Sept. 1929, 60.	December 1959
Cradock	Sept. 1935 Dec. 1959	November 1960

TABLE 19. Showing condition of congesta plants at two localities in the field for different years.

The pattern under cultivation for the entity congesta is similar, with a shift in one of the peak periods to February-April. Interesting variations in length of time between flowering peaks were observed at Kirstenbosch, (see Table 20).

For the entity robusta, in the field, flowering times were observed to be from May to October, with peak blooming time in July and August, in the dry period before the beginning of the summer rainfall season or the second annual precipitation peak, depending upon locality. Under cultivation, for the few instances available, a similar pattern was observed.

Locality.	Date of collection	Condition when collected *	Flowering period in subsequent years under cultivation	Length of time between consecutive peak flowering periods
				Months
Dikkop Vlakte Comins 2064	April 1959	X	Jul-Sep 1960 Mar-May 1961 Dec-Feb 1962	8 9
On Adelaide Grahamstown Rd. Roberts 38, 39	Dec. 1959	X	Feb-Apr 1961 Jan-Mar 1962	10
Cradock Roberts 53	Nov. 1960	X	Feb-Apr 1961 " " 1962 " " 1963 " " 1964	12 12 12
Helspoort Comins 2065	Sept. 1960	FR	Jul-Sep 1961	11

TABLE 20. Showing variation between peak flowering periods for populations of congesta under cultivation at Kirstenbosch.

* See key to Table 21 for meaning.

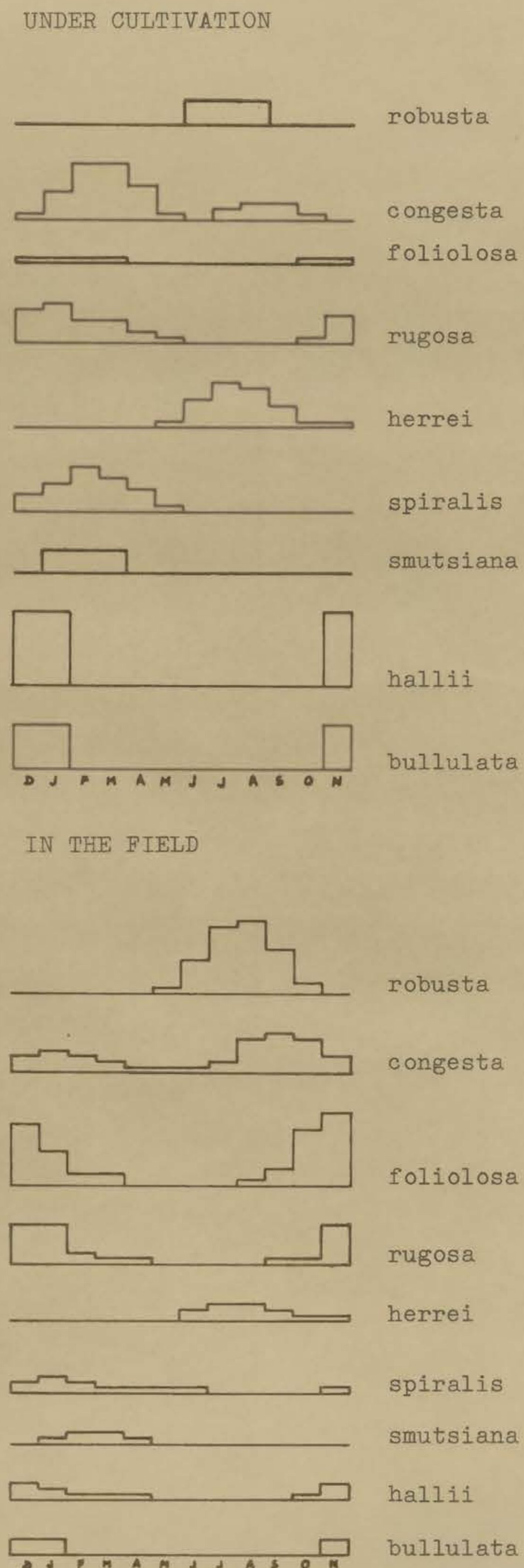


Fig.22. Showing flowering times of the entities of Astroloba.

The entity rugosa in the field has a flowering period from August to May, with peak blooming time in November and December, which apart from the doubtful Graaff Reinet locality, is in the driest season. A similar pattern is observed under cultivation.

In the field the flowering period for the entity herrei is from June to November, with July and August peak flowering times, in the period of low precipitation before the second annual rainfall peak, which as mentioned previously, is lower than the March-May one for Prince Albert. A similar pattern is seen under cultivation.

The entity spiralis in the field has a flowering period from November to July, with the peak flowering period in January. It is felt that were more data available, the extension of the flowering period to July would prove somewhat exceptional, as under cultivation, the flowering period was found to be between December and June, with February and March the peak blooming periods. With the exception of the doubtful Graaff Reinet locality, the peak blooming time occurs in the field in one of the two seasons of low precipitation.

In the field, the entity smutsiana has a flowering time of from January to April with February and March the peak flowering period, occurring just before one of the two annual rainfall peaks, with a similar pattern observed under cultivation.

For both the entities hallii and bullulata the flowering period under cultivation was from November to January. In the field this was similar for bullulata, but longer for hallii, being from October to April, with December the peak period. Peak flowering time in both cases was in the dry season.

TABLE 21.

The localities recorded for all entities, with rainfall data from the nearest weather stations. The mean, minimum and maximum annual rainfall, and annual rainfall expressed as a quarterly percentage over a period of years are given. Data on flowering times are also included. (With regard to the column condition of the specimen at time of collection, U = unknown; X = no inflorescence buds, flowers or fruits; B = inflorescences in bud; F = plants in full flower; R = plants in fruit.)

Collector	Locality	Date of Collection	Condition when Collected	Subsequent Flowering in Cultivation	Nearest Weather Station	Rainfall Mean	Annual mm. Max.	Annual mm. Min.	% Quarterly D-F	M-M	J-A	S-N
	Foliolosa											
Long 1175(GRA)	Addo Bush	11.2.34	F		Addo	354.8	465.8	199.1	-	-	-	-
Long 1175(PRE)	"	11.2.34	X		Moira	383.5	500.6	187.4	-	-	-	-
Zeyher 4184(GRA)	Zwartkops Sundays River	Aug.1904	X									
Zeyher 1054(GRA)	Koegakammas Kloof	1904	F									
Barker 5100(NBG)	Kleinpoort	2.12.47	F		Kleinpoort	290.6	537.7	158.5	-	-	-	-
Nbg 171/59	Springbokvlakte	-	-	Feb.1961	Springbokvlakte	294.6	389.4	242.1	-	-	-	-
Roberts 11	Wolwefontein	Oct.1959	B		Wolwefontein	297.7	384.6	189.7	-	-	-	-
No.27628(BOL)	"	Dec.1933	X									
Roberts 10	Toekomst	Oct.1959	X		Waterford	247.1	348.7	106.9	-	-	-	-
Acocks 11997 (PRE)	nr. Klein Riet R. W. of Waterford	29.10.45	F									
Roberts 36,37	Lake Mentz	Dec.1959	F		Lake Mentz	256.3	361.4	106.4	28	31	14	27
Roberts 12	Baroe	Oct.1959	BF		Waaipoort	214.1	327.4	91.9	-	-	-	-
Roberts 13	Mount Stewart	Oct.1959	BF		Kranskop	177.8	294.4	88.6	-	-	-	-
Roberts 52B	Mount Stewart	Oct-Nov. 1960	F									
Roberts 14	Steytlerville	Oct.1959	BF		Steytlerville	228.6	430.8	74.7	27	31	14	28

						Rainfall						
						Annual mm.			% Quarterly			
Collector	Locality	Date of Collection	Condition when Collected	Subsequent Flowering in Cultivation	Nearest Weather Station	Mean	Max.	Min.	D-F	M-M	J-A	S-N
	Foliolosa Contd.											
Roberts 43A	Steytlerville	July 1960	X									
Roberts 52A	Steytlerville	Oct-Nov. 1960	BF									
Paterson 40	Steytlerville	Nov.1911	F									
Roberts 34	Cranmere	Nov.1959	X		Cranmere	305.6	515.9	84.6	-	-	-	-
Roberts 35	10 miles South of Pearston on Waterford Rd.	Nov.1959	X		Pearston	370.6	477.5	130.6	30	30	13	27
van der Berg Nbg.540/23 (BOL)	Kendrew	April 1929	X		Kendrew Estate	285.2	153.3	117.6	32	32	12	25
Frith H/3606/59 4 (K)	Kendrew	May 1924	X		Kendrew S.A.R.	254.8	472.2	115.1	-	-	-	-
H.Bolus 5264A (BOL)	Kruidfontein	Sept.1870	BF									
H.Bolus 264(BOL)	Graaff Reinet	Aug-Oct. 1870	F		Graaff Reinet Gaol	346.2	545.1	147.1	-	-	-	-
Thode A621(PRE)	Graaff Reinet	Nov-Dec. 1925	F		Graaff Reinet Convent	345.7	573.3	165.9	32	29	13	26
Frith H/3606/59 5 (k)	Graaff Reinet	May 1924	X									
Roberts 29	At turnoff to Valley of Desolation	Dec.1959	F		van Ryne-velds Dam	324.1	511.0	164.8	-	-	-	-
60	"	Feb.1961	F									

Collector	Locality	Date of Collection	Condition when Collected	Subsequent Flowering in Cultivation	Nearest Weather Station	Rainfall Annual mm. Mean	Max.	Min.	% Quarterly D-F	M-M	J-A	S-N
	Foliolosa Contd.											
Roberts 30	10 miles N. of Graaff Reinet on Middleburg Rd.	Dec.1959	X		Bloemhof	301.2	496.1	127.0	-	-	-	-
N.S.Pillans	Between Ladismith and Laingsburg?		U	Aug.1907	Laingsburg	104.4	303.3	20.8	-	-	-	-
						135.1	195.6	73.7	-	-	-	-
					Prinsrivier	143.0	199.9	57.6	-	-	-	-
					Ladismith	337.0	515.1	176.0	20	30	19	31

Collector	Locality	Date of Collection	Condition when Collected	Subsequent Flowering in Cultivation	Nearest Weather Station	Mean	Rainfall Annual mm. Max.	Min.	% Quarterly D-F	M-M	J-A	S-N
	Congesta											
Dyer 975(PRE)	Hel poort	Aug.1927	F		Heatherton Towers	341.7	592.3	240.8	-	-	-	-
Dyer 2096(GRA)	"	Sept.1929	F									
Rosenborth Stell.Un.7851 (BOL)	"	24.9.47	F		Uplands	315.7	455.7	139.2	-	-	-	-
H. Bolus 2687 (BOL)	"	Jan/Feb	F									
H. Bolus 2687(K)	"	Feb.1874	F									
Roberts 41	"	Dec.1959	X	Aug-Oct. 1960								
Comins 2065	"	23.9.60	R	Aug-Sept. 1961								
Cruden 209(GRA)	Alicedale	25.3.17	F		Alicedale	394.2	723.6	152.1	-	-	-	-
Comins	Alicedale	1960	X									
Comins	Dikkop Vlakte	April 1959	X	July-Sept. 1960 March-May 1961 Dec.-Feb. 1962	As for Hellpoort							
Roberts 40	nr Dikkop Vlakte	Dec.1959	X									
Comins	Dikkop Vlakte	23.9.60	R									
Comins 2063	Krantz Drift	21.10.60	F		As for Hel poort							

Collector	Locality	Date of Collection	Condition when Collected	Subsequent Flowering in Cultivation	Nearest Weather Station	Mean	Annual mm. Max.	Annual mm. Min.	Rainfall % Quarterly D-F	M-M	J-A	S-N
	Congesta Contd.											
Acocks 12049 (PRE)	Top of Brakkloof	1.11.45	X		As for Hellpoort							
Roberts 38,39	12-18 miles from Adelaide nr. Friesland on Grahamstown rd.	Dec.1959	X	Feb-Apr.1961 Jan-March 1962, 1963 and 1964	Adelaide	448.0	681.0	220.5	32	30	10	28
					Clifton	366.5	500.4	180.1	-	-	-	-
					Wester-ford	438.9	523.7	195.1	-	-	-	-
					Seven-fontein	345.9	446.8	154.7	-	-	-	-
S.leg (GRA)	Fish River Rand	Oct.1896	X									
Davison, Nbg. 187/15 (BOL)	Mortimer	June 1915	F		Semaphore	310.9	542.5	118.1	-	-	-	-
Acocks 11928 (PRE)	Rayners Kop	25.10.45	X		Tarka Training Farm	297.2	436.1	91.7	-	-	-	-
Roberts 33	nr.Rayners Kop	Dec.1959	F									
No.27632(BOL)	Cradock	19.9.35	F		Cradock (S.A.R.)	356.6	483.1	185.2	-	-	-	-
					(Gaol)	341.9	672.6	104.4	35	33	8	24
Cunningham(BOL)	Cradock	7.10.35	X									
Roberts 32	Cradock	Dec.1959	F									
Roberts 53	Cradock	Nov.1960	X	Feb-Apr.1961, 1962,1963 & 1964								
Roberts 31	19m N. of Cradock nr. Knutsford	Dec.1959	X		Fish River	268.0	496.6	87.9	-	-	-	-
					Fortuin-plaats	291.6	517.4	174.0	-	-	-	-
J.J. Bruwer (BOL)	Rosmead	25.10.37	X		Groot-fontein	365.0	623.3	184.7	-	-	-	-

Collector	Locality	Date of Collection	Condition When Collected	Subsequent Flowering in Cultivation	Nearest Weather Station	Rainfall Annual mm. Mean	Max.	Min.	% Quarterly D-F	M-M	J-A	S-N
	Robusta											
S.Schonland(PRE)	Lake Mentz	Aug.1921	F		Lake Mentz	256.3	361.4	106.4	28	31	14	27
Acocks 11995 (PRE)	5 miles E. of Waterford	29.10.45	X		Waterford	247.1	348.7	106.9	-	-	-	-
Compton 20323 (NBG)	Mount Stewart	5.12.47	X		Waaipoort	214.1	327.4	91.9	-	-	-	-
					Klipplaat	230.6	374.4	65.3	31	31	11	28
Dyer 4022 (PRE)	Steytlerville	Aug.1939	F		Steytler-ville	228.6	430.8	74.7	27	31	14	28
Roberts 15	Steytlerville	Oct.1959	X									
Roberts 43	Steytlerville	July 1960	F									
V.S. Rees Nbg. 1302/25 (NBG)	Miller	12.8.43	F		Fullarton	177.5	421.6	73.7	-	-	-	-
Roberts 8, 9.	nr. Miller	Oct.1959	X	Jun-Aug.1962								
Roberts 45	nr. Miller	July 1960	B									
Leipoldt 3062 (BOL)	Koppie Nr. Willowmore	July 1940	X		Willowmore	236.2	439.4	101.1	-	-	-	-
Stell.Univ.Gdn. 7849 (BOL)	Betw.Oudts-hoorn & Willow-more	12.8.47	F		Schilpads-been	242.6	398.3	138.2	-	-	-	-
Roberts 27	Klaarstroom	Dec.1959	X		Klaarstroom	178.3	374.4	61.2	-	-	-	-
Broom s.n. No. 11652 in Herb. Marloth (PRE	Prince Albert	Aug.1923	F		Prince Alb-ert	182.4	484.1	56.4	21	35	19	26
Roberts 64	Prince Albert	July 1961	F									

Collector	Locality	Date of Collection	Condition When Collected	Subsequent Flowering in Cultivation	Nearest Weather Station	Rainfall Annual mm. Mean	Max.	Min.	% Quarterly D-F	M-M	J-A	S-N
	Robusta Contd.											
Roberts 65	nr. Farm Vleiland	April 1962	X		Rietvlei	175.5	317.8	63.2	16	29	26	28
Roberts 67	nr. Farm Spreeufontein	April 1962	X									
Kirstenbosch trip.	"	Sept. 1961	X									
Roberts 1	nr.Farm Riet-fontein 8 mi. from Laingsburg	May 1959	B		Laingsburg	104.4	303.3	20.8	-	-	-	-
					Laingsburg	135.1	195.6	73.7	-	-	-	-
No.27630(BOL)	Whitehill	Oct.1930	FR									
Roberts 57	nr.Whitehill	Dec.1960	X		Whitehill Rail	122.2	201.2	77.0	-	-	-	-
E.Oliver	nr.Whitehill	Aug-Sept.1960	FR									
Roberts 56	nr.Matjesfontein	Dec.1960	X		Hillandale	159.8	370.6	54.9	-	-	-	-
Bartlett 349(BOL)	"	-			Matjesfon-tein	155.8	345.7	68.3	15	31	33	21
Nbg. 3172/14(NBG)	Beaufort West	1914	F		Beaufort West Gaol	227.6	515.6	62.7	36	29	13	22
Taylor 921(BOL)	North of Beau-fort West	30.9.35	F		De Hoop	230.4	372.4	149.4	-	-	-	-
H.Hall 2284	Foot of Molteno Pass	Aug.1961	FR	June-Aug 1962,1963, 1964	Lemoen-fontein *	317.8+	591.8	131.8	-	-	-	-
Roberts 27	10 miles E. of Nelspoort	Dec.1959	X		Nelspoort	238.8	556.8	77.2	-	-	-	-

Collector	Locality	Date of Collection	Condition When Collected	Subsequent Flowering in Cultivation	Nearest Weather Station	Rainfall Annual mm. Mean	Max.	Min.	Quarterly % D-F	M-M	J-A	S-N
	Robusta Contd.											
	10 miles E.of Nelspoort	July 1960	F		Nelspoort Sanatorium	238.5	504.7	75.9	-	-	-	-

• In Nuweveld Mt.Range, rainfall therefore rather high.

Collector	Locality	Date of Collection	Condition When Collected	Subsequent Flowering in Cultivation	Nearest Weather Station	Rainfall Annual mm. Mean	Max.	Min.	Quarterly % D-F	M-M	J-A	S-N
	Hallii											
Matthews Nbg. 3479/14(BOL)	Prince Albert	March 1915	F		Prince Albert	182.4	484.1	56.4	21	35	19	26
Rennie Nbg. 1418/28(BOL)	Prince Albert Division	May 1929	X									
Joubert 97(BOL)	Ladismith	Jan.1934	X		Ladismith	337.0	515.1	176.0	20	30	19	31
No.27624(BOL)	Between Ladismith and Laingsburg	-	U	May 1904	Prinsrivier	143.0	199.9	57.6	-	-	-	-
Barker 109(BOL)	6 mi.from Laingsburg on Ladismith Rd.	Sept.1932	X		Laingsburg	104.4	303.3	20.8	-	-	-	-
						135.1	195.6	73.7	-	-	-	-
					Rondekop	101.1	153.2	41.4	-	-	-	-
Roberts 48	Approx.10 mi. from Seven Weeks Poort on Laingsburg Rd.	July 1960	X	Nov-Jan. 1960,1961, 1962 and 1963	Rietvlei	175.5	317.8	63.2	16	29	26	28
Roberts 52	"	Oct.1960	B									
H.Hall 202/53	Koup	1953	X	Nov-Jan. 1959,60,61, 62,63.	Koup	108.2	215.1	26.9	-	-	-	-
Roberts 26	Koup	Dec.1959	BF									
Roberts 54	Koup	Dec.1960	F	Nov-Jan.1961 1962 and 1963								

Collector	Locality	Date of Collection	Condition When Collected	Subsequent Flowering in Cultivation	Nearest Weather Station	Rainfall Annual mm Mean	Max.	Min.	% Quarterly D-F	M-M	J-A	S-N
	Bullulata											
Acocks 18396 (Photo)(PRE)	4 miles N.of Matjesfontein	June 1955	X		Matjes-fontein	159.8	370.6	54.9	15	31	33	21
Roberts 25	4 miles N.of Matjesfontein on Sutherland Road.	Dec.1959	F	Nov-Jan. 1961,62, 63.	Hillandale	158.8	345.7	68.3	-	-	-	-
Roberts 55	"	Dec.1960	F									
Roberts 24	Approx.35 mi. N.of Ceres on Sutherland Rd.	Dec.1959	F	Nov-June 1961,62.	Spes Bona	109.7	178.0	37.1	17	28	32	23
No. 27635(BOL)	Ceres Karoo	1946										
H.Hall Nbg. 285/55 (NBG)	Verlatenkloof	Feb.1956	U	Nov-Jan. 1959,60, 61.	Nuwe Dam	244.8	373.1	167.4	-	-	-	-
Logan sn. No.27635(BOL)	Roggeveld mts. nr. Sutherland	July 1936	X		Sutherland	224.8	265.7	122.4	-	-	-	-
					Sutherland (Gaol)	247.6	463.1	104.6	17	28	35	19
No.9363 in Herb. H.Bolus (BOL)	Between Ladismith and Laingsburg	-	U	May 1904	Laingsburg 1	104.4	303.3	20.8	-	-	-	-
					Laingsburg 2	135.1	195.6	73.7	-	-	-	-
					Prinsrivier	143.0	199.9	57.6	-	-	-	-
					Ladismith	337.0	515.1	176.0	20	30	19	31

Collector	Locality	Date of Collection	Condition When Collected	Subsequent Flowering in Cultivation	Nearest Weather Station	Rainfall Annual mm. Mean	Max.	Min.	% Quarterly D-F	M-M	J-A	S-N
	Rugosa											
Roberts A2	23 mi.from Ladismith on road to Barrydale	May 1959	X	Nov-Jan.1960 Jan-March 1961	Poortfontein	108.0	192.8	47.5	-	-	-	-
R.du Plessis (BOL)	7 mi.from Warmwaterberg on road to Barrydale	Aug.1955	X									
P.Ross Frames (BOL)	6 mi. N.of Barrydale	1926	U	April 1929	Barrydale	265.7	410.7	93.7	-	-	-	-
Nbg. 428/58	Barrydale	1958	X	20.12.60								
A.J. Joubert 111 (BOL)	7 mi. East of Vanwyksdorp	May 1939	X									
Compton & Lamb Nbg.2306/27 (BOL)	Muiskraal	1927	U	April 1929 (fruiting)								
E. Ferguson(BOL)	Riversdale +	13.6.29	X									
N.J.S. van der Merwe 227(BOL)	Montagu "ex hort.Bonnievale"	Jan.1937	X		Montagu	312.2	560.8	136.6	11	25	33	30
Hurling & Neil (BOL)	nr.Montagu	Nov.1931	X									
A.J. Joubert (GRA)	Montagu District	Dec.1932	X									
Nbg.668/60	Montagu	1960	U	13.12.60								
J. Neil(BOL)	4m.out of Montagu on Baden Road	Nov.1931	X									

+ obviously Riversdale District

Collector	Locality	Date of Collection	Condition When Collected	Subsequent Flowering in Cultivation	Nearest Weather Station	Rainfall Annual mm. Mean	Max.	Min.	% Quarterly D-F	M-M	J-A	S-N
	Rugosa Contd.											
Roberts A17	On hillside 1 mi. N.W. of upper Baden Montagu District	Dec.1959	F									
Roberts A18	4 mi. out of Montagu shallow	Dec.1959	F	Dec-Feb.1960								
Roberts A59	kloof off Upper Baden Road	Dec.1960	F	Jan-March 1961								
Roberts A23	2 mi. out of Montagu at Baden Rd. turn off	Dec.1959	F									
Roberts A50	Farm Rietvlei No.2, 7 miles out of Montagu	Sept.1960	X		Rietvlei (Nr.Montagu)	233.9	374.1	159.2	-	-	-	-
Roberts A19, A20.	On Pietersfontein Rd.Montague Dist.	Dec.1959	F		Hoek van die berg	184.4	292.9	68.8	21	28	23	28
					Bellair	121.7	268.5	58.7	-	-	-	-
Roberts A21, A22.	Nr. Farm Brakwater on Dobbelaars Kloof Rd.	Dec.1959	F	Nov-Jan. 1960								
N.J.S. van der Merwe 226(BOL)	Bonnievale	Jan.1937	F		Bonnievale	245.6	301.8	140.0	-	-	-	-
Malang Nbg. 1687/22(BOL)	Keisies Hoogte	May 1929	X									
A.J.Joubert (BOL)	12 miles S.E. Touwsriver	Sept.1932	X		Touwsriver	218.2	399.5	85.6	14	24	40	22
						249.7	483.9	152.1	-	-	-	-

Collector	Locality	Date of Collection	Condition When Collected	Subsequent Flowering in Cultivation	Nearest Weather Station	Rainfall Annual mm. Mean	Max.	Min.	% Quarterly D-F	M-M	J-A	S-N
	<u>Rugosa Contd.</u>											
S.leg No. 27638(BOL)	Ladismith	April 1929	FR		Ladismith	337.0	515.1	176.0	20	30	19	31
					Algeryns-kraal	140.0	213.1	45.0	-	-	-	-
					Poortfon-tein	108.0	192.8	47.5	-	-	-	-
A.J.Joubert (BOL)	Ladismith	Dec.1932	X									
N.S.Pillans 857 (BOL)	Between Ladismith & Laingsburg	-	U	Flowered in hort Nov. 1906	Prinsrivier	143.0	199.9	57.6	-	-	-	-
					Rondekop	101.1	153.2	41.4	-	-	-	-
Roberts 66	Nr. Farm Rietvlei on Laingsburg/ Seven Weeks Poort Road.	April 1962	X		Rietvlei (Laingsburg div.)	175.5	317.8	63.2	16	29	26	28
S.leg No.4202 in Herb. Marloth (PRE)	Graaf Rienet	Oct.1905	F		Graaf Rienet (Convent)	345.7	573.3	165.9	32	29	13	26
					(gaol)	346.2	545.1	147.1	-	-	-	-

Collector	Locality	Date of Collection	Condition When Collected	Subsequent Flowering in Cultivation	Nearest Weather Station	Rainfall Annual mm. Mean	Max.	Min.	Rainfall % Quarterly D-F	M-M	J-A	S-N
	Smutsiana											
Roberts A3,4,5,	23-26 miles from Ladismith on old Barrydale Road.	May 1959	X	Jan-March 1960,61, 62,63.	Poortfontein	108.0	192.8	47.5	-	-	-	-
Roberts A62	"	Feb.1961	F		Barrydale	265.7	410.7	93.7	-	-	-	-
					Algeryns-kraal	140.0	213.1	45.0	-	-	-	-
P.Ross Frames Nbg.2155/26 (BOL)	14 mi. S of Ladismith	May 1929	X		Ladismith	337.0	515.1	176.0	20	30	19	31
Roberts 63,63A.	N.of Muiskraal, along Ladismith Road.	May 1961	X									
Nbg. 784/63	Anysberg	1963	U		Prinsrivier	143.0	199.9	57.6	-	-	-	-
P.Bond 259 (NBG)	Rooihoogte, Laingsburg	23.3.40	F		Rondekop	101.1	153.2	41.4	-	-	-	-
Roberts 51	Rooinek Pass Laingsburg Division	Oct.1960	X		Laingsburg	104.4	303.3	20.8	-	-	-	-
						135.1	195.6	73.7	-	-	-	-
Roberts 49	12 m. from Seven Wks.Poort on Laingsburg Road.	July 1960	X		Rietvlei, (Laingsburg Division)	175.5	317.8	63.2	16	29	26	28
Roberts Obs.	Several places between Rooinek Pass and Rietvlei Farm along Laingsburg/7 wks. Poort Road.	April 1962	X									

Collector	Locality	Date of Collection	Condition When Collected	Subsequent Flowering in Cultivation	Nearest Weather Station	Rainfall Annual mm. Mean	Max.	Min.	Rainfall % Quarterly D-F	M-M	J-A	S-N
	Herrei											
A.Erasmus s.n. No.1368 in Herb. Marloth (PRE)	Prince Albert	20.8.29	F		Prince Albert	182.4	484.1	56.4	21	35	19	26
					Willow Glen	207.5	334.5	49.8	-	-	-	-
A.M.Krige s.n. No.13009 in Herb.Bolus (BOL)	nr.Prince Albert	1908	X									
J.P.H. Acocks 18412 (PRE)	5 mi. S.E. of Prince Albert	13.10.55	F									
Roberts 46	5 miles from Prince Albert on hill slopes by Klaarstroom Road.	July 1960	F	June-Aug 62, July-Sept 64.								
Roberts Obs.	"	Dec.1960	X									
Roberts 16	nr.Farm Hoek Plaas about 10 miles N.E. of Uniondale	Oct.1959	X	June-Aug 62, 63 July-Sept. 1964	Uniondale	325.1	714.0	171.2	19	29	24	29
					Uniondale	209.3	410.7	83.6	-	-	-	-
					Vetvlei	230.6	316.7	76.2	-	-	-	-
Roberts 44	"	July 1960	F		Rooirivier	240.8	362.0	141.7	19	29	23	29

Collector	Locality	Date of Collection	Condition When Collected	Subsequent Flowering in Cultivation	Nearest Weather Station	Rainfall Annual mm. Mean	Min.	Max.	% Quarterly D-F	M-M	J-A	S-N
	Spiralis											
Roberts 6	About 26 mi. from Ladismith on old Barrydale Road.	May 1959	X	Dec-Feb. 1960,61, 62,63.	Poortfontein	108.0	192.8	47.5	-	-	-	-
					Algeryns-kraal	14.00	213.1	45.0	-	-	-	-
A.J.Joubert(BOL)	Ladismith	Nov.1932	X		Ladismith	337.0	515.1	176.0	20	30	19	31
Roberts 47	About 5 mi. S. of Calitzdorp hill slope to W. of Rooiberg Pass Rd.	July 1960	X	Jan-March 1962,63	Calitzdorp	198.6	421.4	84.8	24.	30	16	31
Roberts 68	"	April 1962	X									
Roberts 7	About 7 miles S. of Oudtshoorn on Robertson Pass Rd.	Oct.1959	X		Oudtshoorn (gaol)	238.2	419.6	115.1	20	28	20	31
					Oudtshoorn (Convent)	231.6	305.8	140.2	-	-	-	-
					Oudtshoorn (Municipality)	245.1	458.7	105.2	-	-	-	-
Roberts 61	"	Feb.1961	F									
W.F.Barker 5096 (NBG)	Oudtshoorn District	6.12.47	F									
In Herb.Marloth 6510a (PRE)	Oudtshoorn	-	U	March 1925								
S.leg No.27625 (BOL)	Oudtshoorn	May 1929	F									
W.Taylor (GRA)	Oudtshoorn	Jan,1916	F									

Collector	Locality	Date of Collection	Condition When Collected	Subsequent Flowering in Cultivation	Nearest Weather Station	Rainfall Annual mm. Mean	Min.	Max.	Rainfall % Quarterly D-F	M-M	J-A	S-N
	Spiralis Contd.											
Taylor Nbg. 130/16 (BOL)	Oudtshoorn	1916	U	March 1918								
H.Herre Stell. Univ.Gdns.11 (BCL)	Little Karoo		U	3.4.36								
P.Ross Frames Nbg.2525/27 (NBG)	De Rust	1927	U	7.3.43	De Rust	333.0	637.8	224.5	20	29	20	31
					Vlakteplaas	241.3	376.2	140.7	-	-	-	-
P.Ross Frames Nbg.2525/27 (NBG)	De Rust	1927	U		Rooikrans	205.2	396.5	90.2	-	-	-	-
In Herb.Marloth 5112 (PRE)	Graaf Reinet	-	F		Graaf Reinet Convent	345.7	573.3	155.9	32	29	13	26
					Gaol	346.2	545.1	147.1				

CYTOLOGY

Previous history

Riley (1961) has compiled the most recent list of recorded chromosome counts for the genus Astroloba. His table, with literature references is given below. The species are arranged according to Jacobsen (1954).

Species	n no.	2n no.	References
A. aspera (Willd.) Uitew.	7	-	Ferguson 1926
as Haworthia aspera	-	14	Snoad 1951 a
A. bicarinata (Haw.) Uitew.	-	21	Resende 1937
A. congesta (Salm.) Uitew.	9	-	Marshak 1934
A. deltoidea (Hook.f.) Uitew.	7	14	Ferguson 1926
	-	14	Resende 1937
A. foliolosa (Willd.) Uitew.	-	14	Resende 1937
A. pentagona (Haw.) Uitew.			
as A. pentagona Willd.	-	28	Resende 1937
as Haworthia spiralis Haw.	-	14	Sato 1937, 1942
A. pentagona var spiralis (Haw.) Uitew.	12	-	Ferguson 1926
A. spiralis (L.) Uitew.			
as A.spiralis L. (Bak.)	-	14	Resende 1937, Kondo and Magata 1943
A. sp.	7	-	Geitler 1935, Suto 1936
A. sp.	-	14	Riley 1959
Gasteria x Astroloba			
Gasteria x apicroides Bak.	-	ca 14	Ferguson 1926

Table 22: CHROMOSOME COUNTS OF SPECIES OF ASTROLOBA AND AN INTERGENERIC HYBRID. (From Riley (1961), Tables 2 and 3)

It appears that in most cases the plants investigated came from private collections, not from plants collected in the wild. In view of this and in view of the existing confusion over the identification of some species, this list is not of great value.

Unfortunately, a number of the references were unavailable, notably that of Resende (1937) in which the somatic chromosome number of "Apicra bicarinata" was given as 2n = 21 No triploid plants were found by the present author in any field specimens. The cytology of specimens of what the present author considers to be an inter-generic hybrid between H. margaritifera and the entity rugosa, (originally described as Apicra bicarinata by Haworth (1819)), is dealt with later. The somatic number was 2n = 14 in all plants examined.

In the same paper, Resende gave the diploid number of a plant "Apicra pentagona" as 2n = 28. As will be shown later, the identity of the species "pentagona" is open to doubt. The only polyploid found by the present author was the entity spiralis (2n = 28). Resende, on the other hand gave the chromosome number of the plant he considered to be "Apicra spiralis" as 2n = 14. A similar observation was made by Kondo and Megata (1943).

Sato, also in unavailable references, (1937, 1942), gave a chromosome number of 2n = 14 for a plant he identified as Haworthia spiralis Haw. As is shown in this thesis in the account of the taxonomic history of the species the identity of "spiralis Haw" is open to doubt, but it is possibly a specimen either of what the present author describes as the entity hallii, or of the entity smutsiana.

Ferguson (1926) investigated plants of Astroloba, then known as Apicra from the Kew collection of succulants. She noted that the constriction in Chromosomes of the Aloinae is usually subterminal. Of the Apicras, she observed this in "Apicra Deltoidea". It is not clear, however, in the text or in the illustrations, (l.c.p.252, fig 9), whether or not this applied to all chromosomes of this specimen. She gave the average length of the long and short chromosomes in "A. deltoidea" as 7.0 and 2.4 μ respectively.

Riley (1961) quoted Ferguson (1926) as giving the haploid number of "A. pentagona var spiralis" as n = 12. In the original text of Ferguson's paper, however (l.c.p. 234 Table I), the haploid chromosome number of "pentagona spiralis" is given as n = 14. The discrepancy in Riley's paper is not an orthographic one as he also mentioned a chromosome number of n = 12 in the text, (l.c.p. 66 para. 2 line 2). Since he cited only one paper by Ferguson it would appear that Riley has made a mistake. It is very likely that the plant "pentagona spiralis" investigated by Ferguson was in fact a specimen of the entity spiralis.

A record of a haploid chromosome number of n = 9 observed by Marshak (1934) is also mentioned by Riley. Marshak investigated chromosome configuration in the first division of meiosis in "Apicra congesta" and found a variability in chromosome number, the usual count being n = 9 with six long and three short chromosomes. Marshak suggested that in "Apicra congesta" individual chromosomes may have been duplicated, but commented: "One hesitates to draw inferences about wild species from representatives grown so long under cultivation". He did not mention anywhere the possibility of difference in chromosome numbers being caused from lack of pairing at meiotic Metaphase I, and this cannot be suggested from his illustration.

No such unusual behaviour was observed by the present author in any member of the foliolosa complex, namely, the entities foliolosa congesta and robusta, all of which were found to have a diploid number of 2n = 14.

As a point of interest it should be noted that the plant of Astroloba listed, as "A.sp" in Riley's paper of 1961, whose chromosomes were counted by him in 1959, was collected "on the bank of the Great Fish River near the bridge at Commitees", (Riley 1959 p.84). From this locality, the plant may be identified as a specimen of the entity congesta.

There is a further point of interest in Riley's paper of 1961. He listed a hybrid Gasteria x Astroloba, "Gasteria x apicroides Bak.", giving no reasons or references as to why "apicroides" should be an intergeneric hybrid. According to Baker (1896), who described the plant originally as Gasteria apicroides, it was a form allied to G.bayfeldii (Salm). Bak., differing in the way in which the leaves were borne. Both species were described from plants of unknown locality in South Africa.

Rowley (1954) actually transferred G. bayfeldii to the hybrid genus Gasterhaworthia, established by Guillaumin (1931) for hybrids between species of Gasteria and Haworthia. No one, however, appears to have given similar treatment officially to G. apicroides. Ferguson (1926) investigated the chromosome number of the plant as a species of Gasteria.

The present author has never seen a living specimen of G. apicroides Bak., but there is a specimen accompanied by a water colour in the Bolus Herbarium of a putative hybrid between the Genera Gasteria and Astroloba. The specimen, No.27647 (BOL) came from the Ferguson collection in Frames' garden. The leafy stem is shortly caulescent, with white spotted leaves 6 cm long, reminiscent of G. stayneri von Poelln, while the perianth tube is 13 mm. long, pink and inflated at the base, green at the apex and straight with slightly outcurved lobes.

Investigations by the present author.

As is shown in this thesis in the account of the taxonomic history of the species, there has been considerable confusion over the identification of species of Astroloba and this probably applies equally well to those plants of Astroloba of which the cytology has been investigated by previous authors. Again, since in most cases the plants investigated have been long under cultivation, any divergences fromthe usual haploid number of n = 7 must be regarded as not necessarily pertaining to plants in the field, as Marshak (1934) so rightly observed, or they may, in fact, have been inaccurate counts!

All plants investigated by the present author were taken from sample field populations, and are listed in Table 23.

As pieces of leafy shoot strike root readily, the somatic chromosome number in root tips was investigated in each case.

Entity	Locality	No. of plants investigated	Diploid count
BULLULATA	Ceres - Sutherland Karoo R 24	3	2n = 14
	Matjiesfontein R 25	2	2n = 14
HALLII	Koup R 26	4	2n = 14
SMUTSIANA	Ladismith - Barrydale R 3	2	2n = 14
	Ladismith - Barrydale R 5	2	2n = 14
SPIRALIS	Oudtshoorn R 7	3	2n = 28
	Calitzdorp R 47	1	2n = 28
	Ladismith - Barrydale R 6	1	2n = 28
HERREI	Prince Albert R 46	2	2n = 14
	Uniondale R 16	1	2n = 14
RUGOSA	Baden - Baden R 17	1	2n = 14
	R 18	1	2n = 14
	Dobbelaar's Kloof R 19	1	2n = 14
	Rietvlei R 50A	1	2n = 14
CONGESTA	Cradock R 32	2	2n = 14
	S. of Adelaide R 38	3	2n = 14
FOLIOLOSA	Steytlerville R 14	1	2n = 14
	Waterford R 10	1	2n = 14
ROBUSTA	Nelspoort R 28	2	2n = 14
	Klaarstroom R 27	1	2n = 14
	Miller R 8	2	2n = 14
	Steytlerville R 15	1	2n = 14
X ASTRO-WORTHIA	Rietvlei R 50	1	2n = 14
BICARINATA	Kirstenbosch No.7262	1	2n = 14

Table 23. SHOWING DIPLOID CHROMOSOME NUMBERS OBSERVED IN ROOT SQUASHES OF PLANTS OF ASTROLOBA FROM FIELD POPULATION SAMPLES.

(All were treated with colchicine)

Method.

It was found that the most numerous metaphase stages were found in roots which had been excised at about eight o'clock in the morning. The roots were cut off about 3 mm behind the apex and placed in a 0.01% colchicine solution for 6 hours. (Riley, verb. com.)

They were then washed and fixed in a 3 : 1 absolute alcohol - glacial acetic acid solution for 12 to 24 hours. After that they were hydrolysed in N/10 HCl. at 60° for 6 minutes, then washed in distilled water and stained in Feulgen (La Cour), for 30 minutes, or until the root tips were purple and the rest of the tissue still white.

The root tips were squashed in 45% acetic acid and examined under the microscope. Photographs were taken of metaphase configurations in all entities except the entity smutsiana.

It was found that very good separation of chromosomes was obtained at metaphase if the roots were left in a colchicine solution for 12 hours (See Plate 11.). The chromosomes were, however, very much shortened.

Results. (See Plates 11, 12, 13 and 14).

Diploid counts for all plants investigated are given in Table 23. In all cases with the exception of the entity spiralis, the diploid count is 2n = 14, with four pairs of long and three pairs of short chromosomes. The entity spiralis with a diploid number of 2n = 28 is a tetraploid.

Insufficient good preparations were made to obtain an adequate picture of chromosome length or of the relative lengths of the arms of each chromosome on either side of the constriction. All the long chromosomes are subterminal, but there is some variation in the proportion of the length of the long arm to that of the short arm. In all entities one pair of long chromosomes, (two pairs in the tetraploid entity spiralis), has a ratio of roughly 4:1, while in the other pairs of chromosomes the short arm is shorter.

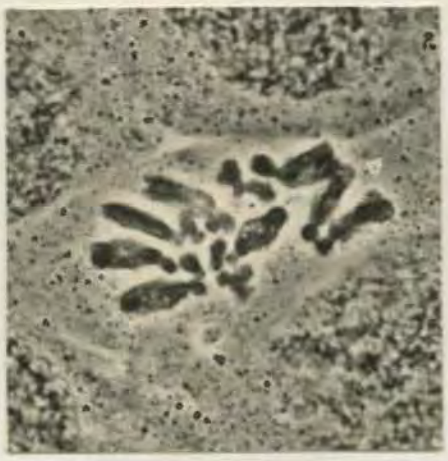
Entity	Locality	Long chromosomes 8 per somatic cell: No. chromosomes in which position of constriction is visible	Long chromosomes 8 per somatic cell: Ratio of length of long arm to length of short arm	Short chromosomes 6 per somatic cell: No. chromosomes in which position of constriction is visible	Short chromosomes 6 per somatic cell: Ratio of length of long arm to length of short arm	No. of cells observed
BULLULATA	R24	5 1	7:1 4:1	3	2:1	1
	R25	6 2	8:1 5:1	1	2:1	1
HALLII	R26	5 2	6:1 3:1	3	2:1	1
SMUTSIANA	R5	6 2	7:1 4:1	6	2:1	1
HERREI	R16	6 2	7:1 4:1	5	2:1	1
	R46	6 2	7:1 4:1	6	2:1	1
RUGOSA	R18,19	4 2 2	7:1 6:1 4:1	4	2:1	2
CONGESTA	R38	6 2	7:1 4:1	5	2:1	1
FOLIOLOSA	R14	1 1	8:1 4:1	4	2:1	1
ROBUSTA	R8	6 2	6:1 3:1	4	2:1	1
	R28	6 2	8:1 5:1	4	2:1	1
X BICARINATA	No.7262	4 2 2	7:1 6:1 4:1	4	2:1	1
SPIRALIS	R7	12 4	8:1 4:1	12	2:1	1

Table 24. SHOWING RELATIVE LENGTHS OF ARMS OF CHROMOSOMES AT SOMATIC METAPHASE.

Has 16 long and 12 short chromosomes per cell.

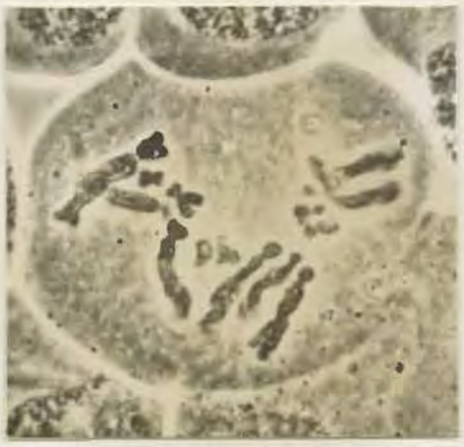
In the entities *smutsiana*, *herrei* and *congesta*, all the short chromosomes were subterminal, but whether or not this was the case for all the short chromosomes of the other entities was not clear.

These very approximate observations are shown in Table 24. It must be emphasised that these observations are very approximate and they must be regarded in this light.



R17 R22

Chromosomes from rootsquashes of the entity rugosa. Note the slight stickiness between two of the long chromosomes in the specimen on the left.



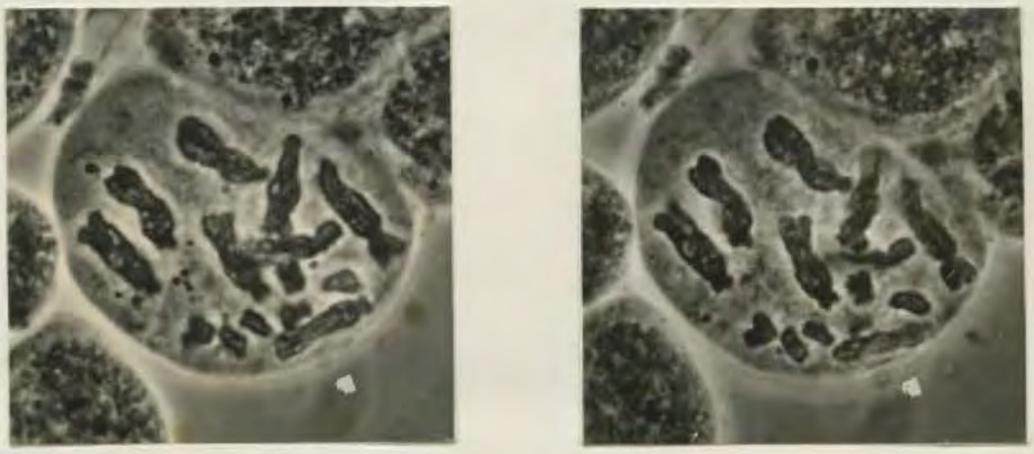
No. 7262

Chromosomes from a rootsquash of a plant of the intergeneric hybrid, referred to by the present author as×Astroworthia bicarinata, between the entity rugosa and Haworthia margaritifera.

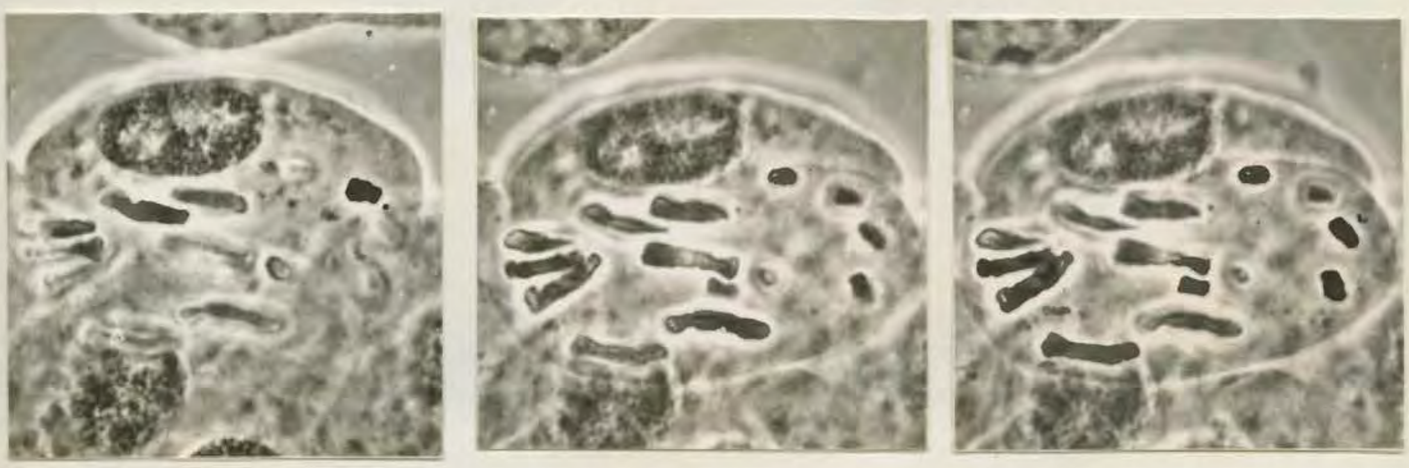
Ex hort. Kirstenbosch.

Chromosomes from a rootsquash of a plant of Poellnitzia rubriflora (L. Bol.) Uitew., after 12 hours treatment with colchicine. (All other specimens photographed were immersed in the colchicine solution for the time specified by Riley).

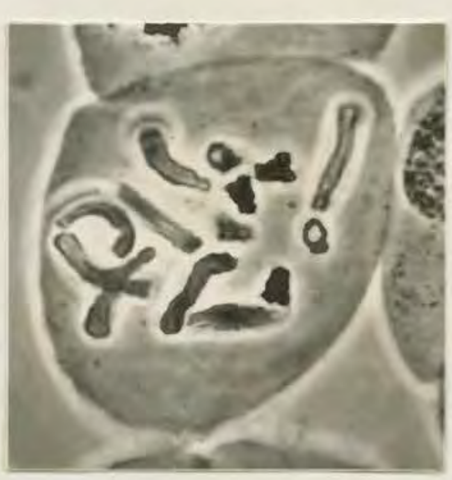
PLATE 11.



Chromosomes from a rootsquash of a plant of the entity congesta (R38) seen at two levels.



Chromosomes from a rootsquash of a plant of the entity foliolosa (R14) seen at three levels.



Chromosomes from a rootsquash of the entity robusta (R9).

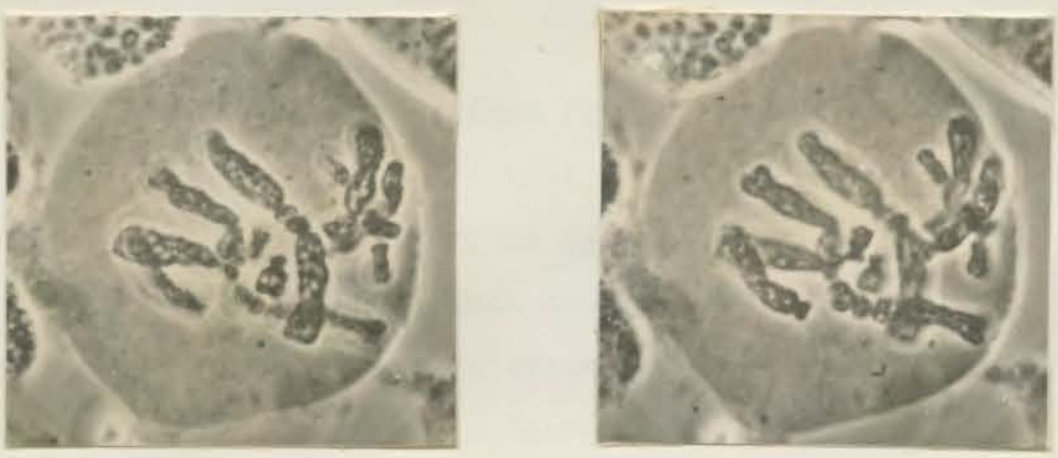
PLATE 12.

Chromosomes from a rootsquash of the entity hallii (R26) seen at three levels.

Chromosomes from a rootsquash of a plant of the entity bullulata (R24). Note the stickiness between some of the chromosomes.

PLATE 13.

Chromosomes from a rootsquash of a plant of the entity <u>spiralis</u> (R7), the only polyploid entity found in field specimens of the genus.



Chromosomes from a rootsquash of a plant of the entity <u>herrei</u> (R16) seen at two levels.

PLATE 14.

ASSESSMENT OF CHARACTERS IN POPULATION SAMPLES.

THE "FOLIOLOSA" COMPLEX

From the introductory survey of the genus as a whole, a group of entities has been delimited, characterised by leaves with a glossy sheen, (due to the almost flat outer surfaces of the epidermal cell walls), inflorescences with long bracts and short pedicels, and flowers with smooth perianth tubes and broad lobes which are always white or cream in colour.

Three entities compose this group, namely foliolosa (formerly Astroloba foliolosa (Haw.) Uitew.), congesta (formerly referred to as Astroloba congesta (Salm-Dyk) Uitew.) and robusta, a new entity recognised by the present author. The complex as a whole is referred to as the foliolosa complex, as "foliolosa" was the first of the three to be described as a species.

Their distribution has already been discussed, and the problem is now to determine their taxonomic status from a survey of the patterns of variation found in the samples made of the various populations.

APPEARANCE OF LEAFY SHOOT.

Leaf Arrangement. (See Table 25) (See Plates 15, 16 and 17.)

Early authors considered leaf arrangement to be of some importance. Haworth (1804) described Aloe foliolosa as having "the thinnest most numerous and most crowded leaves of all the aloes", while Salm Dyk (1836-1863) wrote that Aloe congesta had the leaves in a very dense spiral, "more congested than in A. foliolosa". The keys of Baker (1896) and Berger (1908) incorporated leaf arrangement in delimitation of components of the foliolosa complex, either as species or varieties.

In the introductory survey, it was shown that the entity foliolosa, taken as a whole, did indeed have the most imbricate leaves in the genus, while in the entities congesta and robusta, the spiral angle for the majority of individuals was 0 - 20°.

This pattern is not always seen in samples of individual populations.

Locality	Class range of measurements.						Total no. indiv.	Range actual measurements.
		0	10°	20°	30°	40°		$^\circ$
CONGESTA.								
N. of Cradock R31	-	1	3	1	1	-	6	9 - 33
Cradock R32	-	4	5	5	-	-	14	8 - 28
Rayners Kop R33	-	5	4	-	-	-	9	5 - 20
S. Adelaide R38,39	-	5	11	-	-	-	16	5 - 20
Dikkop Vlakte R40	-	-	2	-	-	2	4	13 - 41
Helspoort R41	-	1	1	3	2	-	7	15 - 36
Krantz Drift (Commins 2063)	-	2	1	-	-	-	3	1 - 17
FOLIOLOSA.								
Graaff Reinet R29	-	4	4	4	3	-	15	7 - 33
nr. Pearston R34	-	-	1	1	-	-	2	20 - 29
Lake Mentz R36,37	-	-	3	8	3	1	15	16 - 45
Waterford R10	-	-	-	2	1	-	3	30 - 36
Wolwefontein R11	-	-	1	2	5	1	9	18 - 45
Baroe R12	-	-	-	1	-	-	1	21
Mt. Stewart R13	-	1	-	4	3	-	8	7 - 40
Steytlerville R14	-	1	4	7	3	-	15	9 - 36
ROBUSTA.								
Steytlerville R15	-	8	9	1	-	-	18	1 - 25
nr. Miller R8,9	1	12	2	-	-	-	15	0 - 20
Klaarstroom R27	-	-	-	1	-	-	1	28
Prince Albert R64	-	6	3	-	-	-	9	2 - 15
E. of Laingsburg R1	-	-	1	-	-	-	1	19
E. of Nelspoort R28	-	1	2	3	7	-	13	6 - 40
Nr. Molteno Pass (Hall 2284.)	-	1	3	2	-	-	6	5 - 30

Class interval 10°

Table 25 VARIATION OF SPIRAL ANGLE IN FIELD SPECIMENS OF THE FOLIOLOSA COMPLEX.

The foliolosa populations sampled have over two thirds of individuals with a spiral angle of more than 20°, with the exception of those from Graaff Reinet and Steytlerville, (at the Northern and Southern known limits of distribution for this entity). In these two, a half and a third, respectively, of the samples have a spiral angle of less than 20°.

Of the congesta populations sampled, four out of seven have a third or more individuals with a spiral angle of over 20°.

In the entity robusta, the majority of individuals in the populations have a spiral angle of less than 20°, with the exception of those from East of Nelspoort and near the Molteno Pass, both near the northernmost known limits of distribution for robusta. It is of interest to note the large number of individuals of robusta with a spiral angle of $0 - 10^{\circ}$ in the samples from Steytlerville, and near Prince Albert and Miller, localities near the South Western limits of distribution of the entity foliolosa.

Angle of leaf with stem. (See Table 26)

In his type description of Aloe foliolosa, Haworth (1804) described the leaves as "horisontal". Salm Dyk (1836 - 1863) observed that the leaves of Aloe congesta were "very patent", while Hooker (1873) in his account of a new species, Aloe deltoidea, (which, as interpreted by Baker (1881) is synonymous with A. congesta), described the leaves as "quite horisontal".

In the introductory survey, it was shown that in the entity foliolosa taken as a whole, the leaves were either patent-erect or patent, while in the other entities, the majority of individuals had sub-erect leaves.

For the most part this is found to apply to samples of individual populations in the foliolosa complex. All individuals of population samples of the entity foliolosa have patent-erect or patent leaves.

In the congesta and robusta population samples, two thirds or more individuals have sub-erect leaves, with the exception in the case of the latter, of the Molteno Pass sample, where the majority of individuals have patent-erect leaves. Compared with the entity

Locality.	Class range of measurements				Total no. indiv.	Range actual measurements
	30°	50°	70°			
	Erect.	Sub Erect.	Patent Erect.	Patent		
CONGESTA.						
N. of Cradock R31	-	6	-	-	6	40 - 50
Cradock R32	1	8	5	-	14	30 - 70
Rayners Kop R33	1	7	2	-	10	30 - 60
S. of Adelaide R38,39	1	11	4	-	16	30 - 60
Dikkop Vlakte R40	-	4	-	-	4	35 - 40
Helspoort R41	-	8	3	-	11	35 - 55
Krantz Drift (Commins 2063)	-	-	3	-	3	60
FOLIOLOSA.						
Graaff Reinet R29	-	-	10	6	16	65 - 85
nr. Pearston R34	-	-	2	-	2	60 - 70
Lake Mentz R36,37	-	-	9	7	16	60 - 80
Waterford R10	-	-	2	2	4	60 - 85
Wolwefontein R11	-	-	2	8	10	60 - 85
Baroe R12	-	-	1	-	1	65
Mt. Stewart R13	-	-	5	3	8	65 - 80
Steytlerville R14	-	-	9	6	15	55 - 80
ROBUSTA.						
Steytlerville R15	1	17	-	-	18	30 - 50
nr. Miller R8,9	-	14	1	-	15	35 - 55
Klaarstroom R27	-	1	-	-	1	40
Prince Albert R64	-	8	1	-	9	40 - 55
E. of Laingsburg R1	-	1	-	-	1	50
E. of Nelspoort R28	-	12	1	-	13	35 - 55
nr. Molteno Pass (Hall 2284)	-	-	7	1	8	60 - 75

Class interval 20°

Table 26. VARIATION IN ANGLE OF LEAF WITH STEM IN FIELD SPECIMENS OF FOLIOLOSA COMPLEX.

Locality.	Class range of measurement.				Total no. indiv.
	Curving upwards.	Following angle of leaf with stem.	Curving outwards.	Curving outwards & downwards.	
CONGESTA.					
N. of Cradock R31	-	4	2	-	6
Cradock R32	1	10	3	-	14
Rayners Kop R33	2	7	1	-	10
S. of Adelaide R38,39	1	7	8	-	16
Kikkop Vlakte R40	-	2	2	-	4
Helspoort R41	1	9	1	-	11
Krantz Drift (Commins 2063)	-	1	2	-	3
FOLIOLOSA.					
Graaff Reinet R29	-	4	12	-	16
Nr. Pearston R34		-	2		2
Lake Mentz R36,37	-	2	10	4	16
Waterford R10	-	1	3	-	4
Wolwefontein R11	-	2	8	-	10
Baroe R12	-	1	-	-	1
Mt. Stewart R13	-	-	8	-	8
Steytlerville R14	-	-	11	4	15
ROBUSTA.					
Steytlerville R15	-	7	11	-	18
nr. Miller R8,9	-	3	12	-	15
Klaarstroom R27	-	-	1	-	1
Prince Albert R64	-	1	8	-	9
E. of Laingsburg R1	-	1	-	-	1
E. of Nelspoort R28	-	3	10	-	13
nr. Molteno Pass (Hall 2284)	-	-	7	1	8

Table 27. VARIATION IN CURVATURE OF LEAF APEX IN FIELD SPECIMENS OF FOLIOLOSA COMPLEX.

congesta, however, the percentage of individuals in the patent-erect class for each sample of the entity robusta is considerably less.

Curvature of leaf apices. (See Table 27)

This was not dealt with by the early authors, but illustrations of Aloe foliolosa (Ker, 1811 and Salm Dyk, 1836-1863) show a tendency for the leaf apex to curve outwards. In Salm Dyk's illustration of Aloe congesta, the leaf apices follow the angle of the leaf with the stem, while in the illustration accompanying Hooker's account of Aloe deltoidea (1873), the leaf apices tend to curve outward.

In the introductory survey, it was shown that in the foliolosa complex, in the entities foliolosa and robusta, the leaf apex curved outward in the majority of individuals, while in congesta, it followed the angle of the leaf with the stem.

This pattern is found in all populations of foliolosa and robusta, with one exception, the Steytlerville robusta sample, where in approximately half of the individuals, the leaf apex followed the angle of the leaf with the stem. In four out of seven of the congesta population samples, a third to a half of the individuals have the leaf apices curving outwards.

It is a combination of the spiral angle, the angle of the leaf with the stem and the curvature of the leaf apices, which contributes to the appearance of the leafy shoot, and on a summation of these characters, there is a slight tendency for the entity foliolosa to be distinct from the entities congesta and robusta on the character of leaves which are more frequently patent and imbricate.

DIMENSIONS AND SHAPE OF LEAVES (See Figs. 23, 25, 25A and B)

Leaf length. (See Table 28)

The introductory survey showed that the longest leaves in the complex were found in the entity congesta, and the shortest leaves in the entity foliolosa, while the entity robusta had the majority of leaves intermediate in length.

In population samples of the entity congesta, the shortest leaves are found in plants from North of Cradock and Krantz Drift,

Locality	Class range of measurements.								Total no. indiv.	Range actual measurements.
	1.5	2	2.5	3	3.5	4	4.5			cm.
CONGESTA.										
N. of Cradock R31	-	-	-	5	2	-	-	-	7	2.6 - 3.5
Cradock R32	-	-	1	4	6	4	-	-	15	2.5 - 4.0
Rayners Kop R33	-	-	-	1	4	3	1	1	10	2.9 - 4.6
S. of Adelaide R38,39	-	-	-	7	4	2	2	-	15	2.7 - 4.4
Dikkop Vlakte R41	-	-	-	-	-	1	2	2	5	3.9 - 4.7
Helspoort R40	-	-	-	-	5	4	1	-	10	3.3 - 4.4
Krantz Drift (Commins 2063)	-	1	-	1	-	-	-	-	2	2.0 - 2.8
FOLIOLOSA.										
Graaff Reinet R29	-	6	12	1	-	-	-	-	19	1.9 - 3.0
nr. Pearston R34	-	2	-	-	-	-	-	-	2	1.7 - 2.0
Lake Mentz R36,37	6	4	4	-	-	-	-	-	14	1.4 - 2.4
Waterford R10	2	4	-	-	-	-	-	-	6	1.4 - 1.9
Wolwefontein R11	-	8	3	-	-	-	-	-	11	1.7 - 2.2
Baroe R12	-	-	1	-	-	-	-	-	1	2.2
Mt. Stewart R13	-	4	4	-	-	-	-	-	8	1.7 - 2.5
Steytlerville R14	-	21	12	-	-	-	-	-	33	1.6 - 2.5
ROBUSTA.										
Steytlerville R15	-	-	7	12	1	-	-	-	20	2.1 - 3.5
nr. Miller R8,9	-	-	-	7	6	5	-	-	18	2.6 - 3.9
Klaarstroom R27	-	-	-	-	-	2	-	-	2	4.0
Prince Albert R64	-	-	-	4	5	1	-	-	10	2.6 - 3.7
SE of Laingsburg R65	-	-	4	2	-	-	-	-	6	2.4 - 3.0
E. of Laingsburg R1	-	-	-	1	-	-	-	-	1	2.7
NW Matjesfontein R56	-	-	2	1	-	-	-	-	3	2.4 - 2.8
Nelspoort R28	-	-	-	2	7	5	-	-	14	2.6 - 3.9
Ft. Molteno Pass	-	1	5	-	-	-	-	-	6	1.8 - 2.3

Class interval 0.50 c.m.

Table 28. VARIATION IN LENGTH OF LEAF IN FIELD SPECIMENS OF FOLIOLOSA COMPLEX.

while in the other populations, half or more than half of the individuals have leaves exceeding 3.0 cm. in length.

For individuals of the entity robusta there is some variation in leaf length, the shortest leaves being found in plants from the foot of Molteno Pass, (majority range 2.0 - 2.5 cm), and the longest leaves in plants from Nelspoort, (majority range 3.0 - 4.0 cm), both localities near the known northern limits of distribution for this entity.

In the entity foliolosa, the longest leaves are found in plants from Graaff Reinet near the northern known limits of distribution, while the other population samples have half, or in most cases, nearly all individuals with leaves less than 2.0 cm long. The shortest leaves are found in individuals from the Waterford - Lake Mentz area, where there is an overlap in geographic distribution with the entity robusta.

The difference in leaf length between the entities congesta and foliolosa is thus considerable and may be judged a character of some significance in the separation of the two. That the entity robusta should have leaves of an intermediate length is of interest in view of the distribution pattern of the three members of this complex.

Leaf width at widest part and length-breadth ratio. (See Tables 29 and 30)

In his type description of Aloe foliolosa, Haworth (1804) described the leaves as "very short, rounded and ovate", and Salm Dyk (1836 - 1863) in his account of Aloe congesta considered his new species to be quite distinct from A. foliolosa on the grounds of, amongst other things, "less orbiculate leaves". Baker (1896) in his key to the genus Apicra, separated A. foliolosa and A. congesta on the character of "leaves deltoid" for A. foliolosa and "leaves lanceolate-deltoid" for A. congesta.

The introductory survey showed that for the entity foliolosa, the majority range for the length-breadth ratio was 1.25 - 1.50, while for the entities congesta and robusta it was 1.50 - 2.00. In individual population samples of the entity congesta, the majority of specimens do have a length-breadth ratio 1.50 - 2.00, and this is also the case for robusta population

Locality	Class range of measurements									Total no. indiv.	Range actual measurements.
		1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75		cm.
CONGESTA.											
N. of Cradock R31	-	-	-	6	-	1	-	-	-	7	1.55 - 2.10
Cradock R32	-	-	2	8	2	3	-	-	-	15	1.40 - 2.10
Rayners Kop R33	-	-	-	-	4	5	1	-	-	10	1.85 - 2.35
S. of Adelaide R38,39	-	-	-	3	7	3	1	1	-	15	1.70 - 2.75
Dikkop Vlakte R40	-	-	-	-	-	1	2	1	1	5	2.18 - 2.80
Helspoort R41	-	-	-	3	3	2	2	-	-	10	1.65 - 2.43
Krantz Drift (Commins 2063)	-	-	1	-	1	-	-	-	-	2	1.38 - 1.91
FOLIOLOSA.											
Graaff Reinet R29	-	-	9	7	3	-	-	-	-	19	1.30 - 1.88
nr. Pearston R34	-	-	2	-	-	-	-	-	-	2	1.28 - 1.40
Lake Mentz R36,37	2	4	5	1	-	2	-	-	-	14	0.92 - 2.07
Waterford R10	1	-	4	1	-	-	-	-	-	6	1.00 - 1.56
Wolvefontein R11	-	2	7	2	-	-	-	-	-	11	1.20 - 1.57
Baroe R12	-	-	-	1	-	-	-	-	-	1	1.60
Mt. Stewart R13	-	2	5	1	-	-	-	-	-	8	1.10 - 1.60
Steytlerville R14	-	17	12	3	1	-	-	-	-	33	1.13 - 1.80
ROBUSTA.											
Steytlerville R15	-	-	7	8	5	-	-	-	-	20	1.27 - 2.00
nr. Miller R8,9	-	-	2	2	9	4	1	-	-	18	1.50 - 2.40
Klaarstroom R27	-	-	-	-	1	1	-	-	-	2	1.80 - 2.10
Prince Albert R64	-	-	2	2	5	-	1	-	-	10	1.40 - 2.40
SE of Laingsburg R65	-	-	-	1	5	-	-	-	-	6	1.70 - 1.90
E. of Laingsburg R1	-	-	1	-	-	-	-	-	-	1	1.40
NW Matjesfontein R56	-	-	2	1	-	-	-	-	-	3	1.40 - 1.55
Nelsport R28	-	-	-	5	7	2	-	-	-	14	1.55 - 2.05
Ft. Molteno Pass (Hall 2284)	-	1	5	-	-	-	-	-	-	6	1.00 - 1.50

Class interval 0.25 cm.

Table 29. VARIATION IN GREATEST WIDTH OF LEAF IN FIELD SPECIMENS OF FOLIOLOSA COMPLEX

samples, with the exception of that from S.E. of Laingsburg, where two thirds of the samples have a lower length-breadth ratio.

Of the foliolosa populations, about half of the samples from the Waterford-Lake Mentz area (which was also associated with the shortest leaves in the entity), have a length-breadth ratio of 1.00 - 1.25. For the great majority of individuals of other populations, the length-breadth ratio is 1.25 - 1.50, with the exception of samples from Mt. Stewart and Steytlerville where 50% and 42% respectively, of individuals have a length-breadth ratio of more than 1.50.

A scatter diagram (Fig. 26) of leaf length plotted against leaf width at the widest part for all three entities shows the tendency towards leaves with a lower length-breadth ratio in the entity foliolosa, but this difference between foliolosa and the entities congesta and robusta is by no means clear cut.

Position of widest part of leaf in relation to longitudinal halfway mark. (See Table 31).

In the introductory survey, it was shown that for the entity foliolosa, the majority of individuals had the widest part of the leaf 0 - 0.25 cm below the longitudinal halfway mark, while for robusta and congesta it was 0.25 - 0.50 cm below in most cases.

The above holds true for all save three plants in individual population samples of foliolosa.

In some of the congesta samples however, notably those from Krantz Drift, south of Adelaide and Cradock the widest part of the leaf is nearer the longitudinal halfway mark in a fair number of plants. This is also the case in several robusta population samples.

Mucro length. (See Table 32)

The introductory survey showed the majority range for mucro length to be 0.50 - 0.10 cm for all three entities of the foliolosa complex. There is little difference in the variation patterns for the different population samples, save that in the robusta samples from Prince Albert and S.E. of Laingsburg, the majority of individuals have a mucro length of less than 0.05 cm.

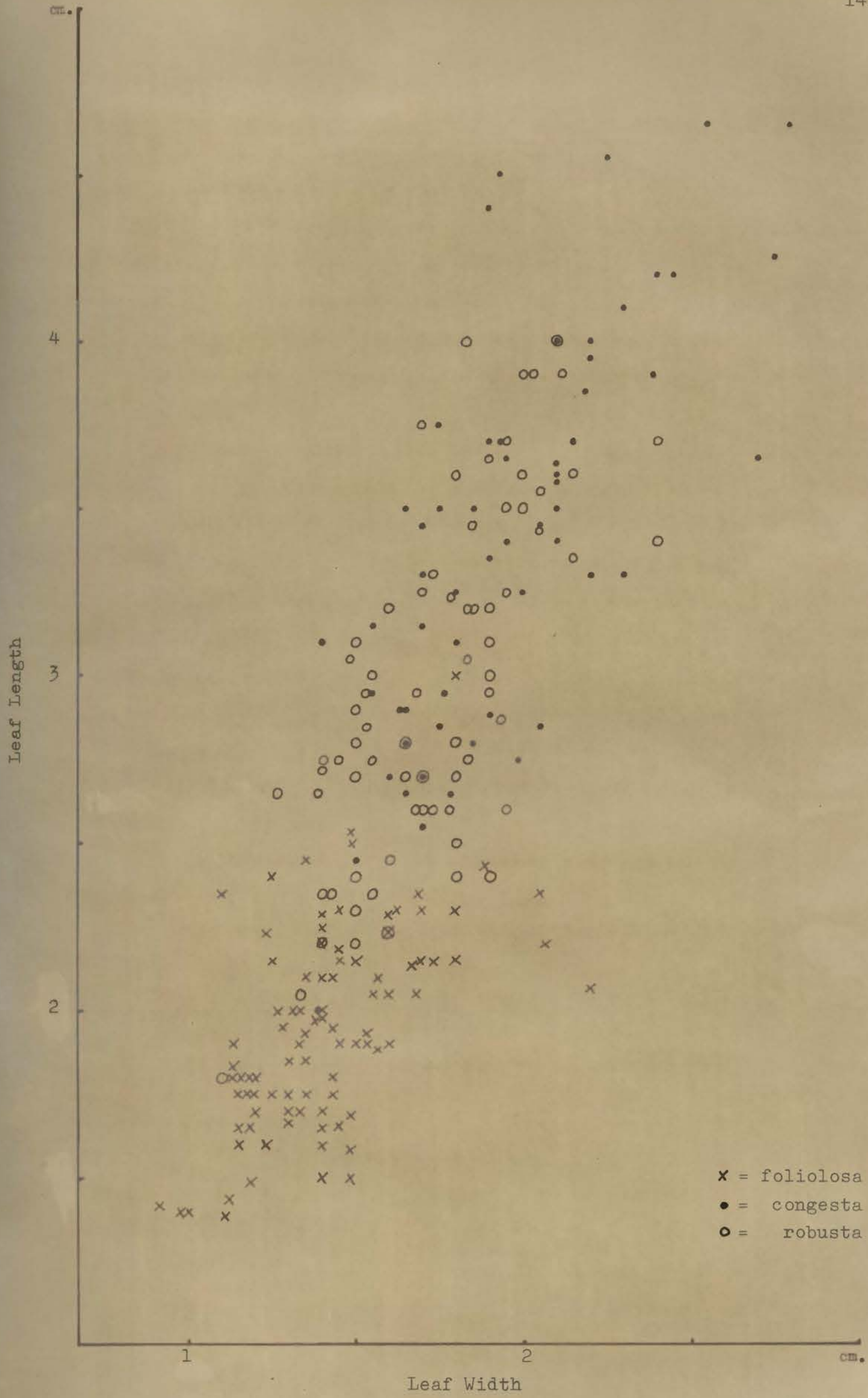


Fig.26. Variation in length and greatest width of leaf, (excluding the sheathing base) in the foliolosa complex.

Locality.	Class range of measurements.					Total no. indiv.	Range actual measurements.
	Above	Below midlength					
	0	0		.25	.50		cm.
CONGESTA.							
N. of Cradock R31	-	-	1	6	-	7	.2 - .5 bel
Cradock R32	-	-	8	7	-	7	.1 - .5 bel
Rayners Kop R33	-	-	2	7	1	10	.1 - .7 bel
S. of Adelaide R38,39	-	-	11	4	-	15	.1 - .3 bel
Dikkop Vlakte R40	-	-	-	3	2	5	.3 - .7 bel
Helspoort R41	-	-	-	8	2	10	.3 - .6 bel
Krantz Drift (Commins 2063)	1	-	1	-	-	2	.1 ab-* .2 bel
FOLIOLOSA.							
Graaff Reinet R29	-	-	18	1	-	19	.1 - .4 bel
nr. Pearston R34	-	-	2	-	-	2	.1 - .2 bel
Lake Mentz R36,37	1	7	6	-	-	14	.1 ab- .2 bel
Waterford R10	-	-	6	-	-	6	.1 - .2 Bel
Wolwefontein R11	-	4	7	-	-	11	0 - .2 bel
Baroe R12	-	1	-	-	-	1	0
Mt. Stewart R13	-	1	7	-	-	8	0 - .2 bel
Steytlerville R14	1	8	22	2	-	33	.1 ab- .3 bel
ROBUSTA.							
Steytlerville R15	-	-	8	12	-	20	.1 - .5 bel
nr. Miller R8,9	-	-	7	11	-	18	.1 - .5 bel
Klaarstroom R27	-	-	-	2	-	2	- .4 bel
Prince Albert R64	1	-	3	6	-	10	.2 ab- .5 bel
S.E. of Laingsburg R65	1	1	2	2	-	6	.1 ab- .4 bel
E. of Laingsburg R1	-	-	-	1	-	1	- .3 bel
NW. Matjesfontein R56	1	-	1	1	-	3	.1 ab- .3 bel
Nelspoort R28	-	-	1	11	2	14	.2 - .7 bel
Ft. of Molteno Pass	-	2	4	-	-	6	0 - .2 bel

Class interval 0.25 cm.

Table 30. VARIATION IN POSITION OF WIDEST PART OF LEAF IN RELATION TO MIDLENGTH OF LEAF IN FIELD SPECIMENS OF FOLIOLOSA COMPLEX.

*(ab = above the midlength, bel = below the midlength).

Locality.	Class range of measurements.						Total no. indiv.	Range actual measurements.
	1.25 1.50 1.75 2.00 2.25							
CONGESTA.								
N. of Cradock R31	-	1	3	2	1	-	7	1.50 - 2.03
Cradock R32	-	-	7	5	3	-	15	1.51 - 2.21
Rayners Kop R33	-	1	4	4	-	1	10	1.39 - 2.33
S. of Adelaide R38,39	-	4	9	2	-	-	15	1.35 - 1.81
Dikkop Vlakte R40	-	-	2	3	-	-	5	1.66 - 1.82
Helspoort R41	-	2	1	4	2	1	10	1.40 - 2.32
Krantz Drift (Commins 2063)	-	2	-	-	-	-	2	1.46
FOLIOLOSA.								
Graaff Reinet R29	-	14	5	-	-	-	19	1.25 - 1.67
nr. Pearston R34	1	-	1	-	-	-	2	1.18 - 1.53
Lake Mentz R36,37	7	6	1	-	-	-	14	1.06 - 1.55
Waterford R10	4	2	-	-	-	-	6	1.02 - 1.40
Wolwefontein R11	1	9	1	-	-	-	11	1.12 - 1.56
Baroe R12	-	1	-	-	-	-	1	1.39
Mt. Stewart R13	1	3	2	1	1	-	8	1.19 - 2.12
Steytlerville R14	3	16	12	2	-	-	33	1.18 - 1.92
ROBUSTA.								
Steytlerville R15	-	4	10	5	1	-	20	1.33 - 2.09
nr. Miller R8,9	1	2	8	6	1	-	18	1.27 - 2.07
Klaarstroom R27	-	-	-	1	1	-	2	1.91 - 2.22
Prince Albert R64	-	-	3	6	1	-	10	1.54 - 2.06
SE of Laingsburg R65	-	4	2	-	-	-	6	1.26 - 1.59
E. of Laingsburg R1	-	-	-	1	-	-	1	1.92
NW Matjesfontein R56	-	-	2	1	-	-	3	1.60 - 1.77
E. of Nelspoort R28	-	-	5	8	1	-	14	1.51 - 2.21
Ft. Molteno Pass (Hall 2284)	-	1	5	-	-	-	6	1.47 - 1.57

Class interval 0.25

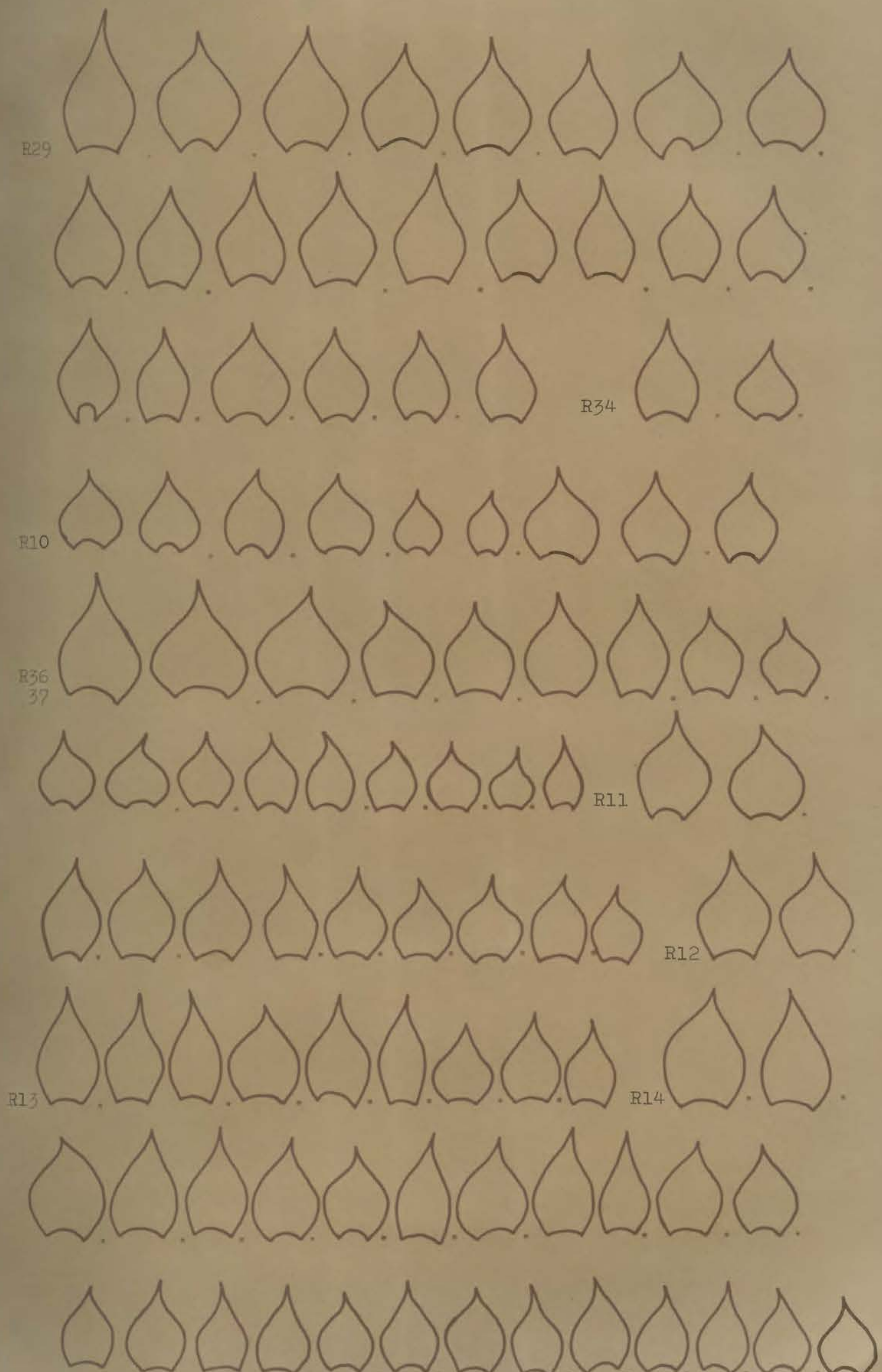
Table 31. VARIATION IN LENGTH-BREADTH RATIO IN FIELD SPECIMENS OF FOLIOLOSA COMPLEX.

Locality.	Class range of measurements.				Total no. indiv.	Range actual measurements
	.05	.10	.15			cm
CONGESTA.						
N. of Cradock R31	-	3	4	-	7	.08 - .13
Cradock R32	1	13	1	-	15	.05 - .13
Rayners Kop R33	1	8	1	-	10	.05 - .11
S. of Adelaide R38,39	1	14	-	-	15	.05 - .10
Dikkop Vlakte R40	1	1	2	-	4	.05 - .13
Helspoort R41	-	10	-	-	10	.05 - .10
Krantz Drift (Commins 2063)	1	1	-	-	2	.05 - .06
FOLIOLOSA.						
Graaff Reinet R29	-	13	6	-	19	.06 - .15
nr. Pearston R34	-	2	-	-	2	.07 - .10
Lake Mentz R36,37	2	9	3	-	14	.05 - .14
Waterford R10	2	3	1	-	6	.05 - .11
Wolwefontein R11	-	8	3	-	11	.06 - .12
Baroe R12	-	1	-	-	1	.09
Mt. Stewart R13	-	5	3	-	8	.07 - .13
Steytlerville R14	5	20	8	-	33	.04 - .12
ROBUSTA.						
Steytlerville R15	1	9	9	1	20	.05 - .18
nr. Miller R8	2	11	5	-	18	.04 - .15
Klaarstroom R27	-	2	-	-	2	.10
Prince Albert R64	8	2	-	-	10	.03 - .06
S.E. of Laingsburg R65	5	1	-	-	6	.03 - .06
E. of Laingsburg R1	1	-	-	-	1	.05
NW Matjesfontein R56	3	-	-	-	3	.05
E. of Nelspoort R28	-	5	7	2	14	.09 - .20
Ft. of Molteno Pass (Hall 2284)	1	5	-	-	6	.04 - .10

Class interval 0.05 c.m.

Table 32. VARIATION IN MUCRO LENGTH IN FIELD SPECIMENS OF FOLIOLOSA COMPLEX.

Fig.23. Variation in leaf shape in population samples of the entity foliolosa. (Only the fleshy part of the leaf base is shown. The dots indicate the number of leaves shown for each plant.)



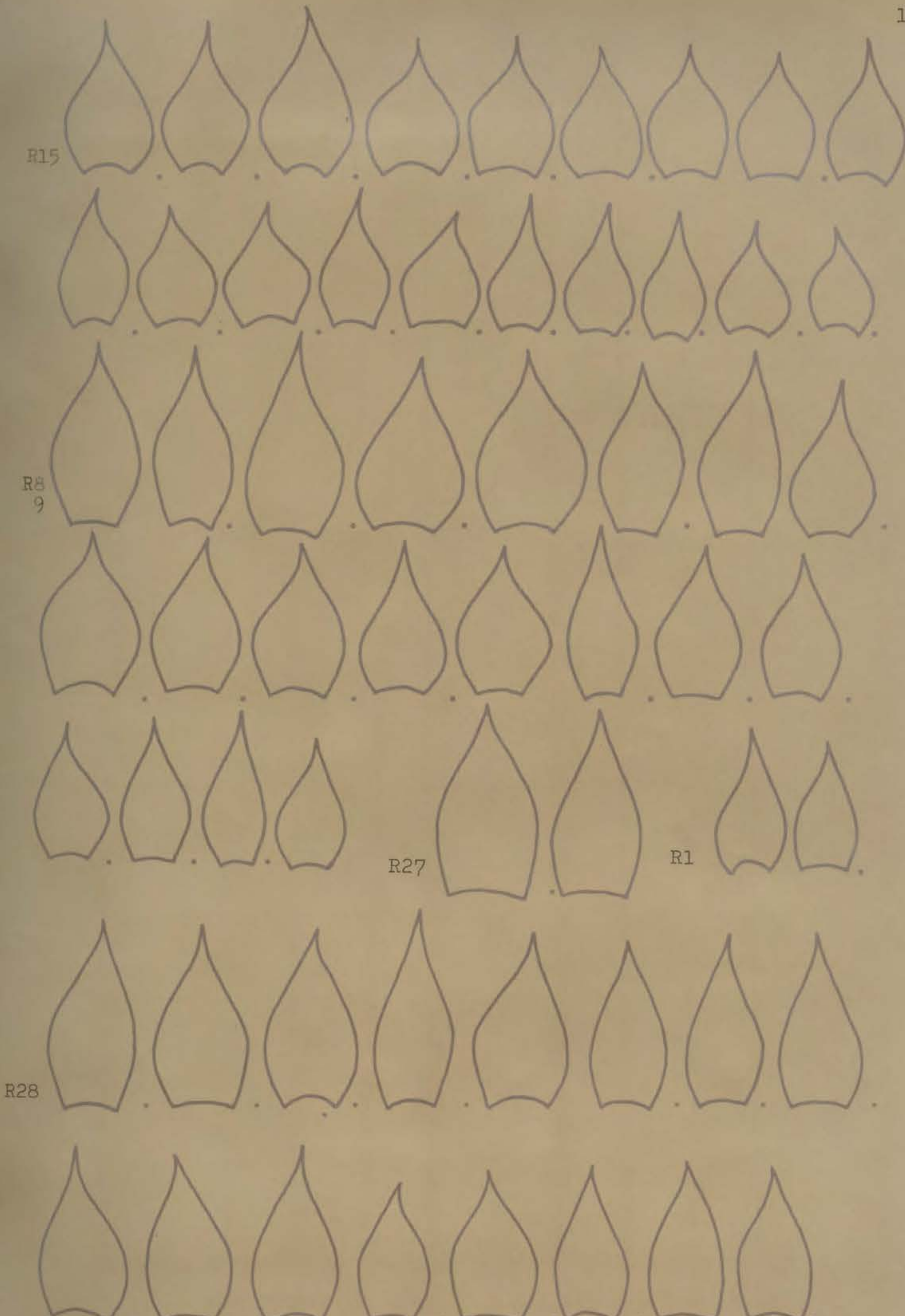


Fig.24. Variation in leaf shape in population samples of the entity <u>robusta</u>. (Only the fleshy part of the leaf base is shown. The dots indicate the number of leaves shown for each plant.)

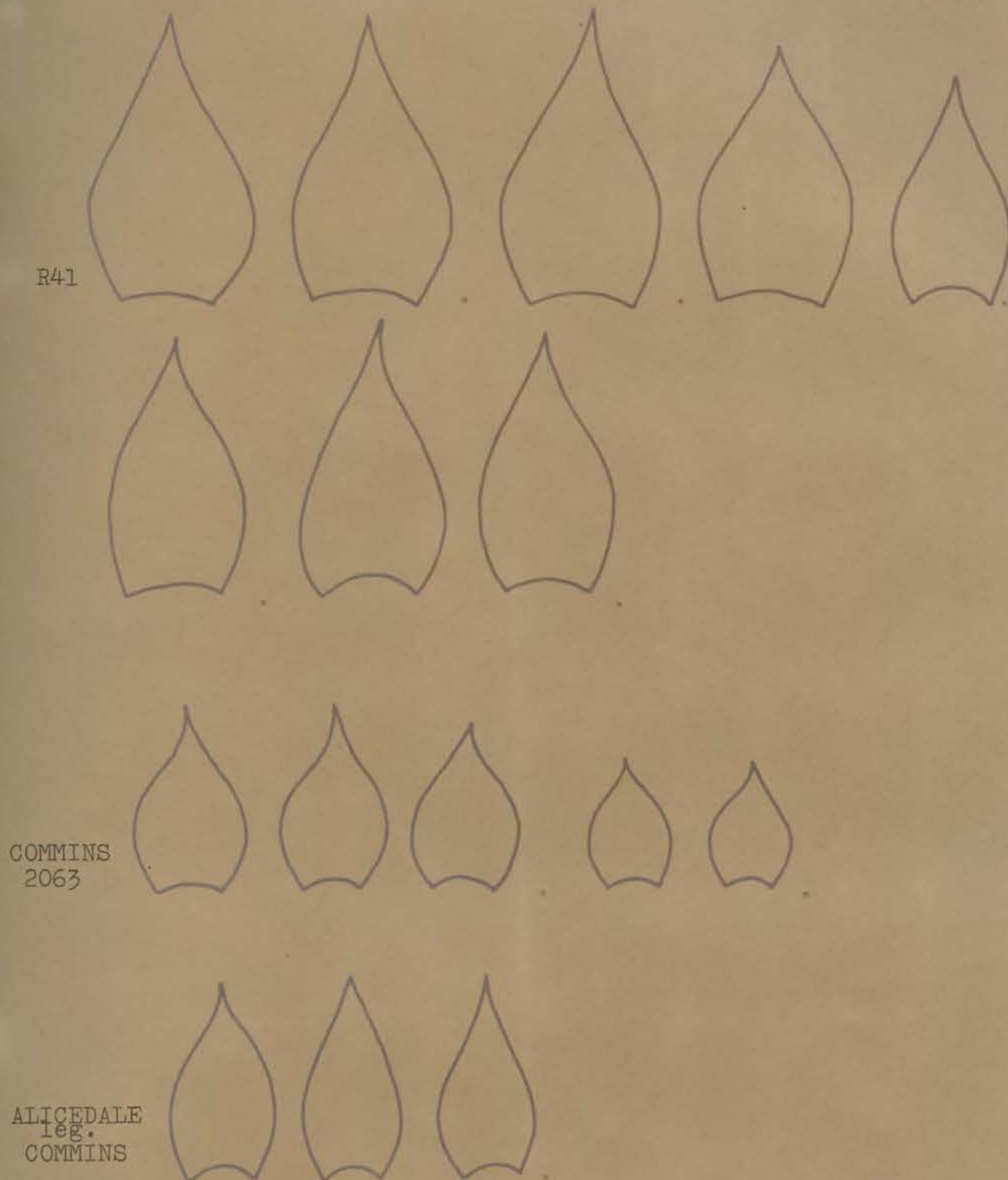


Fig.25A. Variation in leaf shape in population samples of the entity <u>congesta</u>. (Only the fleshy part of the leaf base is shown. The dots indicate the number of leaves shown for each plant.)

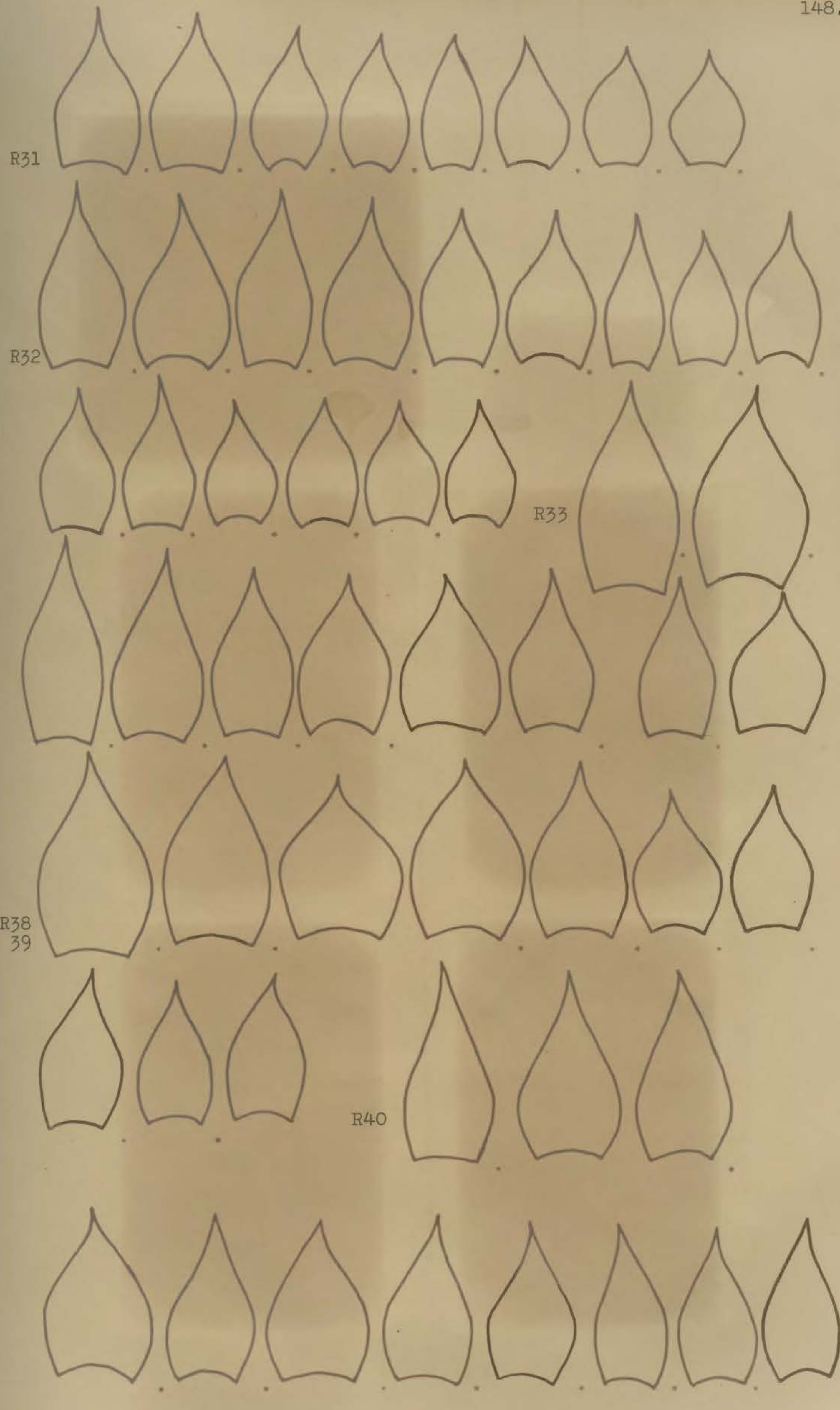


Fig. 25B. Variation in leaf shape in population samples of the entity
<u>congesta</u> cont.

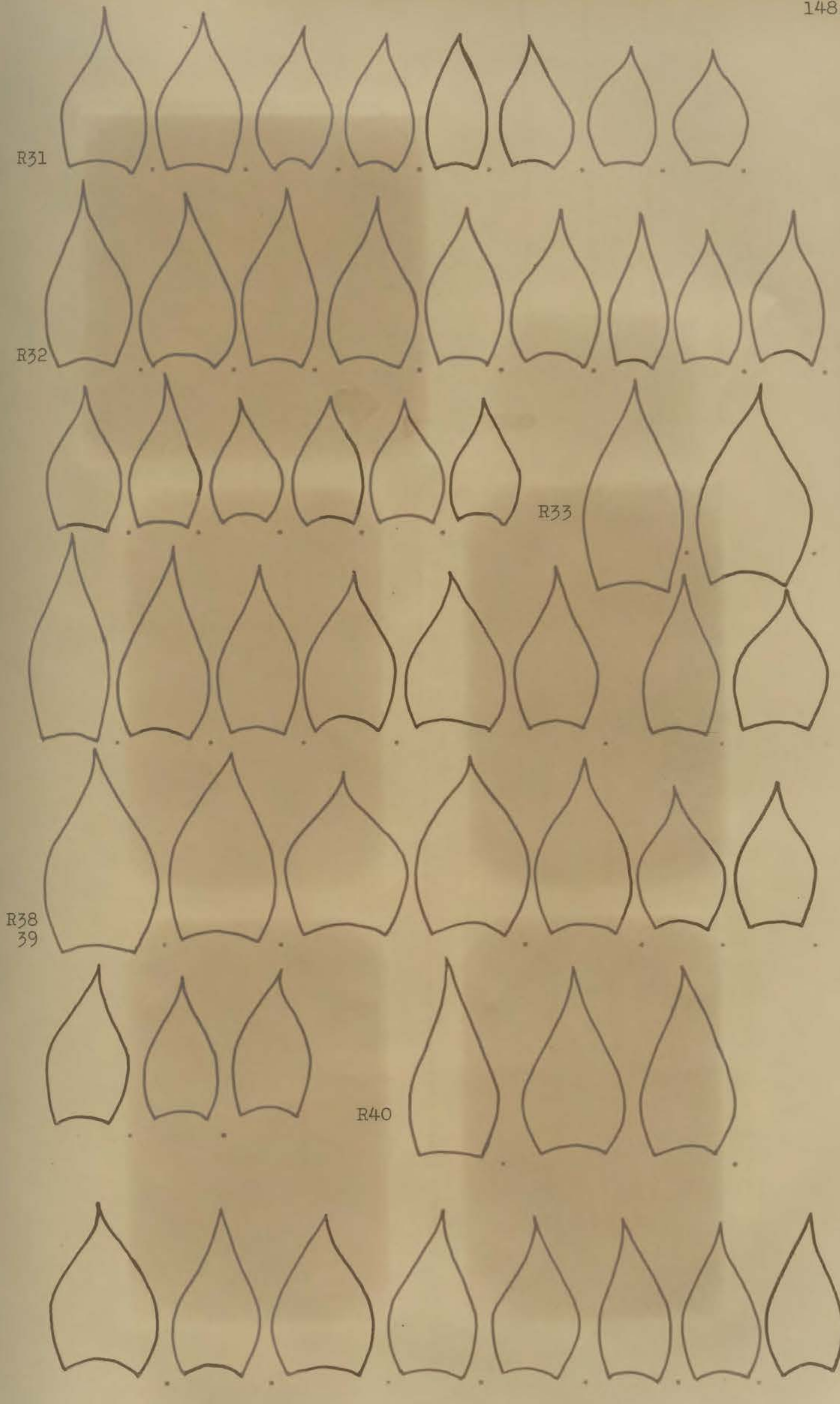


Fig. 25B. Variation in leaf shape in population samples of the entity congesta cont.

THE ENTITY ROBUSTA

Habit of a plant from Klaarstroom, R27(X $\frac{1}{3}$): thick bases of old peduncles visible.

A X $\frac{3}{4}$

B X 1

C X 1

D X $\frac{3}{4}$

Leafy shoots: leaves with maculae in A; vein lines in A, B and C; stout peduncle base in D, and whitish margins and keels in all four shoots. (Scales approximate).

PLATE 15.

THE ENTITY FOLIOLOSA

Habit of a plant from Mount Stewart R13, with very patent, imbricate leaves. (X ½).

C(X 1¼)

A(X 1¼)

D(X 1)

B(X 1)

Variation in appearance of leafy shoots: whitish margins and keels in A, prominent marginal tubercles in B, C and D.
(Scales approximate).

PLATE 16.

THE ENTITY CONGESTA.

Habit of a plant from S. of Adelaide, R38 (X ½): old peduncles are narrower at the base than those seen in the photographs of the entity robusta.

Leafy shoots (X1). Note concolorous margins and keels in both, and elongate, very slightly raised shiny patches in specimen on the left. (Scale approximate).

PLATE 17.

Summary

The entity foliolosa tends to differ from the entities congesta and robusta in that the spiral angle is more frequently greater than 30°, the leaves are always patent erect, the leaf length very rarely exceeds 2.0 cm and the length-breadth ratio is generally 1.50 cm or less. It has in common with the entity robusta a tendency for the leaf apex to curve outwards more frequently than observed in the entity congesta.

The entity robusta has greater number of individuals with leaves less than 2.5 cm long than has the entity congesta, where only 2 individuals examined had a leaf length of 2.5 cm or less.

Thus, although the differences in vegetative character between the entities foliolosa and congesta are considerable, the entity robusta, by being of an intermediate character, precludes their recognition as distinct species on the grounds of vegetative characters.

The species A. congesta and its synonyms were originally distinguished from the species A. foliolosa on vegetative characters of the short just described at some length.

LEAF ANATOMY (See Appendix Tables 5 and 6)

Unfortunately the anatomy of the leaves was investigated a considerable time after the plants were collected. As a result the number of leaves examined was small, especially in the case of the entity foliolosa, which like robusta, did not grow well under cultivation at Kirstenbosch.

In the accompanying tables, except for the entity foliolosa, the observations for each plant are, however, still listed according to locality.

Number of bundle caps per cm. from dorsal and ventral sides of leaf. (See Table 33)

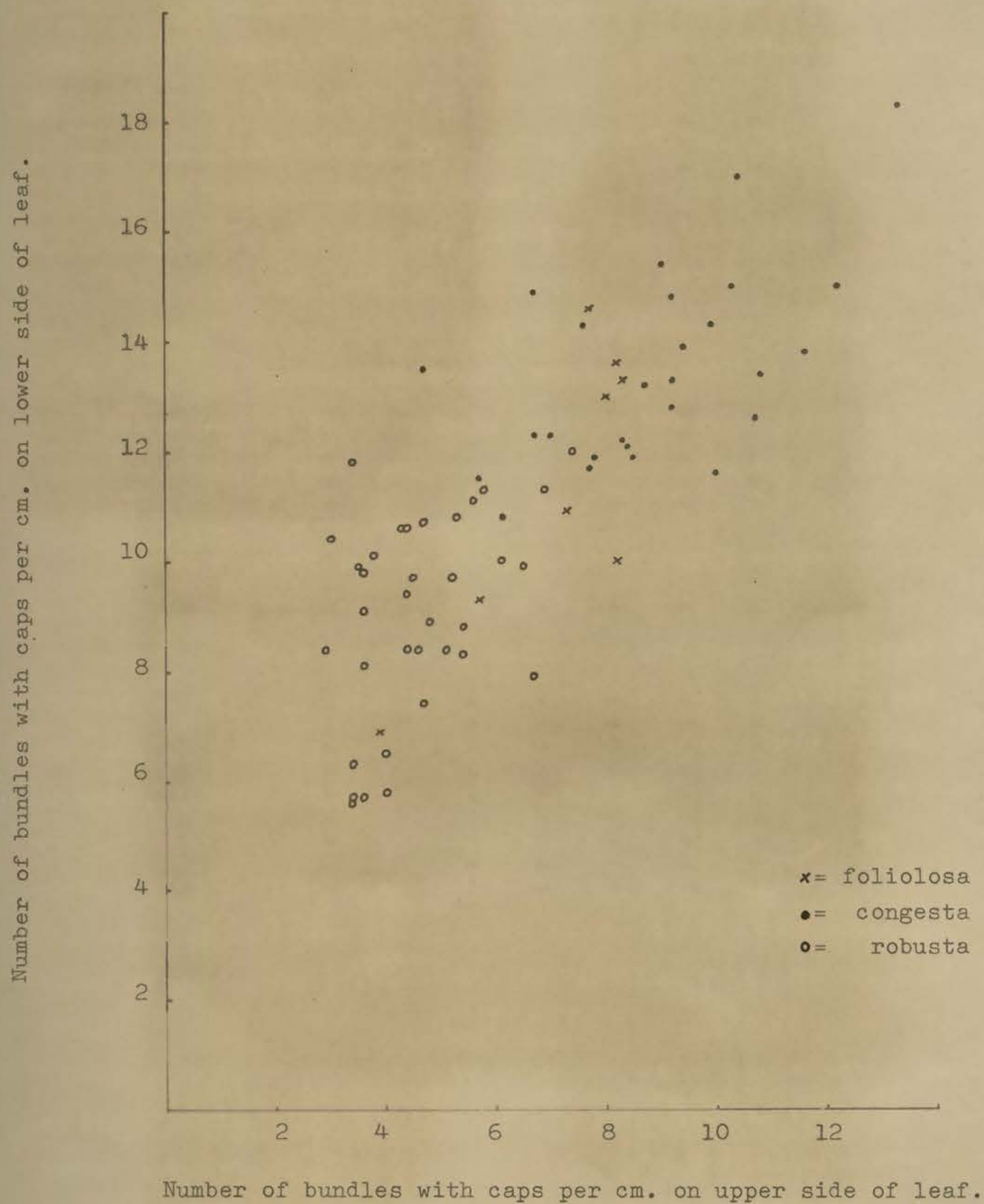
Although the samples are small, it can be seen that for the entity robusta as a whole, the number of bundles with caps per cm. on both upper and lower sides is generally less than for the entity congesta, with an intermediate number of bundle caps in the few

Locality	Class range of numbers							Total no. indiv.	Range actual values.
	FROM LOWER SIDE OF LEAF								
	3	6	9	12	15	18			Bundle caps per cm.
CONGESTA.									
Cradock R32	-	-	-	2	8	3	1	14	10.8 - 18.3
S. of Adelaide R38,39	-	-	-	4	3	-	-	7	11.5 - 14.3
Dikkop Vlakte R40	-	-	-	-	2	-	-	2	13.8 - 15.0
Helspoort R41	-	-	-	-	2	-	-	2	12.3 - 12.8
Nr. Alicedale Com.	-	-	-	-	2	-	-	2	13.4 - 12.6
FOLIOLOSA.									
Miscell. Localities	-	-	2	3	4	-	-	9	6.9 - 14.6
ROBUSTA.									
Steytlerville R15	-	-	-	5	-	-	-	5	9.9 - 11.8
nr. Miller R8	-	-	3	-	-	-	-	3	8.1 - 8.9
Klaarstroom R27	-	-	1	1	-	-	-	2	8.4 - 9.9
Prince Albert R64	-	-	4	4	-	-	-	8	7.4 - 10.7
nr. Whitehill O	-	-	2	1	-	-	-	3	6.3 - 9.1
S.E. of Lainsburg R65	-	4	1	-	-	-	-	5	5.6 - 6.5
E. of Laingsburg R1	-	-	-	1	-	-	-	1	10.1
Nelspoort R28	-	-	1	1	-	-	-	2	9.4 - 8.3
Molteno Pass Hall 2284	-	-	-	6	-	-	-	6	10.0 - 12.0
	FROM UPPER SIDE OF LEAF								
CONGESTA.									
Cradock R32	-	-	9	4	1	-	-	14	6.1 - 13.3
S. of Adelaide R38,39	-	2	2	3	-	-	-	7	4.7 - 10
Dikkop Vlakte R40	-	-	-	1	1	-	-	2	11.6 - 12.2
Helspoort R41	-	-	1	1	-	-	-	2	7.0 - 9.2
Nr. Alicedale Com.	-	-	-	2	-	-	-	2	10.7 - 10.8
FOLIOLOSA.									
Miscell. Localities	-	2	6	-	-	-	-	8	3.9 - 8.3
ROBUSTA.									
Steytlerville R15	1	4	-	-	-	-	-	5	3.0 - 5.3
nr. Miller R8	1	2	-	-	-	-	-	3	2.9 - 4.8
Klaarstroom R27	-	1	1	-	-	-	-	2	5.1 - 6.5
Prince Albert R64	-	8	-	-	-	-	-	8	3.6 - 5.4
nr. Whitehill O	-	2	1	-	-	-	-	3	3.4 - 6.7
S.e.of Laingsburg R65	-	5	-	-	-	-	-	5	3.4 - 4.0
E.of Laingsburg R1	-	1	-	-	-	-	-	1	3.8
Nelspoort R28	-	2	-	-	-	-	-	2	4.4 - 5.4
Molteno Pass Hall 2284	-	3	3	-	-	-	-	6	4.4 - 7.4

Class interval 3 bundles.

Table 33. VARIATION IN NUMBER OF BUNDLE CAPS PER CM. AS SEEN IN TRANSVERSE SECTION FROM LOWER & UPPER SIDE OF LEAF IN THE FOLIOLOSA COMPLEX.

Fig.27. Variation in number of vascular bundles with caps per cm. on upper and lower sides of leaves, (as seen in transverse section half way along the length), in the foliolosa complex.



foliolosa specimens examined. This is shown in a scatter diagram, (Fig. 27), in which the number of bundles with caps per centimetre on the lower side of the leaf is plotted against the corresponding number for the upper side.

Although the number of bundle caps from the upper and lower sides of the leaves cannot be used as a taxonomic criterion, the fact that there does tend to be a difference in bundle cap number in the entities congesta and robusta, helps to justify their recognition as distinct entities. This was not apparent in the survey of external vegetative characters.

Percentage lignification of bundle caps (See Table 34).

In the introductory survey, it was shown that in leaves sectioned a determined distance from the apex, (which depended upon leaf length), 50% of the foliolosa sample had all the bundle cap cells unlignified, and 50% had partial lignification of these cells. Of the congesta sample, 30% had all bundle cap cells unlignified, and 70% had partial lignification, while in the robusta sample all individuals had partial, but not complete lignification of the bundle cap cells.

In a second survey, the percentage lignification of all bundle caps from the ventral side of the leaf, half way along it, was estimated. This was done by estimating the percentage lignification for each bundle cap, totalling this value for all bundle caps and dividing by the actual number of bundle caps. Reference to the Appendix, Table 6, shows the differences in this value for more than one leaf from a plant to be small, with a few exceptions. The percentage lignification of each bundle cap was obtained by counting the number of cells constituting the bundle cap and expressing the number of bundle cap cells which were lignified as a percentage of this.

No attempt was made to determine the effect of water supply on lignification of bundle caps, but included in this survey were two rooted specimens of the entity foliolosa which had received very little water for over six months, and the percentage lignification of their bundle caps was 13 and 25% respectively.

Locality	Class range of measurements					Actual no. indiv.	Range actual measurements
	20	40	60	80			%
CONGESTA.							
Cradock R32	1	2	1	3	5	12	6 - 97
S. of Adelaide R38,39	2	1	2	2	-	7	1 - 77
Dikkop Vlakte R40	1	1	-	-	1	3	0 - 94
Helspoort R41	-	-	-	2	2	4	77 - 88
Nr. Alicedale (Commins 2063)	1	-	1	-	1	3	14 - 90
FOLIOLOSA.							
Miscell. Localities	5	2	1	2	-	10	0 - 75
ROBUSTA.							
Steytlerville R15	2	-	1	2	2	7	4 - 94
Miller R8	-	-	-	-	5	5	82 - 100
Klaarstroom R27	-	-	-	1	1	2	78 - 86
Prince Albert R64	-	-	-	-	8	8	87 - 100
SE of Laingsburg R65	-	-	-	3	-	3	69 - 79
Whitehill R57	-	-	-	1	1	2	77 - 90
Molteno Pass (Hall 2284)	-	-	-	1	4	5	76 - 93

Class interval 20%

Table 34 PERCENTAGE LIGNIFICATION OF BUNDLE CAPS HALF WAY ALONG LEAF FROM VENTRAL SIDE OF LEAF IN FOLIOLOSA COMPLEX.

From Table 34 it can be seen that there is a noticeable tendency for the entity robusta to differ from the entities congesta and foliolosa in the larger number of individuals with a greater percentage lignification of the bundle caps. Again, although this distinction is by no means absolute, it is indicative of a difference between the entity robusta and the other two entities.

Area of largest bundle cap in transverse section from ventral side of leaf. (See Table 35)

The size of the bundle caps also tends to vary in the three entities, and this is represented by measuring the area of the largest bundle cap from the ventral side as seen in transverse section halfway along the leaf. This area was calculated very approximately by multiplying together the widths of the bundle cap at right angles and parallel to the epidermis.

The smallest bundle caps are found in the small foliolosa sample, the largest in the entity robusta, with bundle caps of the entity congesta intermediate in size. Apart from the Molteno Pass robusta sample the overlap of bundle cap size in the entities congesta and robusta is very slight.

Size of bundle caps is thus another anatomical character indicative of a difference between the entities congesta and robusta.

Thickness of fibre-sclereidwall from largest bundle cap of ventral side of leaf. (See Table 36).

With the variation in the percentage lignification of the bundle cap cells, there is a variation in the thickness of the fibre-sclereid walls as seen in transverse section. These measurements were taken from the bundle caps for which the areas were calculated.

The thickest sclereid walls are also found in the entity robusta, and again, apart from the Molteno Pass robusta sample, the overlap of the robusta measurements with those of the two other entities is slight.

A scatter diagram, (Fig. 28), of the area of the largest bundle cap from the ventral side of the leaf, taken halfway along the leaf, plotted against the thickness of its thickest sclereid wall does tend to separate the entity robusta from the entities

Locality	Class range of measurements									Total no. indiv.	Range actual measurements
	1	2	3	4	5	6	7	8			sq. micrometer units.
CONGESTA.											
Cradock R32	2	9	-	-	-	-	-	-	-	11	1.0 - 1.9
S. of Adelaide R38, 39	3	4	-	-	-	-	-	-	-	7	0.9 - 1.3
Dikkop Vlakte R40	-	2	1	-	-	-	-	-	-	3	1.8 - 2.3
Helspoort R41	-	3	1	-	-	-	-	-	-	4	1.2 - 2.4
Nr. Alicedale Commins	2	1	-	-	-	-	-	-	-	3	1.0 - 1.8
FOLIOLOSA.											
Miscell. Localities	9	1	-	-	-	-	-	-	-	10	0.6 - 1.1
ROBUSTA.											
Steytlerville R15	-	-	3	1	1	2	-	-	-	7	2.6 - 6.0
Miller R8	-	-	1	-	1	-	-	2	1	5	3.0 - 8.6
Klaarstroom R27	-	-	-	-	-	-	1	1	-	2	6.4 - 7.2
Prince Albert R64	-	1	-	1	2	2	1	1	-	8	1.7 - 7.7
S.E. Laingsburg R65	-	-	3	-	-	-	-	-	-	3	2.2 - 2.9
Whitehall R57	-	-	-	1	-	-	1	-	-	2	3.2 - 7.0
Molteno Pass (Hall 2284)	1	4	-	-	-	-	-	-	-	5	0.9 - 1.8

Class interval 1 sq. unit
(1 unit = 130 μ)

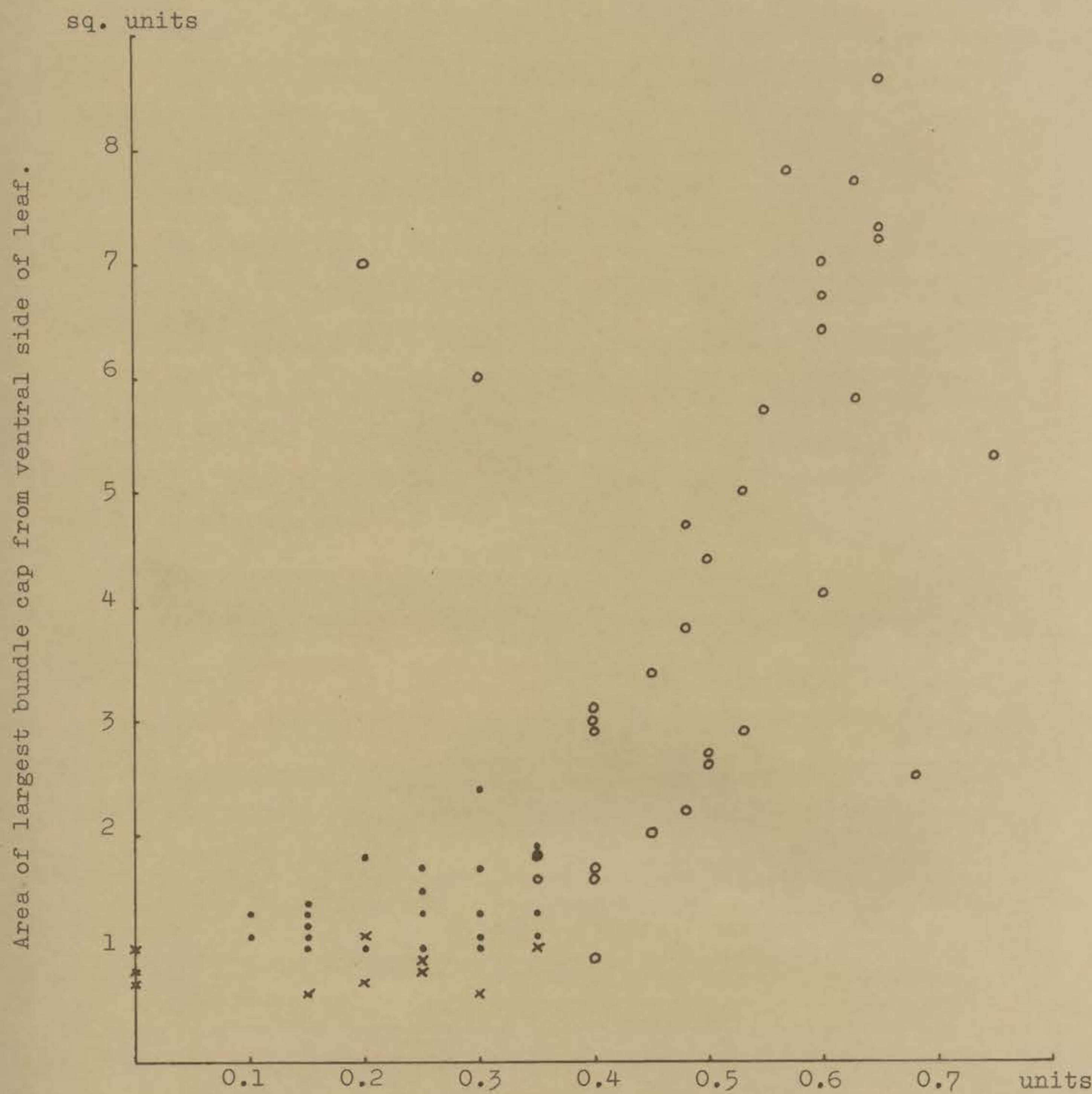
Table 35 AREA IN SQ. UNITS OF LARGEST BUNDLE CAP FROM UNDERSIDE OF LEAF IN FOLIOLOSA COMPLEX.

Locality	Class range of measurements.								Total no. indiv.	Range actual measurements.
		.1	.2	.3	.4	.5	.6	.7		
CONGESTA.										
Cradock R32	-	2	6	4	-	-	-	-	12	.15 - .35
S. of Adelaide R38,39	2	4	1	-	-	-	-	-	7	.10 - .25
Dikkop Vlakte R40	-	1	-	1	-	-	-	-	2	.20 - .35
Helspoort R41	-	-	3	1	-	-	-	-	4	.25 - .35
Nr. Alicedale (Commins 2063)	-	1	2	-	-	-	-	-	3	.20 - .30
FOLIOLOSA.										
Miscell. Localities.	-	3	2	2	-	-	-	-	7	.15 - .35
ROBUSTA.										
Steytlerville R15	-	-	1	1	4	-	-	1	7	.30 - .75
Miller R8	-	-	-	1	-	2	2	-	5	.40 - .65
Klaarstroom R27	-	-	-	-	-	1	1	-	2	.60 - .65
Prince Albert R64	-	-	-	1	2	3	2	-	8	.40 - .63
S.E. of Laingsburg R65	-	-	-	-	1	1	1	-	3	.48 - .68
Whitehill R57	-	1	-	1	-	-	-	-	2	.20 - .40
Molteno Pass (Hall 2284)	-	-	-	4	1	-	-	-	5	.35 - .40

Class interval 0.1 unit
(1 unit = 35μ)

Table 36 THICKNESS, MEASURED IN MICROMETER UNITS OF SCLEREID WALL FROM LARGEST BUNDLE CAP FROM UNDERSIDE OF LEAF IN FOLIOLOSA COMPLEX.

Fig.28. Variation in area of largest bundle cap and thickness of thickest sclereid wall from same cap from ventral side of leaf, (as seen in transverse section halfway along the leaf length), in the foliolosa complex. (1 unit =



Thickness of thickest sclereid wall from largest bundle cap of ventral side of leaf.

(x = foliolosa, • = congesta, o = robusta) foliolosa and congesta, but this separation is not complete.

Summary

Thus it can be seen that, bearing in mind the small size of some of the samples, the entity robusta tends to differ from the congesta and foliolosa on the grounds of fewer bundle caps per leaf, and greater size and degree of lignification of these caps. As in the case of the vegetative characters, however, these differences are not absolute. As has been mentioned earlier, the bundle cap cells may show up externally as faint dark lines, and this is more frequently the case in the entity robusta than in the other two entities.

LEAF COLOUR AND ORNAMENTATION.

A note on the dimensions of the tubercles of the margins and keels is included. In Table 37, the whole range of measurements is included in the class allocations. For example, if the height of the tubercles of one leaf ranged from 0.05 mm to 0.30 mm, then a point would be allocated to each of the three classes: <0.10 mm, 0.10 - 0.20 mm and 0.20 - 0.30 mm.

Height of tubercles of margins and keels (See Table 37)

In the samples for all three entities, the majority of specimens have tubercles less than 0.10 mm in height. It is of interest to note, however, that only 8% and 7% respectively of the congesta and robusta samples have tubercles more than 0.10 mm high, while 38% of the foliolosa sample have tubercles 0.10 - 0.20 mm high. This is particularly noticeable in foliolosa populations from Steytlerville, Mt. Stewart and the Waterford-Lake Mentz area.

Diameter of tubercles of margins and keels. (See Table 37)

The broadest tubercles tend to be found in the entity foliolosa. The entity congesta has 19% of the sample with tubercles less than 0.10 mm in diameter, while only 8% and 3% respectively of the robusta and foliolosa samples have tubercles less than 0.10 mm wide.

Leaf colour and ornamentation of ventral side of leaf. (See Table 38)

This was dealt with in the introductory survey of the genus as a whole, but a table showing variations in these characters

Locality.	Class range of measurements.					Total no. indiv.	Range actual measurements.
	DIAMETER OF TUBERCLES.						
	.1	.2	.3	.4			mm.
CONGESTA.							
N. of Cradock R31	2	7	4	-	-	13	.05 - .25
Cradock R32	3	9	7	-	-	19	.10 - .30
Rayners Kop R33	-	4	8	-	-	12	.20 - .25
S. of Adelaide R38,39	7	8	2	-	-	17	.10 - .25
Dikkop Vlakte R40	2	5	2	-	-	9	.10 - .25
Helspoort R41	4	9	7	-	-	20	.10 - .25
Krantz Drift (Commins 2063)	-	2	1	-	-	3	.15 - .25
FOLIOLOSA.							
Graaff Reinet R29	-	5	15	2	1	23	.15 - .45
Pearston R34	-	-	2	-	-	2	.25 - .30
Lake Mentz R36,37	-	6	12	-	-	18	.15 - .30
Waterford R10	1	6	7	1	-	15	.10 - .35
Wolwefontein R11	-	6	9	-	-	15	.15 - .30
Baroe R12	1	1	1	-	-	3	.10 - .25
Mt. Stewart R13	-	5	6	-	-	11	.15 - .30
Steytlerville R14	1	9	14	-	-	24	.15 - .30
ROBUSTA.							
Steytlerville R15	1	16	17	-	-	34	.10 - .30
Miller R8,9	1	6	5	-	-	12	.10 - .30
Klaarstroom R27	-	1	2	-	-	3	.20 - .25
E. of Laingsburg R1	-	1	-	-	-	1	.20
Nelspoort R28	4	11	13	1	-	28	.10 - .35
	HEIGHT OF TUBERCLES.						
CONGESTA.							
N. of Cradock R31	7	1	-	-	-	8	.03 - .15
Cradock R32	15	2	-	-	-	17	.04 - .15
Rayners Kop R33	10	-	-	-	-	10	.04 - .10
S. of Adelaide R38,39	13	1	-	-	-	14	.04 - .15
Dikkop Vlakte R40	5	-	-	-	-	5	.05 - .08
Helspoort R41	10	-	-	-	-	10	.02 - .10
Krantz Drift (Commins 2063)	2	1	-	-	-	3	.05 - .13
FOLIOLOSA.							
Graaff Reinet R29	14	3	-	-	-	17	.05 - .15
Pearston R34	2	1	-	-	-	3	.05 - .13
Lake Mentz R36,37	10	7	-	-	-	17	.05 - .20
Waterford R10	4	4	1	-	-	9	.06 - .25
Wolwefontein R11	9	3	-	-	-	12	.05 - .15
Baroe R12	1	1	-	-	-	2	.08 - .13
Mt. Stewart R13	5	4	-	-	-	9	.08 - .15
Steytlerville R14	12	8	-	-	-	20	.05 - .15
ROBUSTA.							
Steytlerville R15	19	3	-	-	-	22	.03 - .15
Miller R8,9	14	1	-	-	-	15	.02 - .15
Klaarstroom R27	2	-	-	-	-	2	.05
E. of Laingsburg R1	1	-	-	-	-	1	.05
Nelspoort R28	16	-	-	-	-	16	.03 - .10

Class interval 0.10 mm.

Table 37 VARIATION IN DIMENSIONS OF TUBERCLES OF MARGINS AND KEELS IN FOLIOLOSA COMPLEX.

Locality	Total no. indiv.	Leaves with a greyish tone.	Margins + keels concolorous.	Margins + keels paler.	Margins + keels whitish.	Darker bundle cap lines on undersurface of leaf.	Leaves with whitish flat or slightly raised flecks on underside.	Leaves with longit. elongated slightly raised patches on underside.
		no. indivs.	no. indivs.	no. indivs.	no. indivs.	no. indivs.	no. indivs,	no. indivs.
CONGESTA.								
N. of Cradock R31	7	-	3	4	-	-	-	-
Cradock R32	15	-	10	2	2	2	-	2
Rayners Kop R33	10	-	9	1	-	2	-	2
S. of Adelaide R38,39	14	-	11	2	1	5	-	3
Dikkop Vlakte R40	5	-	4	1	-	4	-	4
Helspoort R41	10	-	9	1	-	2	-	2
Krantz Drift (Commins 2063)	2	-	1	1	-	-	-	-
FOLIOLOSA.								
Graaff Reinet R29	15	-	5	7	3	-	-	-
nr. Pearston R34	2	-	-	1	1	1	-	-
Lake Mentz R36,37	10	-	4	3	3	-	-	-
Waterford R10	6	-	2	3	1	1	-	1
Wolwefontein R11	7	-	-	7	-	-	-	-
Mt. Stewart R13	8	-	5	2	1	-	-	-
Steytlerville	31	-	8	20	3	5	-	-
ROBUSTA.								
Steytlerville R15	20	6	-	3	17	10	13	1
nr. Miller R8,9	14	5	-	4	10	7	4	1
Klaarstroom R27	3	3	-	-	3	3	-	-
Prince Albert R64	6	4	-	2	4	6	2	-
S.E. Laingsburg R65	6	6	-	-	6	6	-	-
E. of Laingsburg R1	1	1	-	1	-	1	1	-
Nelspoort R28	14	7	3	3	8	7	-	-
Molteno Pass (Hall 2284)	6	4	-	3	3	2	-	-

Table 38 VARIATION IN COLOUR AND ORNAMENTATION OF LEAVES IN FIELD SPECIMENS OF FOLIOLOSA COMPLEX.

in the different populations is included here.

Noteworthy characteristics are the greyish overtones to the leaves found throughout populations of the entity robusta, which together with a tendency for most of the individuals to have whitish margins and keels, helps in the recognition of populations of this entity in the field. Also, darker bundle cap lines are found in more individuals of the entity robusta than in the other two entities.

The fact that some individuals of the entity congesta have slightly raised, elongated concolourous patches on the ventral side of some leaves, and some plants of the entity robusta have whitish flecks, which may be very slightly raised, has already been mentioned.

Summary

It can be seen that leaf ornamentation and colour, although showing variations in the different entities, are not characters which can be used as taxonomic criteria, although they may aid in identification of field populations.

INFLORESCENCE CHARACTERS (See Plate 18.)

Measurements made of herbarium specimens, where the shrinkage due to dessication is not critical, are included in this part of the survey, and they are given in separate tables, also according to locality.

Length of peduncle and raceme. (See Tables 39 and 40)

In the introductory survey of the genus as a whole, the shortest peduncles were found to occur in the entity robusta, the length of these being 5 - 15 cm. in the majority of cases. In the entity foliolosa, taken as a whole, the majority of specimens had peduncles 10 - 20 cm. long, while the longest peduncles were found in the entity congesta, with 15 - 25 cm. the length for most individuals.

Individual field population samples conform to this pattern. In the congesta populations it is of interest to note that the peduncles of the southern populations, from Dikkop Vlakte and Helspoort tend to be shorter than the peduncles of the northern populations, from Cradock and South of Adelaide. In the robusta

Locality.	Class range of measurements.							Total no. indiv.	Range actual measurements.
		5	10	15	20	25	30		cm.
				FIELD SPECIMENS.					
CONGESTA.									
Cradock R32	-	-	-	3	5	6	-	14	16 - 30
S. Adelaide R38,39	-	-	-	8	14	6	1	29	16.-31
Dikkop Vlakte R40	-	-	2	4	1	-	-	7	14 - 25
Helspoort R41	-	1	3	7	3	-	-	14	6 - 23
FOLIOLOSA.									
Graaff Reinet R60	-	1	9	14	7	-	-	31	9 - 23
Mt. Stewart R52a	-	-	2	1	-	-	-	3	15 - 19
Baroe R12	-	-	-	1	-	-	-	1	18
Wolwefontein R11	-	-	-	1	-	1	-	2	19 - 28
Springbok Vlakte Nbg	-	-	1	1	-	-	-	2	14 - 17
Steytlerville R52b	-	-	8	6	3	-	-	17	11 - 23
ROBUSTA.									
Steyterville R43	2	10	3	-	-	-	-	15	5 - 14
Miller R45	-	6	1	-	-	-	-	7	6 - 11
Prince Albert R64	-	2	15	6	1	-	-	24	10 - 21
E. Laingsburg R1	-	-	2	-	-	-	-	2	13 - 14
Whitehill O	-	1	5	3	-	-	-	9	10 - 18
E. Nelspoort R42	-	2	6	2	1	-	-	11	8 - 22
Molteno Pass H2284	-	4	7	3	-	-	-	14	7 - 16
				HERBARIUM SPECIMENS.					
CONGESTA.									
Cradock	-	1	-	-	-	-	-	1	9
Rayners Kop	-	-	-	1	-	-	-	1	17
Mortimer	-	-	-	-	1	-	-	1	22
Helspoort	-	-	1	2	1	-	-	4	12 - 21
Alicedale	-	-	-	-	1	-	-	1	22
Brakkloof	-	-	-	1	-	-	-	1	18
FOLIOLOSA.									
Addo Bush	-	-	1	-	-	-	-	1	14
Koega Kammas Kloof	-	-	-	1	-	-	-	1	20
Swartkops Sundays	-	-	-	1	-	-	-	1	16
Kleinpoort	-	-	-	2	1	-	-	3	18 - 21
Steytlerville	-	1	-	-	-	-	-	1	10
Waterford	-	-	1	1	-	-	-	2	13 - 20
Kruidfontein	-	-	-	1	-	-	-	1	18
Graaff Reinet	-	-	2	-	-	-	-	2	13 - 14
E. Laingsburg (?)	-	1	-	-	-	-	-	1	10
ROBUSTA.									
Lake Mentz.	-	1	-	-	-	-	-	1	9
Mt. Stewart	-	2	-	-	-	-	-	2	10
Steytlerville	-	2	-	-	-	-	-	2	6 - 9
Miller	-	-	1	-	-	-	-	1	12
Willowmore	-	1	-	-	-	-	-	1	9
Prince Albert	-	-	1	-	-	-	-	1	12
Whitehill	-	2	1	-	-	-	-	3	8 - 15
Matjesfontein	-	-	1	-	-	-	-	1	15
Beaufort West	-	1	1	1	-	-	-	3	10 - 16

Class Interval 5.0 cm.

Table 39 VARIATION IN LENGTH OF PEDUNCLE IN FOLIOLOSA COMPLEX.

Locality	Class range of measurements.							Total no. Indiv.	Range actual measurements.
		5	10	15	20	25	30		cm.
FIELD SPECIMENS.									
CONGESTA.									
Cradock R32	-	-	4	8	1	-	-	15	12 - 25
S. Adelaide R38,39	-	1	10	10	6	-	-	27	10 - 25
Dikkop Vlakte R40	-	-	4	2	-	-	-	6	11 - 20
Helspoort R41	-	-	9	4	-	-	-	13	12 - 19
FOLIOLOSA.									
Graaff Reinet R60	-	3	12	12	1	-	-	28	12 - 19
Mt. Stewart R52b	-	2	-	-	-	-	-	2	6 - 8
Wolwefontain R11	-	-	2	1	-	-	-	3	12 - 17
Steytlerville R52a	-	1	7	1	-	-	-	9	10 - 18
ROBUSTA.									
Steytlerville R43	-	7	7	1	1	-	-	15	6 - 21
Miller R45	-	2	5	-	-	-	-	7	5 - 13
Prince Albert R64	1	4	14	4	-	2	1	26	5 - 33
E. Laingsburg R1	0	-	2	-	-	-	-	2	11 - 13
Whitehill O	-	1	1	6	1	-	-	9	10 - 23
E. Nelspoort R42	-	4	3	4	-	-	-	11	8 - 20
Molteno Pass H2284	-	5	8	1	-	-	-	14	
HERBARIUM SPECIMENS.									
CONGESTA.									
Cradock	-	1	-	-	-	-	-	1	8
Rayners Kop	-	-	1	-	-	-	-	1	11
Mortimer	-	-	-	1	-	-	-	1	18
Helspoort	-	-	3	-	-	-	-	3	12 - 15
Alicedale	-	-	-	1	-	-	-	1	20
Brakkloof	-	-	-	1	-	-	-	1	18
FOLIOLOSA.									
Kleinpoort	-	-	1	2	-	-	-	3	12 - 19
Steytlerville	-	-	1	-	-	-	-	1	11
Waterford	-	-	1	-	-	-	-	1	12
Graaff Reinet	-	-	1	-	-	-	-	1	11
E. Laingsburg (?)	-	-	1	-	-	-	-	1	12
ROBUSTA.									
Lake Mentz	-	-	1	-	-	-	-	1	11
Mt. Stewart	-	2	-	-	-	-	-	2	8 - 10
Steytlerville	-	1	-	-	-	-	-	1	9
Miller	-	-	1	-	-	-	-	1	15
Willowmore	-	-	1	-	-	-	-	1	11
Prince Albert	-	-	-	-	1	-	-	1	
Whitehill	-	2	1	-	-	-	-	3	7 - 11
Matjesfontein	-	1	-	-	-	-	-	11	9
Beaufort West	-	1	1	1	-	-	-	3	8 - 17

Class Interval 5 cm.

Table 40. VARIATION IN LENGTH OF RACEME IN FOLIOLOSA COMPLEX.

populations, those in the eastern part of the distribution range, from Steytlerville and Miller, tend to have the shortest peduncles.

In the introductory survey, it was seen that, although both the entities <u>foliolosa</u> and <u>robusta</u> had the majority of specimens with racemes 10 - 15 cm. long, only 12% of the <u>foliolosa</u> sample, compared with 30% of the <u>robusta</u> sample, had racemes of 10 cm. or less in length. The longest racemes were found in the entity <u>congesta</u>, where 10 - 20 cm. was the length in most cases. In individual field populations, there are no marked differences in raceme length which might be correlated with distribution.

Thus, although peduncle and raceme length cannot be considered significant taxonomic characters, the differences in peduncle and raceme length in the entities <u>robusta</u> and <u>congesta</u> may be considered as a further indication of a difference between them, while the lengths of the peduncle and raceme in the entity <u>foliolosa</u> are of an intermediate nature.

<u>Number of sterile bracts</u> (See Table 41)

It can be seen that this character varies between different populations of the same entity, and, apart from the slightly greater number of <u>congesta</u> specimens with fewer bracts per peduncle, is not indicative of any difference between the three entities.

<u>Branching of inflorescence</u> (See Table 42)

The introductory survey showed that the greatest number of branched inflorescences were found in the entity <u>congesta</u>, where 33% of the total sample had branched inflorescences, and 41% had one or more unexpanded raceme buds in the axils of the sterile bracts. In the entity <u>foliolosa</u>, taken as a whole, 6% of individuals had branched inflorescences, and 3% undeveloped raceme buds. No plants of the entity <u>robusta</u> had branched peduncles, but 8% had unexpanded raceme buds.

In field populations of the entity <u>congesta</u>, the greatest number of branched inflorescences is found in the Southern populations from Helspoort and Dikkop Vlakte, where over half the samples have branched inflorescences, and the rest unexpanded raceme buds in the sterile bract axils.

Locality.	Class Range of measurement.					Total no. indiv.	Range actual number.
	2	4	6	8			
FIELD SPECIMENS.							
CONGESTA.							
Cradock R32	-	-	12	2	-	14	5 - 7
S. Adelaide R38,39	11	13	5	1	-	30	2 - 7
Dikkop Vlakte R40	3	4	-	-	-	7	2 - 3
Helspoort R41	3	8	3	-	-	14	2 - 5
FOLIOLOSA.							
Graaff Reinet R60	-	13	15	3	-	31	3 - 7
Mt. Stewart R52b	-	1	-	1	-	2	4 - 8
Baroe R12	1	-	-	-	-	1	2
Wolwefontein R11	-	-	2	-	-	2	5 - 6
Springbok Vlakte Nbg	-	-	1	1	-	2	5 - 7
Steytlerville R52a	-	5	9	2	1	17	3 - 10
ROBUSTA.							
Steytlerville R43	1	4	7	3	-	15	2 - 7
Miller R45	-	1	6	-	-	7	4 - 5
Prince Albert	-	10	11	3	0	24	3 - 8
E. Laingsburg R1	-	2	-	-	-	2	3 - 4
Whitehill O	1	7	1	-	-	9	2 - 5
E. Nelspoort R42	1	6	2	1	1	11	2 - 9
Molteno Pass H2284	5	11	-	-	-	16	2 - 4
HERBARIUM SPECIMENS.							
CONGESTA.							
Cradock	-	-	1	-	-	1	5
Mortimer	-	1	-	-	-	1	4
Helspoort	1	2	1	-	-	4	1 - 5
Alicedale	1	-	-	-	-	1	2
Brakkloof	1	-	-	-	-	1	2
FOLIOLOSA.							
Addo Bush	-	-	1	-	-	1	5
Koega Kammas Kloof	-	1	-	-	-	1	3
Swartkops Sundays	-	1	-	-	-	1	4
Kleinpoort	-	1	1	1	-	3	4 - 7
Steytlerville	-	-	1	-	-	1	5
Waterford	-	1	1	-	-	2	3 - 5
Kruidfontein	-	1	-	-	-	1	4
Graaff Reinet	-	1	1	-	-	2	3 - 5
E. Laingsburg (?)	-	1	-	-	-	1	4
ROBUSTA.							
Lake Mentz	-	1	-	-	-	1	4
Mt. Stewart	1	1	-	-	-	2	2 - 4
Steytlerville	-	2	-	-	-	2	4
Miller	-	1	-	-	-	1	3
Willowmore	-	-	-	1	-	1	8
Prince Albert	-	-	1	-	-	1	5
Whitehill	-	3	-	-	-	3	3 - 4
Matjesfontein	-	-	1	-	-	1	5
Beaufort West	-	-	3	-	-	3	5

Class Interval 2 bracts.

Table 41 VARIATION IN NUMBER OF STERILE BRACTS PER PEDUNCLE IN FOLIOLOSA COMPLEX.

Locality.	Individuals with one or more branches to inflorescence.	Individuals with unexpanded raceme buds in axils of sterile bracts.	Total no. Indiv.
CONGESTA.			
Field Pops.			
Cradock R32	0	5	14
S. Adelaide R38,39	7	14	30
Dikkop Vlakte R40	4	3	7
Helspoort R41	8	6	14
Herbarium Specimens.			
Helspoort	2	0	3
Alicedale	1	0	1
FOLIOLOSA.			
Field Pops.			
Graaff Reinet R60	2	0	31
Mt. Stewart R52b	0	0	3
Baroe R12	1	0	1
Wolwe fontein R11	0	0	2
Springbok Vlakte Nbg	0	0	2
Steytlerville R52a	0	1	18
Herbarium Specimens.			
Addo Bush	0	0	1
Swartkops Sundays River	0	0	1
Koega Kammas Kloof	0	0	1
Kleinpoort	1	1	3
Steytlerville	0	0	1
Waterford	0	0	2
Kruidfontein	1	0	2
Graaff Reinet	0	0	2
E. Laingsburg	0	0	1
ROBUSTA.			
Field Pops.			
Molteno Pass H2284	0	0	14
Nelspoort R42	0	0	11
Whitehill10	0	2	9
E. Laingsburg R1	0	0	2
Prince Albert R64	0	5	24
Miller R45	0	0	7
Steytlerville R43	0	0	15
Herbarium Specimens.			
Beaufort West	0	0	3
Matjesfontein	0	0	1
Whitehill	0	0	3
Prince Albert	0	0	1
Willowmore	0	0	1
Miller	0	0	1
Mt. Stewart	0	0	2
Steytlerville	0	0	2
Lake Mentz	0	0	1

Table 42 VARIATION IN BRANCHING OF INFLORESCENCES IN FOLIOLOSA COMPLEX.

Although these characters are not confined to the entity congesta, the high percentage of branched inflorescences and unexpanded raceme buds found in this entity are strongly indicative of a difference between it and the entities foliolosa and robusta.

Thickness of peduncle (See Table 43 and Appendix Table 7)

The very stout bases of old dried peduncles was a character of use in identifying populations of the entity robusta in the field*. (In the Appendix Table 7, the leaf length for each plant is shown, and also the width of old peduncle bases of previous years. If more than one old base was present on a single plant, then an average of the widths was taken).

In the introductory survey, it was seen that for complete flowering inflorescences, the thickest peduncle bases were found in the entity robusta, where in the majority of specimens they were 0.45 - 0.75 cm. wide. The entity foliolosa, with the majority of peduncles 0.30 - 0.45 cm. wide, had the thinnest peduncle bases, while those of the entity congesta, being 0.30 - 0.60 cm. wide in the majority of cases, were intermediate in size.

With some slight local variations the above pattern is observed in field populations.

The greatest width of the peduncle below the raceme was also shown in the introduction also to occur in the entity robusta, this being 0.30 - 0.45 cm, in the majority of cases, while for the majority of the more slender peduncles of the entities congesta and foliolosa, it was 0.15 - 0.30 cm.

Field populations of the entity foliolosa agree with the above, but the two Southern congesta populations tend to have a fair proportion of peduncles which are broader below the first pedicel.

In the robusta populations, peduncles with broad bases tend to be correspondingly broad below the first pedicel.

Three scatter diagrams have been constructed showing variation in peduncle size. The first, (Fig. 29) showing the width of old peduncle bases plotted against leaf length, resolves the foliolosa complex into its three components more clearly than the preceding scatter diagrams, but they are by no means sharply delimited.

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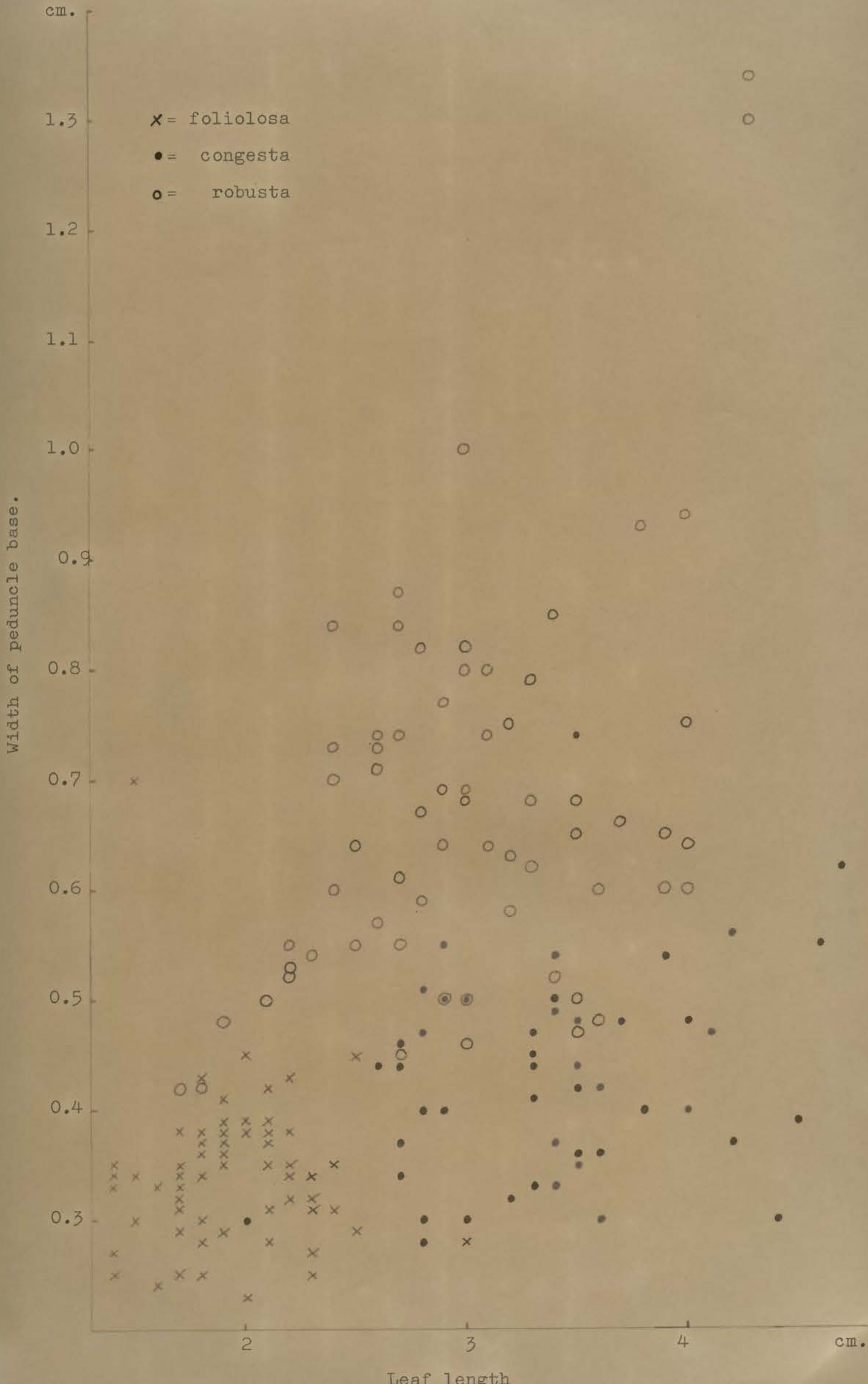
* Hence the author's choice of the epithet "robusta" for this entity.

Locality.	Class range of measurements.								Total no. indiv.	Range actual measurements.
	.15	.30	.45	.60	.75	.90	1.05			cm
	WIDTH PEDUNCLE BASE.									
CONGESTA.										
Cradock R32	-	-	1	9	4	-	-	-	14	0.41 - 0.75
S.of Adelaide R38,39	-	-	15	12	2	-	-	-	29	0.37 - 0.65
Dikkop Vlakte R40	-	-	-	4	2	1	-	-	7	0.50 - 0.80
Helspoort R41	-	-	6	4	3	1	-	-	14	0.32 - 0.77
FOLIOLOSA.										
Graaff Reinet R60	-	3	26	1	-	-	-	-	30	0.28 - 0.48
Mt. Stewart R52b	-	-	3	-	-	-	-	-	3	0.32 - 0.42
Baroe R12	-	-	-	1	-	-	-	-	1	0.50
Wolwefontein R11	-	-	2	-	-	-	-	-	2	0.38 - 0.40
Springbok Vlakte Nbg	-	1	-	1	-	-	-	-	2	0.26 - 0.47
Steytlerville R52a	-	3	12	2	-	-	-	-	17	0.26 - 0.48
ROBUSTA.										
Steytlerville R43	-	-	-	6	8	1	-	-	15	0.50 - 0.82
nr. Miller R45	-	-	-	3	2	-	-	-	5	0.47 - 0.66
Prince Albert R64	-	-	-	3	10	5	3	3	24	0.57 - 1.10
E. of Laingsburg R1	-	-	-	1	1	-	-	-	2	0.57 - 0.61
Whitehill O	-	-	-	-	4	2	2	1	9	0.64 - 1.10
E. of Nelspoort R42	-	-	1	6	4	-	-	-	11	0.42 - 0.68
Ft. Molteno Pass (Hall 2284)	-	-	-	3	-	-	-	-	3	0.50 - 0.58
	WIDTH PEDUNCLE BELOW RACEME.									
CONGESTA.										
Cradock R32	-	11	3	-	-	-	-	-	14	0.23 - 0.40
S. of Adelaide R38,39	-	24	4	-	-	-	-	-	28	0.23 - 0.42
Dikkop Vlakte R40	-	3	4	-	-	-	-	-	7	0.20 - 0.38
Helspoort R41	-	9	5	-	-	-	-	-	14	0.24 - 0.37
FOLIOLOSA.										
Graaff Reinet R60	2	29	-	-	-	-	-	-	31	0.15 - 0.29
Mt. Stewart R52b	-	3	-	-	-	-	-	-	3	0.21 - 0.30
Baroe R12	-	1	-	-	-	-	-	-	1	0.30
Wolwefontein R11	-	2	1	-	-	-	-	-	3	0.25 - 0.35
Springbok Vlakte Nbg	-	2	-	-	-	-	-	-	2	0.16 - 0.23
Steytlerville R52a	-	17	-	-	-	-	-	-	17	0.20 - 0.30
ROBUSTA.										
Steytlerville R43	-	5	13	2	-	-	-	-	20	0.28 - 0.50
nr. Miller R45	-	2	1	-	-	-	-	-	2	0.29 - 0.38
Prince Albert R64	-	-	6	10	5	-	-	-	21	0.35 - 0.73
E. of Laingsburg R1	-	-	2	-	-	-	-	-	2	0.40
Whitehill O	-	-	1	6	2	-	-	-	9	0.44 - 0.66
E.of Nelspoort R42	-	1	8	-	-	-	-	-	9	0.30 - 0.45
Ft.of Molteno Pass (Hall 2284)	-	6	7	1	-	-	-	-	14	0.29 - 0.46

Class interval 0.15 cm.

Table 43 VARIATION IN THICKNESS OF PEDUNCLE IN FIELD SPECIMENS OF THE FOLIOLOSA COMPLEX.

Fig.29. Variation in width of old dried peduncles and leaf length in the foliolosa complex.



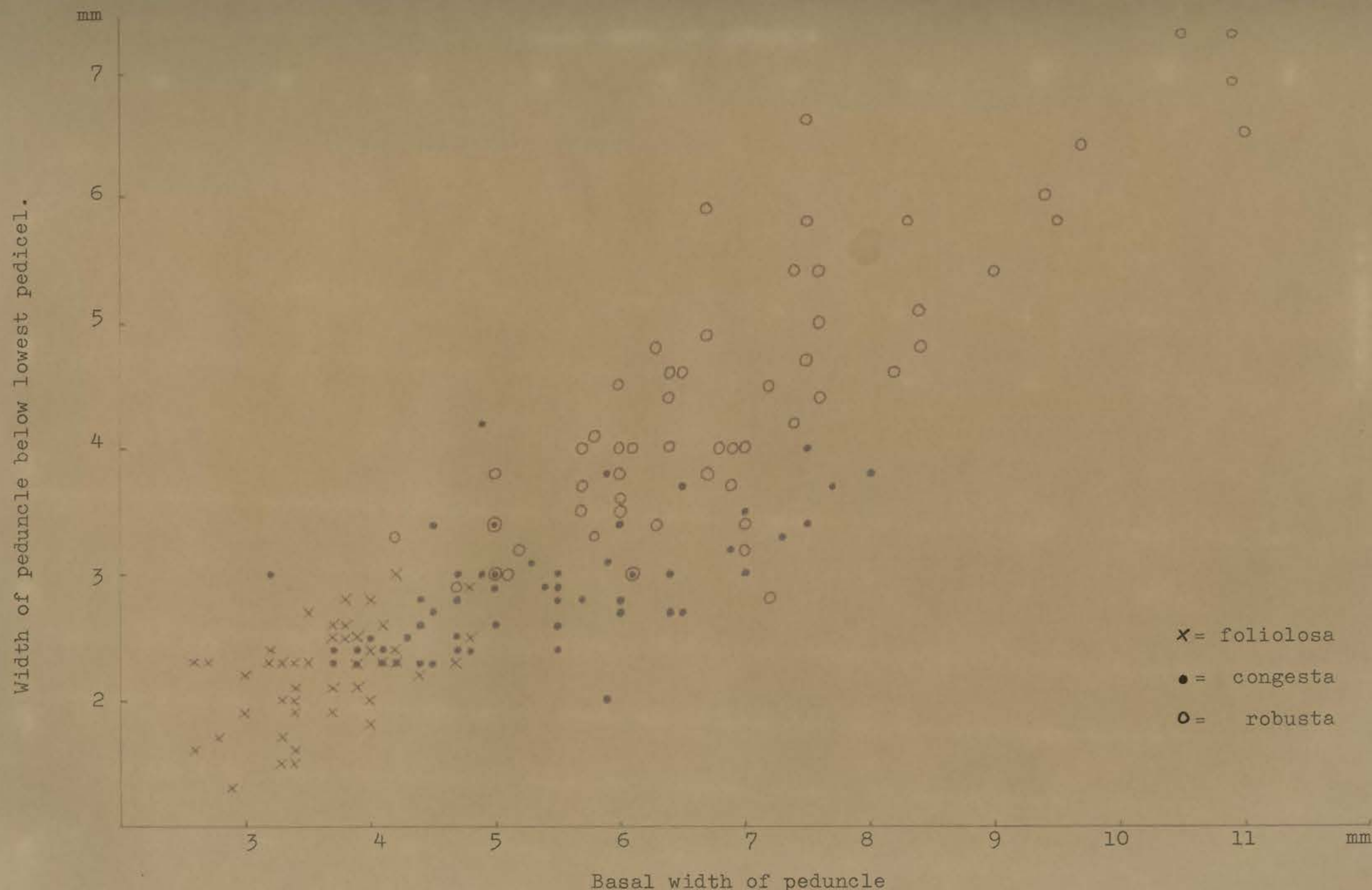
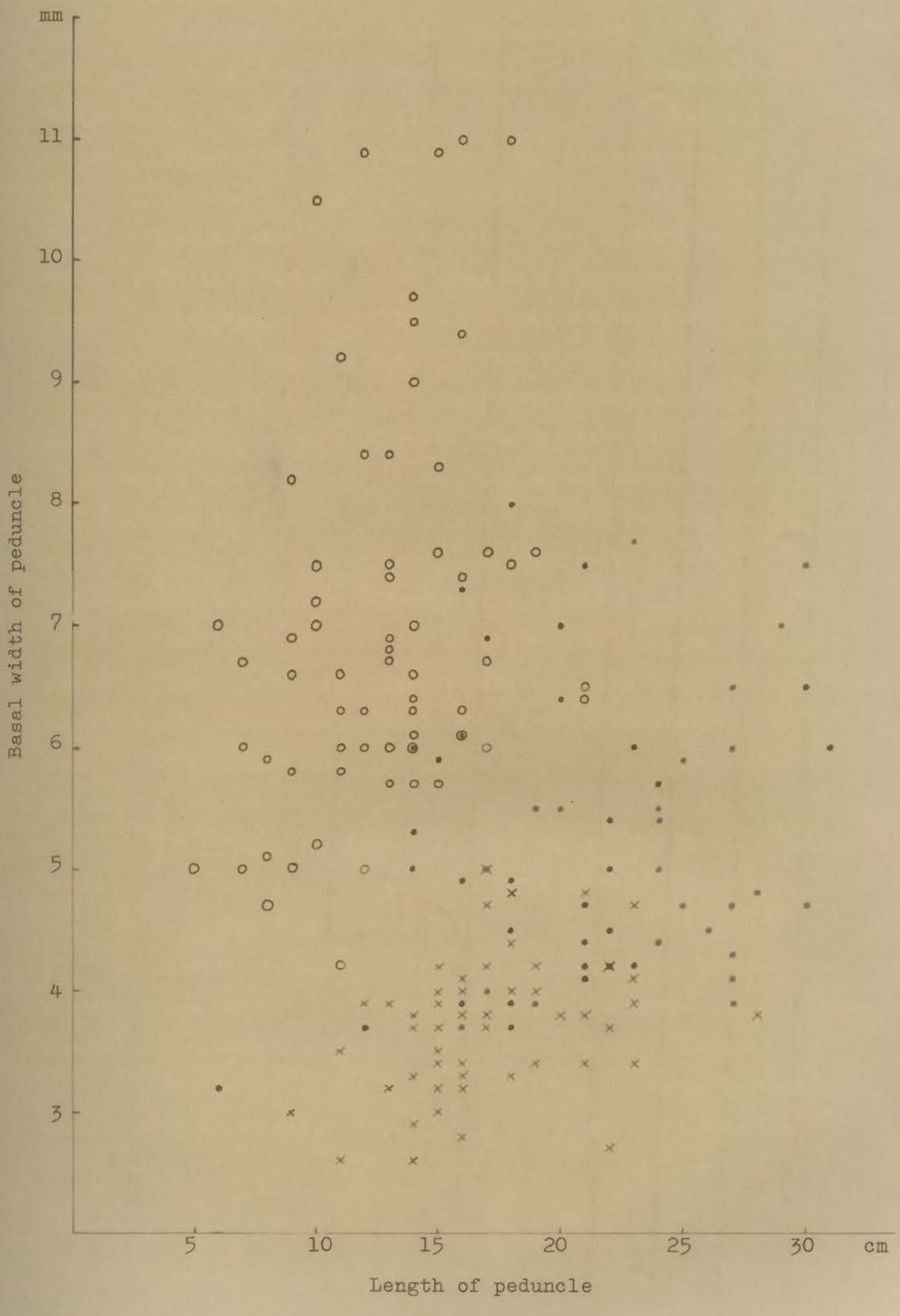


Fig.30. Variation in width of peduncle at base and below lowest pedicel in the foliolosa complex.

Fig.31. Variation in length and basal width of the peduncle in the foliolosa complex (× = foliolosa, • = congesta, o = robusta).



The second scatter diagram (Fig. 31) of peduncle length plotted against width of peduncle base shows a fairly good separation between the entities robusta and foliolosa, with the entity congesta intermediate, but closer in the combination of these characters to the entity foliolosa.

The last of these scatter diagrams (Fig. 30), of diameter of peduncle base plotted against diameter below raceme again shows the entities robusta and foliolosa to be at opposite ends of the variation pattern with the entity congesta intermediate.

Thickness of peduncle, both at the base and below the first pedicel is thus another character which differs in the three entities but this difference is by no means absolute.

Length of lowest sterile bract (See Tables 44A and 44B)

The introductory survey showed that the longest sterile bracts occurred in the entity robusta, where they were 1.0 - 1.4 cm. long in the majority of specimens. The shortest sterile bracts were found in the entity foliolosa where 48% of the sample had bracts 0.6 - 0.8 cm. long and 34% had bracts 0.8 - 1.0 cm. long, while the entity congesta was intermediate, with the lowest sterile bracts 0.8 - 1.0 cm. long in the majority of specimens.

Individual populations of the entity congesta follow the above pattern. In the foliolosa populations, the basal fertile bracts of the Graaff Reinet sample tend to be shorter than those from Mt. Stewart and Steytlerville, localities at the opposite end of the geographic pattern of distribution for the entity foliolosa.

In robusta populations, the length of the lowest sterile bract is very variable, the shortest basal sterile bracts being found in specimens from Molteno Pass.

A scatter diagram, (Fig. 32), of length of lowest sterile bract plotted against the diameter of the peduncle base, illustrates the pattern of variation in a combination of these characters.

The length of the basal sterile bract is thus another character by which the entity robusta tends to differ from the entities foliolosa and congesta, and again this difference is not absolute.

Locality.	Class range of measurements.									Total no. individuals.	Range actual measurements.
	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0			cm.
CONGESTA.											
Cradock R32	-	-	1	-	-	-	-	-	-	1	0.88
S. Adelaide R38.39	-	3	7	-	1	-	-	-	-	11	0.72 - 1.27
Dikkop Vlakte R40	-	1	5	-	-	-	-	-	-	6	0.76 - 1.00
Helspoort R41	-	4	6	3	-	-	-	-	-	13	0.75 - 1.20
Krantz Drift	-	-	1	-	-	-	-	-	-	1	0.82
FOLIOLOSA.											
Graaff Reinet R60	4	19	6	-	-	-	-	-	-	29	0.56 - 0.90
Mt. Stewart R52b	-	1	3	1	-	-	-	-	-	5	0.70 - 1.20
Springbok Vlakte Nbg	-	2	-	-	-	-	-	-	-	2	0.71 - 0.75
Steytlerville R52a	-	5	8	4	1	-	-	-	-	18	0.70 - 1.25
ROBUSTA.											
Steytlerville R43	-	-	2	5	5	2	1	-	-	15	1.00 - 1.70
Miller R45	-	-	-	1	2	2	2	-	-	7	1.10 - 1.70
Prince Albert R64	-	-	-	9	8	6	-	1	-	24	1.10 - 1.85
E. Laingsburg R1	-	-	-	2	-	-	-	-	-	2	1.05 - 1.14
Whitehill O	-	-	-	1	1	3	2	1	1	9	1.20 - 2.15
E. Nelspoort R42	-	-	-	2	4	3	-	2	-	11	1.15 - 2.00
Molteno Pass H2284	-	4	5	5	2	-	-	-	-	16	0.75

Class interval 012 cm.

Table 44A VARIATION IN LENGTH OF BASAL STERILE BRACT IN FIELD SPECIMENS OF THE FOLIOLOSA COMPLEX.

Locality.	Class range of measurements.						Total no. indiv.	Range actual measurements.
	0.8	1.0	1.2	1.4	1.6			cm.
CONGESTA.								
Helspoort.	1	2	-	-	-	-	3	0.70 - 0.95
FOLIOLOSA.								
Koega Kammas Kloof	-	1	-	-	-	-	1	0.90
Swartkops Sundays	-	1	-	-	-	-	1	1.00
Kleinpoort	-	2	-	1	-	-	3	0.90 - 1.30
Steytlerville	-	-	1	-	-	-	1	1.05
Waterford	-	1	-	-	-	-	1	1.00
Kruidfontein	2	-	-	-	-	-	2	0.75
Graaff Reinet	1	-	-	-	-	-	1	0.70
E. Laingsburg	2	1	-	-	-	-	3	0.70 - 0.95
ROBUSTA.								
Lake Mentz	-	-	-	1	-	-	1	1.40
Steytlerville	-	-	1	-	-	-	1	1.10
Miller	-	1	-	-	-	-	1	1.00
Willowmore	-	-	-	-	-	1	1	1.80
Prince Albert	-	-	1	-	-	-	1	1.10
Whitehill	-	-	-	2	1	-	3	1.30 - 1.45
Matjesfontein	-	1	-	-	-	-	1	1.00
Beaufort West	-	2	1	-	-	-	3	0.90 - 1.15

Class interval 0.2 cm.

Table 44B VARIATION IN LENGTH OF BASAL STERILE BRACTS IN HERBARIUM SPECIMENS OF FOLIOLOSA COMPLEX.

Basal width of lowest sterile bract (See Table 45)

In the introductory survey, it was seen that the entity foliolosa had the narrowest bases to the lowest sterile bracts, this measurement being 0.15 - 0.45 cm. in the majority of specimens. In both the entities congesta and robusta, the majority of individuals had bract bases of 0.45 - 0.60 cm. but 37% of the robusta sample, compared with 24% of congesta sample, had wider bract bases. Thus the basal width of the lowest sterile bract corresponds to some extent with the basal width of the peduncle.

For the most part, individual populations of the entity congesta conform to this pattern. In the foliolosa populations, however, it is of interest to note that the basal width of the lowest sterile bract tends to be greater in specimens from Graaff Reinet than in specimens from Steytlerville, while the width of the peduncle base for both populations is the same in the majority of individuals. In the robusta populations, the width of the basal sterile bracts corresponds well with the width of the peduncle bases.

Locality	Class range of measurements.								Total no. indiv.	Range actual measurements.
	.30 .45 .60 .75 .90 1.05 1.20									cm.
FIELD SPECIMENS.										
CONGESTA.										
Cradock R32	-	-	1	-	-	-	-	-	1	0.50
S.of Adelaide R38,39	-	2	6	2	-	-	-	-	10	0.30 - 0.75
Dikkop Vlakte R40	-	-	3	3	-	-	-	-	6	0.45 - 0.75
Helspoort R41	-	5	5	3	-	-	-	-	13	0.35 - 0.70
Krantz Drift (Commins 2063)	-	-	1	-	-	-	-	-	1	0.60
FOLIOLOSA.										
Graaff Reinet R60	7	20	3	-	-	-	-	-	30	0.20 - 0.55
Mt. Stewart R52b	1	4	-	-	-	-	-	-	5	0.15 - 0.45
Springbok Vlakte Nbg	1	1	-	-	-	-	-	-	2	0.24 - 0.35
Steytlerville R52a	17	2	1	-	-	-	-	-	20	0.20 - 0.50
ROBUSTA.										
Steytlerville R43	-	1	10	3	1	-	-	-	15	0.30 - 0.90
nr. Miller R45	-	-	7	-	-	-	-	-	7	0.45 - 0.60
Prince Albert R64	-	2	7	10	5	-	-	-	24	0.30 - 0.90
E. of Laingsburg R1	-	-	2	-	-	-	-	-	2	0.52 - 0.60
Whitehill O	-	-	-	4	4	1	-	-	9	0.70 - 0.95
E. of Nelspoort R42	-	1	7	1	1	-	-	1	11	0.45 - 1.30
Ft. of Molteno Pass (Hall 2284)	-	3	9	3	-	-	-	-	15	0.40 - 0.68
HERBARIUM SPECIMENS.										
CONGESTA.										
Helspoort	-	2	1	-	-	-	-	-	3	0.40 - 0.47
FOLIOLOSA.										
Koega Kammas Kloof	1	-	-	-	-	-	-	-	1	0.30
Swartkops Sundays	1	-	-	-	-	-	-	-	1	0.24
Kleinpoort	2	1	-	-	-	-	-	-	3	0.22 - 0.42
Steytlerville	1	-	-	-	-	-	-	-	1	0.20
Waterford	-	-	1	-	-	-	-	-	1	0.60
Kruidfontein	1	-	-	-	-	-	-	-	1	0.30
E. of Laingsburg	2	1	-	-	-	-	-	-	3	0.30 - 0.36
ROBUSTA.										
Lake Mentz	-	-	-	1	-	-	-	-	1	0.62
Steytlerville	-	1	-	-	-	-	-	-	1	0.40
Miller	-	-	1	-	-	-	-	-	1	0.50
Willowmore	-	-	1	-	-	-	-	-	1	0.60
Prince Albert	-	1	-	-	-	-	-	-	1	0.35
Whitehill	-	1	2	-	-	-	-	-	3	0.40 - 0.60
Matjesfontein	1	-	-	-	-	-	-	-	1	0.30
Beaufort West	1	2	-	-	-	-	-	-	3	0.30 - 0.35

Class interval 0.15 cm.

Table 45 VARIATION IN WIDTH OF BASES OF LOWEST STERILE BRACTS IN FOLIOLOSA COMPLEX.

Locality.	Class range of measurements.						Total no. indiv.	Range actual measurements.
	0.1 0.2 0.3 0.4 0.5							cm.
	FIELD SPECIMENS.							
CONGESTA.								
Cradock R32	-	-	1	-	-	-	1	0.27
S.of Adelaide R38,39	-	8	2	-	-	-	10	0.14 - 0.28
Dikkop Vlakte R40	-	-	4	1	1	-	6	0.23 - 0.46
Helspoort R41	-	2	4	1	2	-	9	0.17 - 0.48
Krantz Drift (Commins 2063)	-	-	-	1	-	-	1	0.30 - 0.40
FOLIOLOSA.								
Graaff Reinet R60	1	19	9	-	-	-	29	0.09 - 0.30
Mt. Stewart R52b	-	5	-	-	-	-	5	0.13 - 0.15
Springbok Vlakte Nbg	-	1	-	-	-	-	1	0.13
Steytlerville R52a	4	14	-	-	-	-	18	0.08 - 0.20
ROBUSTA.								
Steytlerville R43	-	2	8	5	-	-	15	0.20 - 0.40
Nr. Miller R45	-	-	2	3	2	-	7	0.23 - 0.50
Prince Albert R64	-	6	13	5	-	-	24	0.17 - 0.40
E.of Laingsburg R1	-	-	2	-	-	-	2	0.23 - 0.30
Whitehill O	-	1	4	4	-	-	9	0.20 - 0.37
E. of Nelspoort R42	-	3	3	3	1	1	11	0.20 - 0.52
Ft. of Molteno Pass (Hall 2284)	-	3	12	-	-	-	15	0.17 - 0.30
	HERBARIUM SPECIMENS.							
CONGESTA.								
Helspoort	-	1	1	1	-	-	3	0.20 - 0.33
FOLIOLOSA.								
Koega Kammas Kloof	1	-	-	-	-	-	1	0.10
Swartkops Sundays	1	-	-	-	-	-	1	0.10
Kleinpoort	2	1	-	-	-	-	3	0.10 - 0.20
Steytlerville	1	-	-	-	-	-	1	0.10
Waterford	-	-	-	1	-	-	1	0.36
Kruidfontein	2	-	-	-	-	-	2	0.08 - 0.10
E. of Laingsburg	2	1	-	-	-	-	3	0.10 - 0.12
ROBUSTA.								
Lake Mentz	-	-	-	-	1	-	1	0.50
Steytlerville	-	1	-	-	-	-	1	0.20
Miller	-	-	1	-	-	-	1	0.30
Willowmore	-	-	1	-	-	-	1	0.30
Prince Albert	-	1	-	-	-	-	1	0.20
Whitehill	-	2	1	-	-	-	3	0.20 - 0.30
Matjesfontein	-	-	1	-	-	-	1	0.28
Beaufort West	-	2	1	-	-	-	3	0.20 - 0.28

Class interval 0.1 cm.

Table 46 VARIATION IN MIDDLE WIDTH OF BASAL STERILE BRACTS IN FOLIOLOSA COMPLEX.

Locality.	Class range of measurements.						Total no. indiv.	Range actual measurements.
	3	5	7	9	11			
			FIELD SPECIMENS.					
CONGESTA.								
Cradock R32	-	1	-	-	-	-	1	3.26
S.of Adelaide R38,39	1	4	4	1	0	-	10	2.76 - 7.47
Dikkop Vlakte R40	5	1	-	-	-	-	6	2.17 - 3.91
Helspoort R41	4	4	1	-	-	-	9	1.91 - 5.29
Krantz Drift	1	-	-	-	-	-	1	2.48
FOLIOLOSA.								
Graaff Reinet R60	4	20	4	1	-	-	29	2.38 - 7.22
Mt. Stewart R52	-	-	4	1	-	-	5	5.38 - 8.57
Baroe R12	-	-	-	-	-	1	1	12.80
Springbok Vlakte Nbg	-	-	1	-	-	-	1	5.46
Steytlerville	-	2	6	6	3	1	18	4.41 -12.50
ROBUSTA.								
Steytlerville R43	1	12	2	-	-	-	15	2.50 - 6.50
Nr. Miller R45	1	4	2	-	-	-	7	2.80 - 5.65
Prince Albert R64	-	9	12	3	-	-	24	3.15 - 8.52
E.of Laingsburg R1	-	2	-	-	-	-	2	4.56 - 3.80
Whitehill O	-	3	5	1	-	-	9	4.56 - 3.80
E. of Nelspoort R42	1	5	3	2	-	-	12	2.69 - 8.00
Ft. of Molteno Pass (Hall 2284)	4	5	2	1	-	-	12	2.50 - 7.06
			HERBARIUM SPECIMENS.					
CONGESTA.								
Helspoort	2	1	-	-	-	-	3	2.50 - 4.25
FOLIOLOSA.								
Koega Kammas Kloof	-	-	-	1	-	-	1	9.00
Swartkops Sundays	-	-	-	-	1	-	1	10.00
Kleinpoort	-	1	1	-	-	1	3	4.50 -13.00
Steytlerville	-	-	-	-	1	-	1	10.50
Waterford	1	-	-	-	-	-	1	2.77
Kruidfontein	-	-	-	1	1	-	2	7.50 - 9.37
E. of Laingsburg	-	-	2	-	1	-	3	6.60 - 9.50
ROBUSTA.								
Lake Mentz	1	-	-	-	-	-	1	2.80
Steytlerville	-	-	1	-	-	-	1	5.50
Miller	-	1	-	-	-	-	1	3.33
Willowmore	-	-	1	-	-	-	1	6.00
Prince Albert	-	-	1	-	-	-	1	5.50
Whitehill	-	1	2	-	-	-	3	4.63 - 6.75
Matjesfontein	-	1	-	-	-	-	1	3.57
Beaufort West	-	3	-	-	-	-	3	4.10 - 4.75

Class interval 2.0

Table 47 VARIATION IN LENGTH - BREADTH RATIO OF BASAL STERILE BRACTS IN FOLIOLOSA COMPLEX.

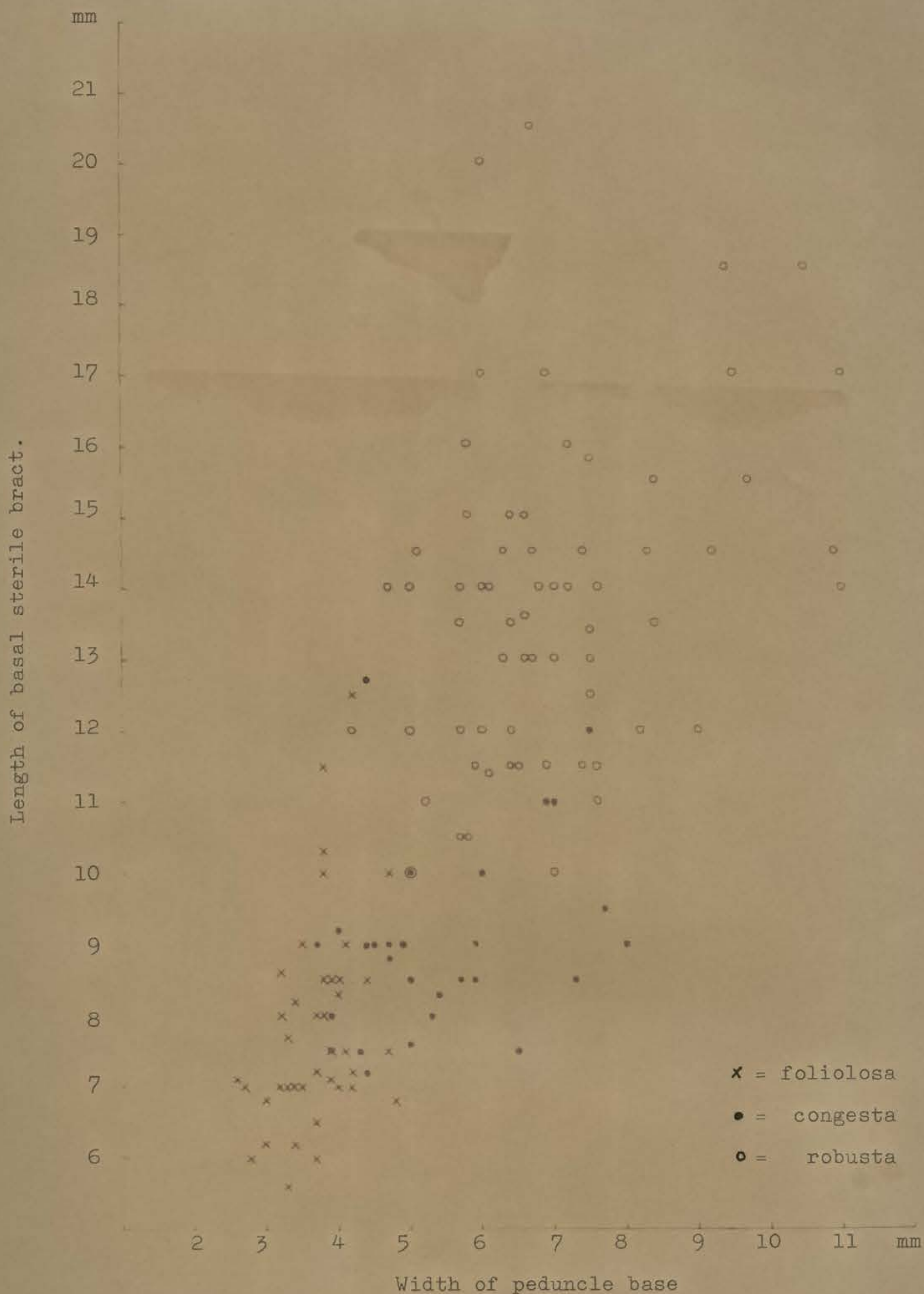


Fig.32. Variation in length of basal sterile bract and width of peduncle base in the foliolosa complex.

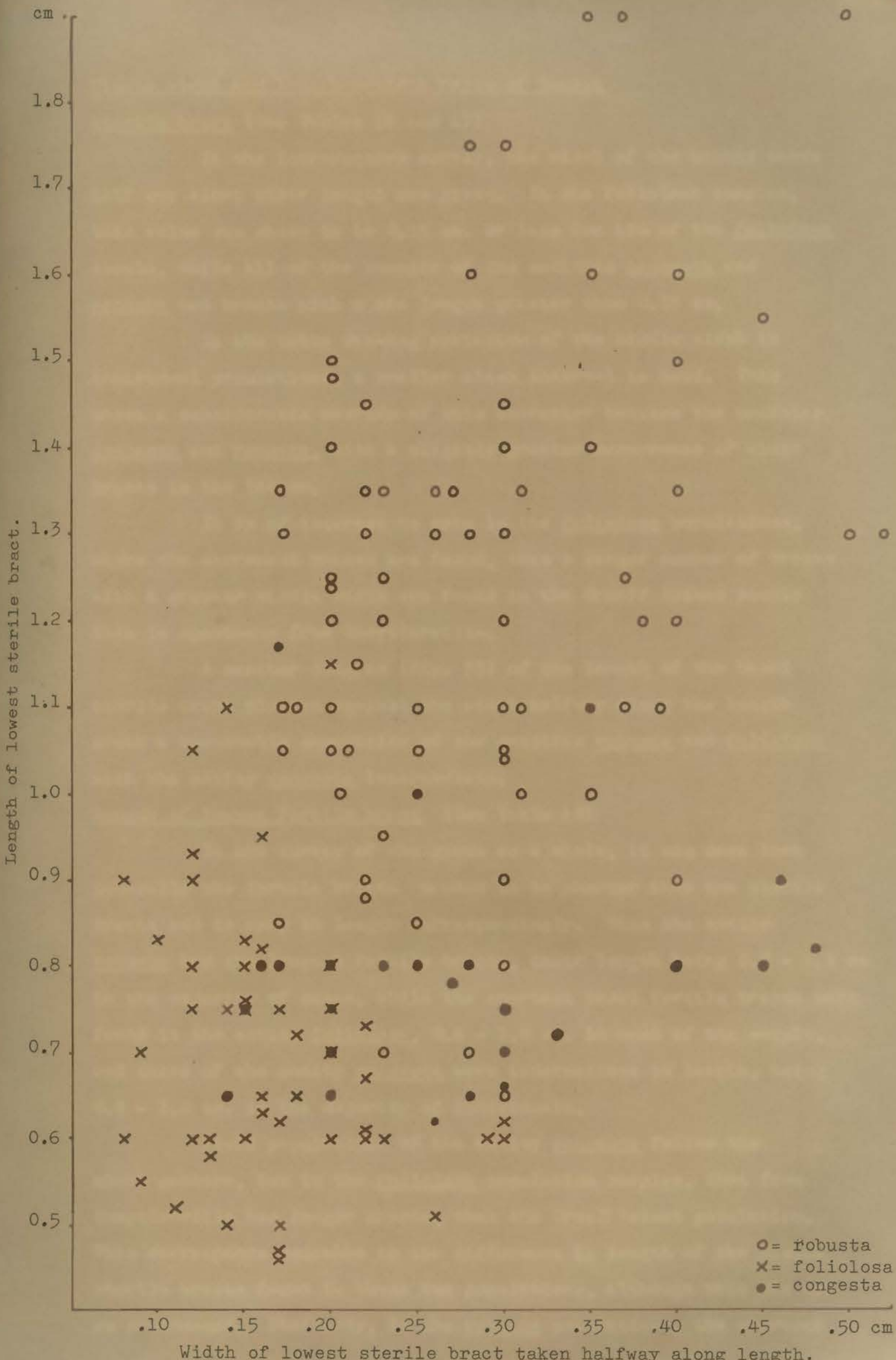


Fig.33. Variation in length and middle width of lowest sterile bract in the foliolosa complex.

Middle width and length-breadth ratio of lowest sterile bract (See Tables 46 and 47)

In the introductory survey, the width of the bracts taken half way along their length was given. In the foliolosa complex, this value was shown to be 0.15 cm. or less for 45% of the foliolosa sample, while all of the samples of the entities congesta and robusta had bracts with a mid length greater than 0.15 cm.

In the table showing variation of the middle width in individual populations, a smaller class interval is used. This shows a considerable overlap of this character between the entities congesta and robusta, with a slightly greater occurrence of wider bracts in the latter.

It is of interest to note in the foliolosa populations, where the narrowest bracts are found, that a larger number of bracts with a greater middle width are found in the Graaff Reinet sample than in specimens from Steytlerville.

A scatter diagram (Fig. 33) of the length of the basal sterile bract plotted against the width halfway along the length shows a reasonable separation of the entities robusta and foliolosa with the entity congesta intermediate.

Length of lowest fertile bract (See Table 48)

In the survey of the genus as a whole, it was seen that generally the fertile bracts tended to be shorter than the sterile bracts and to vary in length correspondingly. Thus the entity robusta had the longest fertile bracts, their length being 0.8 - 1.2 cm in the majority of cases, while the shortest basal fertile bracts were found in the entity foliolosa, 0.6 - 1.0 cm. in most of the sample, and those of the entity congesta were intermediate in length, being 0.8 - 1.0 cm. in the majority of individuals.

Field populations of the entity congesta follow the above pattern, but in the foliolosa population samples, that from Steytlerville has longer bracts, than the Graaff Reinet population. This corresponds somewhat to the difference in length of the lowest sterile bracts found in these two populations, although this was not as pronounced. Similarly, in the robusta populations, the shortest

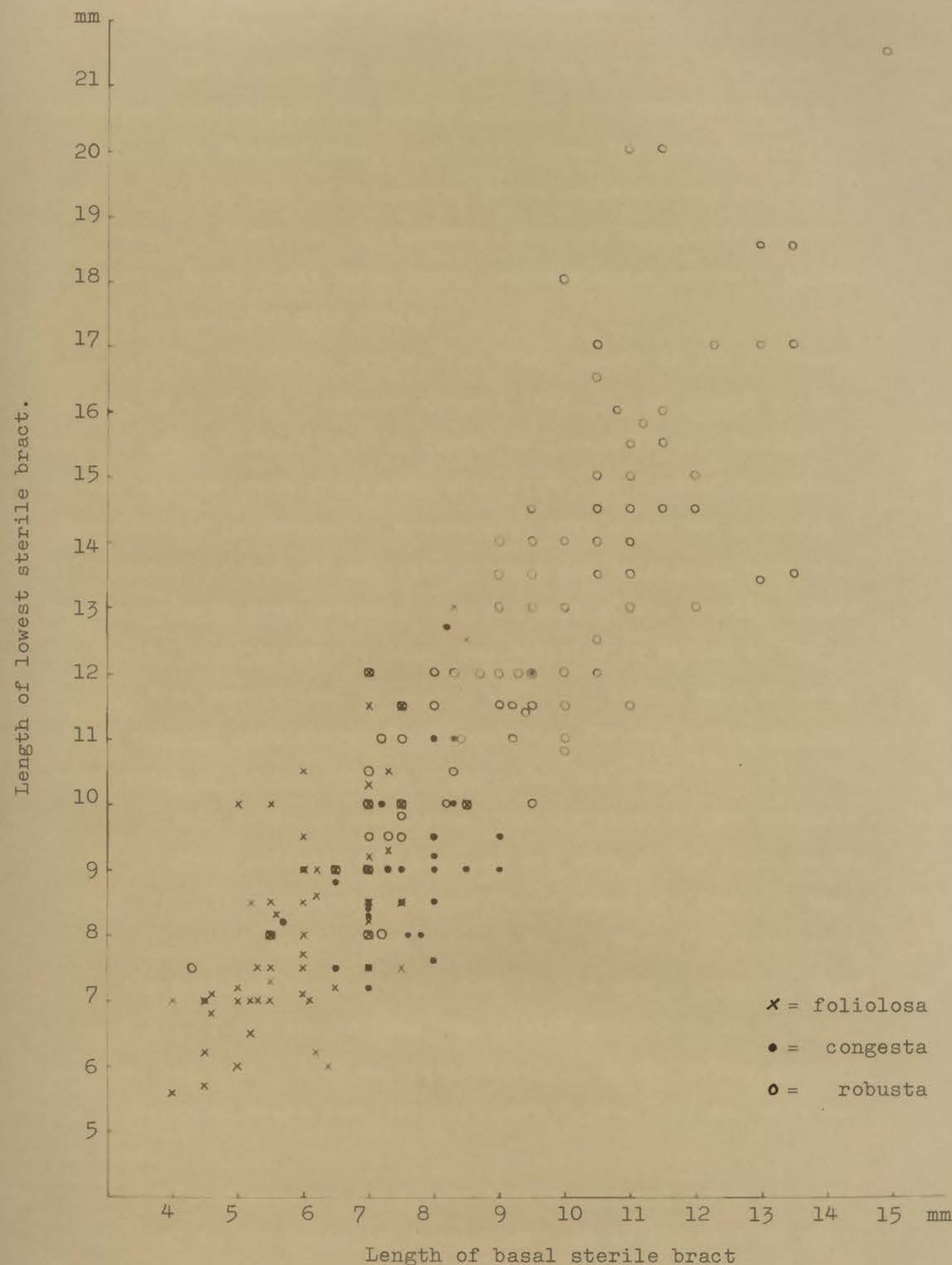


Fig.34. Variation in length of basal sterile and fertile bracts in the foliolosa complex.

basal fertile bracts are found in plants from the foot of Molteno Pass.

Measurements of sterile and fertile bract lengths of herbarium specimens of the entity robusta from Beaufort West, a locality near Molteno Pass, agree with those for this locality. Both are to the West of Nelspoort, which could account for the difference in bract length recorded for these localities and for Nelspoort, despite all three being near the known northern limits of distribution for this entity.

The variation pattern for bract length in the foliolosa complex is shown in a scatter diagram (Fig. 34) of length of lowest sterile bract plotted against length of lowest fertile bract. As has been the case previously with regard to scatter diagrams incorporating inflorescence characters, this shows the greatest differences between the entities robusta and foliolosa, with the entity congesta intermediate. A great part of the overlap between the entity robusta and the other two entities is caused by the Molteno Pass population, which geographically is the most distant of all robusta populations from localities for the entity foliolosa.

Basal width of lowest fertile bract (See Table 49)

This tends to correspond with the width of the peduncle below the first pedicel, and thus, as was seen in the introductory survey, fertile bracts with the narrowest bases are found in the entity foliolosa, their width being 0.15 - 0.30 cm. in most cases, while the broadest based bracts occur in the entity robusta, where 34% and 51% of the sample have bracts with a basal width of 0.30 - 0.45 cm. and 0.45 - 0.60 cm. respectively. In the entity congesta the majority of basal fertile bracts are 0.30 - 0.45 cm. wide at the base.

Field populations of the entity congesta agree with the above, but, in the foliolosa populations, as in the case of the sterile bracts, there is a tendency for individuals from Graaff Reinet to have broader bases to the fertile bracts than those from Steytlerville.

In robusta populations, fertile bracts with the narrowest bases are found in specimens from Nelspoort and Molteno Pass. In

Locality	Class Range of Measurements							Total no. Indiv.	Range actual measurements.
	0.4 0.6 0.8 1.0 1.2 1.4								cm.
				FIELD SPECIMENS.					
CONGESTA.									
Cradock R32	-	-	1	-	-	-	-	1	0.65
S. Adelaide R38,39	-	4	14	2	-	-	-	20	0.50 - 0.90
Dikkop Vlakte R40	-	-	3	3	-	-	-	6	0.70 - 0.90
Helspoort R41	-	1	10	3	-	-	-	14	0.55 - 0.95
Krantz Drift	-	1	-	-	-	-	-	1	0.57
FOLIOLOSA.									
Graaff Reinet R60	2	23	8	-	-	-	-	33	0.40 - 0.75
Mt. Stewart R52b	-	2	5	-	-	-	-	7	0.53 - 0.73
Baroe R12	-	-	-	1	-	-	-	1	0.90
Wolwefontein R11	-	1	2	-	-	-	-	3	0.57 - 0.70
Springbok Vlakte Nbg	-	1	1	-	-	-	-	2	0.46 - 0.75
Steytlerville R52a	-	6	14	1	-	-	-	21	0.50 - 0.85
ROBUSTA.									
Steytlerville R43	-	-	2	7	6	-	-	15	0.70 - 1.10
Miller R45	-	-	-	1	5	1	-	7	1.00 - 1.30
Prince Albert R64	-	-	3	8	11	2	-	24	0.75 - 1.35
E. Laingsburg R1	-	-	-	2	-	-	-	2	0.83 - 0.94
Whitehill O	-	-	-	1	4	3	1	9	1.00 - 1.50
E. Nelspoort R42	-	-	-	2	9	-	-	11	0.95 - 1.2
Molteno Pass H2284	-	2	10	3	-	-	-	15	0.43 - 1.0
			HERBARIUM SPECIMENS.						
CONGESTA.									
Cradock	-	-	1	-	-	-	-	1	0.63
Mortimer	-	1	-	-	-	-	-	1	0.50
Helspoort	-	2	3	-	-	-	-	5	0.50 - 0.80
Brakkloof	-	1	-	-	-	-	-	1	0.60
FOLIOLOSA.									
Addo Bush	-	1	-	-	-	-	-	1	0.45
Koega Kammas Kloof	-	1	-	-	-	-	-	1	0.60
Swartkops Sundays	-	1	-	-	-	-	-	1	0.50
Kleinpoort	-	-	1	2	-	-	-	3	0.70 - 0.85
Steytlerville	-	-	1	-	-	-	-	1	0.73
Waterford	-	-	1	-	-	-	-	1	0.75
Kruidfontein	-	1	-	-	-	-	-	1	0.60
Graaff Reinet	-	1	1	-	-	-	-	2	0.50 - 0.63
E. Laingsburg (?)	-	3	-	-	-	-	-	3	0.55 - 0.60
ROBUSTA.									
Lake Mentz	-	-	-	1	-	-	-	1	0.90
Steytlerville	-	-	2	-	-	-	-	2	0.70 - 0.75
Miller	-	-	-	1	-	-	-	1	0.82
Willowmore	-	-	-	1	-	-	-	1	1.00
Prince Albert	-	-	-	1	-	-	-	1	0.92
Whitehill	-	-	-	1	1	1	-	3	1.00 - 1.35
Matjesfontein	-	-	1	-	-	-	-	1	0.75
Beaufort West	-	-	2	1	-	-	-	3	0.70 - 1.00

Class interval 0.2 c.m.

Table 48 VARIATION IN LENGTH OF BASAL FERTILE BRACT IN FOLIOLOSA COMPLEX.

Locality.	Class range of measurements					Total no. indiv.	Range actual measurements.
	0.30 0.45 0.60 0.75						cm.
			FIELD SPECIMENS.				
CONGESTA.							
Cradock R32	-	1	-	-	-	1	0.45
S.of Adelaide R38,39	-	18	1	-	-	19	0.34 - 0.47
Dikkop Vlakte R40	-	4	2	-	-	6	0.35 - 0.58
Helspoort R41	-	13	1	-	-	14	0.34 - 0.46
Krantz Drift (Commins 2063)	-	1	-	-	-	1	0.45
FOLIOLOSA.							
Graaff Reinet R60	19	14	-	-	-	33	0.22 - 0.45
Mt. Stewart R52b	6	-	-	-	-	6	0.28 - 0.30
Wolwefontein R11	1	-	-	-	-	1	0.22
Springbok Vlakte Nbg	2	-	-	-	-	2	0.22 - 0.30
Steytlerville R52a	20	1	-	-	-	21	0.20 - 0.40
ROBUSTA.							
Steytlerville R43	-	1	12	2	-	15	0.45 - 0.65
nr. Miller R45	-	2	5	-	-	7	0.45 - 0.55
Prince Albert R64	-	4	16	4	-	24	0.40 - 0.75
E. of Laingsburg R1	-	1	1	-	-	2	0.45 - 0.47
Whitehill O	-	-	2	6	1	9	0.57 - 0.80
E. of Nelspoort R42	-	7	3	1	-	11	0.40 - 0.62
Ft. of Molteno Pass (Hall 2289)	-	8	8	-	-	16	0.35 - 0.55
			HERBARIUM SPECIMENS.				
CONGESTA.							
Cradock	1	-	-	-	-	1	0.28
Mortimer	-	1	-	-	-	1	0.34
Helspoort	2	3	-	-	-	5	0.30 - 0.40
Brakkloof	-	1	-	-	-	1	0.33
FOLIOLOSA.							
Addo Bush	1	-	-	-	-	1	0.20
Koega Kammas Kloof	1	-	-	-	-	1	0.20
Swartkops Sundays	1	-	-	-	-	1	0.18
Kleinpoort	3	-	-	-	-	3	0.20 - 0.24
Steytlerville	1	-	-	-	-	1	0.26 -
Waterford	1	-	-	-	-	1	0.23
Kruidfontein	1	-	-	-	-	1	0.30
Graaff Reinet	2	-	-	-	-	2	0.22 - 0.28
E. of Laingsburg	3	-	-	-	-	3	0.25 - 0.30
ROBUSTA.							
Lake Mentz	-	1	-	-	-	1	0.40
Steytlerville	-	1	1	-	-	2	0.40 - 0.55
Miller	-	-	1	-	-	1	0.48
Willowmore	-	1	-	-	-	1	0.44
Prince Albert	-	1	-	-	-	1	0.40
Whitehill	-	3	-	-	-	3	0.40 - 0.43
Matjesfontein	-	1	-	-	-	1	0.40
Beaufort West	1	2	-	-	-	3	0.30 - 0.40

Class interval 0.15 cm

Table 49 VARIATION IN WIDTH OF BASE OF LOWEST FERTILE BRACT IN FOLIOLOSA COMPLEX.

Locality.	Class range of measurements.				Total no. indiv.	Range actual measurements.
	0.1	0.2	0.3			cm.
		FIELD SPECIMENS.				
CONGESTA.						
Cradock R32	-	1	-	-	1	0.16
S.of Adelaide R38,39	-	16	3	-	19	0.11 - 0.28
Dikkop Vlakte R40	-	-	4	2	6	0.25 - 0.40
Helspoort R41	-	2	6	2	10	0.20 - 0.35
Krantz Drift (Commins.2063)	-	-	1	-	1	0.30
FOLIOLOSA.						
Graaff Reinet R60	3	29	1	-	33	0.06 - 0.22
Mt. Stewart R52b	3	3	-	-	6	0.10 - 0.15
Wolwefontein R11	-	1	-	-	1	0.13
Sprinbok Vlakte Nbg	-	1	-	-	1	0.11
Steytlerville R52a	17	4	-	-	21	0.06 - 0.17
ROBUSTA.						
Steytlerville R43	-	-	9	6	15	0.25 - 0.40
nr. Miller R45	-	-	4	3	7	0.25 - 0.35
Prince Albert R64	-	14	8	2	24	0.17 - 0.37
E.of Laingsburg R1	-	-	2	-	2	0.25
Whitehill O	-	1	8	-	9	0.17 - 0.30
E. of Nelspoort R42	-	-	10	1	11	0.23 - 0.33
Ft. of Molteno Pass (Hall 2284)	-	7	9	-	16	0.14 - 0.28
		HERBARIUM SPECIMENS.				
CONGESTA.						
Cradock	-	1	-	-	1	0.20
Mortimer	-	-	1	-	1	0.23
Brakkloof	-	-	1	-	1	0.23
Helspoort	-	3	2	-	5	0.16 - 0.28
FOLIOLOSA.						
Addo Bush	1	-	-	-	1	0.08
Koega Kammas Kloof	1	-	-	-	1	0.06
Swartkops Sundays	1	-	-	-	1	0.08
Kleinpoort	2	1	-	-	3	0.08 - 0.14
Steytlerville	1	-	-	-	1	0.10
Waterford	1	-	-	-	1	0.08
Kruidfontein	1	-	-	-	1	0.10
Graaff Reinet	2	-	-	-	2	0.10
E. of Laingsburg	1	2	-	-	3	0.10 - 0.14
ROBUSTA.						
Lake Mentz	-	1	-	-	1	0.20
Steytlerville	-	-	2	-	2	0.23 - 0.28
Miller	-	-	1	-	1	0.30
Willowmore	-	-	1	-	1	0.24
Prince Albert	-	1	-	-	1	0.20
Whitehill	-	1	2	-	3	0.16 - 0.30
Matjesfontein	-	-	1	-	1	0.26
Beaufort West	-	2	1	-	3	0.20 - 0.28

Class interval 0.1 cm.

Table 50 VARIATION IN MIDDLE WIDTH OF BASAL FERTILE BRACTS IN FOLIOLOSA COMPLEX.

Locality.	Class range of measurements.						Total no. indiv.	Range actual measurements.
	3	5	7	9	11			
FIELD SPECIMENS.								
CONGESTA.								
Cradock R32	-	1	-	-	-	-	1	4.06
S.of Adelaide R38,39	2	12	5	-	-	-	19	2.73 - 6.82
Dikkop Vlakte R40	4	2	-	-	-	-	6	2.12 - 3.60
Helspoort R41	4	6	-	-	-	-	10	2.17 - 4.15
Krantz Drift (Commins2063)	1	-	-	-	-	-	1	1.90
FOLIOLOSA.								
Graaff Reinet R60	6	23	3	1	-	-	33	2.50 - 7.50
Mt. Stewart R52	-	1	5	-	-	-	6	4.13 - 7.00
Wolwefontein R11	-	1	-	-	-	-	1	4.38
Springbok Vlakte Nbg	-	1	-	-	-	-	1	4.18
Steytlerville R52	-	4	9	4	3	1	21	4.12 -11.67
ROBUSTA.								
Steytlerville R43	7	8	-	-	-	-	15	2.43 - 3.75
Miller R45	-	7	-	-	-	-	7	3.28 - 4.80
Prince Albert R64	1	14	8	1	-	-	24	2.28 - 7.06
E.of Laingsburg R1	-	2	-	-	-	-	2	3.32 - 3.76
Whitehill O	-	6	3	-	-	-	9	3.57 - 6.00
Nelspoort R42	-	10	1	-	-	-	11	3.18 - 5.21
Molteno Pass (Hall 2284)	5	7	4	-	-	-	16	1.95 - 6.42
HERBARIUM SPECIMENS.								
CONGESTA.								
Cradock	-	1	-	-	-	-	1	3.15
Mortimer	1	-	-	-	-	-	1	2.17
Helspoort	3	2	-	-	-	-	5	2.00 - 4.37
Brakkloof	1	-	-	-	-	-	1	2.61
FOLIOLOSA.								
Addo Bush	-	-	1	-	-	-	1	5.62
Koega Kammas Kloof	-	-	-	-	1	-	1	10.00
Swartkops Sundays	-	-	1	-	-	-	1	6.25
Kleinpoort	-	-	2	-	1	-	3	6.07 -10.37
Steytlerville	-	-	-	1	-	-	1	7.30
Waterford	-	-	-	-	1	-	1	9.38
Kruidfontein	-	-	1	-	-	-	1	6.00
Graaff Reinet	-	1	1	-	-	-	2	6.30 - 5.00
E.of Laingsburg	-	2	1	-	-	-	3	4.29 - 5.50
ROBUSTA.								
Lake Mentz	-	1	-	-	-	-	1	4.50
Steytlerville	1	1	-	-	-	-	2	2.68 - 3.04
Miller	-	-	1	-	-	-	1	6.73
Willowmore	-	1	-	-	-	-	1	4.17
Prince Albert	-	1	-	-	-	-	1	4.60
Whitehill	-	2	1	-	-	-	3	3.50 - 6.25
Matjesfontein	1	-	-	-	-	-	1	2.88
Beaufort West	1	2	-	-	-	-	3	2.68 - 5.00

Class interval 2.0

Table 51 VARIATION IN LENGTH-BREADTH RATIO OF BASAL FERTILE BRACTS IN FOLIOLOSA COMPLEX.

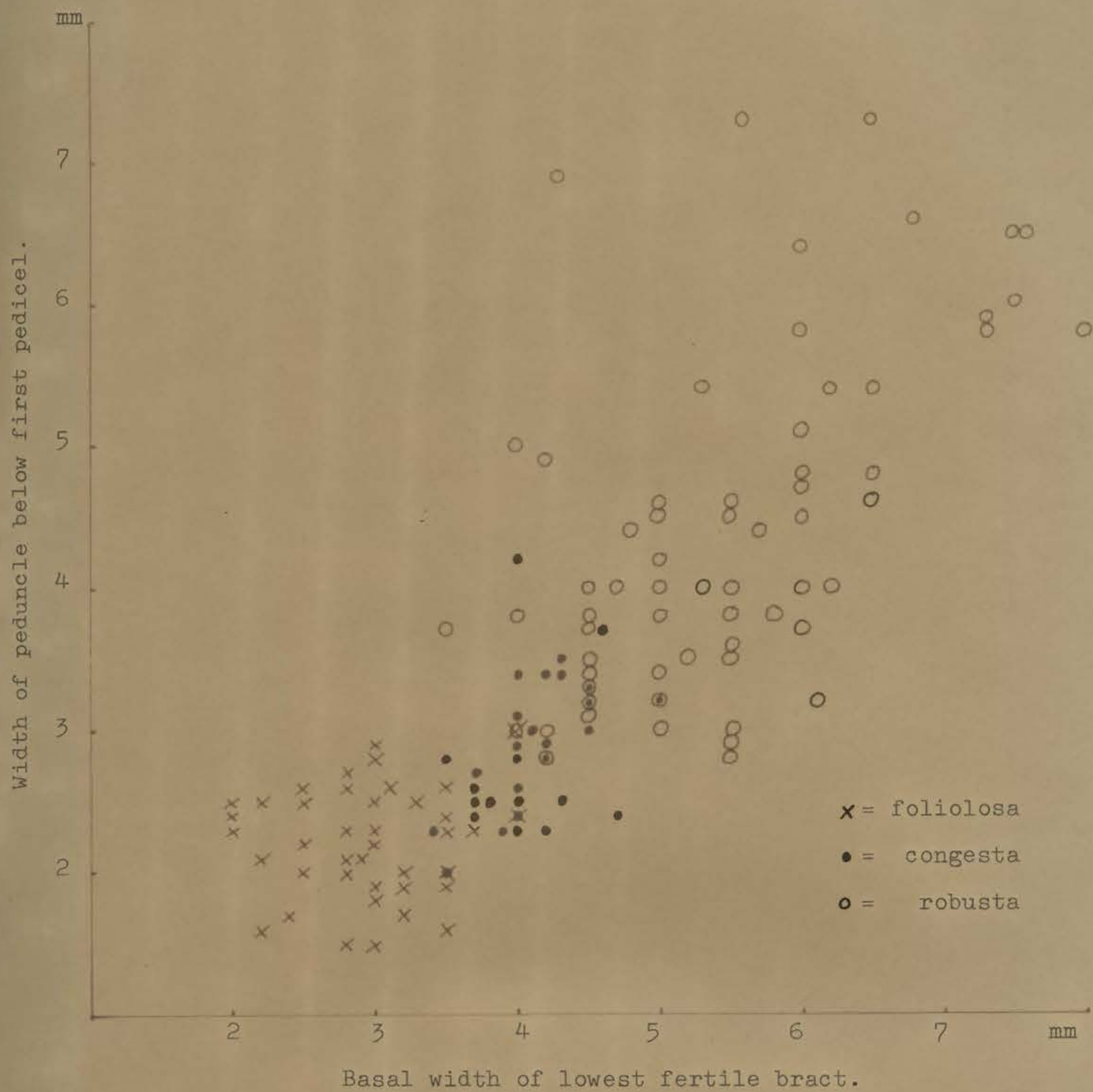


Fig.35. Showing variation in width of peduncle below raceme and basal width of lowest fertile bract in the foliolosa complex.

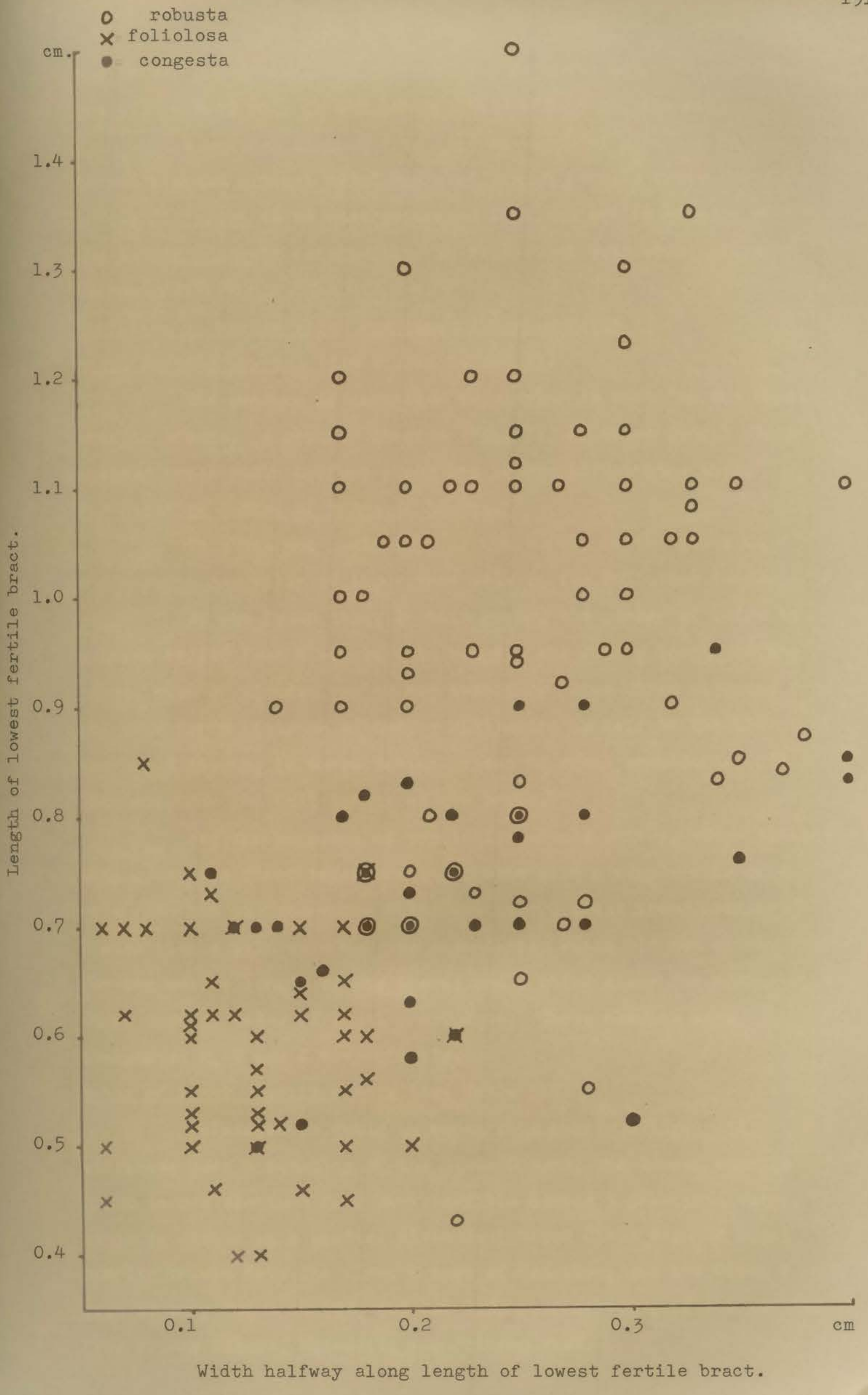


Fig.36. Variation in length, and width halfway along length of lowest fertile bract in the foliolosa complex.

the former population, the width of the peduncle below the raceme was 0.30 - 0.45 cm., in the latter, 0.15 - 0.45 cm. for most specimens.

A scatter diagram (Fig. 35) of width of peduncle below raceme plotted against basal width of lowest fertile bract shows the entity foliolosa to be most separated from the entity robusta with the entity congesta intermediate in respect of this combination of characters.

Variation in middle width and length-breadth ratio in basal fertile bracts. (See Tables 50 and 51)

The pattern of variation is similar to that for the basal sterile bracts. A scatter diagram (Fig. 36) of bract length plotted against bract width halfway along the length illustrates this.

Variation in number of veins in bracts.

This was not dealt with in the survey of the genus as a whole as it is really of importance only in the foliolosa complex.

It was found that, in this group, the number of veins in a bract varied from a single vein running the entire length of the bract, with or without one or two secondary veins which extended from the base for a distance of only a millimetre to half or two thirds of the bract length, to three central veins of equal prominence, all extending for the full length of the bract.

For the purposes of population sample survey, three classes were used, the first incorporating bracts with a single vein or a main vein and one secondary vein; the second class incorporating bracts with a main vein and two secondaries which did not extend for the entire length of the bract; and a third class for bracts with three central veins of equal prominence. These classes were designated A, B and C respectively.

Veins of basal sterile bracts (See Table 52)

Reference to Table 52 shows that nearly all robusta specimens have a venation of the Class C type, the lowest sterile bract in one specimen from Steytlerville having 5 prominent veins, (this is placed in a special class designated Class D). No basal sterile bracts have the Class A type of venation, and the Class B type is only found in 17%, 10% and 27%, respectively, of the samples from Prince Albert, Whitehill and Molteno Pass.

Locality.	D	C	B	A	No. in sample.
CONGESTA.					
Cradock R32	-	-	2	-	2
S. of Adelaide R38,39	-	-	5	1	6
Dikkop Vlakte R40	-	2	4	-	6
Helspoort R41	-	-	9	1	10
Krantz Drift (Commins 2063)	-	-	1	-	1
FOLIOLOSA.					
Graaff Reinet R10	-	2	19	11	32
Mt. Stewart R52	-	1	3	1	5
Wolwefontein R11	-	-	1	-	1
Springbok Vlakte Nbg	-	1	1	-	2
Steytlerville R52	-	2	10	3	15
ROBUSTA.					
Steytlerville R43	1	14	-	-	15
nr. Miller R45	-	7	-	-	7
Prince Albert R64	-	23	5	-	28
E. of Laingsburg R1	-	2	-	-	2
Whitehill O	-	9	1	-	10
E. of Nelspoort	-	11	-	-	11
Ft. of Molteno Pass (Hall 2284)	-	11	4	-	15

TABLE 52 Variation in veins of lowest sterile bract in Field Specimens of Foliolosa Complex.

In *foliolosa* and *congesta* population samples, the majority of basal sterile bracts have venation of the Class B type, the Class C type only being found in 8% of the *congesta* sample and 11% of the *foliolosa* sample. It is of interest to note in the *foliolosa* samples, that Class A venation is found in 34% of specimens from Graaff Reinet, compared with 20% of the Steytlerville sample.

Veins of fertile bracts (See Table 53)

The type of venation found in bracts from the base middle and top of the raceme was noted.

Basal fertile bracts

All populations of the entity *robusta* have Class C venation, in the great majority of specimens, with two exceptions. In the Molteno Pass population, 45% of the basal fertile bracts have Class B venation, while in specimens from Prince Albert, Class B venation is found in 30%, and Class A in 25% of the sample.

In *congesta* populations, the basal fertile bracts have a venation of Class A or Class B type, while the majority of specimens in the *foliolosa* populations have Class A venation.

Middle fertile bracts.

With the exception of one *congesta* specimen all bracts from the middle of racemes of *foliolosa* and *congesta* samples have Class A venation.

In the *robusta* populations, all individuals from Steytlerville and Miller, and 56% of the Whitehill sample still have bracts with Class C venation. Class B venation is found in 73% of the Molteno Pass sample, while the majority of individuals from Prince Albert have Class B or Class A venation, and Class A venation is found in 70% of the Nelspoort sample.

Apical fertile bracts

All bracts from the apices of racemes of the entities *congesta* and *foliolosa* have Class A venation, and this now applies to the majority of *robusta* specimens, with a few exceptions. In the Steytlerville population 75% of the bracts still have Class C venation, but the remainder have the Class A type. Mention must be made of the three specimens from East of Laingsburg, the apical

Locality.	Class range of variation in veins of bracts.									No. in sample.
	BASE OF RACEME.			MIDDLE OF RACEME.			TOP OF RACEME.			
	C	B	A	C	B	A	C	B	A	
CONGESTA.										
Cradock R32	-	1	1	-	-	2	-	-	2	2
S.of Adelaide R38,39	-	6	8	-	-	14	-	-	14	14
Dikkop Vlakte R40	-	3	2	-	-	5	-	-	5	5
Helspoort R41	-	5	5	-	1	9	-	-	10	10
Krantz Drift (Commins 2063)	-	-	1	-	-	1	-	-	1	1
FOLIOLOSA.										
Graff Reinet R60	-	8	23	-	-	31	-	-	31	31
Mt. Stewart R52	-	1	5	-	-	6	-	-	6	6
Wolwefontein R11	-	-	1	-	-	1	-	-	1	1
Springbok Vlakte Nbg	-	-	1	-	-	1	-	-	1	1
Steytlerville R52	-	2	13	-	-	15	-	-	15	15
ROBUSTA.										
Steytlerville R43	12	-	-	12	-	-	8	-	4	12
nr. Miller R45	7	-	-	7	-	-	-	-	-	7
Prince Albert R64	11	7	6	2	9	13	2	-	22	24
E. of Laingsburg R1	3	-	-	-	3	-	-	3	-	3
Whitehill O	7	1	1	5	3	1	-	2	7	9
E. of Nelspoort R42	9	1	-	-	3	7	-	-	10	10
Ft. of Molteno Pass (Hall 2284)	5	5	1	-	8	3	-	-	11	11

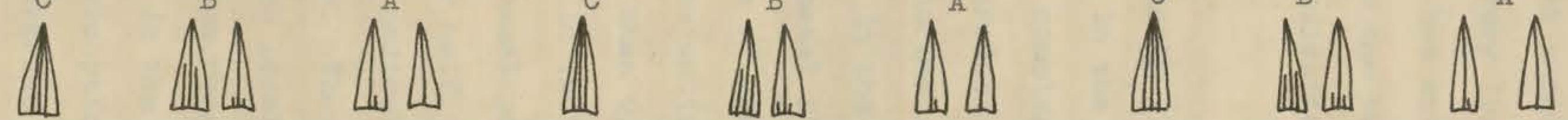


Table 53 Variation in veins of Fertile Bracts in Field Populations of the Foliolosa Complex.

bracts of which all have Class B venation.

The very high incidence of basal sterile and fertile bracts with three central veins in the entity robusta, compared with the very low incidence of such veins in the basal sterile bracts of the entities congesta and foliolosa, and their complete absence in the basal fertile bracts of these two entities is a further indication of a difference between them and the entity robusta.

Pedicel length (See Tables 54A, B, C and D)

In the tables showing variation in pedicel length in the foliolosa complex, a class interval of 0.05 cm., smaller than that of the introductory survey, is used to show more clearly the extreme shortness of the pedicels in the robusta entity.

In the introductory survey, it was shown that the shortest basal flowering pedicels occur in the entity robusta, where none of the specimens were found to be more than 0.2 cm. long. In both the entities congesta and foliolosa these pedicels ranged from less than 0.2 cm. to 0.4 cm. in length.

In individual populations of the entity robusta, the shortest basal pedicels are found in specimens from Nelspoort, where over half the sample have sessile flowers. It is of interest to note a pedicel length of 0.18 cm. recorded from the same population. The longest pedicels are found in plants from Molteno Pass, which locality, like Nelspoort, is at the northern end of the distribution range for this entity.

In the congesta and foliolosa populations, all pedicels, with the exception of four specimens, exceed 0.1 cm. in length. Thus the overlap with measurements for the entity robusta is quite small.

A scatter diagram (Fig. 37) of length of lowest flowering pedicel plotted against length of lowest fertile bract gives a good separation of the entities robusta from congesta and foliolosa, with the exception of an overlap due to individuals from Molteno Pass.

In the entity robusta, all pedicels from the middle of flowering racemes are found to be less than 0.05 cm. long, with

Locality.	Class range of measurements.									Total no. indiv.	Range actual measurements.
	0	0.05	0.10	0.15	0.20	0.25	0.30	0.35			cm.
CONGESTA.											
Cradock R32	-	-	-	-	2	3	2	-	-	8	0.17 - 0.40
S. of Adelaide R38,39	-	-	-	2	4	5	1	1	-	13	0.14 - 0.35
Dikkop Vlakte R40	-	-	1	1	2	-	-	-	-	4	0.08 - 0.20
Helspoort R41	-	-	2	1	1	2	-	-	-	6	0.07 - 0.25
FOILOLOSA.											
Graaff Reinet R60	-	-	-	1	10	5	4	1	-	21	0.14 - 0.34
Mt. Stewart R52b	-	-	-	1	1	-	-	-	1	3	0.15 - 0.38
Baroe R12	-	-	-	-	-	-	-	1	-	1	0.32
Wolwefontein R11	-	-	-	-	-	1	2	-	-	3	0.23 - 0.30
Springbok Vlakte Nbg	-	-	-	1	1	-	-	-	-	2	0.14 - 0.19
Steytlerville R52a	-	-	1	4	3	3	4	-	-	15	0.09 - 0.30
ROBUSTA.											
Steytlerville R43	2	5	2	-	-	-	-	-	-	9	0.00 - 0.08
Nr. Miller R45	-	5	2	-	-	-	-	-	-	7	0.02 - 0.09
Prince Albert R64	4	11	3	-	-	-	-	-	-	18	0.00 - 0.07
E. of Laingsburg R1	2	-	-	-	-	-	-	-	-	2	0.00
Whitehill O	1	4	3	1	-	-	-	-	-	9	0.00 - 0.13
E. of Nelspoort R42	6	3	1	-	1	-	-	-	-	11	0.00 - 0.18
Ft. of Molteno Pass (Hall 2284)	1	-	3	2	-	-	-	-	-	6	0.00 - 0.13

Class interval 0.05 cm.

Table 54A VARIATION IN LENGTH OF BASAL FLOWERING PEDICEL IN FIELD SPECIMENS OF FOLIOLOSA COMPLEX.

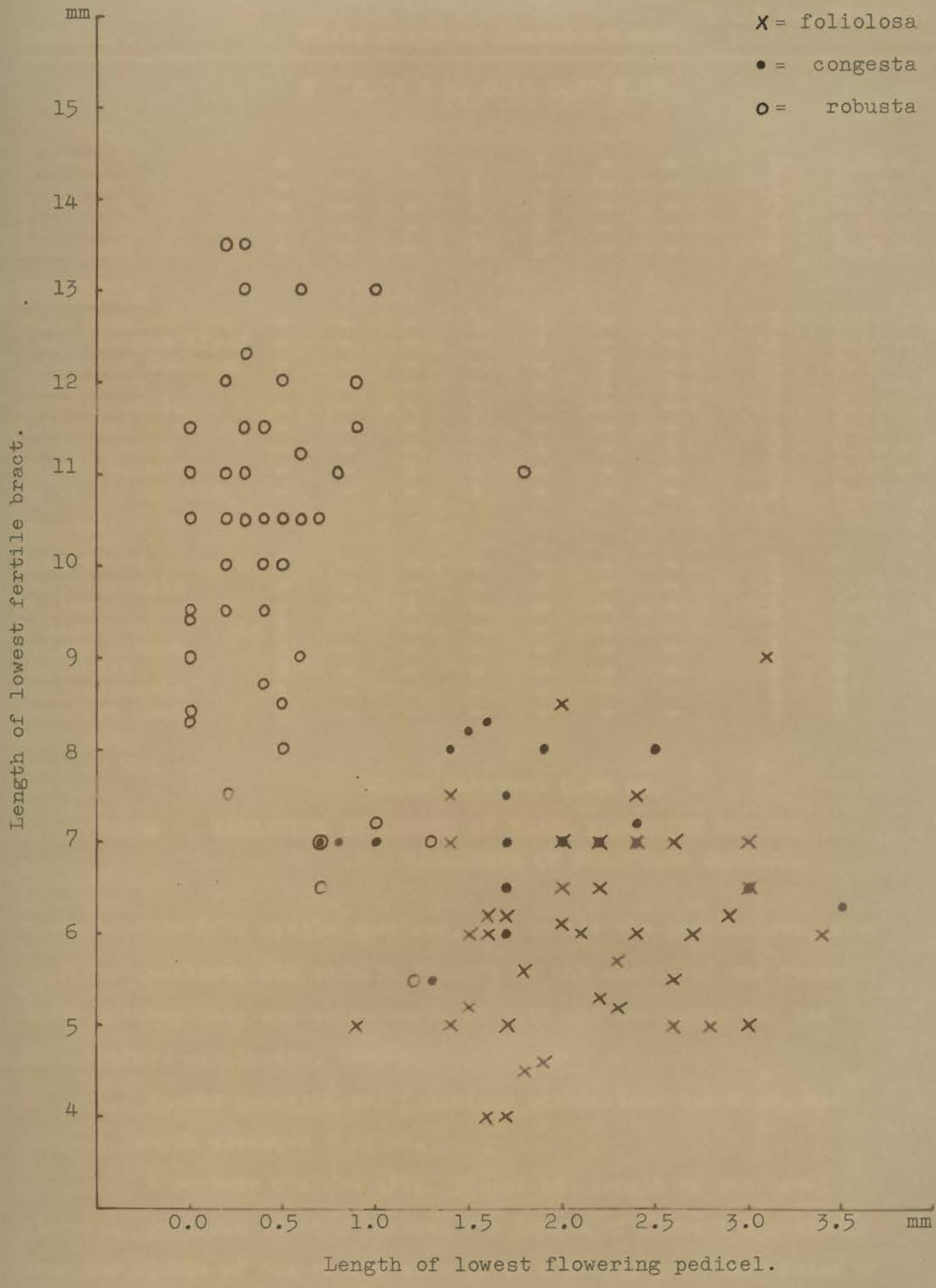


Fig.37. Variation in length of lowest fertile bract and length of lowest flowering pedicel in the foliolosa complex.

Locality.	Class range of measurements.							Total no. indiv.	Range actual measurements.
	0	0.05	0.10	0.15	0.20	0.25			cm.
CONGESTA.									
Cradock	-	-	-	-	1	-	-	1	0.16 -
Mortimer	-	-	-	1	-	-	-	1	0.14 -
Helspoort	-	-	-	1	2	-	-	3	0.14 - 0.18
Alicedale	-	-	-	-	1	-	-	1	0.18 -
Brakkloof	-	-	-	1	-	-	-	1	0.15 -
FOLIOLOSA.									
Addo Bush	-	-	-	1	1	-	-	2	0.14 - 0.18
Koega Kammas Kloof	-	-	-	-	1	-	-	1	0.18 -
Swartkops Sundays	-	-	-	-	-	1	-	1	0.25
Kleinpoort	-	-	-	-	-	1	2	3	0.23 - 0.28
Steytlerville	-	-	-	1	-	-	-	1	0.15
Waterford	-	-	-	1	-	-	-	1	0.15
Kruidfontein	-	-	-	-	1	-	1	2	0.20 - 0.29
Graaff Reinet	-	-	1	1	-	-	-	2	0.08 - 0.14
E. of Laingsburg	-	-	-	1	-	-	-	1	0.15
ROBUSTA.									
Lake mentz	1	-	-	-	-	-	-	1	0.00
Steytlerville	-	2	-	-	-	-	-	2	0.05
Miller	-	-	1	-	-	-	-	1	0.08
Willowmore	1	-	-	-	-	-	-	1	0.00
Prince Albert	1	-	-	-	-	-	-	1	0.00
Whitehill	2	-	-	-	-	-	-	2	0.00
Matjesfontein	1	-	-	-	-	-	-	1	0.00
Beaufort West	3	-	-	-	-	-	-	3	0.00

Class interval 0.05 cm.

Table 54B VARIATION IN LENGTH OF BASAL FLOWERING PEDICEL IN HERBARIUM SPECIMENS OF FOLIOLOSA COMPLEX.

the exception of a single specimen, and in all the populations, over half the specimens had sessile flowers by the middle of the raceme. Unfortunately only one measurement of this was available for the Molteno Pass population.

In the congesta and foliolosa populations examined, mid pedicel length exceeded 0.05 cm.

A scatter diagram (Fig. 38) of the length of the basal flowering pedicels plotted against the length of flowering pedicels from the middle of the raceme also gives a fairly good separation of the entity robusta from the entities congesta and foliolosa. Pedicel length in the two latter entities is very similar.

In general, herbarium specimens agree with the above observations. It is of interest to note the shortness of the pedicels of the few specimens of the entity robusta from Beaufort West in

Locality.	Class range of measurements.								Total no. indiv.	Range actual measurements
	0	.05	.10	.15	.20	.25	.30			cm.
	FIELD SPECIMENS.									
CONGESTA.										
Cradock R32	-	-	-	2	5	3	-	-	10	0.14 - 0.24
S. of Adelaide R38,39	-	-	4	4	4	-	1	-	13	0.09 - 0.28
Dikkop Vlakte R40	-	-	1	4	-	-	-	-	5	0.10 - 0.14
Helspoort R41	-	-	8	4	1	-	-	-	13	0.06 - 0.17
FOLIOLOSA.										
Graaff Reinet R60	-	-	2	8	12	3	-	-	25	0.08 - 0.23
Mt. Stewart R52b	-	-	1	1	-	-	-	1	3	0.10 - 0.32
Baroe R12	-	-	-	-	-	1	-	-	1	0.25
Wolwefontein R11	-	-	-	-	2	1	-	-	3	0.18 - 0.25
Springbok Vlakte Nbg	-	-	1	1	-	-	-	-	2	0.09 - 0.14
Steytlerville R52a	-	-	5	4	8	2	-	-	19	0.08 - 0.24
ROBUSTA.										
Steytlerville R43	9	6	-	-	-	-	-	-	15	0.00 - 0.05
nr. Miller R45	6	1	-	-	-	-	-	-	7	0.00 - 0.02
Prince Albert R64	15	7	-	-	-	-	-	-	22	0.00 - 0.04
E. of Laingsburg R1	2	-	-	-	-	-	-	-	2	0.00
Whitehill O	5	3	1	-	-	-	-	-	9	0.00 - 0.07
E. of Nelspoort R42	7	4	-	-	-	-	-	-	11	0.00 - 0.03
Ft. of Molteno Pass	-	1	-	-	-	-	-	-	1	0.05
	HERBARIUM SPECIMENS.									
CONGESTA.										
Rayners Kop	-	-	1	-	-	-	-	-	1	0.09
Mortimer	-	-	1	-	-	-	-	-	1	0.09
Helspoort	-	-	2	2	-	-	-	-	4	0.09 - 0.15
Alicedale	-	-	1	-	-	-	-	-	1	0.05 - 0.10
FOLIOLOSA.										
Addo Bush	-	-	1	-	-	-	-	-	1	0.07
Koega Kammas Kloof	-	-	-	1	-	-	-	-	1	0.15
Kleinpoort	-	-	-	1	2	-	-	-	3	0.15 - 0.20
Waterford	-	-	1	-	-	-	-	-	1	0.10
Kruidfontein	-	-	-	1	-	-	-	-	1	0.15
E. of Langsburg	-	-	1	-	-	-	-	-	1	0.07
ROBUSTA.										
Lake Mentz	1	-	-	-	-	-	-	-	1	0.00
Steytlerville	-	2	-	-	-	-	-	-	2	0.02 - 0.03
Miller	-	1	-	-	-	-	-	-	1	0.04
Willowmore	1	-	-	-	-	-	-	-	1	0.00
Prince Albert	1	-	-	-	-	-	-	-	1	0.00
Whitehill	2	-	-	-	-	-	-	-	2	0.00
Matjesfontein	1	-	-	-	-	-	-	-	1	0.00
Beaufort West	3	-	-	-	-	-	-	-	3	0.00

Class interval 0.05 cm.

Table 54C VARIATION IN LENGTH OF FLOWERING PEDICEL FROM MIDDLE OF RACEME IN FOLIOLOSA COMPLEX.

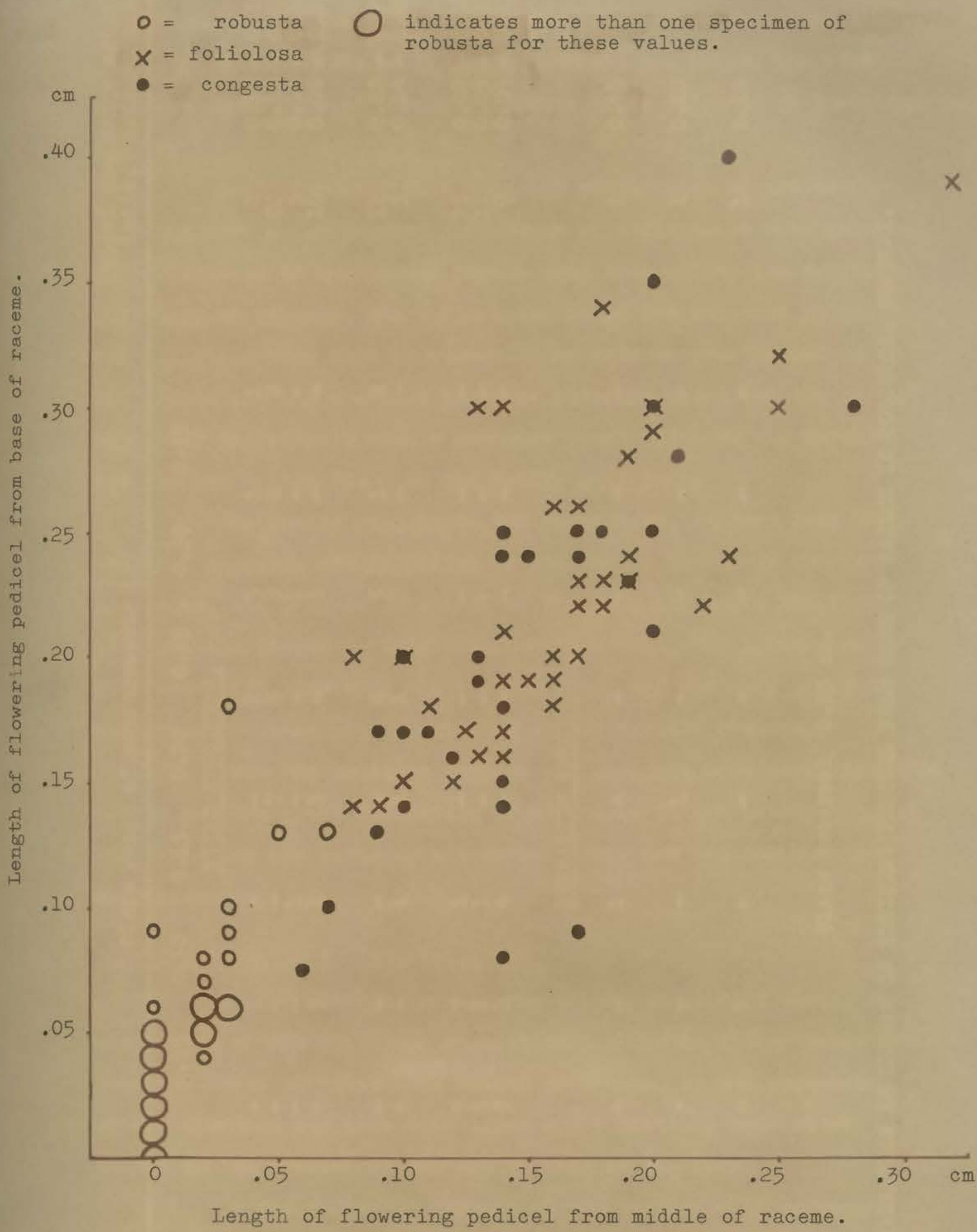


Fig.38. Variation in length of flowering pedicels from the base and the middle of racemes in the foliolosa complex.

Locality.	Class range of measurements								Total no. indiv.	Range actual measurements.
	0.05	0.10	0.15	0.20	0.25	0.30	0.35			cm.
				FIELD SPECIMENS.						
CONGESTA.										
Cradock R32	-	1	-	-	2	3	1	1	8	0.10 - 0.36
S. of Adelaide R38,39	-	-	-	7	6	3	2	2	20	0.18 - 0.38
Dikkop Vlakte R40	-	-	1	-	-	2	-	-	3	0.14 - 0.30
Helspoort R41	-	5	1	3	-	1	-	-	10	0.06 - 0.28
FOLIOLOSA.										
Graaff Reinet R60	-	-	-	-	6	3	1	2	12	0.22 - 0.37
Steytlerville R52a	-	-	1	1	1	2	-	-	5	0.14 - 0.28
ROBUSTA.										
Steytlerville R43	7	7	1	-	-	-	-	-	15	0.02 - 0.14
Prince Albert R64	6	4	1	-	-	-	-	-	11	0.03 - 0.12
Ft. of Molteno Pass (Hall 2284)	3	2	4	-	-	-	-	-	9	0.04 - 0.15
				HERBARIUM SPECIMENS.						
CONGESTA.										
Rayners Kop	-	-	1	-	-	-	-	-	1	0.15
FOLIOLOSA.										
Waterford	-	-	-	1	-	-	-	-	1	0.20
ROBUSTA.										
Whitehill	-	1	-	-	-	-	-	-	1	0.10

Class interval 0.05 cm.

Table 54D VARIATION IN LENGTH OF FRUITING PEDICEL FROM BASE OF RACEME IN FOLIOLOSA COMPLEX.

comparison with those from the nearby Molteno Pass locality.

Measurements of fruiting pedicels are fewer, but also show the above pedicel elongation which takes place after fertilisation.

Summary

Apart from the fact that all populations of the entity congesta have a far greater percentage of individuals with branched inflorescences or unexpanded raceme buds than either the entities foliolosa or robusta, the inflorescences of the entities congesta and foliolosa have much in common. The only noteworthy points of difference are the somewhat narrower peduncle bases and the larger number of individuals with a narrower basal width in the fertile and sterile bracts found in the entity foliolosa.

The entity robusta on the other hand, differs from the entities congesta and foliolosa in the larger number of shorter peduncles, the greater thickness of the peduncle below the first pedicel, the longer fertile and sterile bracts, the larger number of bracts with more than one central vein, and the very great numbers of racemes with sessile or almost sessile flowers.

Both the entities robusta and congesta have stout peduncle bases, but the great flattening of old bases in the entity robusta is not typical in congesta. Although these differences between robusta and the other two entities are marked, they are not completely discontinuous.

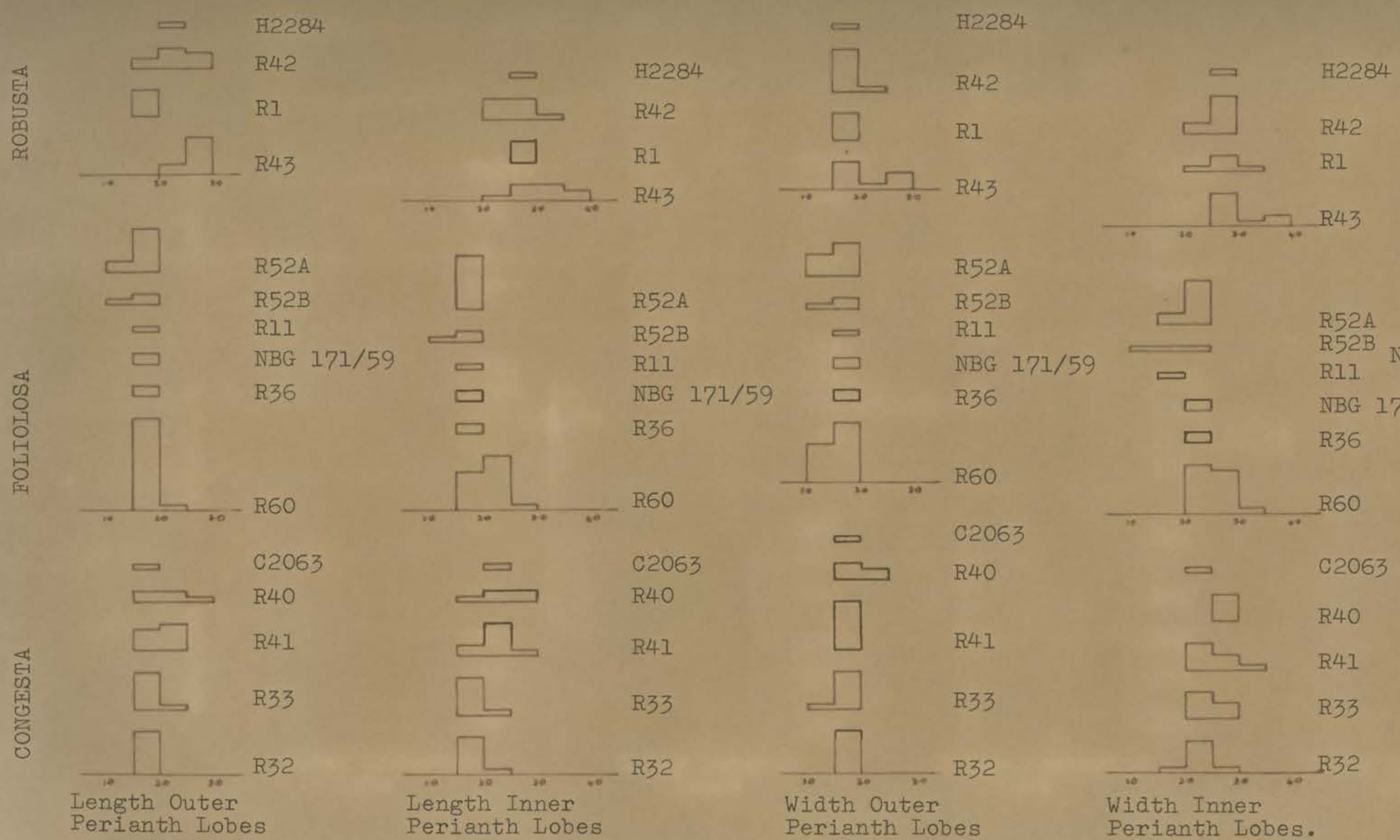
PERIANTH CHARACTERS (See Plate 18).

In the introductory survey of the genus as a whole, the components of the foliolosa complex were shown to differ somewhat from the other entities with smooth perianths, in the possession of the broadest and most open lobes and a perianth tube which tended to be broader in the middle than at the base.

In the following account of the variation of perianth characters within the foliolosa complex, the variation patterns for each population are represented by more compact histograms, for the differences in dimensions between the entities are, with few exceptions, slight.

Length of perianth lobes. (See Fig. 39)

In general inner and outer perianth lobes tend to be



	LOCALITY
H2284	Nr. Molteno Pass
R42	E. of Nelspoort
R1	E. of Laingsburg
R43	Steytlerville
R52A	Steytlerville
R52B	Mt. Stewart
R11	Wolvefontein
NBG 171/59	Springbok Vlakte
R36	Lake Mentz
R60	Graaf Reinet
C2063	Krantz Drift
R40	Dikkop Vlakte
R41	Helspoort
R33	Rayners Kop
R32	Cradock

Fig. 39. Variation in dimensions of perianth lobes in the foliolosa complex.

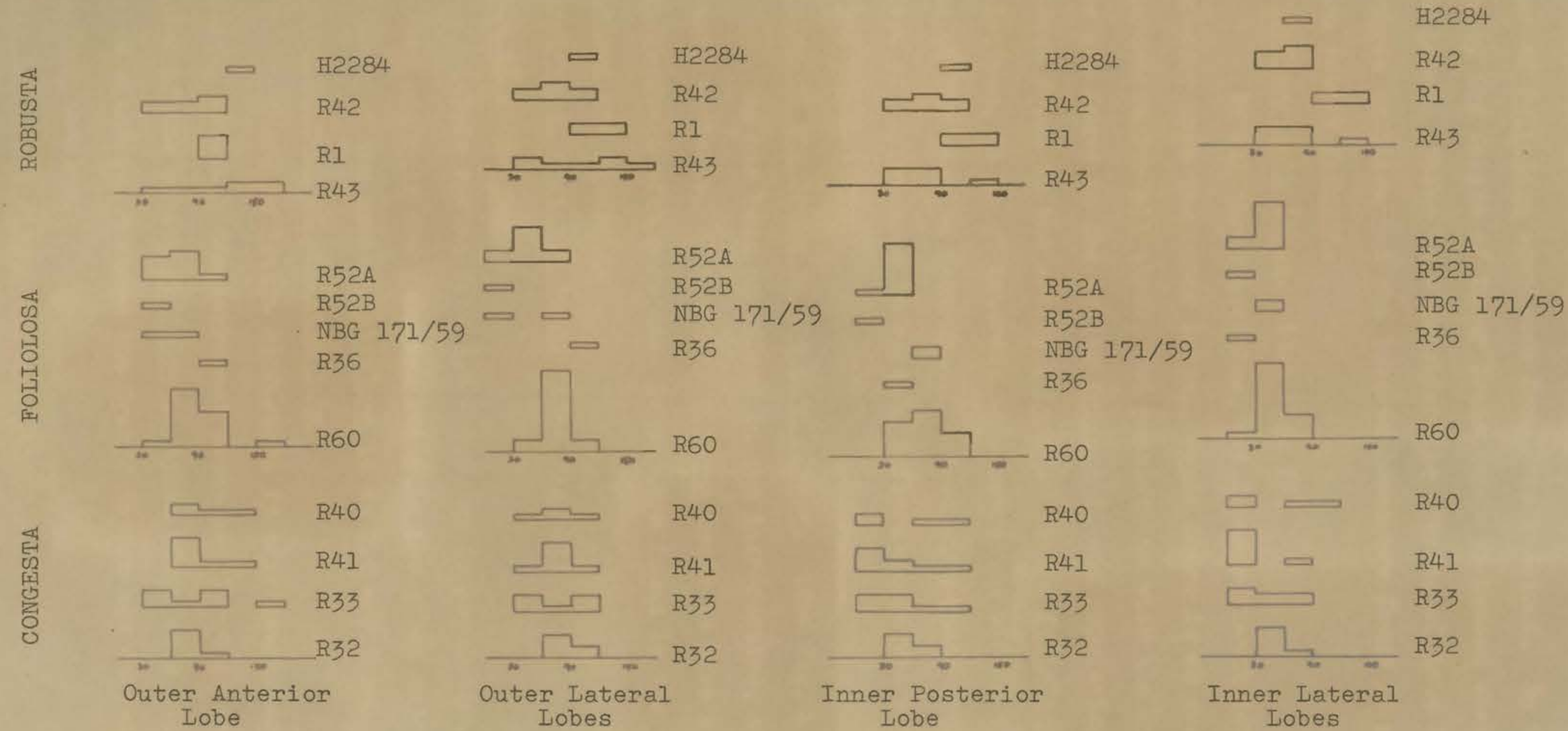


Fig.40. Variation in position of lobes in open flowers of the foliolosa complex.

of the same length in the <u>congesta</u> and <u>foliolosa</u> samples, with the exception of the slightly longer inner lobes of a large number of <u>foliolosa</u> specimens from Graaff Reinet. In the entity <u>robusta</u>, the length of inner lobes tends to exceed that of the outer lobes. There is a considerable overlap of lobe length in all three entities but the longest lobes are found in populations of the entity <u>robusta</u>.

<u>Width of perianth lobes</u>. (See Fig. 39)

In all three entities, the inner perianth lobes tend to be broader than the outer lobes. Again there is an overlap of measurements for all three, but populations with the narrowest lobes are found in the entity <u>foliolosa</u>, and populations with the broadest lobes in the entity <u>robusta</u>. In the <u>foliolosa</u> populations, it is of interest to compare the widths of the inner lobes of the samples from Graaff Reinet with those from Steytlerville, in view of differences in certain inflorescence characters between the two populations.

<u>Position of the lobes in the open flower</u>. (See Fig. 40)

As has been mentioned in the introduction, these characters, are very variable. The entity <u>robusta</u> tends to have a larger number of individuals with more open lobes than found in the entities <u>foliolosa</u> and <u>congesta</u>.

<u>Dimensions of perianth tube</u>. (See Fig. 41)

<u>Length of tube</u>.

This varies from 5.0 - 9.0 mm in populations of the entities <u>congesta</u> and <u>robusta</u>, while in the great majority of specimens of the entity <u>foliolosa</u> it is 7.0 - 9.0 mm.

<u>Diameter of neck of perianth tube</u>

There is little difference in this character in the three entities, although the narrowest necks are found in population samples of the entity <u>foliolosa</u>. Again there is a slight difference in this dimension between the Graaff Reinet and Steytlerville <u>foliolosa</u> samples.

<u>Middle and basal diameters of perianth tube</u>.

There is little difference between the three entities with regard to these dimensions. There is again a slight difference

A(X 1¼)

C(X ½)

B(X 1⅓)

D(X 1¼)

A and B: Portions of inflorescences from specimens of the entity foliolosa. The lobes in B are not as open as in A.

C and D: Portions of inflorescences from specimens of the entity congesta.

E: Part of inflorescence of a specimen of the entity robusta.

E(X 1⅕)

PLATE 18.

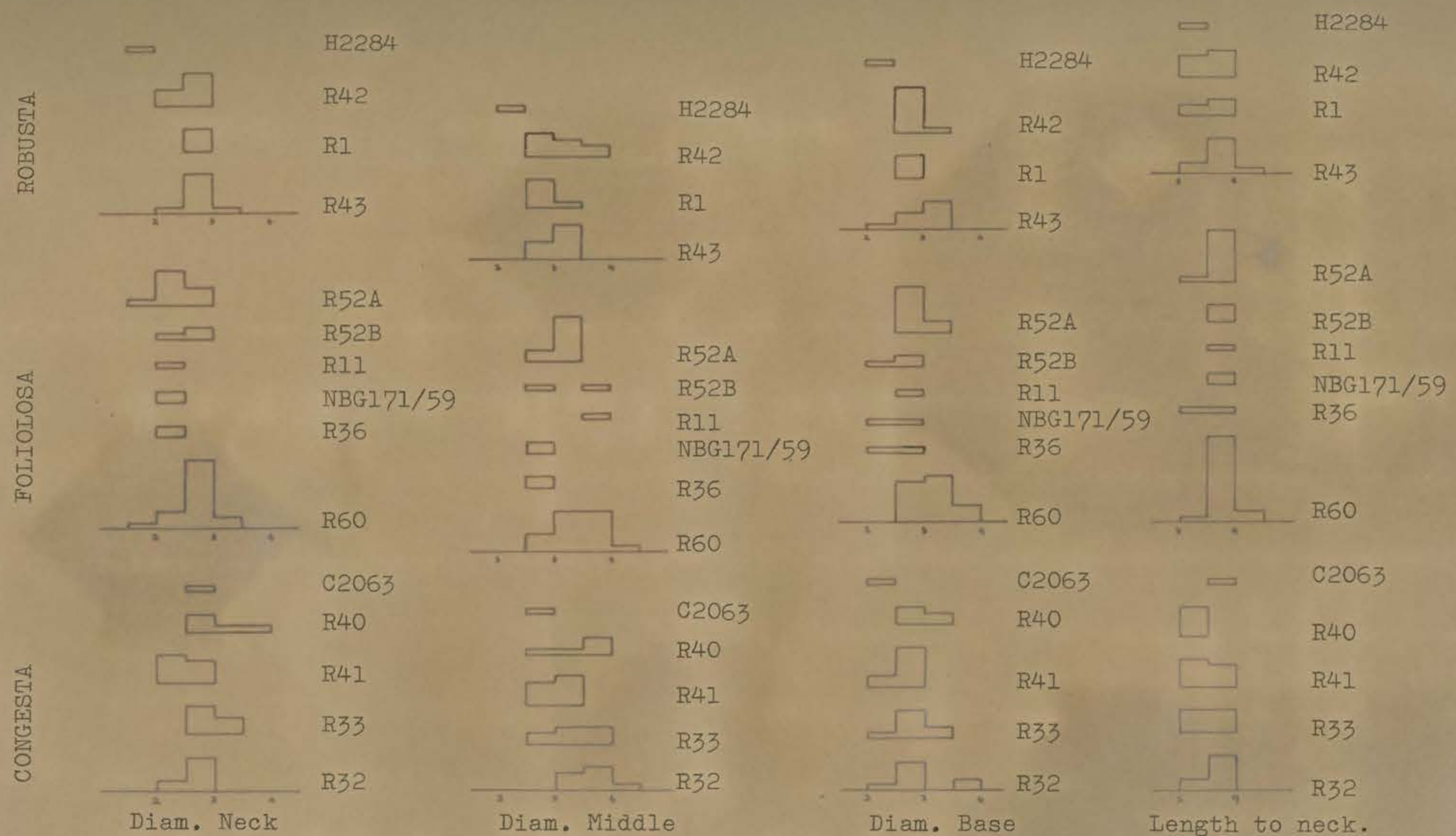


Fig.41. Variation in dimensions of perianth tube in the foliolosa complex.

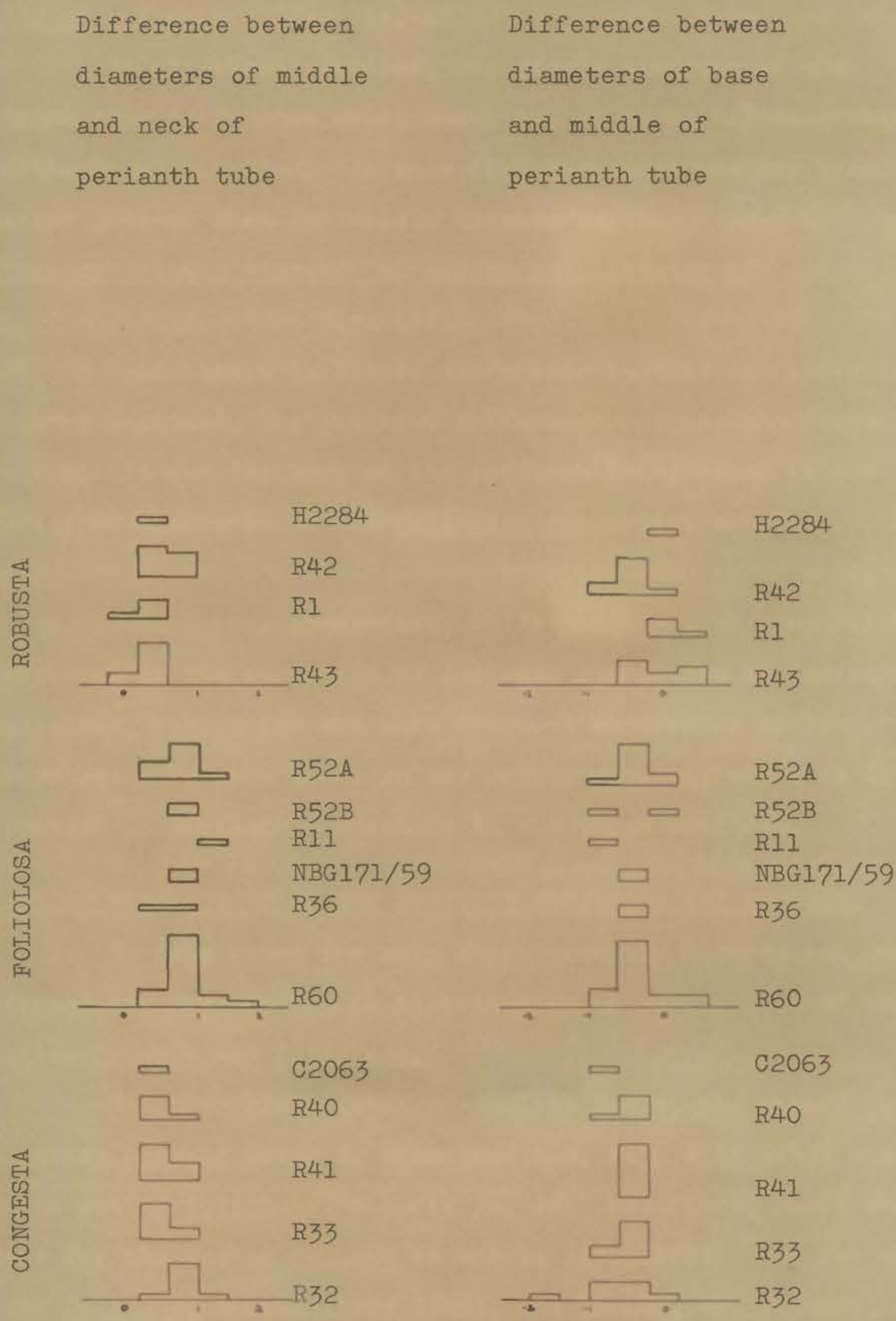


Fig.42. Variation in the shape of the perianth tube in the foliolosa complex.

in the diameter of the base of the perianth tube between the majority of specimens of the entity foliolosa from Graaff Reinet and those from Steytlerville.

Difference between diameter of base and diameter of middle of perianth. (See Fig. 42)

In all three entities, the middle diameter of the perianth tube is in most cases equal to, or up to 0.5 mm greater than the basal diameter. In only five instances was the basal diameter greater than the middle diameter.

Difference between diameter of middle and diameter of neck of perianth. (See Fig. 42)

Again there is little difference in this character in the three entities, the greatest difference between the diameters of the middle and the neck of the perianth being found in the majority of specimens of the foliolosa population samples.

Summary

This survey shows that, while there may be some slight differences in the variation of perianth characters in individual populations, except for the more frequent occurrance of longer broader and more open lobes in the entity robusta, there is little difference in perianth characters in the three entities.

MIXED POPULATIONS OF THE ENTITIES FOLIOLOSA AND ROBUSTA.

To date there are only three probable records and one confirmed one for overlap in distribution of populations of the entities robusta and foliolosa.

The probable records are: Lake Mentz, the record for the entity robusta being S. Schonland s.n. Aug. 1921 (PRE) and for the entity foliolosa, Roberts 36, 37; Waterford, where the record for the entity robusta is Acocks 11995 (PRE), and for the entity foliolosa Acocks 11997 (PRE), and lastly, Mt. Stewart, where the record for the entity robusta is Compton 20323 (NBG) and for the entity foliolosa, Roberts 13 and 52B.

The confirmed locality where these two entities have been found growing together, is at Steytlerville and has been described previously.

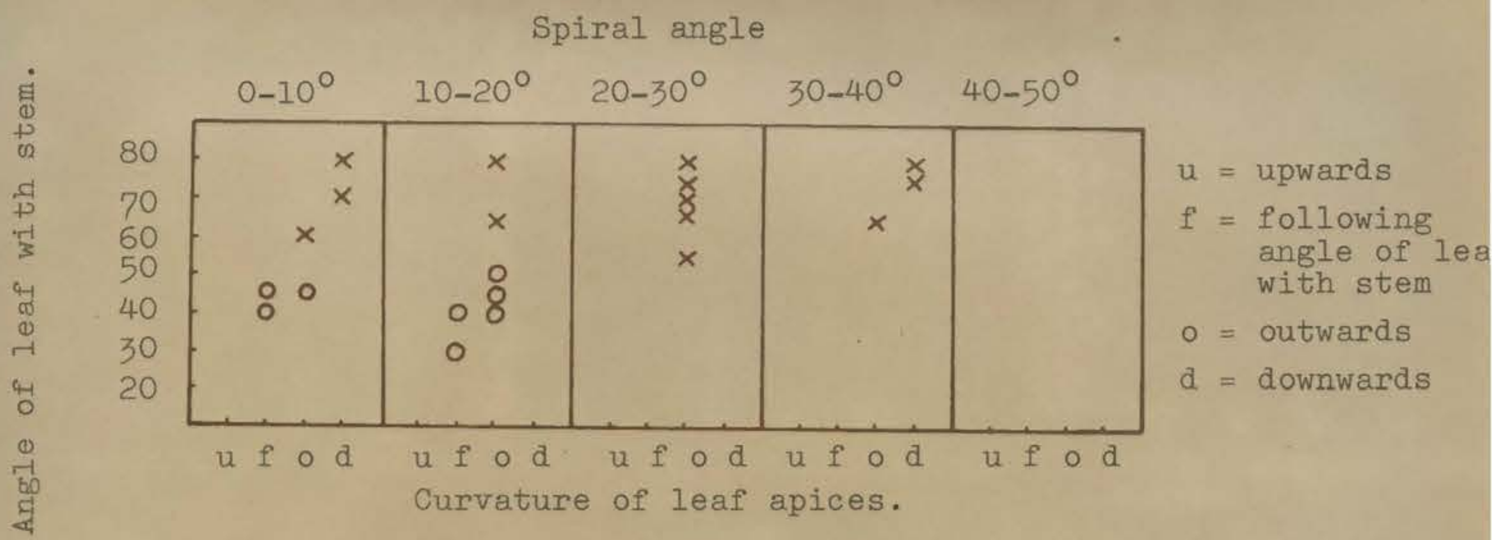
There are no known records of overlap of populations of the entities foliolosa and congesta or of the entities robusta and congesta.

Scatter diagrams incorporating vegetative and inflorescence characters of the mixed Steytlerville population have been compiled. (See Figs. 43 and 44). These show that the two entities are distinguishable at this locality, but more so by inflorescence characters than by vegetative ones. In the case of the scatter diagrams involving inflorescence characters, apart from that showing length of lowest fertile bract plotted against length of lowest sterile bract (Fig. 44F) the overlap of values for each entity is none or very slight. Separation is most wide in the diagrams of length of peduncle plotted against basal width of peduncle, (Fig. 44A) and length of pedicel from base of flowering raceme plotted against length of lowest fertile bract, (Fig. 44G). In the case of the vegetative characters the overlap of values for the two entities is more, but in no case are they completely intermingled.

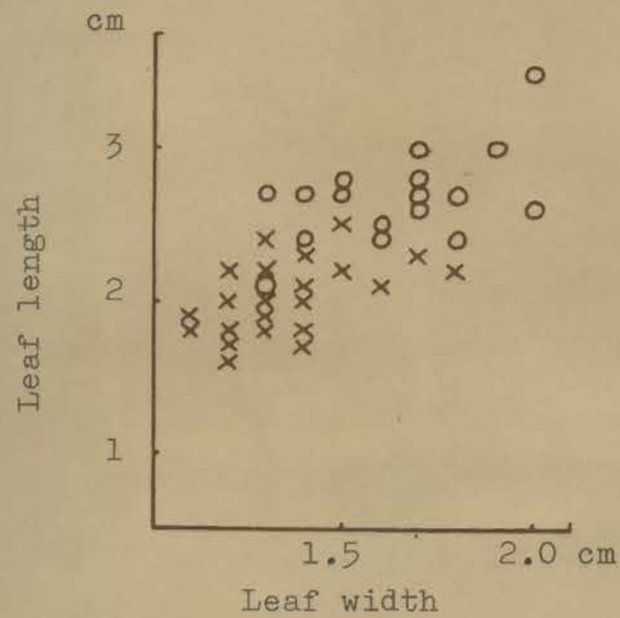
Entity	Collector	Date	Condition at time of collecting
ROBUSTA	Dyer 4022 (PRE)	Aug. 1939	Flowering
	Roberts 15	Oct. 1959	No buds or flowers
	Roberts 43	Jul. 1960	Flowering
	Roberts Obs.	Oct-Nov.1960	No buds or flowers
FOLIOLOSA	Paterson 40 (BOL)	Nov. 1911	Flowering
	Roberts 14	Oct. 1959	Buds and flowers
	Roberts 43A	Jul. 1960	No buds or flowers
	Roberts 52A	Oct-Nov.1960	Buds and flowers

Table 55: FLOWERING TIMES OF THE ENTITIES FOLIOLOSA AND ROBUSTA IN A MIXED POPULATION FROM STEYTLERVILLE.

As can be seen from Table 55, flowering times for the two entities tend to differ, which lessens the chance of hybridisation. In view of the morphological similarity of the chromosome complements of the entities, one would expect the possibility of hybridisation with vigorous off-spring. If hybridisation has indeed taken place

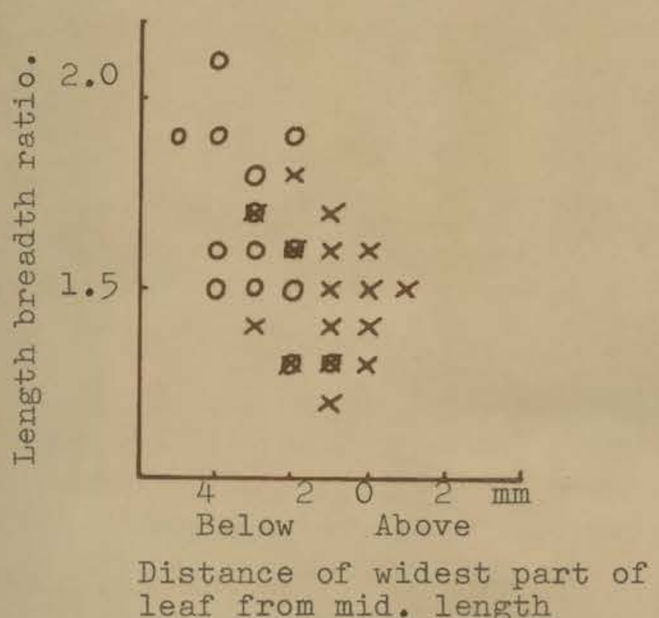


A. APPEARANCE OF LEAFY SHOOT INCORPORATING SPIRAL ANGLE, ANGLE OF LEAF WITH STEM AND TREND OF LEAF APICES.

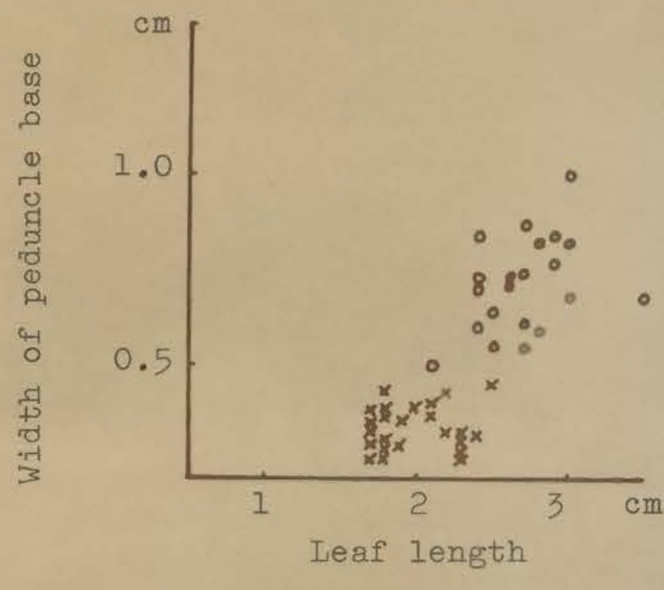


B. LENGTH AND WIDTH OF LEAF

Plants of the two entities growing next to one another in this mixed population. The entity robusta is on the left.



D. LENGTH BREADTH RATIO AND DISTANCE OF WIDEST PART OF LEAF FROM MID LENGTH.



E. BASAL WIDTH OF OLD DRIED PEDUNCLES AND LEAF LENGTH.

Fig.43. Showing variation in vegetative characters of a mixed population of the entities <u>foliolosa</u> (R14) and <u>robusta</u> (R15 from Steytlerville. (o = robusta, x = foliolosa).

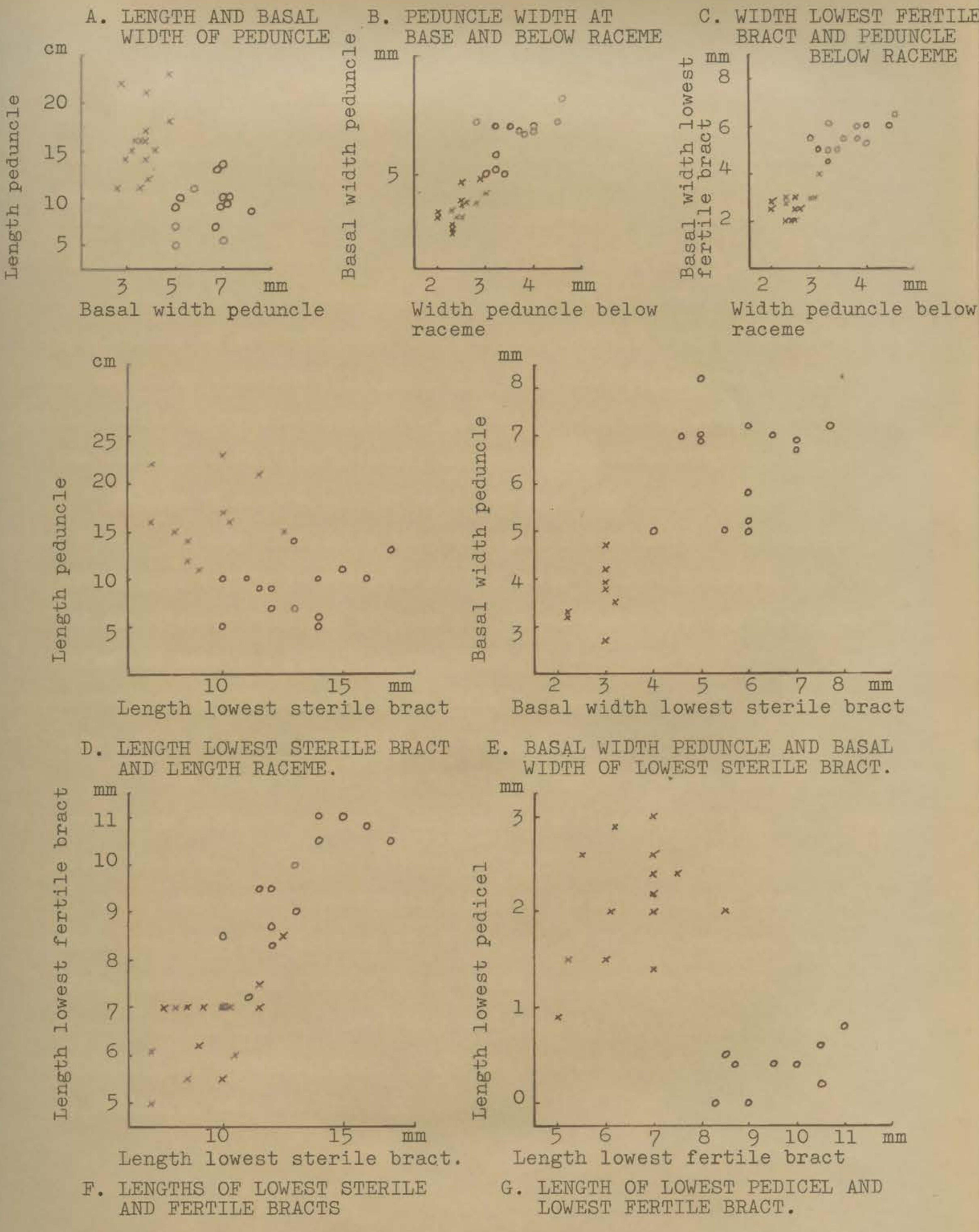


Fig.44. Showing variation in inflorescence characters of a mixed population of the entities <u>foliolosa</u> (R14) and <u>robusta</u> (R15) from Steytlerville. (o = robusta, x = foliolosa).

then the off-spring have reverted back to parental types, for the two entities in this mixed population are still recognisably distinct.

CONCLUSION.

It is felt that the foregoing detailed survey of populations of the foliolosa complex does justify the recognition of the three entities foliolosa, congesta and robusta, but shows that while there are many features characteristic of each, these characters are not sufficiently discontinuous to warrant the recognition of each entity as separate species.

As the discussion on geographic distribution has shown, the robusta entity is confined to the drier western karoid areas and experiences rainfall of both the summer and winter patterns, while the entities foliolosa and congesta occur in the more easterly marginal (according to Acock's classification), karoid areas, with a summer rainfall pattern.

It would appear that the foliolosa complex is diverging into three distinct species, but that this divergence is by no means complete.

Because of the almost disjunct distributions of the three entities, and because of the degree of differentiation in each, it seems most reasonable to treat them as sub-species, namely; A. foliolosa (Haw.) Uitewaal sub. sp. foliolosa, A. foliolosa subsp. congesta (Salm Dyk) Roberts comb. nov. and A. foliolosa sub. sp. robusta Roberts subsp. nov.

THE ENTITIES SMUTSIANA, HALLII, BULLULATA AND RUGOSA

The fact that the remaining entities with smooth perianthe tubes are dealt with together, does not at the outset imply a relationship between them. Compared with the A.foliolosa complex, they have in common a tendency for the perianth lobes to be slightly smaller and less open and for the perianth tube to be broader at the base than at the middle in most cases. Further, all have epidermal cells with markedly convex outer walls.

The introductory survey has shown that the entities hallii and bullulata have in common a tendancy for the spiral angle to be low, the leaf apices to curve upward, and to be of a keeled marginate nature. There is a considerable similarity in their inflorescences, and in both, the perianth lobes tend to develop a chrome yellow colour found in no other entities with smooth perianths. Together with the entity rugosa they are the only entities in which tubercles have been found on the leaves of plants found in the field.

In the past, there has been little confusion over the identification of the entity bullulata (referable to Astroloba bullulata (Jacq.) Uitew) and the entity rugosa (formerly Astroloba aspera (Haw.) Uitew), these being recognised as distinct species by all authors except Baker (1881, 1896-1897) who considered bullulata a variety of a species, "Apicra pentagona Willd," and von Poellnitz (1930) who described a new species, Apicra egregia, from what appear to have been undoubtedly specimens of bullulata.

There has, however, been considerable confusion over the identity of specimens belonging to the entities hallii and smutsiana as construed by the present author. In the past, the epithets "pentagona" and "spirella" have been applied to both entities, but it is impossible to determine the true identity of the species originally described as "A.pentagona" and "A.spirella", and the present author has been forced to abandon these epithets and to construe anew the taxonomic concepts of the components of these two species.

Mention has been made of a suspected hybrid between members of the entities rugosa and smutsiana which was found in the Ladismith-Barrydale Karoo, and it is for this reason, in addition to the tuberculate nature of the leaves, that the entity rugosa is included in this survey.

An account of the distribution of all four entities has already been given, and examination of the accompanying tables shows that the four populations of the entity smutsiana come from both the Little Karoo and the northern foothills of the Swartberg, while there are only two samples for hallii, one from the northern foothills of the Swartberg, the other from the Great Karoo. There are also only two localities for the entity bullulata,one from near Matjesfontein, the other from the eastern Tanqua Karoo. For the entity rugosa, a number of samples were collected in the Montagu Karoo, and one from the Ladismith-Barrydale Karoo.

The putative hybrid between members of the entities rugosa and smutsiana is included in the following population variation tables under the name "Hybrid R4." In this instance, although only one such plant was found, measurements of leaf arrangement etc., for several shoots are given in each table. This hybrid was found amongst plants of the smutsiana population referred to as Ladismith-Barrydale II, R3.

VEGETATIVE FEATURES (See Plates 19, 20, 21, 22, 23).

In the tables showing variation in appearance of the leafy shoot, the Montagu Karoo specimens of the entity rugosa are given together as a single sample, in the other tables, individual localities are given. The Rietvlei locality for the entity rugosa from the Montagu Karoo must not be confused with the Rietvlei localities for the entities halii and smutsiana in the northern fotthills of the Swartberg.

Leaf arrangement (See Table 56)

It was on this character that the early authors separated the various species they described belonging to what are now recognised as the entities hallii and smutsiana.

The introductory survey showed the entities hallii, bullulata and rugosa to have the majority of individuals with the smallest spiral angle, (0 - 10°), in the whole genus. Only 13% of the total samples of the entities bullulata and hallii has a spiral angle of more than 10°.

Locality.	Class range of measurements.					Total no. indiv.	Range actual measurements.
	SPIRAL ANGLE. Class interval 10°						
		0°	10°	20°	30°		°
HYBRID R4	-	-	3	-	-	3	11 - 15
SMUTSIANA.							
L'smith-B'dale I R5	-	5	6	6	1	18	3 - 40
L'smith-B'dale II R3	-	2	3	2	2	9	8 - 36
Rooinek Pass R51	-	1	3	7	3	14	2 - 33
nr. Rietvlei R49	-	-	4	-	1	5	11 - 33
HALLII.							
nr. Rietvlei R48	1	6	1	-	-	8	0 - 15
Koup R26	2	12	2	-	-	16	0 - 16
BULLULATA.							
N. Matjesfontein R25	1	7	-	1	-	9	0 - 21
Ceres-S'land R24	-	13	2	-	-	15	1 - 20
RUGOSA.							
nr. Montagu R17-23,50a	1	13	4	2	-	20	0 - 25
L'smith-B'dale R2	-	-	2	-	-	2	14 - 20
	ANGLE OF LEAF WITH STEM. Class interval 20°						
	Erect.	30°	Sub-erect.	50°	Patent erect.		°
HYBRID R4	-		3		-	3	40 - 45
SMUTSIANA.							
L'smith-B'dale I R5	-		16		2	18	35 - 60
L'smith-B'dale II R3	-		9		-	9	40 - 50
Rooinek Pass R51	-		12		2	14	40 - 60
nr. Rietvlei R49	1		1		3	5	30 - 55
HALLII.							
nr. Rietvlei R48	-		7		1	8	40 - 55
Koup R26	6		10		-	16	20 - 50
BULLULATA.							
N. Matjesfontein R25	-		9		-	9	35 - 50
Ceres-S'land R24	-		14		1	15	40 - 55
RUGOSA.							
nr. Montagu R17-23,50a	-		19		1	20	40 - 60
L'smith-B'dale R2	-		2		-	2	40 - 50
	CURVATURE OF LEAF APICES. *						
	us	u	f	o			
HYBRID R4	-	-	-	3		3	o
SMUTSIANA.							
L'smith-B'dale I R5	-	-	7	11		18	f - o
L'smith-B'dale II R3	-	-	-	9		9	o
Rooinek Pass R51	-	-	8	6		14	f - o
nr. Rietvlei R49	-	-	1	4		5	f - o
HALLII.							
nr. Rietvlei R48	-	7	1	-		8	u - f
Koup R26	-	14	2	-		16	u - f
BULLULATA.							
N. Matjesfontein R25	10	5	-	-		15	us - u
Ceres-S'land R24	9	-	-	-		9	us
RUGOSA.							
nr. Montagu R17-23,50a	-	-	4	16		20	o - f
L'smith-B'dale R2	-	-	-	2		2	o

TABLE 56 **Variation in appearance of leafy shoot in field specimens of "smutsiana", "hallii", "bullulata" and "rugosa",** and the putative hybrid between members of "rugosa" and "smutsiana". *(See page 212).

In the samples of the entity smutsiana, excluding those from the Ladismith-Barrydale Karoo, where no populations of hallii have to date been found, the spiral angle is 10 - 30° in the majority of specimens.

In the samples of the entity rugosa the great majority of the specimens from the Montagu Karoo have a spiral angle of 0 - 10°, while for the two specimens and the suspected hybrid from the Ladismith Karoo the spiral angle is 10 - 20°.

Angle of leaf with stem (See Table 56)

In all four entities this is 30 - 50°, that is sub-erect, in the majority of specimens. This applies to individual population samples with the exception of the population of the entity smutsiana from Rietvlei, in the northern foothills of the Swartberg, where 60% of the small sample have patent-erect leaves.

It is of interest to note that 38% of the sample of the entity hallii from Koup, in the Great Karoo, have erect leaves. Out of all the other population samples this is the case only in a single specimen of the entity smutsiana from Rietvlei.

Leaf apices (See Table 56)

Here the entity bullulata is unique in that the leaf apices curve upward and slightly to one side in all individuals examined, except for 33% of the sample from Matjesfontein where they only curve upward. The latter is the case in all save 13% of samples of the entity hallii, where the apices follow the angle of the leaf with the stem.

In the population samples of the entity smutsiana from Ladismith-Barrydale I and Rooinek Pass, the apices follow the angle of the leaf with the stem or curve outwards, while in the two remaining populations, in the majority of rugosa specimens, and in the suspected hybrid between members of the entities rugosa and smutsiana, the leaf apices curve outward in the great majority of plants.

The appearance of leafy shoots of all four entities is shown in a diagram incorporating all three of the above characters (See fig. 45).

It is the fact that the leaf apices curve upwards, and upwards and sideways in the majority of specimens of the entities

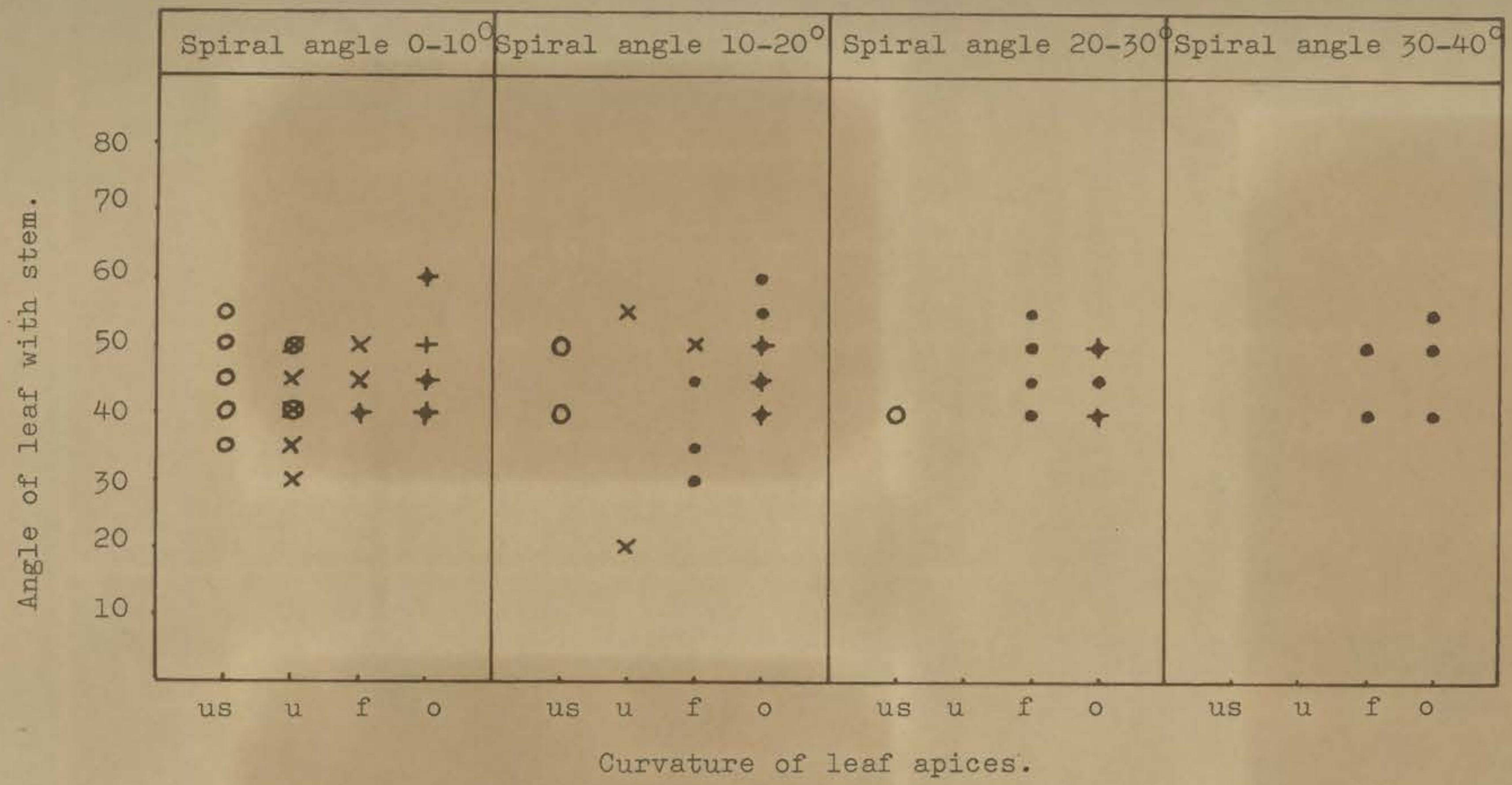


Fig.45. Variation in appearance of leafy shoot, incorporating the spiral angle, angle of the leaf with the stem, and curvature of leaf apices, in the entities smutsiana (•), hallii (x), bullulata (o), and rugosa (+). (us = apices curving upwards and to one side, u = apices curving upward, f = apices following the angle of the leaf with the stem, o = apices curving outward).

Leaves of, from left to right, the entities bullulata, hallii and smutsiana, seen from the upper side. Keeled marginate apices are seen in the leaves of bullulata and hallii, the apex of the entity smutsiana is true marginate. (X1½).

A (X 1)

B (X 1¾)

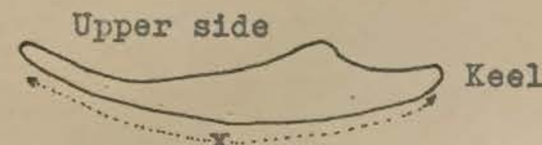
Leafy shoots of the entity rugosa. A: from Pietersfontein, R19, B: from Dobbelaar's Kloof R22. (Scales approximate).

PLATE 19.

hallii and bullulata, which tends to distinguish these two from the entities rugosa and smutsiana. The distinction is rendered absolute by the presence of keeled-marginate apices in the entities bullulata and hallii as opposed to true marginate apices in the entities smutsiana and rugosa. As previously mentioned, keeled-marginate apices have been found in some or all the leaves of all plants of the entities hallii and bullulata so far examined. In dried specimens, however, this character is not always obvious. Also in specimens of the entities hallii and bullulata the leaf apex is often somewhat "shouldered" below the mucro, as opposed to the acute acuminate condition always found in the other entities.

BULLULATA			HALLII		
Leaf length	Distance from apex at which x is measured	Width x	Leaf length	Distance from apex at which x is measured	Width x
cm.	cm.	cm.	cm.	cm.	cm.
4.2	0.9	0.96	4.8	1.0	0.75
4.0	0.8	0.82	4.4	0.9	0.65
3.9	0.8	1.04	4.2	0.9	0.64
3.5	0.7	1.02	4.1	0.9	0.79
3.3	0.7	1.13	4.0	0.8	0.69
3.3	0.7	0.95	4.0	0.8	0.60
3.3	0.7	0.77	3.9	0.8	0.88
3.1	0.7	0.85	3.9	0.8	0.74
3.0	0.6	0.91	3.9	0.8	0.64
3.0	0.6	0.82	3.9	0.8	0.58
3.0	0.6	0.81	3.8	0.8	0.65
2.9	0.6	0.80	3.6	0.8	0.62
2.9	0.6	0.76	3.5	0.7	0.59
2.7	0.6	0.92	3.5	0.7	0.56
2.7	0.6	0.79	3.4	0.7	0.57
2.5	0.5	0.80	3.2	0.7	0.61
2.5	0.5	0.63	3.2	0.7	0.57
2.3	0.5	0.58	3.1	0.7	0.58
2.1	0.5	0.70	3.1	0.7	0.56
			3.1	0.7	0.47
1.8	0.4	0.50	3.0	0.6	0.40
			2.9	0.6	0.60
			2.9	0.6	0.58
			2.9	0.6	0.39
			2.8	0.6	0.56

Table 57 SHOWING VARIATION IN WIDTH x IN RANDOM SAMPLES OF THE ENTITIES HALLII AND BULLULATA.



T.S. Leaf apex

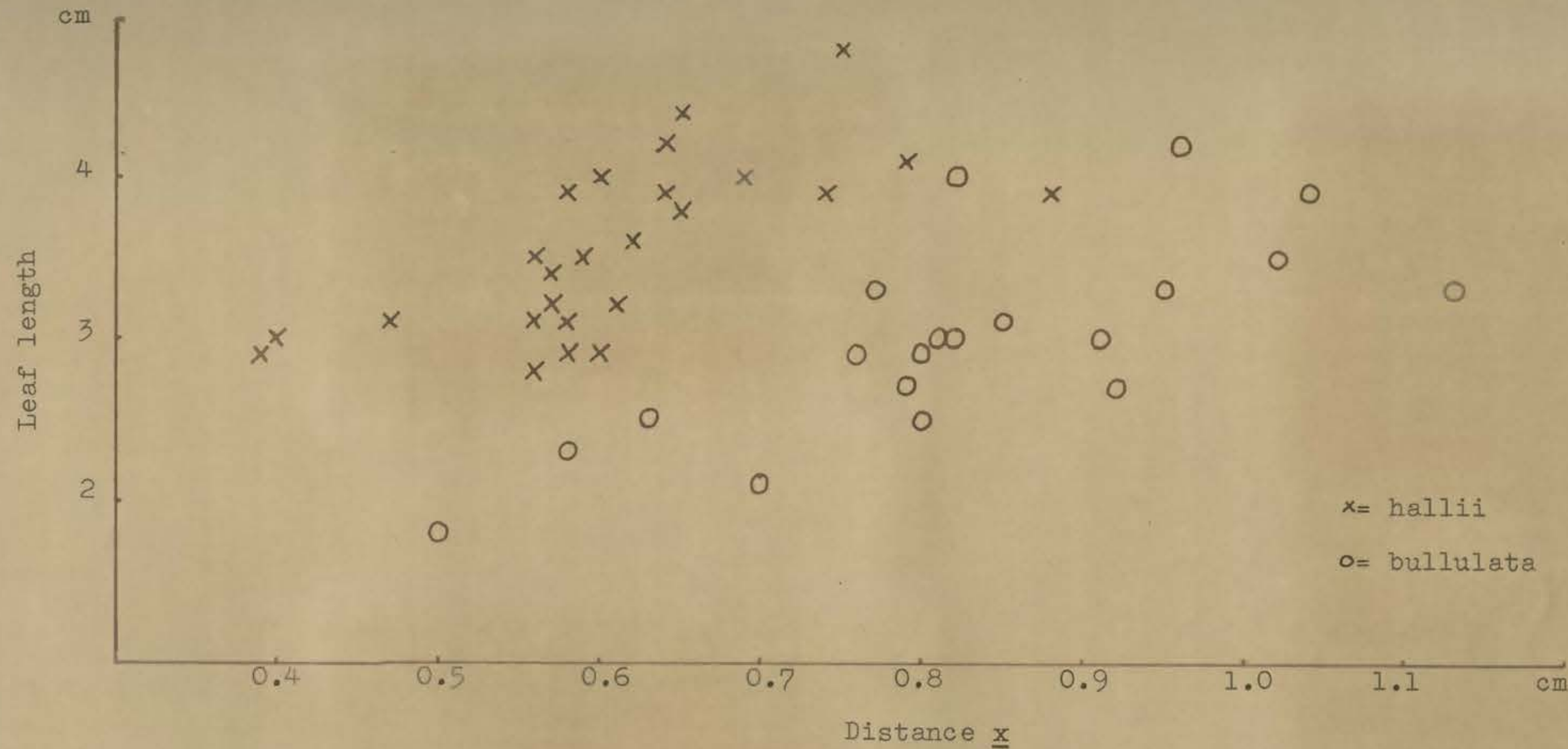


Fig.46. Variation in leaf length and the distance x between the keel and the leaf margin furthest from it at a distance from the leaf apex, which is approximately one fifth of the length of the leaf, in the entities hallii and bullulata.

The leaf apex of the entity bullulata is also in general broader than that of the entity hallii, as is shown by measuring the distance between the keel and the leaf margin furtherst from it, at a set distance from the apex, which is approximately one fifth of the length of the leaf. This is shown in Table 57, where the distance from keel to leaf margin is, for the sake of brevity referred to as x, and in a scatter diagram (Fig.46) where leaf length is plotted against the value of this measurement. The scatter diagram gives a fairly good, if not an absolute separation between the two entities.

Leaf length (See Table 58 and figs. 49, 50, 47 and 48)

The longest leaves amongst the four entities tend to be found in the majority of specimens of the entities hallii and bullulata. Of the plants of the entity hallii, only 18%, (all from the Rietvlei locality), have leaves less than 30 cm. in length. In the entity bullulata, 29% of the plants examined have leaves less than 3.0 cm. in length.

Leaf length is quite variable in population samples of the entity smutsiana, being shortest (1.5 - 2.5 cm.) in the Rietvlei plants, and longest, (2.0 - 4.0 cm.), in plants from Adams Kraal in the Little Karoo, where no plants of the entity hallii have yet been found. Leaves are generally of an intermediate length in the other Little Karoo smutsiana samples.

In samples of the entity rugosa leaves vary from 1.5 - 2.5 cm. in length, while the leaves of the putative hybrid between members of this entity and the entity smutsiana are 2.0 cm. long.

Leaf width at widest part and length-breadth ratio (See Tables 59 and 60).

In the past, the terms lanceolate acuminate, ovate acuminate, ovate acute, and lanceolate deltoid have been used to describe the leaves of plants belonging to what are now recognised as the entities hallii and smutsiana.

The leaves with the highest length-breadth ratio are found in the entity hallii, this being less than 2.00 in only 19% of the specimens examined.

Locality	Class range of measurements.										Total no. indiv.	Range actual measurements.
	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5			cm.
HYBRID R4	-	2	-	-	-	-	-	-	-	-	2	2.0
SMUTSIANA.												
Adams Kraal R63	-	-	1	2	1	2	-	-	-	-	6	2.3 - 3.9
L'smith-B'dale I R5	-	-	11	9	3	-	-	-	-	-	23	2.1 - 3.1
L'smith-B'dale II R3	-	6	11	5	-	-	-	-	-	-	22	1.8 - 2.7
Rooinek Pass R51	-	-	6	5	3	-	-	-	-	-	14	2.1 - 3.1
nr. Rietvlei R49	-	3	2	-	-	-	-	-	-	-	5	1.8 - 2.2
HALLII.												
nr. Rietvlei R48	-	-	-	3	5	2	6	-	-	1	17	2.7 - 5.8
Koup R26	-	-	-	-	9	-	-	-	-	-	9	3.1 - 3.5
BULLULATA.												
N. Matjesfontein R25	-	-	3	1	9	2	-	-	-	-	15	2.3 - 4.0
Ceres-S'land R24	-	-	-	3	4	2	-	-	-	-	9	2.8 - 4.0
RUGOSA.												
Pietersfontein R19+20	-	5	5	-	-	-	-	-	-	-	10	1.7 - 2.5
Upper Baden R17	1	5	1	-	-	-	-	-	-	-	7	1.4 - 2.2
Baden Rd R18	-	3	4	-	-	-	-	-	-	-	7	1.7 - 2.2
nr. Montagu R23	-	8	2	-	-	-	-	-	-	-	10	1.6 - 2.2
Rietvlei R50a	-	2	2	-	-	-	-	-	-	-	4	2.0 - 2.4
Dobbelaars Kloof I R21	-	3	4	-	-	-	-	-	-	-	7	1.8 - 2.3
Dobbelaars Kloof II R22	-	4	3	-	-	-	-	-	-	-	7	1.6 - 2.2
L'smith-B'dale R2	-	5	-	-	-	-	-	-	-	-	5	1.7 - 2.0

Class interval 0.5 cm.

TABLE 58 Variation in length of leaf in field specimens of "smutsiana", "hallii", "bullulata" and "rugosa". and the putative "smutsiana" X "rugosa" hybrid.

Locality.	Class range of measurements.									Total no. indiv.	Range actual measurements.
	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75			cm.
HYBRID R4	-	-	2	-	-	-	-	-	- .	2	1.3 - 1.5
SMUTSIANA.											
nr. Adams Kraal R63	-	-	2	2	2	-	-	-	-	6	1.3 - 1.9
L'smith-B'dale I R5	-	3	12	5	3	-	-	-	-	23	1.2 - 1.9
L'smith-B'dale II R3	1	1	11	6	3	-	-	-	-	22	1.0 - 2.0
Rooinek Pass R51	-	2	7	4	1	-	-	-	-	14	1.2 - 1.9
Rietvlei R49	1	1	3	-	-	-	-	-	-	5	1.0 - 1.4
HALLII.											
Rietvlei R48	-	-	4	5	-	-	-	-	-	9	1.4 - 1.7
Koup R26	-	-	3	5	8	1	-	-	-	17	1.3 - 2.0
BALLULATA.											
N. Matjesfontein R25	-	-	5	1	4	2	3	-	-	15	1.3 - 2.3
Ceres-S'land R24	-	-	-	1	3	2	2	1	-	9	1.6 - 2.6
RUGOSA.											
Pietersfontein R19+20	-	1	7	2	-	-	-	-	-	10	1.1 - 1.7
Upper Baden R17	-	-	5	1	1	-	-	-	-	7	1.3 - 1.8
Baden Rd R18	-	1	3	3	-	-	-	-	-	7	1.2 - 1.7
nr. Montagu R23	-	1	5	4	-	-	-	-	-	10	1.2 - 1.7
Rietvlei R50a	-	1	2	1	-	-	-	-	-	4	1.2 - 1.6
Dobbelaars Kloof I R21	-	1	5	1	-	-	-	-	-	7	1.2 - 1.6
Dobbelaars Kloof II R22	-	1	6	-	-	-	-	-	-	7	1.1 - 1.5
L'smith-B'dale R2	-	-	5	-	-	-	-	-	-	5	1.4 - 1.5

Class interval

TABLE 59 Variation in greatest width of leaf in field specimens of "smutsiana", "hallii", "bullulata" "rugosa" and the putative hybrid "smutsiana" X "rugosa".

Locality.	Class range of measurements									Total no. indiv.	Range actual measurements.
	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00		cm.
HYBRID R4	-	-	1	1	-	-	-	-	-	-	2	1.30 - 1.53
SMUTSIANA.												
nr. Adams Kraal R63	-	-	-	2	2	1	1	-	-	-	6	1.53 - 2.31
L'smith-B'dale I R5	-	-	3	9	6	4	1	-	-	-	23	1.32 - 2.30
L'smith-B'dale II R3	-	2	9	8	2	1	-	-	-	-	22	1.14 - 2.11
Rooinek Pass R51	-	-	1	5	5	3	-	-	-	-	14	1.46 - 2.23
Riwtvlei R49	-	-	2	2	1	-	-	-	-	-	5	1.48 - 2.00
HALLII.												
nr. Rietvlei R48	-	-	-	-	1	6	2	-	-	-	9	1.91 - 2.48
Koup R26	-	-	-	2	2	7	4	1	-	1	17	1.72 - 3.14
BULLULATA.												
N. Matjesfontein R25	-	-	4	4	1	-	-	-	-	-	9	1.38 - 1.90
Ceres-S'land R24	-	-	1	10	1	2	-	1	-	-	15	1.42 - 2.72
RUGOSA.												
Pietersfontein R19+20	-	1	4	5	-	-	-	-	-	-	10	1.24 - 1.69
Upper Baden R17	-	3	3	1	-	-	-	-	-	-	7	1.06 - 1.69
Baden Rd R18	1	2	2	2	-	-	-	-	-	-	7	1.00 - 1.69
nr. Montagu R23	-	3	5	2	-	-	-	-	-	-	10	1.06 - 1.67
Rietvlei R50a	-	-	3	-	1	-	-	-	-	-	4	1.43 - 1.83
Dobbelaars Kloof I R21	-	-	5	1	1	-	-	-	-	-	7	1.44 - 1.77
Dobbelaars Kloof II R22	-	1	3	3	-	-	-	-	-	-	7	1.23 - 1.57
L'smith-B'dale R2	-	2	3	-	-	-	-	-	-	-	5	1.20 - 1.43

Class interval 0.25 cm.

TABLE 60 Variation in length-breadth ratio in field specimens of "smutsiana", "hallii", "bullulata" "rugosa" and the putative "smutsiana" X "rugosa" hybrid.

POSITION OF WIDEST PART OF LEAF Class interval 0.25 cm.

Locality.	Class range of measurements.								Total no. indiv.	Range actual measurements.
	0	0	.25	.50	.75	1.00	1.25			cm.
HYBRID R4	-	-	2	-	-	-	-	-	2	.1bel - .2bel*
SMUTSIANA.										
nr. Adams Kraal R63	-	-	3	2	1	-	-	-	6	.1bel - .6bel
L'smith-B'dale I R5	-	-	13	9	1	-	-	-	23	1.bel - .6bel
L'smith-B'dale II R3	-	4	16	2	-	-	-	-	22	0 - .3bel
Rooinek Pass R51	-	-	7	6	1	-	-	-	14	.1bel - .6bel
Rietvlei R49	-	1	4	-	-	-	-	-	5	0 - .2bel
HALLII.										
Rietvlei R48	-	-	-	7	2	-	-	-	9	.3bel - .6bel
Koup R26	-	-	1	7	5	3	-	1	17	.2bel -1.3bel
BULLULATA.										
N. Matjesfontein R25	-	-	6	3	-	-	-	-	9	.1bel - .4bel
Ceres-S'land R24	-	1	3	10	1	-	-	-	15	0 - .6bel
RUGOSA.										
Pietersfontein R19+20	-	5	5	-	-	-	-	-	10	0 - .1bel
Upper Baden R17	3	2	2	-	-	-	-	-	7	.1 ab - .1bel
Baden Rd R18	3	3	1	-	-	-	-	-	7	.1 ab - .1bel
nr. Montagu R23	4	3	2	1	-	-	-	-	10	.2 ab - .3bel
Rietvlei R50a	-	2	2	-	-	-	-	-	4	0 - .1bel
Dobbelaars Kloof I R21	-	2	5	-	-	-	-	-	7	0 - .2bel
Dobbelaars Kloof II R22	1	4	2	-	-	-	-	-	7	.2 ab - .1bel
L'smith-B'dale R2	-	2	3	-	-	-	-	-	5	0 - .2bel

*(ab = above the midlength, bel = below the midlength)

LENGTH OF MUCRO. Class interval 0.05 cm

Locality	.05	.10	.15		Total no. indiv.	Range actual measurements (cm.)
HYBRID R4	-	2	-	-	2	.07 -
SMUTSIANA.						
nr. Adams Kraal R63	3	3	-	-	6	.04 - .09
L'smith-B'dale I R5	4	16	3	-	23	.03 - .13
L'smith-B'dale II R3	2	19	1	-	22	.05 - - .12
Rooinek Pass R51	3	11	-	-	14	.05 - .09
Rietvlei R49	1	4	-	-	5	.05 - .08
HALLII.						
Rietvlei R48	-	5	4	-	9	.08 - .13
Koup R26	1	7	8	-	16	.05 - .15
BULLULATA.						
N. Matjesfontein R25	1	7	1	-	9	.03 - .11
Ceres S'land R24	-	10	3	1	14	.06 - .20
RUGOSA.						
Pietersfontein R19+20	5	5	-	-	10	.05 - .10
Upper Baden R17	2	5	-	-	7	.05 - .06
Baden Rd R18	3	4	-	-	7	.04 - .07
nr. Montagu R23	6	3	-	-	9	.04 - .08
Rietvlei R50a	3	1	-	-	4	.05 - .06
Dobberlaars Kloof I R21	4	3	-	-	7	.04 - .07
Dobbelaars Kloof II R22	4	3	-	-	7	.04 - .08
L'smith - B'dale R2	4	1	-	-	5	.04 - .06

TABLE 61 Variation in position of widest part of the leaf in relation to mid length, & in length of mucro in field specimens of "smutsiana", "hallii", "bullulata" & "rugosa", and the putative "smutsiana" X "rugosa" hybrid.

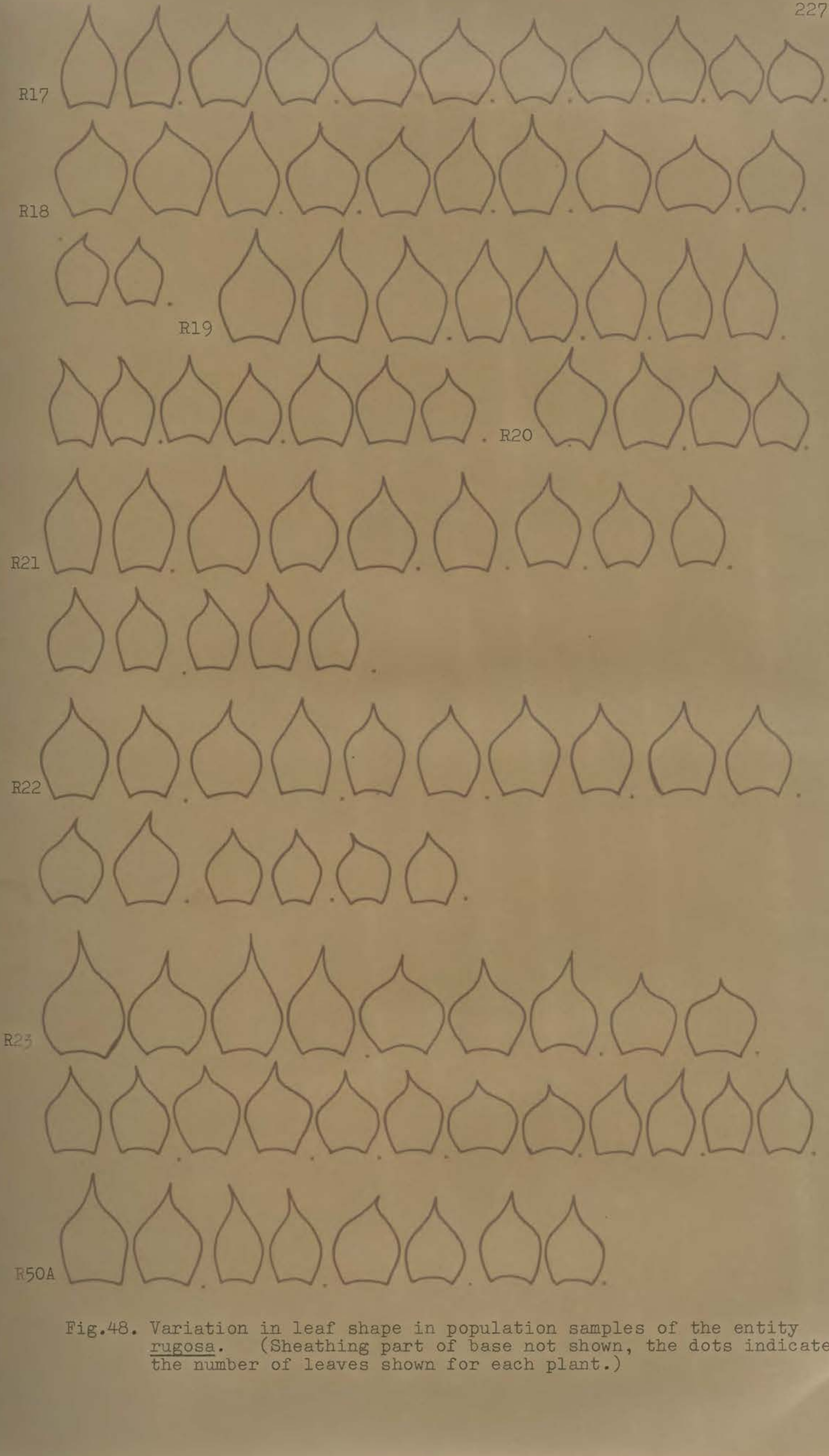


Fig.48. Variation in leaf shape in population samples of the entity rugosa. (Sheathing part of base not shown, the dots indicate the number of leaves shown for each plant.)

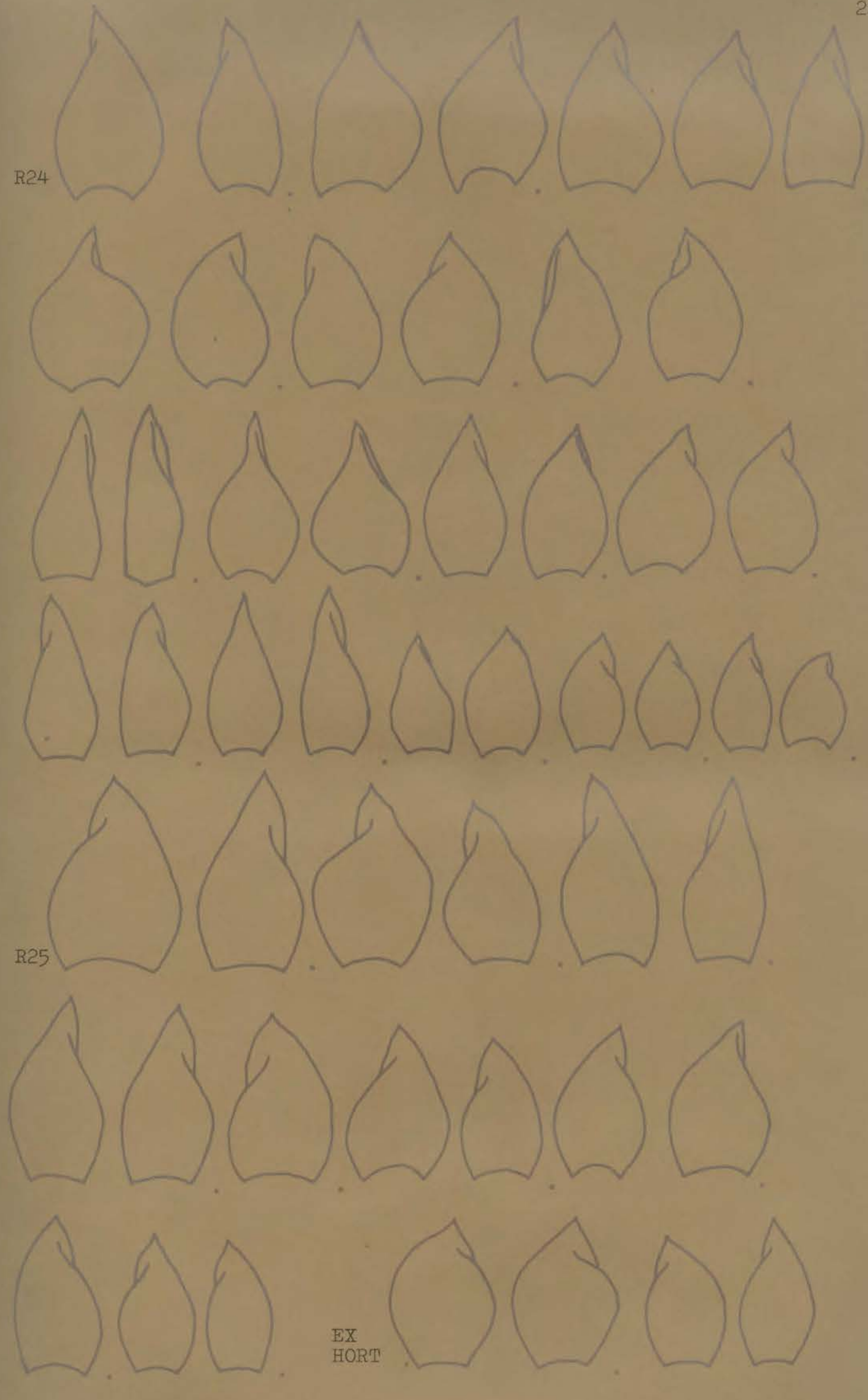


Fig.47. Variation in leaf shape in population samples of the entity <u>bullulata</u>. (Sheathing part of base not shown, the dots indicate the number of leaves shown for each plant.)

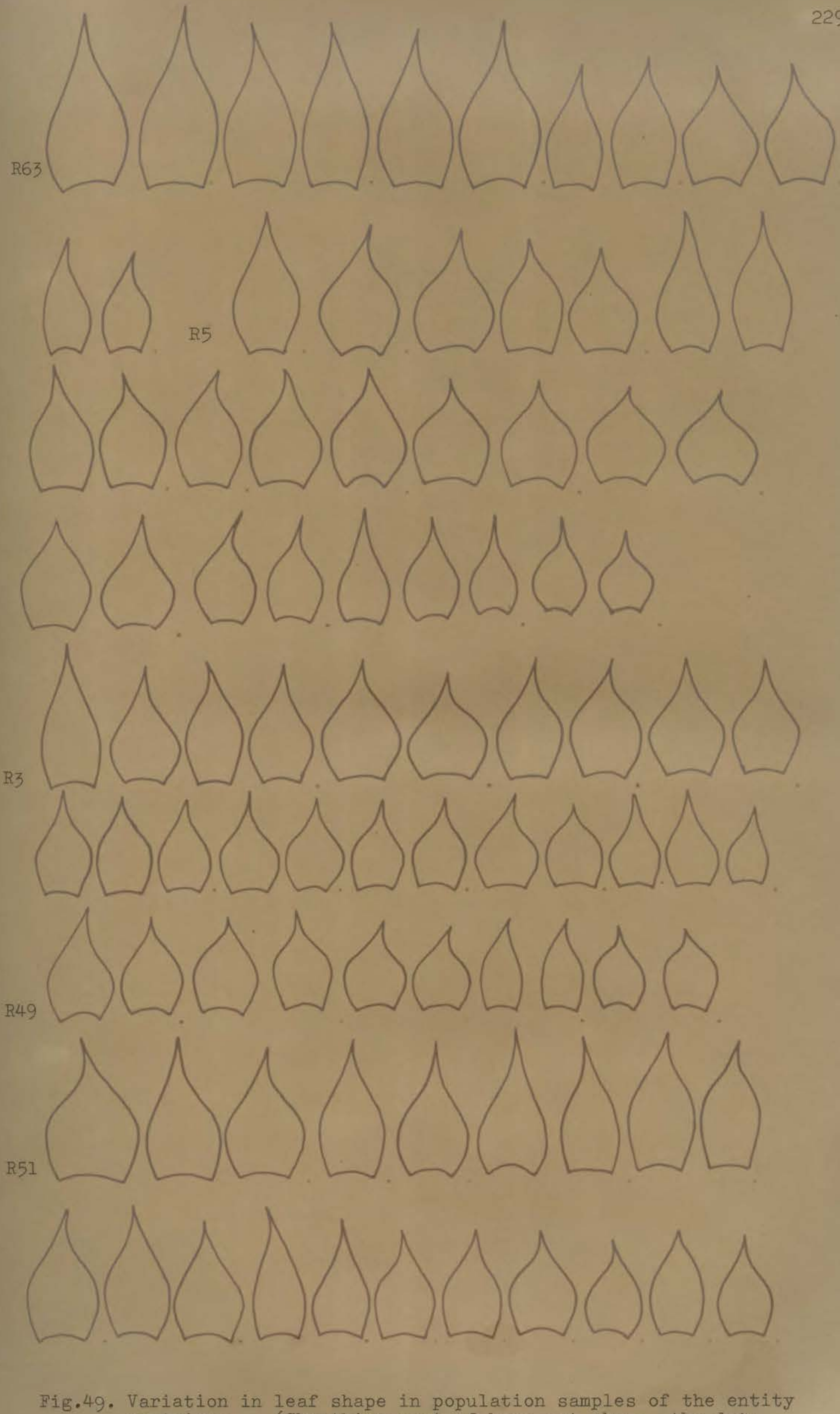


Fig.49. Variation in leaf shape in population samples of the entity smutsiana. (Sheathing part of base not shown, the dots indicate the number of leaves shown for each plant).

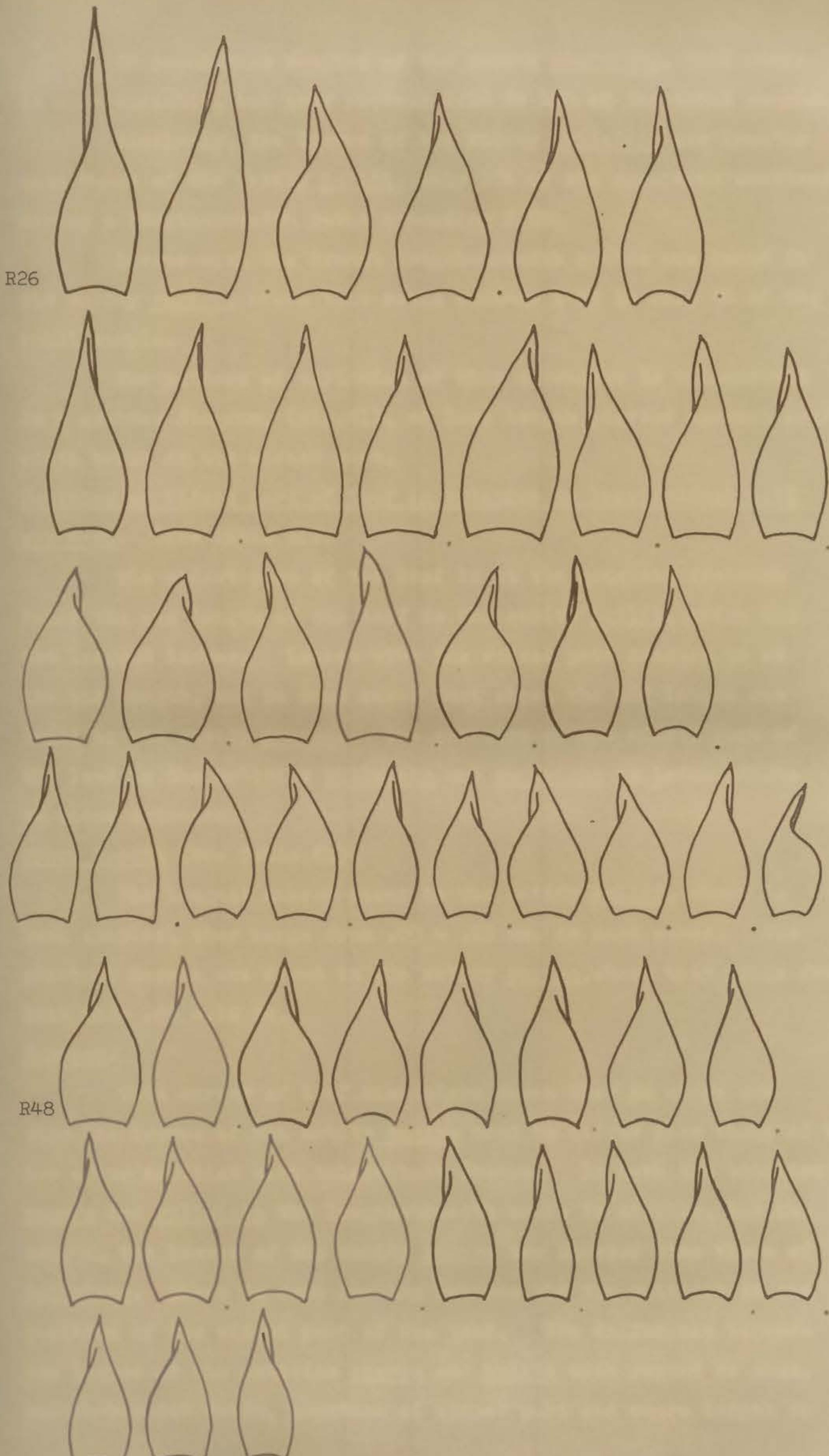


Fig. 50. Variation in leaf shape in population samples of the entity hallii. (Sheathing part of base not shown, the dots indicate the number of leaves shown for each plant.)

In population samples of the entity smutsiana, this ratio is more variable, but only exceeds 2.00 in 16% of the total sample.

Similarly, the leaves of the entity bullulata are broader than those of the entity hallii, only 12% of the specimens examined having a length-breadth ratio exceeding 2.00.

Leaves with the lowest length-breadth ratios are found in the entity rugosa, where this ratio exceeds 1·75 in only 4% of the total sample.

The pattern of variation of this character is illustrated in a scatter diagram, (Fig.51), of leaf length plotted against leaf width taken at the widest part.

Position of widest part of leaf in relation to longitudinal half way mark. (See Table 61).

The widest part of the leaf is at the greatest distance below the mid length of the leaf in the entity hallii, which has the longest leaves. Leaves with the widest part nearest or at the mid length, and in some cases just above the mid length are found in the entity rugosa. The position of the widest part of the leaf in the entities bullulata and smutsiana is intermediate to these extremes.

Mucro length (See Table 61).

The longest nucros occur in the entity hallii, where in both samples, they range from .05 - .15 cm. in most cases. The shortest mucros are found in the entity rugosa, where they range from less than .05 -.10 cm.

Summary.

This survey of leaf dimensions shows that in shape and size the leaves of the entity rugosa tend to differ from those of the two other entities with tuberculate leaves. In both the entities rugosa and bullulata the length-breadth ratio is similar, but in length, the leaves of the entity rugosa are shorter than those of bullulata. There is some overlap between the two entities in the position of the widest part of the leaf. The difference between the leaves of the entities rugosa and hallii with regard to size, length-breadth ratio, position of widest part and mucro length is

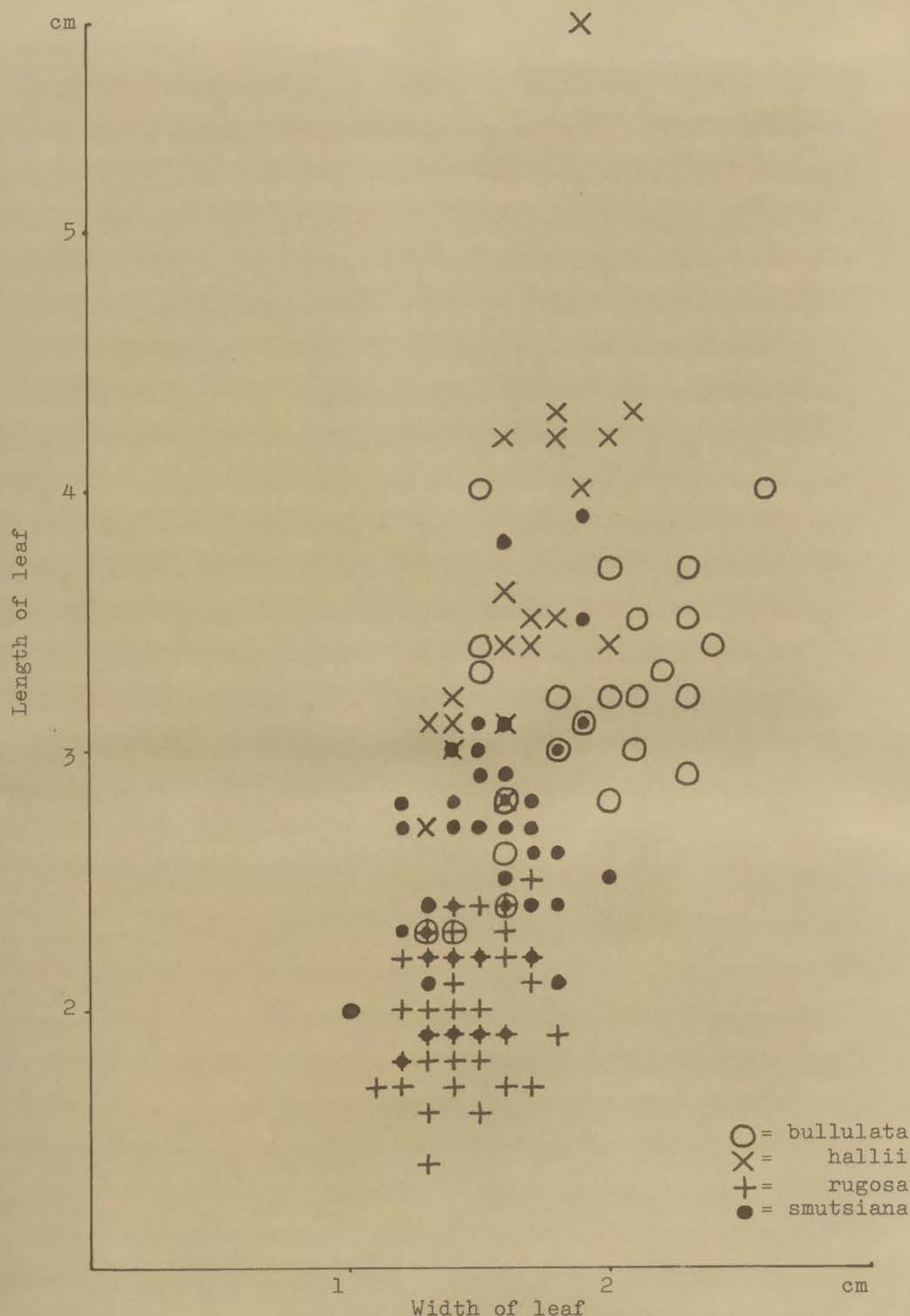


Fig.51. Variation in length and width of leaf at the widest part excluding the basal sheath in the entities smutsiana, hallii, bullulata and rugosa.

much more marked.

The entities _hallii_ and _bullulata_ have leaves similar in size but differing in shape, in that in the entity _hallii_, the length-breadth ratio is generally greate and the leaf apex narrower than in _bullulata_. As mentioned before, both have keeled marginate apices in common.

The entity _smutsiana_ has, on the whole, shorter leaves than the entities _hallii_ and _bullulata_, but in length-breadth ratio and in position of the widest part of the leaf it is intermediate between the two. It does however, lack keeled marginate apices.

From this it can be seen that, with regard to leaf shape, there is only one character of primary taxonomic significance, and that is the keeled marginate leaf apex found in the entities _hallii_ and _bullulata_. Although there is an overlap of the characters leaf length and length breadth ratio between the four entities, the fact that they do tend to differ in each, is indicative of a difference between these entities.

The leaves of the putative hybrid between members of the entities _smutsiana_ and _rugosa_ are intermediate in the above characters to those of the parent entities.

LEAF ANATOMY.

This is only of significance in separating the entities _bullulata_ and _hallii_. The bundle caps of the entity _hallii_ are completely lignified for the entire length of the leaf, while in the entity _bullulata_ they are completely unlignified towards the leaf apex, and, by the mid length of the leaf are lignified partially in only a few specimens. This is considered a character of some importance in the separation of these two entities.

A further feature of interest and to date only observed in leaves of the entity _rugosa_ is that the outer walls of the lower epidermal cells from the upper half of the leaf are very frequently papillate (See Fig 8A). The epidermal cells of the putative hybrid between members of this entity and the entity _smutsiana_ also

also exhibit this character. (See Fig. 7D1).

LEAF ORNAMENTATION.

Leaf Ornamentation excluding margins and keel.

As was mentioned in the introductory survey, fine, darker green bundle cap lines are visible towards the leaf apices in all specimens of the entity hallii and in the great majority of leaves examined of the entity smutsiana. These lines, the tendency for the leaf apices to have a reddish tinge and the similarity in the colour of the leaves have probably been responsible in the past, for part of the confusion over identification of these two entities, which have both, at various times been referred to as A.pentagona.

However, as has been mentioned, no specimens of the entity smutsiana with tuberculate or spotted leaf under-surfaces, have been found in the field. Under cultivation, a few specimens of this entity did develop a few whitish spots on the under surface of the leaf, but these were never raised. It was also mentioned in the introduction that 8 of the 50 specimens examined of the entity smutsiana had some leaves with elongated very slightly raised patches, such as were found in a few members of A.foliolosa complex.

The differences between the ornamentation of the exposed part of the ventral side of the leaves in the entities hallii and bullulata are shown in Table 62. The fact that darker vein lines are always present in the entity hallii, and have never been observed in the entity bullulata is another character considered of primary taxonomic significance in the separation of the two. In both entities, the degree of tuberculation on the leaves of any one plant is irregular, but when the tubercles are numerous they tend to be arranged in transverse groups in the entity bullulata and in longitudinal series along the vein lines in the entity hallii. This character and the fact some plants of the entity hallii lack any maculae or tubercles, or have only maculae, features not observed in the entity bullulata, are further indicative of a difference between these two entities.

It should be mentioned that what appear to be large tubercles

Table 62. VARIATION IN ORNAMENTATION OF VENTRAL SIDE OF LEAF IN FIELD SPECIMENS OF THE ENTITIES HALLII AND BULLULATA.

	Plants with no spots or tubercles	Plants with white spots on some or all leaves	Plants with tubercles on some leaves	Plants with tubercles on all leaves	Bundle cap lines present	Tubercles arranged in transverse rows	Tubercles along veins lines	No. of plants examined
HALLII								
Rietvlei R48	1	3	5	-	9	-	5	9
Koup R26	2	7	7	-	16	-	6	16
BULLULATA								
Ceres-S'land R24	-	-	4	11	-	7	-	15
Matjesfontein R25	-	-	2	9	-	8	-	11

Table 63. VARIATION IN DEGREE OF TUBERCULATION OF VENTRAL SIDE OF LEAF IN FIELD SPECIMENS OF THE ENTITY RUGOSA AND THE PUTATIVE HYBRID BETWEEN MEMBERS OF THE ENTITIES SMUTSIANA AND RUGOSA.

Locality	No. of tubercles per 4 mm.sq.				Height of tubercles in mm.				Total no. plants
	5	15	25		0.1	0.2	0.3		
Pietersfontein R19 & R20	-	-	3	7	-	6	4	-	10
Upper Baden R17	-	-	2	5	-	3	4	1	7
Baden Rd. R18	-	-	1	6	-	5	5	-	7
nr Montagu R23	-	-	4	6	-	7	5	-	10
Riet Vlei R50A	-	-	4	-	-	2	2	-	4
Dobbelaars Kloof R21	3	3	2	-	6	4	-	-	8
Dobbelaars Kloof R22	3	3	1	-	6	4	-	-	7
L'smith-B'dale R2	-	-	4	-	-	2	3	-	5
HYBRID R4	1	1	-	-	-	1	1	-	2

Table 64 VARIATION IN HEIGHT OF TUBERCLES OF MARGINS AND KEELS IN FIELD SPECIMENS OF THE ENTITIES <u>HALLII</u>, <u>BULLULATA</u>, <u>SMUTSIANA</u> AND <u>RUGOSA</u>. Class interval 0.05 mm.

Locality	Class range of measurements.							Total no. indiv.	Range actual measurements.
	.05	.10	.15	.20	.25	.30			mm.
<u>HYBRID R4</u>	-	1	-	-	-	-	-	1	.10
<u>SMUTSIANA</u>									
L'smith - B'dale I R5	13	12	1	-	-	-	-	20	.05-.15
L'smith - B'dale II R3	7	7	1	1	-	-	-	10	.05-.20
Rooinek Pass R51	8	7	1	-	-	-	-	14	.05-.15
Rietvlei R49	3	-	-	-	-	-	-	3	.05
<u>HALLII</u>									
Rietvlei R48	1	7	6	5	1	-	-	9	.05-.25
Koup R26	1	9	10	5	1	-	-	15	.05-.25
<u>BULLULATA</u>									
Ceres - S'land R24	1	4	10	3	2	-	-	15	.05-.25
Matjesfontein R25	-	4	7	3	2	2	1	11	.10-.35
<u>RUGOSA</u>									
Pietersfontein R19,20	-	4	5	4	-	-	-	10	.10-.20
Upper Baden R17	-	4	5	4	2	-	-	7	.10-.25
Baden Rd R18	-	2	4	-	-	-	-	5	.10-.15
nr Montagu R23	-	3	6	1	-	-	-	9	.10-.20
Ri et Vlei R50A	-	2	-	-	1	-	-	3	.10-.25
Dobbelaar's Kloof R21	3	6	-	-	-	-	-	7	.05-.10
Dobbelaar's Kloof R22	1	7	3	-	-	-	-	7	.05-.15
L'smith-B'dale R2	-	3	5	1	-	-	-	5	.10-.20

Table 65 VARIATION IN HEIGHT OF TUBERCLES FROM LOWER SIDE OF LEAF IN FIELD SPECIMENS OF THE ENTITIES <u>HALLII</u> AND <u>BULLULATA</u>. Class interval 0.10 mm.

Locality	Class range of measurements.				Total no. indiv.	Range actual measurements.
	.10	.20	.30			
<u>HALLII</u>						
Rietvlei R48	5	-	-	-	5	.05-.10
Koup R26	6	4	2	-	6	.05-.25
<u>BULLULATA</u>						
Ceres-S'land R24	4	9	8	3	15	.10-.35
Matjesfontein	3	5	5	3	11	.10-.35

in the entity bullulata, with a diameter of from one to two millimetres, are seen under a lens to consist of a large mound topped by a number of very fine protuberances, so that these large tubercles are actually an aggregation of confluent smaller tubercles. It is only where the tubercles are few that they are not arranged in any particular order on the under side of the leaf.

Tubercles from the ventral side of the leaf are much more prominent in the entity bullulata than in the entity hallii. (See Table 6.).

In the entity rugosa, where the degree of tuberculation is the same for all the leaves on any one plant, unlike the condition in the entities hallii and bullulata, the Dobbelaars Kloof populations have the least amount of tuberculation. This is shown in Tables 63 and 64. It is seen that the under sides of the leaves of the putative hybrid have very few tubercles compared with the leaves of plants of the entity rugosa from the same area.

(N.B. The tables showing variation in height of tubercles in field populations of these entities have been compiled in the same way as those for the A. foliolasa complex).

Tubercles of margins and keels. (See Table 64).

These are least prominent in the entity smutsiana. In the entities hallii and bullulata the height of these tubercles is on the whole similar. In the population samples of the entity rugosa, the least raised tubercles on the margins and keels are again found in specimens from the Dobbelaars Kloof localities.

Summary.

In these four entities, leaf ornamentation is a character of taxonomic significance. The fact that the degree of tuberculation is more even and regular on all the leaves of a single plant tends to distinguish the entity rugosa from the entities hallii and bullulata. These two in turn are distinguished by the nature of the tuberculation and by the darker vein lines in the entity hallii. The total absence of tuberculate or maculate leaves in field

THE ENTITY BULLULATA

A(X 1)

B(X 1)

C(X $\frac{5}{6}$)

D(X 2)

A and B: leafy shoots; in A tubercles few, some leaves without tubercles; in B tubercles more numerous, compound nature of tubercle apparent. C and D: lower sides of leaves, tubercles when numerous arranged roughly in transverse rows. In some specimens the leaf apices are seen to curve upward and to one side. (Scales approximate).

PLATE 20.

THE ENTITY HALLII.

A X 1

C (X 1½)

B X 1

Leafy shoots: keeled marginate apices visible in some leaves of all specimens; darker bundle cap lines very apparent. In B tubercles present corresponding to the bundle cap lines. (Scales approximate).

THE ENTITY SMUTSIANA.

Leafy shoots (X 1 approx.). All leaves with true marginate apices darker bundle cap lines seen in some leaves.

PLATE 22.

A.

B.

C.

Inflorescences of: A, the entity rugosa; B, the putative hybrid between the entities rugosa and smutsiana; C, the entity smutsiana. (X 1 approx.)

Leafy shoots of, from left to right: the entity rugosa, the putative hybrid between the entities rugosa and smutsiana; the entity smutsiana. (X ¾ approx.)

PLATE 23.

populations of the entity smutsiana indicates a difference between this entity and the entity hallii.

INFLORESCENCE CHARACTERS (See Plate 24).

In this part of the survey, herbarium material is also included.

In field populations of the entities smutsiana and bullulata, flowering material was only available from the Ladismith-Barrydale Karoo and Matjesfontein, respectively.

Length of peduncle and raceme. (See Tables 66, 67 and 68).

Peduncle length is somewhat variable in all four entities. The longest peduncles are found in speciments of the entity hallii from Koup, the shortest peduncles in plants of the entity smutsiana from the Ladismith-Barrydale II locality. Apart from the latter, the majority of the peduncles of the population samples exceed 15 cm. in length.

In the putative hybrid between members of the entities rugosa and smutsiana, which was found at the Ladismith-Barrydale II locality, most peduncles are 20 - 25 cm. long.

Raceme length is also variable, the shortest racemes occurring in sample populations of the entity rugosa. In the Montagu Karoo a number of racemes were found to be stunted due to insect parasites. In these the pedicels tended to become thickened.

Number of sterile bracts (See Tables 69A and B).

In the entities bullulata, hallii and smutsiana there is little difference in the number of sterile bracts, which is variable. In the entity rugosa however, the number of sterile bracts per peduncle is smaller, although there is an overlap with the other three entities. In 27% of the field samples of the entity rugosa, only 2 sterile bracts per peduncle are found.

The range of variation in the number of sterile bracts in the putative hybrid incorporates the numbers found in both the entities rugosa and smutsiana.

Branching of inflorescence. (See Table 70)

Apart from a single specimen of the entity smutsiana, where

Locality.	Class range of measurements.									Total no. indiv.	Range actual measurements.
	5	10	15	20	25	30	35	40			cm.
<u>HYBRID</u> R4	-	-	-	1	4	1	-	-	-	6	16
<u>SMUTSIANA</u>.											
L'smith-B'dale I R5,62b	-	-	4	9	3	2	-	-	-	18	12 - 28
L'smith-B'dale II R3,62a	-	3	7	5	3	2	-	-	-	20	8 - 29
<u>HALLII</u>.											
Rietvlei R52	-	-	-	1	1	5	3	-	-	10	19 - 32
Koup R54	-	1	4	10	6	1	2	-	-	24	8 - 31
<u>BULLULATA</u>.											
Matjesfontein R55	-	-	1	4	1	3	-	-	-	9	14 - 30
<u>RUGOSA</u>.											
Pietersfontein R19+20	-	-	4	2	2	2	-	-	-	10	12 - 29
Baden-Baden R17,18,59	-	-	1	3	8	3	3	-	-	18	14 - 34
nr. Montagu R23	-	-	-	1	4	1	1	-	-	7	18 - 31
"Montagu Dist." Nbg	-	-	-	-	3	1	-	-	1	5	21 - 43
Dobbelaars Kloof R21,22	-	-	1	1	4	3	-	-	-	9	13 - 26
L'smith-B'dale R2	-	-	1	2	3	1	-	-	-	7	14 - 27

Class interval 5.0 cm.

Table 66 VARIATION IN LENGTH OF PEDUNCLE IN FIELD SPECIMENS OF "<u>SMUTSIANA</u>", "<u>HALLII</u>", "<u>BULLULATA</u>", "<u>RUGOSA</u>"

AND THE PUTATIVE "<u>SMUTSIANA</u>" x "<u>RUGOSA</u>" HYBRID.

Locality.	Class range of measurements.									Total no. indiv.	Range actual measurements.
	5	10	15	20	25	30	35	40			cm.
HYBRID R4	-	1	3	1	1	-	-	-	-	6	7 - 21
SMUTSIANA.											
L'smith-B'dale I R5,62b	-	3	7	7	1	-	-	-	-	18	8 - 23
L'smith-B'dale II R3,62a	-	3	8	7	1	-	-	-	-	19	8 - 25
HALLII.											
Rietvlei R52	-	-	2	3	5	-	-	-	-	10	13 - 24
Koup R54	-	-	5	10	6	1	2	-	-	24	12 - 32
BULLULATA.											
Matjesfontein R55	-	-	2	1	3	3	-	-	-	9	11 - 29
RUGOSA.											
Pietersfontein R19+20	1	7	1	-	-	1	-	-	-	10	5 - 27
Baden-Baden R17,18,59	-	4	6	6	1	-	-	-	-	17	9 - 22
nr. Montagu R23	-	3	1	1	-	1	-	-	-	6	6 - 27
"Montagu Dist." Nbg	-	-	3	2	-	-	-	-	-	5	11 - 16
Dobbelaars Kloof R21,22	1	1	5	1	-	-	-	-	-	8	5 - 16
L'smith-B'dale R2	-	2	3	1	-	-	-	-	-	6	9 - 17

Class interval 5.0 cm.

Table 67 VARIATION IN LENGTH OF RACEME IN FIELD SPECIMENS OF 'SMUTSIANA', 'HALLII', 'BULLULATA', 'RUGOSA' AND THE PUTATIVE 'SMUTSIANA' x 'RUGOSA' HYBRID.

Locality.	Class range of measurements.					Total no. indiv.	Range actual measurements.
	10	15	20	25			cm.
			LENGTH PEDUNCLE.				
HALLII.							
Prince Albert	1	-	-	-	-	1	9
BULLULATA.							
Verlaten Kloof	-	-	1	-	-	1	18
Ceres Karoo	-	-	1	-	-	1	19
Laingsb'g-L'smith	-	1	2	-	-	3	15 - 18
RUGOSA.							
Graaff Reinet	-	1	1	-	-	2	9^+ - 17+
Bonnievale	-	-	1	-	-	1	17
Barrydale	-	1	2	-	-	3	15 - 18
Muiskraal	-	-	1	-	-	1	18
Laingsb'g-L'smith	-	1	-	1	-	2	13 - 26
Ladismith	-	-	2	-	-	2	16
			LENGTH RACEME.				
HALLII.							
Prince Albert	1	-	-	-	-	1	8
BULLULATA.							
Verlaten Kloof	-	-	-	-	1	1	26
Ceres Karoo	-	-	1	-	-	1	17
Laingsb'g-L'smith	-	2	-	-	1	3	11 - 26
RUGOSA.							
Graaff Reinet	-	-	1	1	-	2	17 - 24
Bonnievale	-	-	1	-	-	1	19
Barrydale	3	-	-	-	-	3	6 - 8
Muiskraal	1	-	-	-	-	1	9
Laingsb'g-L'smith	-	1	-	-	-	1	11
Ladismith	1	-	-	-	-	1	7

Class interval 5.0 cm.

TABLE 68 VARIATION IN LENGTH OF RACEME AND PEDUNCLE IN HERBARIUM SPECIMENS OF 'HALLII', 'BULLULATA' AND 'RUGOSA'.

Locality.	Number of bracts.							Total no. indiv.	Range actual no. bracts.
	2	4	6	8	10	12			
HYBRID R4	2	2	1	1	-	-	-	6	2 - 7
SMUTSIANA.									
L'smith-B'dale R5,62b I	1	3	12	2	-	-	-	18	2 - 7
L'smith-B'dale R3,62a II	-	9	8	3	1	-	-	21	3 - 10
HALLII.									
Rietvlei R52	-	-	7	2	1	-	-	10	5 - 9
Koup R54	-	6	10	5	2	-	1	24	3 - 14
BULLULATA.									
Matjesfontein R55	-	2	4	3	-	-	-	9	3 - 7
RUGOSA.									
Pietersfontein R19+20	2	8	-	-	-	-	-	10	2 - 4
Baden-Baden R17,18,59	6	13	-	-	-	-	-	19	2 - 4
nr. Montagu R23	2	5	-	-	-	-	-	7	2 - 4
"Montagu Dist" Nbg	1	4	-	-	-	-	-	5	2 - 4
Dobbelaars Kloof R21,22	2	7	-	-	-	-	-	9	2 - 4
L'smith-B'dale R2	1	7	-	-	-	-	-	8	2 - 4

Class interval 2 bracts.

Table 69A VARIATION IN NUMBER OF STERILE BRACTS PER PEDUNCLE IN FIELD SPECIMENS OF 'SMUTSIANA', 'HALLII', 'BULLULATA', 'RUGOSA' + THE PUTATIVE 'SMUTSIANA' x 'RUGOSA' HYBRID.

Locality.	Number of bracts. 2	4	6	8	10	12		Total no. indiv.	Range actual no. bracts.
HALLII.									
Prince Albert Nbg 141/28 (BOL)	-	1	-	-	-	-	-	1	4
BULLULATA.									
Verlaten Kloof Nbg 258/55(NBG)	-	-	1	-	-	-	-	1	5
Ceres Karoo No. 27635(BOL)	-	1	-	-	-	-	-	1	3
Laingsb'g-L'smith 9363(BOL)	-	1	1	-	-	-	-	2	4 - 6
RUGOSA.									
Graaff Reinet (?) 4202 in herb Marloth (PRE)	-	1	1	-	-	-	-	2	4 - 5
Bonnievale v.d. Merwe 226(BOL)	1	-	-	-	-	-	-	1	2
Barrydale, Nbg 2154/26 (BOL)	1	2	-	-	-	-	-	3	2 - 3
Muiskraal Nbg 2306/27 (BOL)	-	2	-	-	-	-	-	2	3
Laingsb'g-L'smith Pillans 857(BOL)	1	-	1	-	-	-	-	2	2 - 5
Ladismith No. 27638 (BOL)	2	-	-	-	-	-	-	2	2

Class interval 2 bracts.

Table 69B VARIATION IN NUMBER OF STERILE BRACTS PER PEDUNCLE IN HERBARIUM SPECIMENS OF "SMUTSIANA", "HALLII", "BULLULATA" & "RUGOSA"

Locality.	Individuals with one or more branches to inflorescence	Individuals with unexpanded infl. buds in axils of sterile bracts.	Total no. indiv.
HYBRID R4	0	0	6
SMUTSIANA.			
L'smith-B'dale I R5,62b	0	0	18
L'smith-B'dale II R3,62a	0	1	21
HALLII.			
nr. Rietvlei R52	0	2	10
Koup R54	1	10	24
BULLULATA.			
Matjesfontein R55	0	2	9
RUGOSA.			
Pietersfontein R19+20	0	0	10
Baden-Baden R17,18,59	0	0	19
nr. Montagu R23	0	0	7
"Montagu Dist." Nbg	0	0	5
Dobbelaars Kloof R21,22	0	0	9
L'smith-B'dale R2	0	0	7

Table 70. VARIATION IN DEGREE OF BRANCHING OF INFLORESCENCES IN FIELD SPECIMENS OF 'SMUTSIANA', 'HALLII', 'BULLULATA' AND 'RUGOSA', + THE PUTATIVE 'SMUTSIANA' X 'RUGOSA' HYBRID.

an unexpanded raceme bud was found in the axil of a sterile bract, branched inflorescences or undeveloped raceme buds were found only in the entities bullulata and hallii. It is of interest to note the higher incidence of unexpanded raceme buds found in the axils of the Koup sample of the entity hallii, compared with that in specimens of this entity from Rietvlei.

Thickness of peduncle (See Table 71).

Peduncles with the stoutest bases are found in the entities hallii and bullulata. In the population samples of these, the broadest peduncle bases are found in specimens of the entity hallii from Koup, where in 42% of the sample, the width of the peduncle base exceeds 0.6 cm.

Peduncle bases in the entities rugosa and smutsiana tend to be narrower, but this difference is by no means absolute.

Locality.	Class range of measurements.					Total no. indiv.	Range actual measurements.
DIAMETER PEDUNCLE BASE. Class interval 0.15 cm.							
	.30	.45	.60	.75			cm.
HYBRID R4	3	4	-	-	-	7	0.25 - 0.38
SMUTSIANA.							
L'smith-B'dale I R5,62b	5	12	-	-	-	17	0.22 - 0.38
L'smith-B'dale II R3,62a	10	10	-	-	-	20	0.23 - 0.42
HALLII.							
Rietvlei R52	-	3	7	-	-	10	0.39 - 0.57
Koup R54	-	1	13	7	3	24	0.45 - 0.90
BULLULATA.							
Matjesfontein R55	-	1	8	-	-	9	0.44 - 0.56
RUGOSA.							
Pietersfontein R19,20	9	1	-	-	-	10	0.23 - 0.40
Baden-Baden R17,18,59	8	9	-	-	-	17	0.22 - 0.41
nr. Montagu R23	7	-	-	-	-	7	0.25 - 0.30
"Montagu Dist." Nbg	3	2	-	-	-	5	0.28 - 0.37
Dobbelaars Kloof R21,22	6	3	-	-	-	9	0.25 - 0.40
L'smith-B'dale R2	4	3	-	-	-	7	0.27 - 0.40
DIAMETER PEDUNCLE BELOW RACEME. Class interval 0.10 cm.							
	.10	.20	.30	.40			cm.
HYBRID R4	-	4	2	-	-	7	0.15 - 0.25
SMUTSIANA.							
L'smith-B'daleIR5,62b	-	15	6	-	-	21	0.11 - 0.24
L'smith-B'dale II R3,62a	-	16	2	-	-	18	0.12 - 0.27
HALLII.							
Rietvlei R52	-	3	6	1	-	10	0.17 - 0.31
Koup R54	-	-	9	14	1	24	0.28 - 0.44
BULLULATA.							
Matjesfontein R55	-	-	7	2	-	9	0.24 - 0.33
RUGOSA.							
Pietersfontein R19,20	-	5	5	-	-	10	0.18 - 0.25
Baden, Baden R17,18,59	-	14	3	-	-	17	0.14 - 0.26
nr. Montagu R23	-	4	3	-	-	7	0.19 - 0.27
"Montagu Dist." Nbg	-	5	-	-	-	5	0.14 - 0.20
Dobbelaars Kloof R21,22	-	5	4	-	-	-9	0.15 - 0.28
L'smith-B'dale R2	-	6	1	-	-	7	0.16 - 0.23

Table 71 VARIATION IN BROADNESS OF PEDUNCLE IN FIELD SPECIMENS OF 'SMUTSIANA', 'HALLII', 'BULLULATA', 'RUGOSA', + THE PUTATIVE 'SMUTSIANA' X 'RUGOSA' HYBRID.

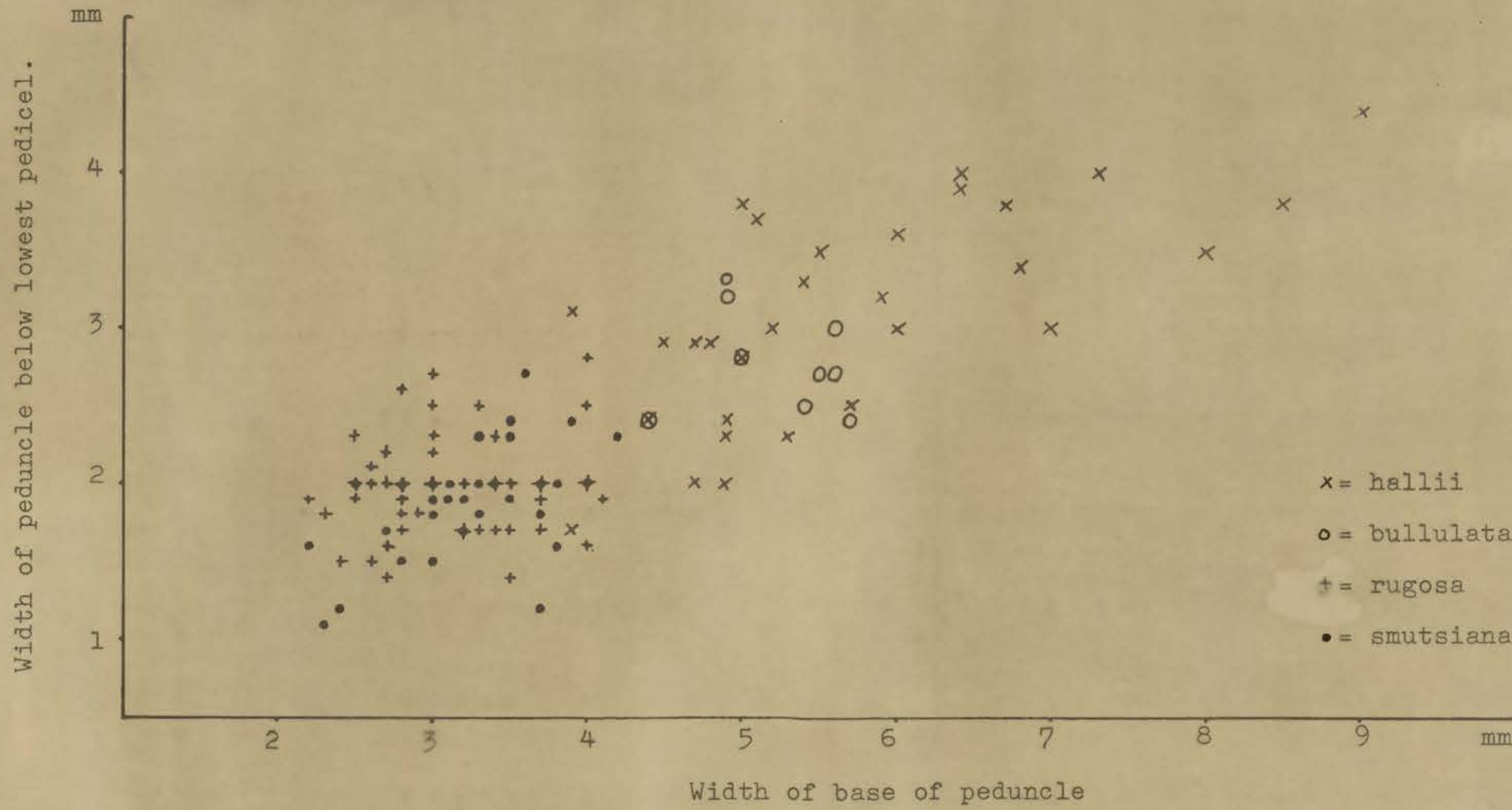


Fig.52. Variation in thickness of peduncle in the entities smutsiana, hallii, bullulata and rugosa.

A similar pattern of variation is observed for the width of the peduncle below the first pedicel.

A scatter diagram, (Fig.52), of the diameter of the base of the peduncle plotted against the diameter of the peduncle below the first pedicel gives a fairly good, but by no means complete, separation of the entities smutsiana and rugosa from the entities hallii and bullulata.

Dimensions of basal sterile bract. (See Tables 72 and 73).

There is considerable overlap in the length of the lowest sterile bract between the four entities. The shortest bracts are found in population samples of the entity rugosa. The length of the basal sterile bract of the putative hybrid between this entity and the entity smutsiana is very variable.

The width of the base of the lowest sterile bract is similar in all four entities, with the exception of specimens of the entity hallii from Koup, where the bases of the sterile bracts are broader, agreeing with the broader peduncle base observed in specimens of this sample.

Although there is an overlap in the length-breadth ratio of the basal sterile bract between all four entities, a majority of specimens with the highest ratios is found in the entity smutsiana, while the lowest ratios are found in the majority of specimens of the entities rugosa and bullulata.

The length-breadth ratio of the basal sterile bracts of the putative hybrid is very variable.

Dimensions of basal fertile bract. (See Tables 74 and 75)

There is little difference in the length of the lowest fertile bract between the four entities. A larger number of longer bracts tends to be found in the entities hallii and bullulata, and a greater number of shorter bracts is found in the entity rugosa.

Differences with regard to the basal width and the length-breadth ratio are also slight, the greatest number of bracts with a length-breadth ratio exceeding 5.0 being found in the entity smutsiana. Again this ratio is very variable in the putative hybrid between members of the entities smutsiana and rugosa.

Locality.	Class range of measurements.						Total no. indiv.	Range actual measurements.
	BRACT LENGTH. Class interval 0.2 cm.							
	0.4 0.6 0.8 1.0 1.2							cm.
Field Specimens.								
HYBRID R4	-	1	-	1	-	1	3	0.48 - 1.40
SMUTSIANA.								
L'smith-B'dale I R5 62b	-	4	9	2	1	-	16	0.55 - 1.05
L'smith-B'dale II R3 62a	-	9	8	3	-	-	20	0.42 - 0.90
HALLII.								
Rietvlei R52	-	1	9	-	-	-	10	0.60 - 0.80
Koup R54	-	8	12	3	-	-	23	0.43 - 0.93
BULLULATA.								
Matjesfontein R55	-	5	4	-	-	-	9	0.55 - 0.73
RUGOSA.								
Pietersfontein R19+20	-	-	-	-	-	-	-	-
Baden-Baden R17,18,59	1	7	-	-	-	-	8	0.40 - 0.55
"Montagu Dist" Nbg	-	3	1	-	-	-	4	0.47 - 0.65
Dobbelaars Kloof R21,22	-	1	-	-	-	-	1	0.48
L'smith-B'dale R2	-	8	1	-	-	-	9	0.45 - 0.80
Herbarium Specimens.								
BULLULATA.								
Verlaten Kloof	-	-	1	-	-	-	1	0.70
Ceres Karoo	-	1	-	-	-	-	1	0.42
Laingsb'g-L'smith	-	2	1	-	-	-	3	0.55 - 0.70
RUGOSA.								
Graaff Reinet	-	-	1	-	-	-	1	0.80
Laingsb'g-L'smith	-	-	1	-	-	-	1	0.75
Ladismith	-	1	-	-	-	-	1	0.48
	BASAL WIDTH OF BRACT. Class interval 0.1 cm.							
Field Specimens.	0.2 0.3 0.4							
HYBRID R4	-	3	-	-			3	0.23 - 0.30
SMUTSIANA.								
L'smith-B'dale I R5,62b	2	13	1	-			16	0.18 - 0.32
L'smith-B'dale II R3,62a	4	15	1	-			20	0.15 - 0.37
HALLII								
Rietvlei R52	1	7	2	-			10	0.19 - 0.40
Koup R54	-	9	9	4			23	0.22 - 0.47
BULLULATA.								
Matjesfontein R55	-	7	2	-			9	0.26 - 0.40
RUGOSA.								
Baden-Baden R17,18,59	1	6	1	-			8	0.18 - 0.36
"Montagu Dist" Nbg.	1	3	-	-			4	0.20 - 0.27
Dobbelaars Kloof R21,22	-	1	-	-			1	0.28
L'smith-B'dale R2	-	6	2	-			8	0.24 - 0.35
Herbarium Specimens.								
RUGOSA.								
Graaff Reinet	-	1	-	-			1	0.25
Bonnievale	-	-	-	-			-	-
Laingsb'g-L'smith	1	-	-	-			1	0.20
Ladismith	-	1	-	-			1	0.23

TABLE 72 Variation in length and width of base in lowest Sterile bract in field and herbarium specimens of "smutsiana", 'halli', 'bullulata', 'rugosa' and the putative "smutsiana x 'rugosa'" hybrid.

Locality.	Class range of measurements.					Total no. indiv.	Range actual measurements.
MIDDLE WIDTH OF BRACT. Class interval 0.05 cm.							
	.05	.10	.15	.20			cm.
Field Specimens.							
HYBRID R4	1	2	-	-	-	3	0.05 - 0.10
SMUTSIANA.							
L'smith-B'dale I R5,62b	-	10	6	-	-	16	0.06 - 0.15
L'smith-B'dale II R3,62a	1	13	6	-	-	20	0.05 - 0.15
HALLII.							
Rietvlei R52	-	3	5	-	-	8	0.10 - 0.14
Koup R54	-	4	7	3	1	15	0.08 - 0.22
BULLULATA.							
Matjesfontein R55	-	2	2	3	2	9	0.08 - 0.23
RUGOSA.							
Baden-Baden R17,18,59	-	4	3	-	1	8	0.06 - 0.23
"Montagu Dist". Nbg	-	1	3	-	-	4	0.08 - 0.12
Dobbelaars Kloof R21,22	-	1	-	-	-	1	0.10
L'smith-B'dale R2	-	-	5	3	-	8	0.11 - 0.16
Herbarium Specimens.							
RUGOSA.							
Graaff Reinet	-	1	-	-	-	1	0.06
~~Bonnievale~~	-	-	-	-	-	—	-
Laingsb'g-L'smith	-	-	1	-	-	1	0.13
Ladismith	-	-	1	-	-	1	0.12

LENGTH-BREADTH RATIO OF BRACT. Class interval 0.20 cm.

	3	5	7	9	11	13			
Field Specimens.									
HYBRID R4	-	-	1	-	-	1	-	3	4.8 - 28.00
SMUTSIANA.									
L'smith-B'dale I R5,62b	-	1	7	6	1	-	1	16	4.83 - 15.00
L'smith-B'dale II R3,62a	1	4	7	5	-	2	1	20	3.00 - 14.66
HALLII.									
Rietvlei R52	-	2	3	3	-	-	-	8	4.42 - 8.00
Koup	1	6	6	2	-	-	-	15	2.88 - 8.12
BULLULATA.									
Matjesfontein R55	-	7	1	-	1	-	-	9	3.09 - 9.13
RUGOSA.									
Baden-Baden R17,18,59	1	6	-	-	1	-	-	8	1.82 - 9.16
"Montagu dist". Nbg	-	2	2	-	-	-	-	4	4.33 - 5.87
Dobbelaars Kloof R21,22	-	1	-	-	-	-	-	1	4.80
L'smith-B'dale R2	-	7	1	-	-	-	-	8	3.50 - 5.06
Herbarium Specimens.									
RUGOSA.									
Graaff Reinet	-	-	-	-	-	1	-	1	13.0
Laingsb'g-L'smith	-	-	1	-	-	-	-	1	5.76
Ladismith	-	1	-	-	-	-	-	1	4.00

Table 73 Variation in width of basal sterile bract taken half way along the length, and in the length-breadth ratio in field and herbarium specimens of '<u>smutsiana</u>', '<u>hallii</u>', '<u>bullulata</u>', '<u>rugosa</u>' + the putative '<u>rugosa</u>' x '<u>smutsiana</u>' hybrid.

Locality.	Class range of measurements.						Total no. indiv.	Range Actual measurements.
	BRACT LENGTH. Class interval 0.10 cm. 0.3 0.4 0.5 0.6 0.7							cm.
Field Specimens.								
HYBRID R4	-	1	-	-	1	1	3	0.38 - 0.76
SMUTSIANA.								
L'smith-B'dale I R5,62b	2	8	3	3	-	-	16	0.29 - 0.58
L'smith-B'dale II R3,62a	3	7	5	4	-	-	19	0.30 - 0.60
HALLII.								
Rietvlei R52	1	3	6	-	-	-	10	0.30 - 0.48
Koup R54	2	5	13	4	-	-	24	0.30 - 0.54
BULLULATA.								
Matjesfontein R55	-	3	6	-	-	-	9	0.35 - 0.48
RUGOSA.								
Pietersfontein R19+20	3	6	1	-	-	-	10	0.23 - 0.50
Baden-Baden R17,18,59	7	10	2	-	-	-	19	0.30 - 0.45
nr. Montagu R23	1	5	1	-	-	-	7	0.28 - 0.50
"Montagu Dist." Nbg	-	5	-	-	-	-	5	0.32 - 0.40
Dobbelaars Kloof R21,22	1	5	3	-	-	-	9	0.30 - 0.49
L'smith-B'dale R2	1	5	3	-	-	-	9	0.30 - 0.45
Herbarium Specimens.								
HALLII.								
Prince Albert	1	-	-	-	-	-	1	0.30
BULLULATA.								
Verlaten Kloof	-	-	-	1	-	-	1	0.53
Ceres Karoo	-	1	-	-	-	-	1	0.37
Laingsb'g-L'smith	-	3	-	-	-	-	3	0.35 - 0.38
RUGOSA.								
Graaff Reinet	-	-	1	-	-	-	1	0.48
Bonnievale	-	-	1	-	-	-	1	0.50
Barrydale Nbg	-	1	-	-	-	-	1	0.35
Muiskraal Nbg	-	1	-	-	-	-	1	0.40
Laingsb'g-L'smith	-	-	1	-	-	-	1	0.45
Ladismith	-	1	-	-	-	-	1	0.35

	BASAL WIDTH OF BRACT. Class interval 0.10 cm. 0.2 0.3 0.4					cm.
Field Specimens.						
HYBRID R4	2	1	-	-	3	0.19 - 0.25
SMUTSIANA.						
L'smith-B'dale I R5,62b	4	15	-	-	19	0.17 - 0.30
L'smith-B'dale II R3,62a	8	7	1	-	16	0.14 - 0.34
HALLII.						
nr. Rietvlei R52	4	6	-	-	10	0.19 - 0.26
Koup R54	4	17	2	-	23	0.20 - 0.40
BULLULATA.						
Matjesfontein R55	2	7	-	-	9	0.20 - 0.30
RUGOSA.						
Baden-Baden R17,18,59	4	6	-	-	10	0.20 - 0.25
"Montagu Dist." Nbg	2	3	-	-	5	0.20 - 0.30
Dobbelaars Kloof R21,22	-	1	-	-	1	0.23
L'smith-B'dale R2	-	8	-	-	8	0.22 - 0.30
Herbarium Specimens.						
Prince Albert Nbg	1	-	-	-	1	0.15
RUGOSA.						
Graaff Reinet	-	1	-	-	1	0.23
Bonnievale	-	1	-	-	1	0.23
Barrydale Nbg	-	1	-	-	1	0.25
Muiskraal Nbg	-	1	-	-	1	0.26
Laingsb'g-L'smith	-	1	-	-	1	0.23
Ladismith	-	1	-	-	1	0.25

TABLE 74 **Variation in length and width of base in lowest** fertile **bract in field and herbarium specimens of "smutsiana", "hallii", "bullulata", "rugosa" + the putative "smutsiana x rugosa" hybrid.**

Locality.	Class range of measurements.			Total no. indiv.	Range actual measurements.
MIDDLE WIDTH OF BRACT. Class interval 0.05 cm.					
	.10	.15			
Field Specimens.					cm.
HYBRID R4	3	-	-	3	0.07 - 0.10
SMUTSIANA.					
L'smith-B'dale I R5,62b	15	1	-	16	0.07 - 0.11
L'smith-B'dale II R3,62a	15	4	-	19	0.06 - 0.13
HALLII.					
Rietvlei R52	5	4	-	9	0.07 - 0.13
Koup R54	11	4	-	15	0.08 - 0.12
BULLULATA.					
Matjesfontein R55	3	5	1	9	0.08 - 0.16
RUGOSA.					
Baden-Baden R17,18,59	7	3	-	10	0.07 - 0.12
"Montagu Dist". Nbg	2	3	-	5	0.08 - 0.13
Dobbelaars Kloof R21,22	1	-	-	1	0.09
L'smith-B'dale R2	1	6	1	7	0.10 - 0.17
Herbarium Specimens.					
RUGOSA.					
Graaff Reinet (?)	1	-	-	1	0.07
Bonnievale	1	-	-	1	0.08
Barrydale Nbg	1	-	-	1	0.09
Muiskraal Nbg	1	-	-	1	0.08
Laingsb'g-L'smith	1	-	-	1	0.08
Ladismith	-	1	-	1	0.13

Locality.	Class range of measurements.					Total no. indiv.	Range actual measurements.
LENGTH-BREADTH RATIO OF BRACT. Class interval 2.0 cm.							
	3	5	7	9			
Field Specimens.							
HYBRID R4	-	1	-	-	2	3	3.45 - 11.00
SMUTSIANA.							
L'smith-B'dale I R5,62b	2	8	5	1	-	16	2.90 - 7.28
L'smith-B'dale II R3,62a	3	8	6	1	1	19	2.31 - 10.00
HALLII.							
nr. Rietvlei R52	-	7	1	-	-	8	3.30 - 5.14
Koup R54	3	8	4	-	-	15	2.50 - 6.62
BULLULATA.							
Matjesfontein R55	5	2	2	-	-	9	2.69 - 6.00
RUGOSA.							
Baden-Baden R17,18,59	2	7	1	-	-	10	2.50 - 5.71
"Montagu Dist." Nbg	1	4	-	-	-	5	2.46 - 4.12
Dobbelaars Kloof R21,22	-	1	-	-	-	1	3.66
L'smith-B'dale R2	3	5	-	-	-	8	2.17 - 3.46
Herbarium Specimens.							
RUGOSA.							
Graaff Reinet (?)	-	-	1	-	-	1	6.85
Bonnievale	-	-	1	-	-	1	6.25
Barrydale Nbg	-	1	-	-	-	1	3.88
Muiskraal Nbg	-	1	-	-	-	1	5.00
Laingsb'g-L'smith	-	-	1	-	-	1	5.62
Ladismith	1	-	-	-	-	1	2.69

TABLE 75 Variation in width of basal fertile bract taken half way along the length and in the length-breadth ratio in field and herbarium specimens of "smutsiana", "hallii" "bullulata", "rugosa" + the putative "rugosa" x "smutsiana" hybrid.

Locality.	Class range of measurements.								Total no. indiv.	Range actual measurements.
	0.2 0.3 0.4 0.5 0.6 0.7 0.8									cm.
				FIELD SPECIMENS.						
HYBRID R4	-	1	3	3	-	-	-	-	7	0.28 - 0.50
SMUTSIANA.										
L'smith-B'dale I R5,62b	1	7	8	-	-	-	-	-	16	0.15 - 0.40
L'smith-B'dale II R3,62a	2	8	8	3	-	-	-	-	21	0.14 - 0.48
HALLII.										
nr. Rietvlei R52	-	-	2	3	2	3	-	-	10	0.35 - 0.69
Koup R54	-	-	5	12	3	2	1	-	23	0.35 - 0.75
BULLULATA.										
Matjesfontein R55	-	-	1	4	4	-	-	-	9	0.37 - 0.53
RUGOSA.										
Pietersfontein R19+20	-	-	2	1	2	1	4	-	10	0.32 - 0.80
Baden-Baden R17,18,59	-	-	2	5	4	4	3	-	18	0.40 - 0.80
nr. Montagu R23	-	-	1	1	3	2	-	-	7	0.35 - 0.75
"Montagu Dist." Nbg	-	-	-	2	-	-	-	-	2	0.45 - 0.80
Dobbelaars Kloof R21,22	-	1	-	2	3	-	1	2	9	0.30 - 0.90
L'smith-B'dale R2	-	-	3	3	-	-	-	-	6	0.35 - 0.49
				HERBARIUM SPECIMENS.						
HALLII.										
Prince Albert Nbg	-	-	1	-	-	-	-	-	1	0.33
BULLULATA.										
Verlaten Kloof Nbg	-	-	-	1	-	-	-	-	1	0.45
Ceres Karoo	-	-	1	-	-	-	-	-	1	0.38
Laingsb'g-L'smith	-	1	1	-	-	-	-	-	2	0.30 - 0.38
RUGOSA.										
Graaff Reinet (?)	-	-	-	1	1	-	-	-	2	0.42 - 0.54
Bonnievale	-	-	-	-	-	-	1	-	1	0.73
Barrydale Nbg	1	1	-	1	-	-	-	-	3	0.20 - 0.46
Muiskraal Nbg.	-	1	-	-	-	-	-	-	1	0.27
Laingsb'g-L'smith	-	-	-	1	1	-	1	-	3	0.50 - 0.74
Ladismith	-	-	-	1	-	-	-	-	1	0.47

Class interval 0.10 cm.

Table 76A VARIATION IN FLOWERING PEDICEL FROM BASE OF RACEME IN FIELD SPECIMENS AND HERBARIUM SPECIMENS OF "SMUTSIANA", "HALLII", "BULLULATA", "RUGOSA" + THE PUTATIVE "SMUTSIANA" x "RUGOSA" HYBRID.

Locality.	Class range of measurements.										Total no. indiv.	Range actual measurements.
		0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9		cm.
FIELD SPECIMENS.												
HYBRID R4	-	2	3	1	-	-	-	-	-	-	6	0.18 - 0.40
SMUTSIANA.												
L'smith-B'dale I R5,62B	1	6	10	1	-	-	-	-	-	-	18	0.09 - 0.35
L'smith-B'dale II R3,62a	-	4	12	4	-	1	-	-	-	-	21	0.13 - 0.60
HALLII.												
nr. Rietvlei R52	-	-	-	6	3	-	-	-	-	-	9	0.34 - 0.50
Koup R54	-	-	2	13	6	3	-	-	-	-	24	0.28 - 0.59
BULLULATA.												
Matjesfontein R55	-	-	2	3	4	-	-	-	-	-	9	0.30 - 0.47
RUGOSA.												
Pietersfontein R19+20	-	-	1	1	3	1	1	1	-	-	8	0.30 - 0.72
Baden-Baden R17,18,59	-	-	1	5	6	3	-	-	-	1	15	0.30 - 0.92
nr. Montagu R23	-	-	-	3	2	-	-	-	-	-	5	0.35 - 0.49
"Montagu Dist." Nbg	-	-	1	3	1	-	-	-	-	-	5	0.30 - 0.57
Dobbelaars Kloof R21,22	-	-	-	-	2	2	2	-	-	-	6	0.45 - 0.68
L'smith-B'dale R2	-	-	2	4	-	-	-	-	-	-	6	0.28 - 0.40
HERBARIUM SPECIMENS.												
HALLII.												
Prince Albert Nbg.141/28(BOL)	-	-	1	-	-	-	-	-	-	-	1	0.24
BULLULATA.												
Ceres KarooNo. 27635(BOL)	-	-	1	-	-	-	-	-	-	-	1	0.29
RUGOSA.												
Graaff Reinet (?) 4202 herb.Marloth (PRE)	-	-	1	1	-	-	-	-	-	-	2	0.28 - 0.37
Bonnievale v.d. Merwe 226(BOL)	-	-	-	-	-	1	-	-	-	-	1	0.58
Barrydale Nbg.2154/26(BOL)	-	1	1	1	-	-	-	-	-	-	3	0.18 - 0.39
Muiskraal Nbg.2306/27(BOL)	-	1	-	-	-	-	-	-	-	-	1	0.20
Laingsb'g-L'smith Pillans 857(BOL)	-	-	1	1	-	-	-	-	-	-	2	0.30 - 0.39
Ladismith No. 27638(BOL)	-	-	-	2	-	-	-	-	-	-	2	0.38 - 0.39

Class interval 0.10 cm.

Table 76B VARIATION IN FLOWERING PEDICEL LENGTH FROM MIDDLE OF RACEME IN FIELD SPECIMENS AND HERBARIUM SPECIMENS OF "SMUTSIANA", "HALLII", "BULLULATA", "RUGOSA" + THE PUTATIVE "SMUTSIANA" x "RUGOSA" HYBRID.

Locality.	Class range of measurements.							Total no. indiv.	Range actual measurements.
	.3	.4	.5	.6	.7	.8			cm.
FIELD SPECIMENS.									
HYBRID R4	-	-	-	-	-	-	-		
SMUTSIANA.									
L'smith-B'dale I R5,62b	2	3	-	-	-	-	-	5	0.24 - 0.40
L'smith-B'dale II R3,62a	3	2	1	-	-	-	-	6	0.25 - 0.43
HALLII.									
Koup R54	-	-	3	1	-	-	-	4	0.41 - 0.53
BULLULATA.									
Matjesfontein R55	-	1	1	-	-	-	-	2	0.39 - 0.42
RUGOSA.									
Baden-Baden R17,18,59	-	-	-	-	-	-	1	1	0.89
"Montagu Dist." Nbg.	-	-	-	2	-	-	-	2	0.52 - 0.55
HERBARIUM SPECIMENS.									
RUGOSA.									
Muiskraal Nbg	-	-	-	1	-	-	-	1	0.53
Ladismith	-	-	-	1	-	-	-	1	0.53

Class interval 0.10 cm

Table 76C VARIATION IN FRUITING PEDICEL LENGTH FROM BASE OF RACEME IN FIELD POPULATIONS AND HERBARIUM SPECIMENS OF 'SMUTSIANA', 'HALLII', 'BULLULATA', 'RUGOSA' + THE PUTATIVE 'SMUTSIANA' x 'RUGOSA' HYBRID.

Pedicel length. (See Tables 76 A, B and C).

In the tables showing variation of this character in field population samples of these entities, the class interval used is 0.1 cm., compared with that of 0.2 cm. in the introductory survey.

There is an overlap of flowering pedicel length between the entities but the shortest basal flowering pedicels, 0.2 - 0.4 cm. in length in most cases, are found in the entity smutsiana. The majority of pedicels in the three other entities are longer. Pedicel length in the entity rugosa, and to a lesser extent in the entity hallii, is very variable.

By the middle of the raceme, most flowering pedicels in the samples of the entity smutsiana are 0.2 - 0.3 cm. in length while there are only a small number of specimens with pedicels less than 0.3 cm. long in the three other entities.

The putative hybrid tends to have pedicels of a length intermediate between that of the entities rugosa and smutsiana.

A scatter diagram of the length of the lowest flowering pedicel plotted against the width of the peduncle base (Fig.53) shows some separation of the entities rugosa and smutsiana from the entities hallii and bullulata, while a second scatter diagram (Fig.54) of the length of the lowest fertile bract plotted against the length of the lowest flowering pedicel shows a very slight tendency for the entities rugosa, bullulata and hallii to be distinct from the entity smutsiana in a combination of these characters.

Summary

The considerable overlap of inflorescence characters between all four entities precludes their being of any great taxonomic significance. The slight differences that are present do however indicate differences between the entities, which are more completely expressed in other characters.

All inflorescence characters of the entities hallii and bullulata apart from the greater frequency of axillary raceme buds in the former, are very similar.

The entity rugosa differs slightly from these two in the possession of more slender peduncles with fewer sterile bracts, which have no axilarry branches or undeveloped axillary r ceme buds, and a slight tendency towards shorter basal fertile bracts and longer pedicels.

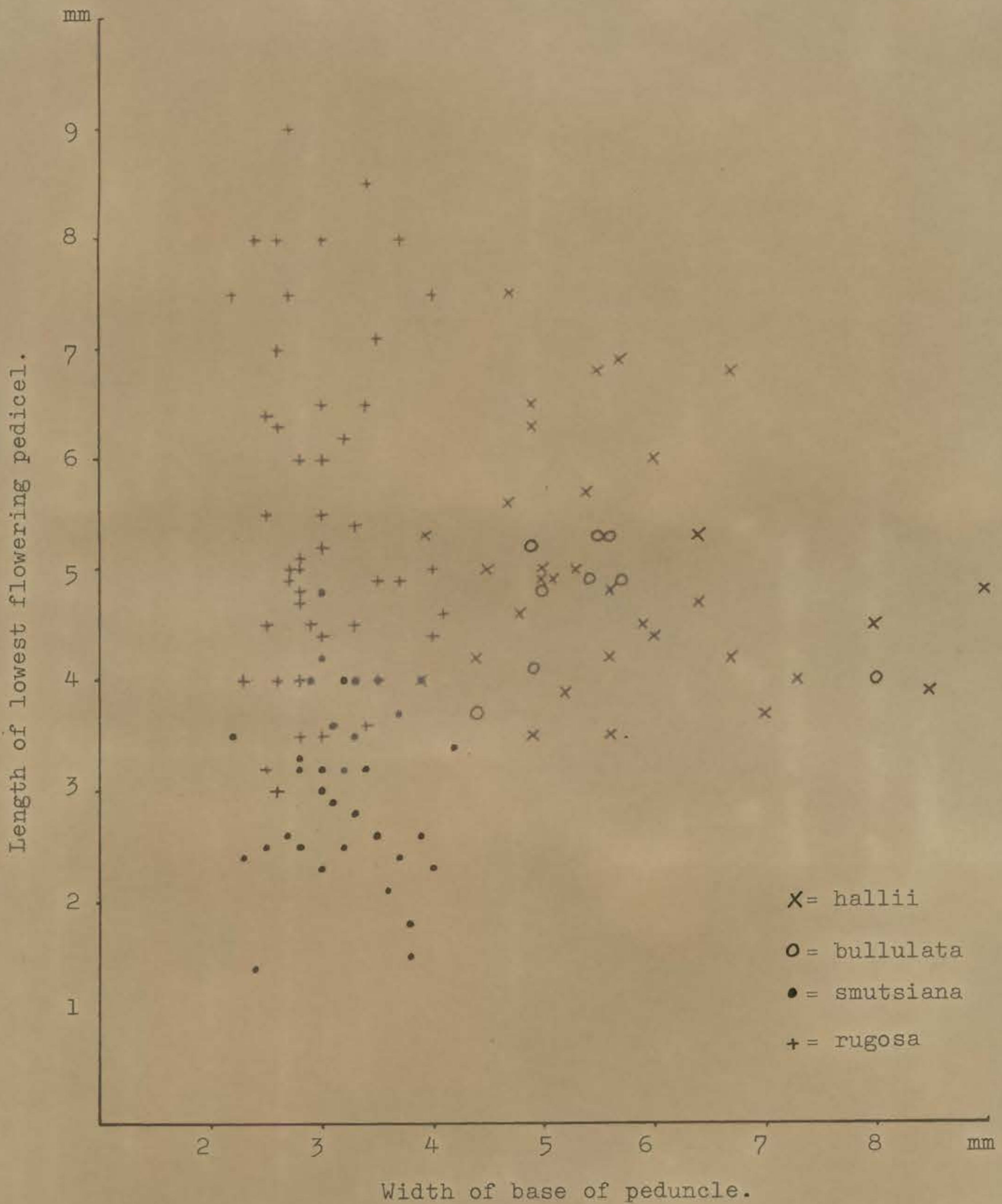


Fig.53. Variation in width of base of peduncle and length of lowest flowering pedicel in the entities smutsiana, hallii, bullulata and rugosa.

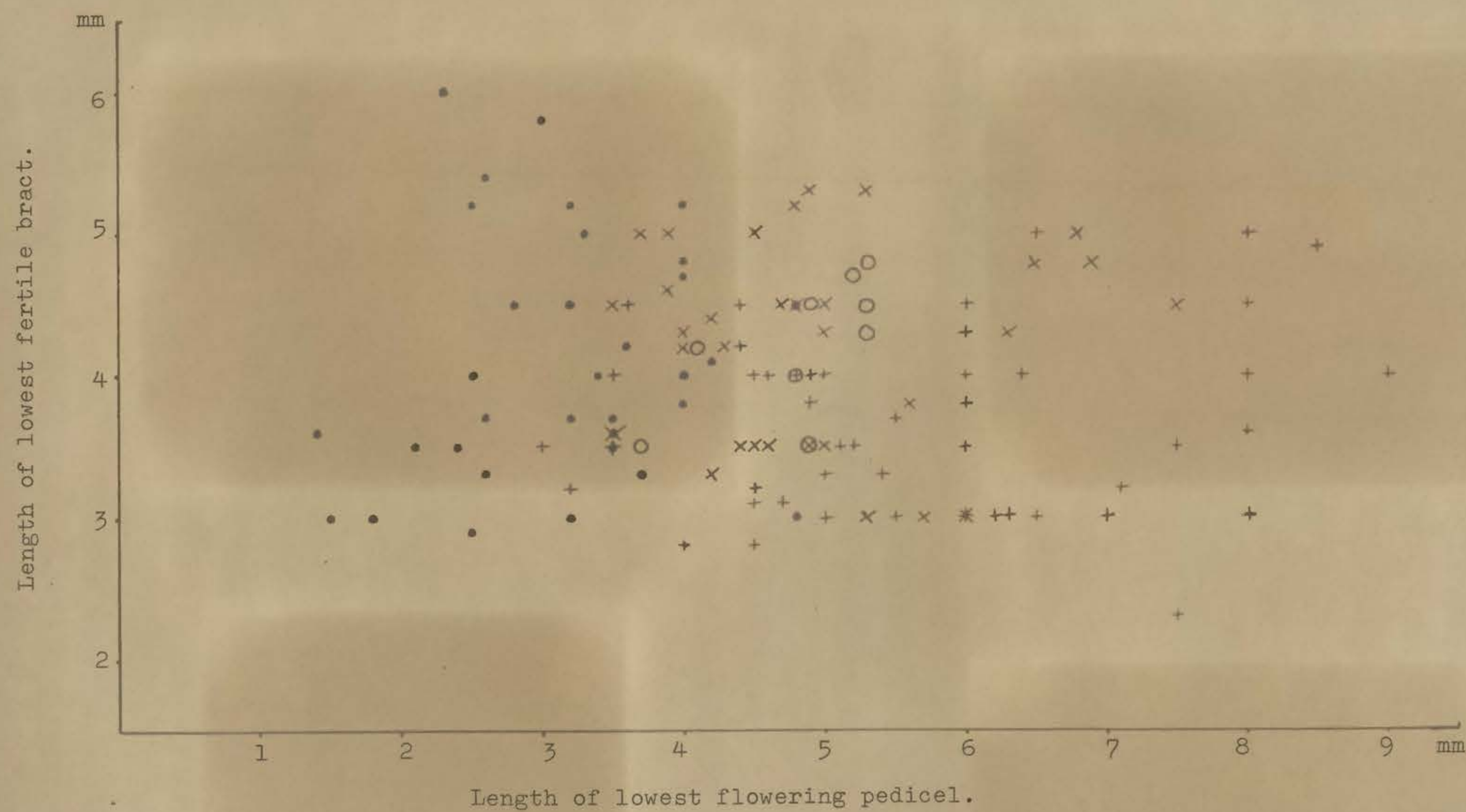


Fig.54. Variation of lowest fertile bract and length of lowest flowering pedicel in the entities smutsiana (•), hallii (×), bullulata (o), and rugosa (+).

Portion of an inflorescence of a specimen of the entity <u>bullulata</u>. (X $1\frac{1}{10}$).

Portion of an inflorescence of a specimen of the entity <u>smutsiana</u>. (X $1\frac{2}{10}$).

Portion of an inflorescence of a specimen of the entity <u>hallii</u>. (X $1\frac{1}{10}$).

Capsules from an inflorescence of the entity <u>hallii</u>.

PLATE 24.

The entity smutsiana also differs from the entity hallii in the frequency of undeveloped raceme buds, but in other respects its inflorescences differ little from those of this entity and the entity bullulata, save for peduncles which tend to be thinner, and lowest fertile bracts and pedicels which tend to be shorter.

The inflorescence characters of the putative hybrid between members of the entities smutsiana and rugosa are in general intermediate between those of these two entities.

PERIANTH CHARACTERS (See Plate 24.)

Variation in perianth characters is again shown in a series of histograms. Measurements for perianths of rugosa from the Montagu karoo area are shown as from a single locality.

Position of lobes in open flower. (See Fig.55)

This is very similar in the entities smutsiana, hallii, bullulata, and the putative hybrid between members of the entities smutsiana and rugosa.

The perianths of the entity rugosa differ from the other entities in that in most perianths, the outer lateral lobes and all the inner lobes are at an angle of 30° or less.

Length of perianth lobes. (See Fig.55)

Here the differences between the entities are slight, the lobes of the entity smutsiana tending to be shorter than those of the entities hallii and bullulata, whilst those of the entity rugosa are more variable.

Lobe length in the putative hybrid is similar to that found in the entity rugosa.

Width of perianth lobes. (See Fig.55)

In this character too the lobes of all four entities are very similar. The inner perianth lobes tend to be slightly broader than the outer ones.

The narrowest lobes occur in the entity smutsiana, the broadest in the Rietvlei speciment of the entity hallii.

Length of perianth. (See Fig.56)

Perianth length is somewhat variable, ranging from 7 - 11 mm.

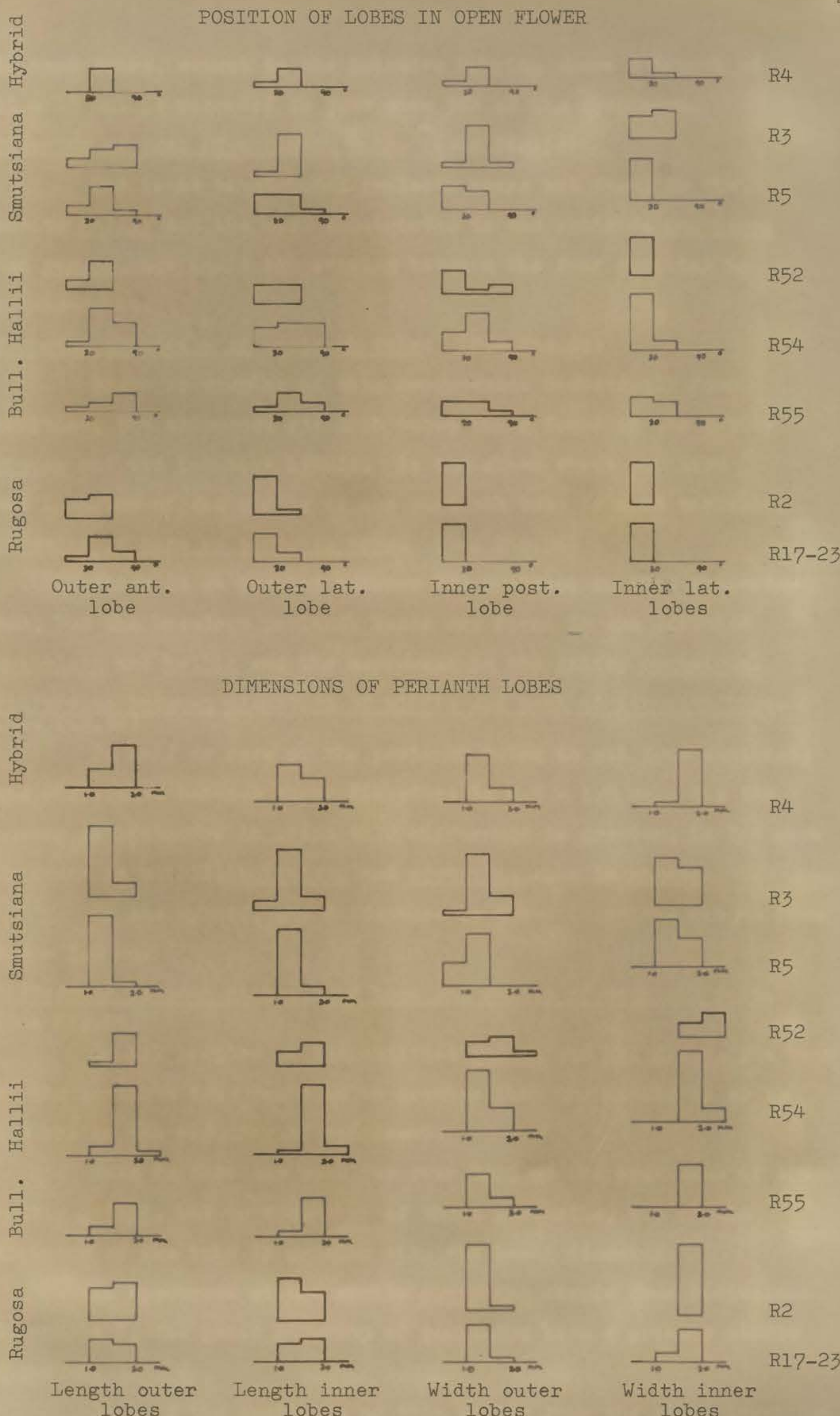


Fig. 55. Variation in position and dimensions of lobes in open flower in the entities smutsiana, hallii, bullulata, rugosa, and the putative smutsiana x rugosa hybrid.

in most cases, except in the putative hybrid, where a length of 11 - 13 mm. is recorded in just over 50% of the specimens.

Diameter of neck of perianth tube. (See Fig.56)

The least constricted perianth necks are found in the entity hallii and the most constricted in the entities smutsiana and rugosa, but again the overlap between the four entities is considerable.

Diameter of middle of perianth tube. (See.Fig.56)

There is overlap of this measurement between all four entities, the narrowest perianth tubes being found in the entity rugosa and the putative hybrid. In the other three entities the diameter of the middle of the perianth tube is more variable.

Diameter of base of perianth tube. (See Fig.56)

There is an overlap between the entities in this character too, but the broadest perianth bases are found in the entities bullulata and hallii and the narrowest in the entity smutsiana.

Difference between diameters of middle and neck of perianth tube. (See Fig.56)

In half or more of the perianth tubes in all four entities, the difference between these diameters is 0.5 - 1.0 mm., but the number of instances in which this difference is greater, is far more frequent in hallii, bullulata and smutsiana than in rugosa.

In the hybrid, the difference in these diameters ranges from 0.5 - 1.0 mm.

Difference between diameter of base and middle of perianth tube. (See Fig.56)

In all samples of the entities rugosa and bullulata, the base of the perianth tube tends to be greater than the middle by up to 0.5 mm. in the majority of specimens.

This is also the case for over half of the specimens of the entity hallii, but in a quarter of these perianths, the middle diameter of the tube is greater than the basal diameter.

In specimens of the entity smutsiana sample from Ladismith-Barrydale I, the great majority of perianths have a greater middle diameter.

In half the specimens of this entity from the other locality, however, there is no difference between the basal and mid diameter

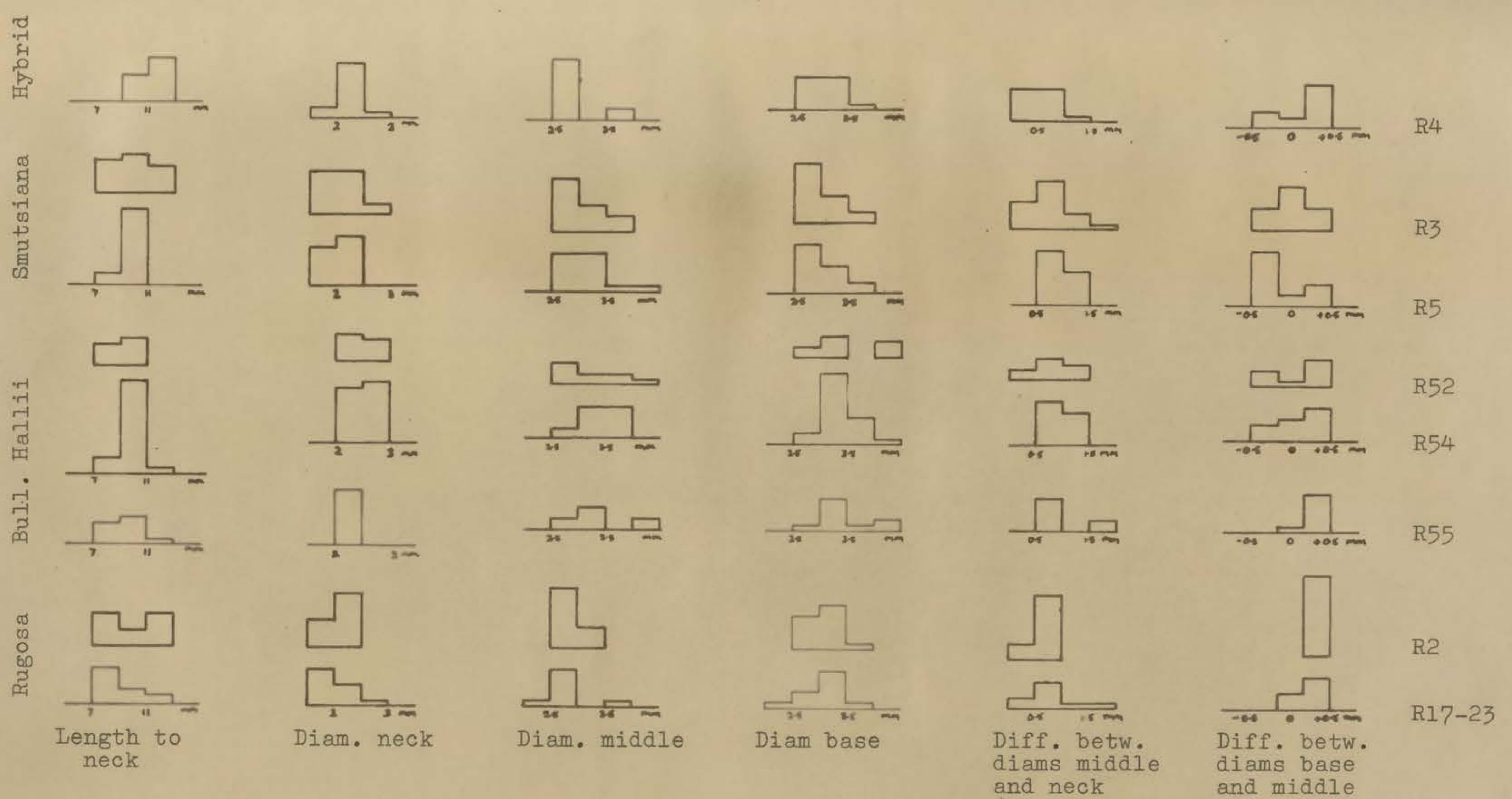


Fig.56. Variation in dimensions and shape of perianth tube in the entities smutsiana, hallii, bullulata, rugosa, and the putative hybrid between rugosa and smutsiana.

of the perianth tubes, while equal numbers of the rest have the middle diameter greater than or less than the basal diameter.

In the hybrid, the shape of the perianth tube ranges from the basal diameter being less than to greater than the mid diameter, but in the majority of cases, the basal diameter is greater.

Summary

From the foregoing it is seen that the perianths of the entities bullulata and hallii are almost identical.

The entity smutsiana tends to differ slightly from the other three entities in the possession of slightly narrower inner lobes, and in the fact that the middle diameter of the perianth tube is more frequently equal to or greater than that of the base.

The entity rugosa differs from the other three entities in the fact that the outer lateral and all of the inner perianth lobes are least open. The narrowest neck and middle diameters in perianth tubes tend to be found in the entity rugosa, and this makes the fact that the basal diameter is greater than the middle diameter more pronounced than in the entities hallii and bullulata, although the basal diameter is similar in all three entities.

Colour of perianth

This has been already dealt with in the introduction, and the fact has been mentioned that in the entity rugosa the outer tepals of the perianth tube may be very slightly inflated. This was not observed in flowers of the putative hybrid between members of the entities rugosa and smutsiana. It may well be that certain authors in the past, who mentioned perianths "spongey at the angles" in connection with species other than A. herrei and A. spiralis, were, in fact, referring either to specimens of the entity rugosa with leaves with few tubercles, or to hybrids between the entities rugosa and smutsiana in which the outer tepals were slightly inflated on either side of the midrib.

CONCLUSION

In conclusion, it would appear that the similarity between the entities hallii and bullulata is closer than between these entities and other members of the genus. Their floral and inflorescence characters are extremely similar, apart from the fact that in both the perianth lobes are frequently bright or pale yellow - which is not found in any other entities with smooth perianths in the genus.

Vegetatively, they have in common a low spiral angle ($0 - 10^{\circ}$ in the majority of individuals), a tendency for the leaf apices to curve upward, and, which must be considered the most distinguishing feature, keeled marginate apices, present in some or all the leaves of any one plant.

Points of difference between the two entities which are not absolute are : the tendency for the leaf apices of the entity bullulata to curve upward and sideways, and the fact that the length-breadth ratio is greater in the entity hallii than in the entity bullulata, and the leaf apex narrower. This last character gave fairly good separation in a scatter diagram (See Fig.50). The fact that all plants of the entity bullulata have some leaves with tubercles, while some plants of the entity hallii do not, is another difference of secondary importance, as is the tendency for the tubercles of the entity bullulata to be grouped in approximate transverse rows on the leaf under-surface, and to be somewhat more prominent than those of the entity hallii, where the tubercles are arranged in longitudinal series in nearly all cases.

A point of absolute difference between the two are the presence of fine lines towards the apex on the underside of some or all of the leaves in any one plant of the entity hallii; these lines have never been observed in the entity bullulata. A second point of absolute difference is the fact that in all the plants of the entity hallii examined, the bundle caps were lignified for the entire length of the leaf, while in the entity bullulata, in the plants examined, the bundle caps were only completely lignified at the base of the leaf, and completely unlignified at the apex.

It is on these two characters that the recognition of the entities hallii and bullulata as two separate, but similar, species, is justified in the present author's opinion. They are consequently termed Astroloba hallii Roberts sp. nov. and Astroloba bullulata (Jacq.) Uitew.

The differences between these two and the third entity of the genus with tuberculate leaves is very marked. In the entity rugosa, the leaf apices are true marginate and curve outwards in most plants, the majority of leaves are much smaller and broader, and the distribution of the tubercles on the exposed part of the ventral side of the leaf is more regular and denser, even in the specimens from Dobbelaars Kloof. It is the nature of the leaf apex, the degree of tuberculation and to a lesser extent, the size and shape of the leaves which are the characters separating, at specific level, the entity rugosa from the two other tuberculate entities of the genus.

The differences in inflorescence and floral characters between the entities rugosa and these two are not as marked. In the entities rugosa, the peduncles tend to be more slender, the sterile bracts fewer, and, to a lesser extent, the lowest fertile bracts shorter. In floral characters, the entity rugosa tends to be distinguished by the very slight angle at which the outer lateral and all inner lobes lie open, (30° or less), and the fact that the neck and middle diameters of the perianth are less than in A. hallii and A. bullulata, giving the whole flower a more slender appearance. In the entity rugosa, the perianth lobes may have a faint yellowish tinge, but are never bright yellow. The slight inflation on either side of the midribs of the outer tepals found in some flowers of the entity rugosa has never been observed in the other two.

On the grounds of vegetative characters then, the entity rugosa is considered a distinct species, and is referred to as Astroloba rugosa Roberts sp. nov., formerly known incorrectly as Astroloba aspera (Haw.) Uitew.

The fact that the entity smutsiana and A. hallii both have almost identical leaf colour, and darker longitudinal striations on the underside of the leaf towards the apex has been mentioned.

However, on the grounds that keeled marginate apices are never present in the entity smutsiana it seems reasonable, in the opinion of the present author, to consider this as a species distinct from A. hallii. In a genus where the facies of the components are as similar as they are in Astroloba, any character such as this, which shows a complete discontinuity, must be considered of taxonomic significance. Further, while populations of A. hallii and the entity smutsiana occur in close proximity in the northern foothills of the Swartberg, they still remain distinct.

Other characters by which the entity smutsiana tends to differ from A. hallii, but not absolutely, are : a greater variability in the spiral angle, a greater tendency for the leaf apices to curve outwards, and shorter leaves which tend to be slightly broader, and are never tuberculate in the field.

There is a good deal of similarity in the inflorescences of the entity smutsiana and A. hallii, but in the former, the peduncles tend to be more slender and the pedicels shorter. The perianth of the entity smutsiana differs slightly from that of A. hallii in that the mid diameter is greater than the basal diameter in a large number of cases. The perianth lobes of the entity smutsiana are generally white or cream and rarely have a yellowish tinge.

Accordinly this entity is referred to as Astroloba smutsiana Roberts sp. nov.

The putative hybrid is in every way intermediate in character between its suggested progenitors. Although cytological evidence has not yet been obtained, and the hybrid has not been artificially recreated, the evidence with regard to its occurrence in the field, its morphology and the anatomy of the epidermal cells of the leaf, indicates most convincingly that it is a naturally occurring hybrid between the species A. rugosa and A. smutsiana.

THE ENTITIES HERREI AND SPIRALIS

It was shown in the introductory survey, that these two entities were distinguished from the other members of the genus, by the great inflation of loosely packed parenchyma tissue on either side of the midribs of the outer tepals of the perianth.

Apart from the dubious herbarium specimen from Graaff Reinet, (Marloth 5112 in Herb. Marloth (PRE)), the know records for the entity spiralis are in the Little Karoo, from Ladismith and Barrydale to Oudtshoorn and De Rust, while the entity herrei has, to date, only been found in marginal karoid areas North of Uniondale, and near Prince Albert in the northern foothills of the Swartberg.

"Spiralis" was first described as a species by Linneus in the Species Plantarum (1753), but he did not mention the rugosity of the perianth in his description of the flowers until his publication of the Mantissa in 1771. "Herrei" was described as a species by Uitewaal in 1948. In 1950, Uitewaal published another new species of Astroloba, A. dodsoniana, which appears to be identical to his A. herrei. Uitewaal wrote "... it ("dodsoniana") is easily distinguished (from A. herrei) by its more erect, and more whitish leaves, which have only very inconspicuous lines on the back, and by its light margins and keel." The problem now is to determine the extent of the similarity between the entities spiralis and herrei.

VEGETATIVE CHARACTERS (See Figs. 57 and 58, and Plates 25 and 26.)

An examination of the introductory comparison of vegetative characters in the genus as a whole shows some similarity between the entities spiralis and smutsiana. In the field, it is often difficult to distinguish between non flowering populations of the two. It is the author's opinion, that in the past there was considerable confusion between plants of the two entities. A. spiralis was the first species in the genus to be described. Later Aiton in the first edition of the Hortus Kewensis described two varieties of A. spiralis, pentagona and imbricata, on the grounds of leaf arrangement. Haworth in 1804 raised "pentagona" to specific level, without describing the flowers. An illustrated account of a flowering plant described as Aloe pentagona only appeared in 1811. It had a smooth perianth. While the identity of this particular plant is open to doubt, as it might have been a specimen either of what is now referred to by the present author as A. smutsiana or as A. hallii, it seems very likely that originally, non-flowering plants of the entities smutsiana and spiralis were taken to be one species. Later, plants of A. hallii and A. smutsiana, which, apart from the shape of the apex and the presence of tubercles, may look alike on account of similar coloration and the presence of vein lines, were also confused, resulting in a taxonomic muddle over the identity of the species A. pentagona.

The reader is asked to refer again to the introduction and to the survey of field populations in A. smutsiana to see how this compares with the entity spiralis in vegetative characters.

Leaf Arrangement (See Table 77)

In the entity spiralis, the spiral angle ranges from less than 10 - 30° in most plants from Hoekplaas, South of the Swartberg, and 10 - 15° in plants near Prince Albert in the northern foothills of the Swartberg.

The majority of plants in both samples of the entity herrei, have sub-erect leaves, but in most plants of the Prince Albert sample, the leaf apices follow the angle of the leaf with the stem or curve upward, while in the Hoekplaas sample they curve outward. One of the few reasons given by Uitewaal for the recognition of A. dodsoniana was the more erect position of the leaves, but, as is obvious, this is not a good taxonomic character.

In the entity spiralis, the majority of leaves from Calitzdorp are erect, the majority from Oudtshoorn sub-erect. All leaf apices in the Calitzdorp sample follow the angle of the leaf with the stem, while in nearly half of the plants from Oudtshoorn they curve outward.

Thus, while there is some variation in leaf arrangement between individual populations, the two entities, taken as a whole,

Locality.	Class range of measurements.						Total no. indiv.	Range actua[illegible] measuremen[illegible]
	SPIRAL ANGLE. Class interval 10°							
	0	10	20	30				°
SPIRALIS.								
Calitzdorp R47	-	1	2	2	1		6	7 - 3[illegible]
Oudtshoorn R7	1	6	3	6	1		17	0 - 3[illegible]
HERREI.								
Hoekplaas R16	-	1	3	5	-		9	10 - 3[illegible]
Prince Albert R46	-	5	5	-	-		10	10 - 1[illegible]
	ANGLE OF LEAF WITH STEM. Class interval 20°							
	Erect 30	Sub-erect 50	Patent-erect 70	Patent.				°
SPIRALIS.								
Calitzdorp R47	4	2	-	-			6	23 - 4[illegible]
Oudtshoorn R7	3	15	-	-			18	25 - 5[illegible]
HERREI.								
Hoekplaas R16	-	7	2	-			9	40 - 6[illegible]
Prince Albert R46	-	10	-	-			10	35 - 4[illegible]
	CURVATURE OF LEAF APICES.							
	u	f	o					
SPIRALIS.								
Calitzdorp R47	-	6	-				6	f
Oudtshoorn R7	1	10	7				18	u - o
HERREI.								
Hoekplaas R16	-	1	8				9	f - o
Prince Albert R46	5	4	1				10	u - o
	ANGLE OF LEAF APEX. Class interval 5°							
	10	15	20	25	30			°
SPIRALIS.								
Calitzdorp R47	-	-	-	2	2	2	6	22 - 3[illegible]
Oudtshoorn R7	-	-	9	8	6	-	23	18 - 2[illegible]
HERREI.								
Hoekplaas R16	-	5	5	-	-	-	10	13 - 1[illegible]
Prince Albert R46	1	8	2	-	-	-	11	9 - 2[illegible]

Table 77 VARIATION IN APPEARANCE OF LEAFY SHOOT IN FIELD SAMPLES OF "SPIRALIS" AND "HERREI".

(u = leaf apices curving upwards; f = leaf apices following the angle of the leaf with the stem; o = leaf apices curving outwards).

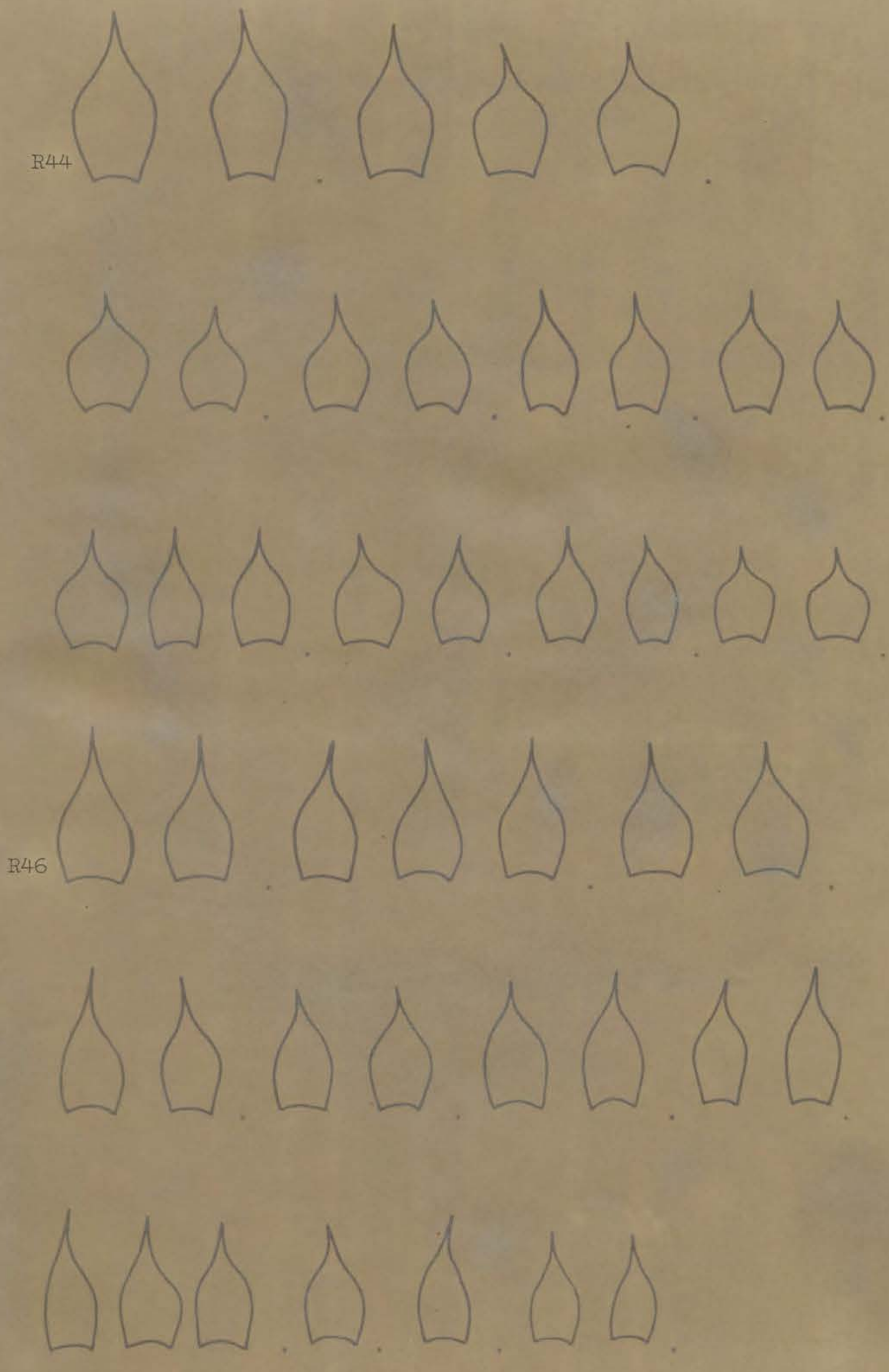


Fig.57. Variation in leaf shape in population samples of the entity <u>herrei</u>. (Sheathing part of leaf base not shown, the dots indicate the number of leaves shown per plant).

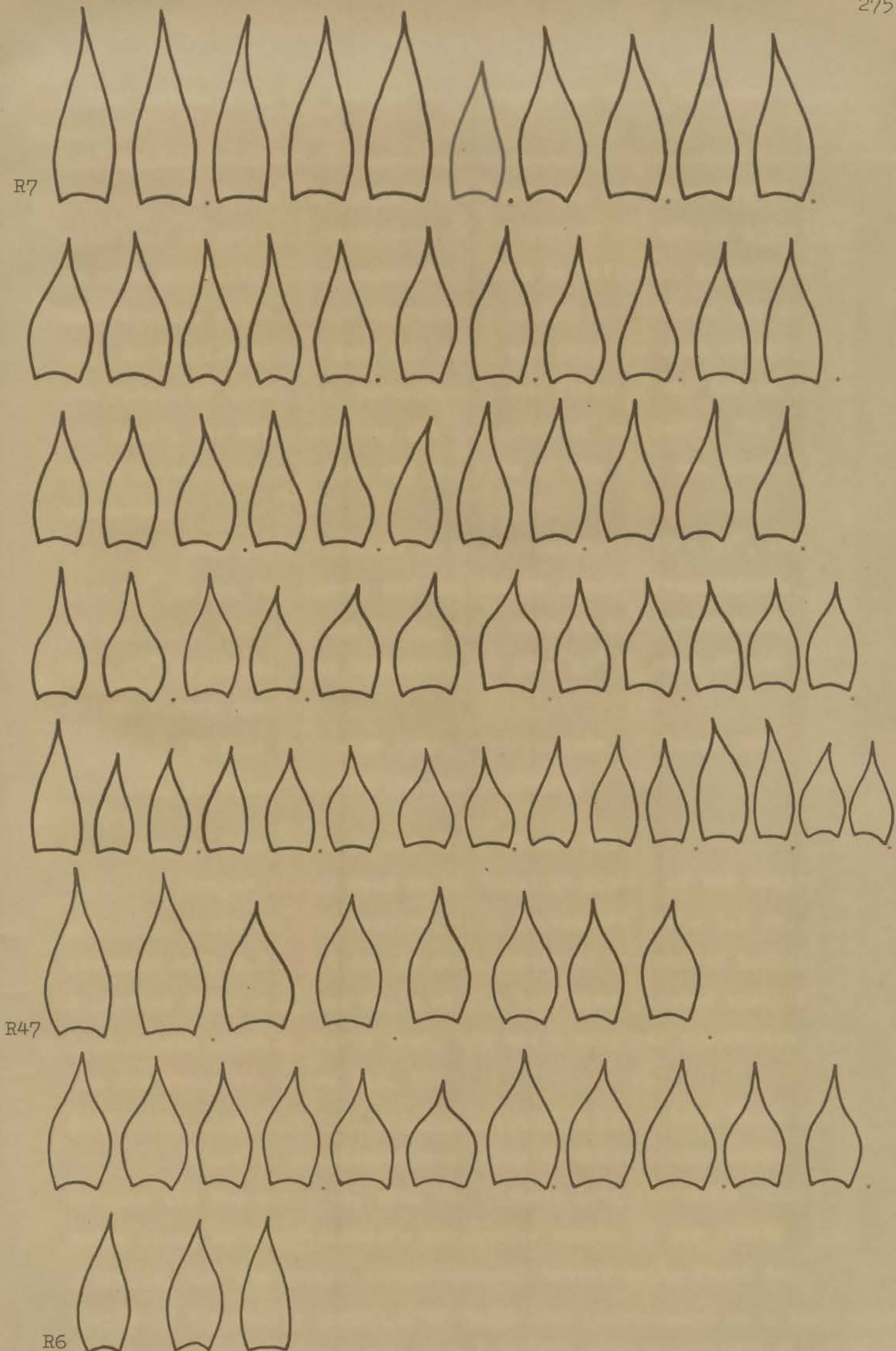


Fig.58. Variation in leaf shape in population samples of the entity <u>spiralis</u>. (Sheathing part of base not shown, the dots indicate the number of leaves shown for each plant.)

differ little from one another with regard to these characters.

Leaf apex (See Table 78)

In the entity herrei, the leaf apex may generally be described as narrowly acuminate, while that of the entity spiralis is more generally acute acuminate. This is difficult to express numerically, and a rather approximate method was devised for doing so. An imprint of the leaf was made, and from the apex an arc, the radius of which was approximately one fifth of the length of the leaf*, was drawn cutting the two sides of the leaf. The angle between these points and the apex of the leaf was then measured.

This angle is found to be approximately 20 - 35°, and 15 - 30° in the Calitzdorp and Oudtshoorn samples respectively, of spiralis, while in the herrei specimens it is approximately 10 - 20° in plants from Hoekplaas and 10 - 15° in most of the Prince Albert sample.

In this character then, a difference, although not absolute, is found between the two entities.

Leaf length (See Table 79 and Figs. 57 and 58)

Longer leaves tend to be found in plants of the entity spiralis, where in both samples, most leaves are 2.0 - 3.0 cm, compared with 2.0 - 2.5 cm. in most plants of the entity herrei. A scatter diagram of the angle of the leaf apex plotted against leaf length gives a fairly good, but not a complete separation of the two entities. (See Fig. 59)

Leaf width at widest part and length-breadth ratio (See Table 79)

There is considerable overlap in these measurements between the two entities, with the highest length-breadth ratios being found in the Oudtshoorn population sample of the entity spiralis, and the lowest length-breadth ratios being found in plants of the entity herrei from Hoekplaas.

Position of widest part of leaf in relation to length. (See Table 79)

As has been seen previously, the longer the leaf, the

---

* If the leaf was 1.5 - 2.0 cm, the radius was 0.4 cm, if 2.0 - 2.5 cm, 0.5 cm, if 2.5 - 3.0 cm, 0.6 cm and so on.

Locality	Radius of arc.	Leaf length	Angle of apex.	Length-breadth ratio.
	cm.	cm.	o	
SPIRALIS.				
Oudtshoorn R47.	0.9	4.2	18	2.90
	0.8	3.7	19	2.82
	0.8	3.6	18	2.70
	0.7	3.5	19	2.60
	0.7	3.3	22	2.54
	o.6	3.0	23	1.95
	0.6	3.0	19	2.19
	0.6	3.0	27	2.19
	0.6	2.9	19	2.37
	0.6	2.9	20	2.37
	0.6	2.8	21	2.33
	0.6	2.8	26	2.33
	0.6	2.7	19	2.02
	0.5	2.5	19	2.44
	0.5	2.5	26	2.47
	0.5	2.4	27	1.96
	0.5	2.4	21	1.64
	0.5	2.4	26	2.00
	0.5	2.3	24	2.18
	0.5	2.2	22	2.00
	0.5	2.2	26	1.86
	0.5	2.2	25	1.86
	0.4	1.9	22	1.85
Calitzdorp R47.	0.7	3.4	22	2.41
	0.6	2.7	30	1.86
	0.6	2.6	33	1.71
	0.6	2.6	28	2.06
	0.5	2.5	25	1.92
	0.5	2.4	34	1.57
HERREI.				
Uniondale Hoekplaas R16.	0.7	3.2	14	2.03
	0.6	2.6	13	1.67
	0.5	2.3	14	1.80
	0.5	2.2	14	1.78
	0.5	2.2	16	1.96
	0.5	2.1	17	1.62
	0.5	2.1	15	1.68
	0.5	2.1	18	1.44
	0.5	2.1	17	1.87
	0.4	1.8	16	1.46
Prince Albert R46.	0.6	2.9	13	2.00
	0.6	2.7	9	2.08
	0.6	2.7	14	1.98
	0.5	2.5	15	2.42
	0.5	2.5	12	2.00
	0.5	2.5	13	1.75
	0.5	2.5	20	2.21
	0.5	2.4	18	2.40
	0.5	2.4	15	2.09
	0.5	2.3	14	1.76
	0.5	2.1	14	2.28

TABLE 78 Variation in angle of leaf apex constructed on a leaf print by drawing an arc from the leaf apex to cut the sides of the leaf below, and measuring the angle made by these three points. The radius of the arc depends upon the length of the leaf. This is shown for field specimens of "spiralis" and "herrei", together with the length-breadth ratio of the leaves.

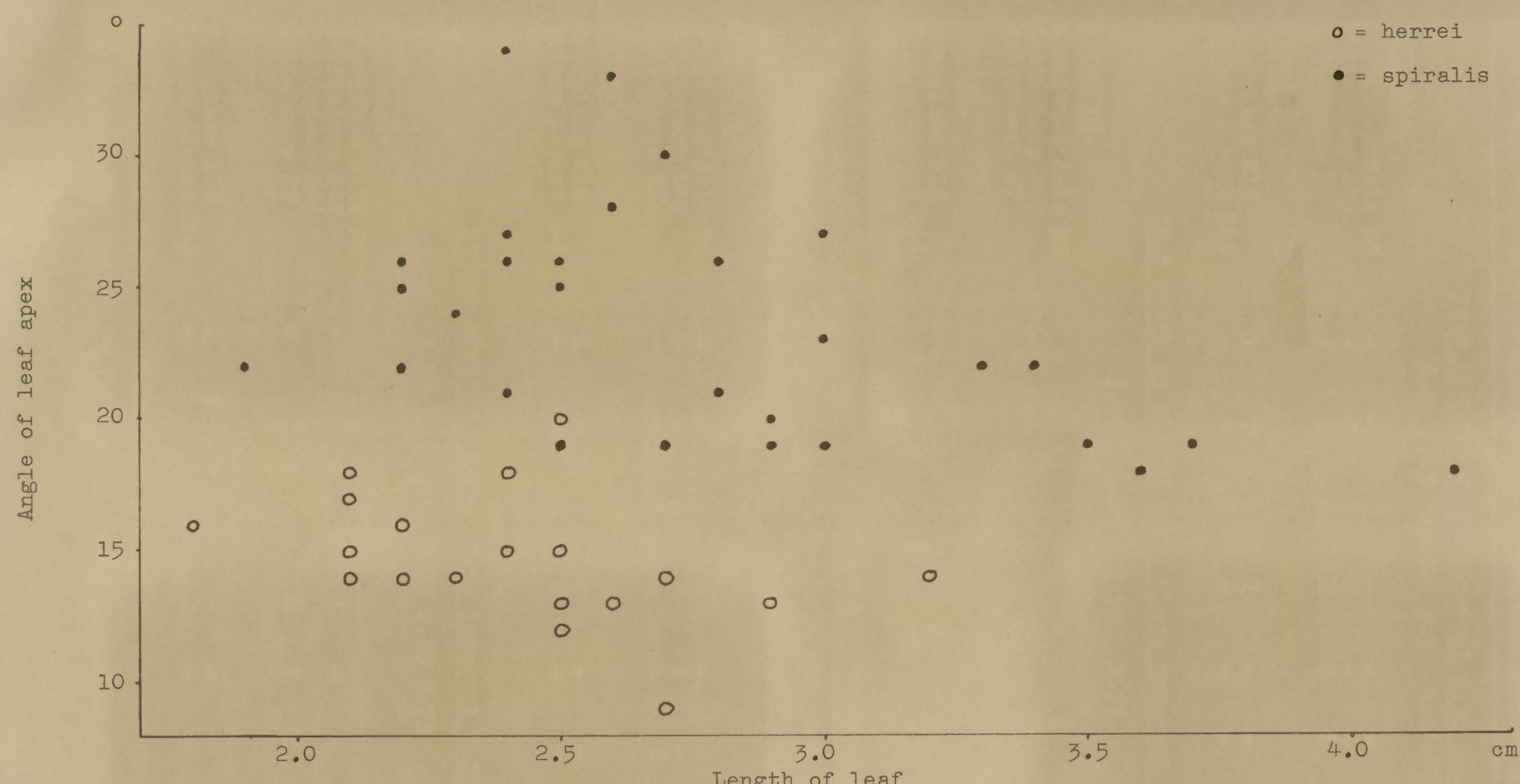


Fig.59. Variation in leaf length and in the angle of the leaf apex in the entities <u>spiralis</u> and <u>herrei</u>.

Locality.	Class range of measurements.						Total no. indiv.	Range actual measurements
	LEAF LENGTH. Class interval 0.50 cm.							
		2.0	2.5	3.0	3.5	4.0		cm.
SPIRALIS.								
L'smith-B'dale R6	-	-	1	-	-	-	1	3.0
Calitzdorp R47	-	2	3	1	-	-	6	2.4 - 3.4
Oudtshoorn R7	1	9	8	2	2	1	23	1.9 - 4.2
HERREI.								
Hoekplaas R16	1	7	1	1	-	-	10	1.8 - 3.2
Prince Albert R46	-	8	3	-	-	-	11	2.1 - 2.9

LEAF WIDTH AT WIDEST PART. Class interval 0.25 cm.

		1.00	1.25	1.50	1.75		cm.
SPIRALIS.							
L'smith-B'dale R6	-	-	-	-	1	1	1.7
Calitzdorp R47	-	-	6	-	-	6	1.3 - 1.50
Oudtshoorn R7	4	9	10	-	-	23	1.0 - 1.50
HERREI.							
Hoekplaas R16	-	4	5	1	-	10	1.1 - 1.6
Prince Albert R46	3	2	6	-	-	11	0.9 - 1.4

POSITION OF WIDEST PART OF LEAF w.r.t. MIDLENGTH. Class interval 0.25 cm.

	Above	0	Below half way mark .25	.50	.75			cm.
SPIRALIS.								
L'smith-B'dale R6	-	-	1	-	-	-	1	0.1bel*
Calitzdorp R47	-	-	3	2	1	-	6	0.1bel-0.6be
Oudtshoorn R7	-	-	4	16	1	2	23	0.2bel-0.9be
HERREI.								
Hoekplaas R16	1	-	9	-	-	-	10	0.1ab - 0.2b
Prince Albert R46	-	-	5	6	-	-	11	0.1bel-0.5be

LENGTH-BREADTH RATIO. Class interval 0.25

		1.50	1.75	2.00	2.25	2.50	2.75		
SPIRALIS.									
L'smith-B'dale R6	-	1	-	-	-	-	-	1	1.67
Calitzdorp R47	-	2	2	1	1	-	-	6	1.57 - 2.41
~~Calitzdorp R46~~									
Oudtshoorn R7	-	1	7	4	6	3	2	23	1.64 - 2.90
HERREI.									
Hoekplaas R16	2	3	4	1	-	-	-	10	1.44 - 2.03
Prince Albert R46	-	1	4	4	2	-	-	11	1.75 - 2.42

Table 79 VARIATION IN DIMENSIONS OF LEAVES IN FIELD POPULATIONS OF SPIRALIS AND HERREI.

*(ab = above midlength, bel = below midlength).

Locality.	Class range of measurements.				Total no. indiv.	Range actua measurement
	.05	.10	.15			cm.
	MUCRO LENGTH. Class interval 0.05 cm.					
SPIRALIS.						
L'smith-B'dale R6	-	1	-	-	1	.10
Calitzdorp R47	1	5	-	-	6	.06 - .08
Oudtshoorn R7	1	13	8	1	23	.04 - .16
HERREI.						
Hoekplaas R16	-	6	2	2	10	.08 - .18
Prince Albert R46	-	7	4	-	11	.07 - .13

Table 80 VARIATION IN MUCRO LENGTH IN FIELD SAMPLES OF SPIRALIS AND HERREI.

further below the half way mark of the length does the widest part tend to be.

Mucro length. (See Table 80)

Here too, the difference between the two entities is slight, but the samples of the entity herrei have a slightly larger percentage of mucros more than 0.10 cm. long, than found in the samples of the entity spiralis.

In actual leaf dimensions then, apart from the angle of the leaf apex, there is little difference between the entities spiralis and herrei.

LEAF COLOUR AND VEIN LINES.

This has been described in the introduction. All the leaves of the entity herrei have fine vein lines running the entire length of the leaf on the underside, and these lines often appear as very fine longitudinal ridges. In the entity spiralis, on the other hand, vein lines are not always apparent, (they were present in 43% of the plants examined) and never appear as fine ridges. The reason for this is because in the entity herrei, the bundle caps are much larger and close to the epidermis than in the entity spiralis. (See Appendix Table 8). A scatter diagram of the vertical distance of the largest bundle cap from the ventral side of the leaf from the lower epidermis, plotted against the area of this cap, gave a good separation of the entities spiralis and herrei for the few specimens

THE ENTITY SPIRALIS.

A(X $1\frac{1}{8}$). Shoot of plant from Calitzdorp R47, showing white maculae on leaves which developed under cultivation at Kirstenbosch.

B(X $1\frac{1}{5}$)

C(X $1\frac{1}{8}$)

D(X 1)

Leafy shoots B and C from Oudtshoorn R7, D from Calitzdorp R47. (Scales approximate).

PLATE 25.

THE ENTITY HERREI.

Habit of plants from Hoekplaas in which the leaf apices curve outwards (X $\frac{4}{5}$).

Leafy shoots (X $1\frac{1}{6}$): showing bundle cap lines and acute acuminate leaf apices.

(Scales approximate).

PLATE 26.

examined. (See Fig. 9).

Uitewaal gave as the other features by which A. dodsoniana differed from "herrei", the more whitish leaves and the very inconspicuous lines in the former. Again these are poor characters as they are so indefinite, and on these grounds, "dodsoniana" cannot be considered as a species distinct from the entity herrei.

Summary

Of all the vegetative characters, the ones in which there is a noticeable difference between the entities herrei and spiralis are the narrowly acuminate apices of the former, compared with the acute acuminate apices of the latter, and the very prominent bundle caps in the entity herrei. These two characters, render the two entities easily distinguishable in the field and lend support to their recognition as separate species. The leaves of the entity herrei dry with a series of very fine longitudinal ridges, this has never been the case in any specimens of the entity spiralis thus far examined.

The entity spiralis has in fact, more vegetative characters in common with A. smutsiana than with the entity herrei.

INFLORESCENCE CHARACTERS.

In this part of the survey, herbarium specimens are also included. Unfortunately the number of inflorescences of the entity herrei examined is rather few.

Peduncle and raceme length (See Table 81)

Peduncle length tends to be greater in the entity spiralis than in the entity herrei. Unfortunately many of the racemes of the entity herrei were damaged and it was not possible to obtain a fair comparison of raceme lengths in the two entities.

Thickness of peduncle (See Table 82)

There is an overlap in the width of the peduncle base between the majority of individuals of both entities, but there are a larger number of peduncles in the entity spiralis with narrower bases than are found in the entity herrei.

With regard to the width of the peduncle below the first pedicel, this tends to be broader in the entity herrei.

Locality.	Class range of measurements.							Total no. indiv.	Range actu measuremen
				PEDUNCLE LENGTH.					
	10	15	20	25	30	35			cm.
Field Specimens.									
SPIRALIS.									
L'smith-B'dale R6	-	-	-	1	-	2	-	3	25 -
Calitzdorp R64	-	-	1	1	4	1	-	7	19 -
Oudtshoorn R68	-	-	2	2	11	4	5	24	16 -
HERREI.									
Hoekplaas R44	1	-	3	2	-	-	-	6	10 -
Prince Albert R46	-	-	4	4	2	-	-	10	18 -
Herbarium Specimens.									
SPIRALIS.									
Graaff Reinet ?	-	-	-	1	-	-	-	1	25
Oudtshoorn	-	-	1	5	1	2	-	9	19 -
De Rust	-	-	-	-	-	1	-	1	34
Little Karoo	-	-	1	-	-	-	-	1	16
HERREI.									
Prince Albert	-	-	-	1	-	-	-	1	22
				RACEME LENGTH.					
Field Specimens.									
SPIRALIS.									
L'smith-B'dale R6	1	-	1	1	-	-	-	3	8 -
Calitzdorp R64	1	3	1	2	-	-	-	7	10 -
Oudtshoorn R68	-	3	8	10	-	2	1	24	13 -
HERREI.									
Hoekplaas R44	1	2	1	-	1	-	-	5	9 -
Prince Albert R46	-	1	-	1	-	-	-	2	14 -
Herbarium Specimens.									
SPIRALIS.									
Graaff Reinet ?	-	1	-	-	-	-	-	1	14
Oudtshoorn	-	6	-	1	-	-	-	7	11 -
De Rust	-	-	-	1	-	-	-	1	21
Little Karoo	-	1	-	-	-	-	-	1	15
HERREI.									
Prince Albert	-	1	1	2	1	-	-	5	14 -

Class interval 5.0 cm

Table 81 VARIATION IN LENGTH OF PEDUNCLE AND RACEME IN "SPIRALIS" AND "HERREI".

Locality.	Class range of measurements.					Total no. indiv.	Range actual measurement[s]
	WIDTH PEDUNCLE BASE. Class interval 0.15 cm.						cm.
SPIRALIS.							
L'smith-B'dale R6	-	3	-	-	-	3	.28 - .3
Calitzdorp R64	-	-	3	-	-	3	.40 - .6
Oudtshoorn R68	-	13	10	1	-	24	.26 - .5
HERREI.							
Hoekplaas R44	-	-	5	1	-	6	.42 - .5
Prince Albert R46	-	1	7	2	-	10	.40 - .6
	PEDUNCLE DIAM. BELOW RACEME. Class interval 0.10 cm.						
	.10	.20	.30				cm.
SPIRALIS.							
L'smith-B'dale R6	-	1	2	-		3	.14 - .
Calitzdorp R64	-	1	2	-		3	.19 - .
Oudtshoorn R68	-	17	7	-		24	.13 - .
HERREI.							
Hoekplaas R44	-	-	6	-		6	.23 - .
Prince Albert R46	-	2	8	1		11	.20 - .

Table 82 VARIATION IN THICKNESS OF PEDUNCLE BASE IN FIELD SPECIMENS OF "SPIRALIS" AND "HERREI".

Branching of inflorescence and number of sterile bracts (See Tables 83 and 8

Out of all field and herbarium specimens of both entities examined, only one branched inflorescence was found, in a specimen of the entity spiralis from Oudtshoorn, while unexpanded raceme buds in the axils of sterile bracts were found in a few specimens of the same entity from both Oudtshoorn and Calitzdorp. There was a slight difference in the number of sterile bracts between the two entities, this being 3 - 6 bracts in most of the samples of the entity spiralis, and 2 - 4 bracts in most of the samples of the entity herrei.

Sterile and fertile bracts (See Tables 85, 86, 87 and 88)

There is an overlap in the length of the bracts in the two entities, the fertile bracts of the entity herrei tending to be slightly longer.

As would be expected, the sterile and fertile bracts are also somewhat broader at the base in the entity herrei, where the peduncle is generally slightly thicker than in the entity spiralis.

Locality.	Indivs. with one or more branches to inflorescence.	Inflorescences unbranched but unexpanded raceme buds in axils of sterile bracts.	Total no. indiv.
Field Specimens.			
SPIRALIS.			
L'smith-B'dale R6	0	0	3
Calitzdorp R64	0	2	6
Oudtshoorn R68	1	2	24
HERREI.			
Hoekplaas R44	0	0	6
Prince Albert R46	0	0	10
Herbarium Specimens.			
SPIRALIS.			
Graaff Reinet ?	0	0	1
Oudtshoorn	0	0	8
De Rust	0	0	1
Little Karoo	0	0	1
HERREI.			
Prince Albert	0	0	2

Table 83 VARIATION IN DEGREE OF BRANCHING OF INFLORESCENCE IN 'SPIRALIS' AND 'HERREI'.

Locality	Class range of numbers				Total no. indiv.	Range in no. brac
	1-2	3-4	5-6	7-8		
Field Specimens.						
SPIRALIS.						
L'smith-B'dale R6	-	-	1	2	3	5 -
Calitzdorp R64	-	2	4	1	7	4 -
Oudtshoorn R68	-	10	12	2	24	3 -
HERREI.						
Hoekplaas R44	2	3	1	-	6	1 -
Prince AlbertR46	3	7	-	-	10	2 -
Herbarium Specimens.						
SPIRALIS.						
Graaff Reinet ?	-	1	-	-	1	4
Oudtshoorn	-	1	6	-	7	4 -
De Rust	-	-	-	1	1	7
Little Karoo	-	1	-	-	1	4
HERREI.						
Prince Albert	2	-	-	-	2	2

Table 84 VARIATION IN NUMBER OF STERILE BRACTS IN 'SPIRALIS' AND 'HERREI'.

Locality.	Class range of measurements.					Total no. indiv.	Range actual measurements
	LENGTH BASAL STERILE BRACT.						
	0.7	0.9	1.1	1.3			cm.
Field Specimens.							
SPIRALIS.							
L'smith-B'dale R6	1	1	2	-	-	3	0.67 - 1.00
Calitzdorp R64	-	4	1	-	-	5	0.77 - 0.95
Oudtshoorn R68	7	7	5	1	1	21	0.52 - 1.40
HERREI.							
Hoekplaas R44	1	3	2	-	-	6	0.70 - 1.00
Prince Albert R46	1	6	3	-	-	10	0.70 - 1.10
Herbarium Specimens.							
SPIRALIS.							
Graaff Reinet ?	-	-	-	-	1	1	1.40
Oudtshoorn	-	3	2	-	-	5	0.75 - 1.00
De Rust	-	-	1	-	-	1	1.10
HERREI.							
Prince Albert	-	1	3	-	-	4	0.90 - 1.10
	LENGTH BASAL FERTILE BRACT.						
	0.4	0.6	0.8	1.0			cm.
Field Specimens.							
SPIRALIS.							
L'smith-B'dale R6	-	1	-	-	-	1	0.57
Calitzdorp R64	-	6	-	-	-	6	0.47 - 0.60
Oudtshoorn R68	1	12	8	1	-	22	0.32 - 0.86
HERREI.							
Hoekplaas R44	-	2	6	-	-	8	0.60 - 0.75
Prince Albert R46	-	2	7	1	-		0.60 - 0.85
Herbarium Specimens.							
SPIRALIS.							
Graaff Reinet ?	-	-	1	-	-	1	0.65
Oudtshoorn	1	5	1	-	-	7	0.40 - 0.65
De Rust	-	-	1	-	-	1	0.70
Little Karoo	1	-	-	-	-	1	0.35
HERREI.							
Prince Albert	-	-	6	2	1	9	0.70 - 1.10

Class interval 0.20 cm.

Table 85 VARIATION IN LENGTHS OF BRACTS IN "SPIRALIS" AND "HERREI".

Locality.	Class range of measurements.					Total no. indiv.	Range actu measuremen
BASAL WIDTH BASAL STERILE BRACT.							
	0.1	0.2	0.3	0.4			cm.
Field Specimens.							
SPIRALIS.							
L'smith-B'dale R6	-	-	1	-	-	1	0.23
Calitzdorp R64	-	-	4	1	-	5	0.25 - 0.3
Oudtshoorn R68	-	3	13	5	-	21	0.20 - 0.4
HERREI.							
Hoekplaas R44	-	-	2	3	1	6	0.30 - 0.5
Prince Albert R46	-	-	4	3	3	10	0.28 - 0.5
Herbarium Specimens.							
SPIRALIS.							
Graaff Reinet ?	-	-	-	1	-	1	0.40
Oudtshoorn	-	2	2	-	-	4	0.20 - 0.2
De Rust	-	-	1	-	-	1	0.28
HERREI.							
Prince Albert	-	-	-	3	1	4	0.40 - 0.5
BASAL WIDTH BASAL FERTILE BRACT.							
Field Specimens.							
SPIRALIS.							
L'smith-B'dale R6	-	-	1	-	-	1	0.23
Calitzdorp R64	-	2	3	1	-	6	0.18 - 0.3
Oudtshoorn R68	-	3	19	-	-	22	0.20 - 0.3
HERREI.							
Hoekplaas R44	-	-	3	4	1	8	0.30 - 0.4
Prince Albert R46	-	-	4	4	2	10	0.30 - 0.4
Herbarium Specimens.							
SPIRALIS.							
Graaff Reinet ?	-	1	-	-	-	1	0.20
Oudtshoorn	1	5	1	-	-	7	0.10 - 0.2
De Rust	-	-	1	-	-	1	0.25
Little Karoo	-	1	-	-	-	1	0.14
HERREI.							
Prince Albert	-	-	1	3	5	9	0.30 - 0.5

Class interval 0.10 cm.

Table 86 VARIATION IN BASAL WIDTH OF BRACTS IN 'SPIRALIS' AND 'HERREI'.

Locality.	Class range of measurements.						Total no. indiv.	Range actua measurement
			MIDDLE WIDTH BASAL STERILE BRACT.					
	.05	.10	.15	.20	.25			cm.
Field Specimens.								
SPIRALIS.								
L'smith-B'dale R6	-	1	-	-	-	-	1	0.10
Calitzdorp R64	-	2	3	-	-	-	5	0.08 - 0.13
Oudtshoorn R68	1	16	4	-	-	-	21	0.05 - 0.15
HERREI.								
Hoekplaas R44	-	-	1	4	-	1	6	0.15 - 0.27
Prince Albert R46	-	-	6	4	-	-	10	0.14 - 0.20
Herbarium Specimens.								
SPIRALIS.								
Graaff Reinet ?	-	-	1	-	-	-	1	0.14
Oudtshoorn	-	4	-	-	-	-	4	0.06 - 0.10
De Rust	-	1	-	-	-	-	1	0.10
HERREI.								
Prince Albert	-	3	-	-	1	-	4	0.10 - 0.23
			MIDDLE WIDTH BASAL FERTILE BRACT.					
Field Specimens.								
SPIRALIS.								
L'smith-B'dale R6	-	1	-	-	-	-	1	0.10
Calitzdorp R64	2	3	-	-	1	-	6	0.05 - 0.23
Oudtshoorn R68	-	21	1	-	-	-	22	0.06 - 0.12
HERREI.								
Hoekplaas R44	-	1	3	3	1	-	8	0.10 - 0.24
Prince Albert R46	-	-	4	5	1	-	10	0.12 - 0.13
Herbarium Specimens.								
Graaff Reinet ?	1	-	-	-	-	-	1	0.04
Oudtshoorn	1	6	-	-	-	-	7	0.04 - 0.06
De Rust	-	1	-	-	-	-	1	0.07
Little Karoo	-	1	-	-	-	-	1	0.06
HERREI.								
Prince Albert	-	3	3	3	-	-	9	0.08 - 0.17

Class interval 0.05 cm.

Table 87 VARIATION IN WIDTH OF BRACTS TAKEN HALF WAY ALONG LENGTH OF BRACT IN "SPIRALIS" AND "HERREI."

Locality.	Class range of measurements.								Total no. indiv.	Range actu measuremen
LENGTH-BREADTH RATIO BASAL STERILE BRACT.										
	2.0	4.0	6.0	8.0	10.0	12.0	14.0			
Field Specimens.										
SPIRALIS.										
L'smith-B'dale R6	-	-	-	1	-	-	-	-	1	6.70
Calitzdorp R64	-	-	-	3	-	2	-	-	-5	6.00 - 1
Oudtshoorn R68	-	-	3	5	5	3	3	2	21	4.26 - 2
HERREI.										
Hoekplaas R44	-	3	3	-	-	-	-	-	6	3.33 -
Prince Albert R46	-	3	4	3	-	-	-	-	10	3.50 -
Herbarium Specimens.										
SPIRALIS.										
Graaff Reinet ?	-	-	-	-	1	-	-	-	1	10.00
Oudtshoorn	-	-	-	-	2	1	1	-		9.00 - 1
De Rust	-	-	-	-	-	1	-	-	1	11.00
HERREI.										
Prince Albert	-	1	-	-	1	2	-	-	4	3.91 - 1
LENGTH-BREADTH RATIO BASAL FERTILE BRACT.										
Field Specimens.										
SPIRALIS.										
L'smith-B'dale R6	-	-	1	-	-	-	-	-	1	5.70
Calitzdorp R64	-	1	2	-	1	2	-	-	6	2.08 - 1
Oudtshoorn R68	-	2	4	9	5	-	2	-	22	3.50 - 1
HERREI.										
Hoekplaas R44	-	4	3	1	-	-	-	-		2.50 -
Prince Albert R46	-	4	5	1	-	-	-	-	10	3.33 -
Herbarium Specimens.										
Graaff Reinet ?	-	-	-	-	-	-	-	1	1	16.25
Oudtshoorn	-	-	-	1	6	-	-	-	7	6.25 - 1
De Rust	-	-	-	-	1	-	-	-	1	10.00
Little Karoo	-	-	1	-	-	-	-	-	1	5.83
HERREI.										
Prince Albert.	-	-	3	4	2	-	-	-	9	4.50 - 1

Class interval 2.00

Table 88 VARIATION IN LENGTH-BREADTH RATIO OF BRACTS IN "SPIRALIS" AND "HERREI".

Locality.	Class range of measurements.									Total no. indiv.	Range actual measurements.
	FLOWERING PEDICEL FROM BASE OF RACEME.										
	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6			cm.
Field Specimens.											
SPIRALIS.											
L'smith-B'dale R6	-	2	1	-	-	-	-	-	-	3	0.38 - 0.40
Calitzdorp R64	1	-	1	2	-	-	-	-	-	4	0.17 - 0.80
Oudtshoorn R68	3	9	-	-	-	-	-	-	-	12	0.18 - 0.39
HERREI.											
Hoekplaas R44	-	1	3	2	1	-	-	-	-	7	0.35 - 0.95
Prince Albert R46	-	-	3	5	1	-	-	-	-	9	0.50 - 0.94
Herbarium Specimens.											
SPIRALIS.											
Graaff Reinet ?	-	1	-	-	-	-	-	-	-	1	0.25
Oudtshoorn	1	5	1	-	-	-	-	-	-	7	0.20 - 0,42
Little Karoo	-	1	-	-	-	-	-	-	-	1	0.22
HERREI.											
Prince Albert	-	-	-	2	1	2	-	-	1	6	0.63 - 1.68

Class interval 0.2 cm.

Table 89A VARIATION IN LENGTH OF PEDICEL IN 'SPIRALIS' AND 'HERREI'.

Locality.	Class range of measurements.										Total no. indiv.	Range actual measurements.
	FLOWERING PEDICEL FROM MIDDLE OF RACEME.											
		0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8		cm.
Field Specimens.												
L'smith-B'dale R6	-	2	1	-	-	-	-	-	-	-	3	0.30 - 0.43
Calitzdorp R64	2	1	3	-	-	-	-	-	-	-	6	0.13 - 0.51
Oudtshoorn R68	17	7	-	-	-	-	-	-	-	-	24	0.14 - 0.38
HERREI.												
Hoekplaas R44	-	2	2	3	-	-	-	-	-	-	7	0.23 - 0.70
Prince Albert R46	-	-	6	1	-	-	-	-	-	-	7	0.47 - 0.64
Herbarium Specimens.												
SPIRALIS.												
Graaff Reinet ?	-	1	-	-	-	-	-	-	-	-	1	0.24
Oudtshoorn	1	6	-	-	-	-	-	-	-	-	7	0.20 - 0.31
De Rust	-	1	-	-	-	-	-	-	-	-	1	0.27
Little Karoo	1	-	-	-	-	-	-	-	-	-	1	0.12
HERREI.												
Prince Albert	-	1	2	-	2	1	-	-	-	-	6	0.39 - 1.10
	FRUITING PEDICEL FROM BASE OF RACEME.											
Field Specimens.												
SPIRALIS.												
Calitzdorp R64	1	1	-	1	1	-	-	-	-	-	4	0.20 - 0.82
Oudtshoorn R68	2	10	1	-	-	-	-	-	-	-	13	0.17 - 0.44
HERREI.												
Prince Albert	-	-	-	-	-	-	-	-	-	1	1	2.0
Herbarium Specimens.												
SPIRALIS.												
Oudtshoorn	-	3	-	-	-	-	-	-	-	-	3	0.30 - 0.39
De Rust	-	1	-	-	-	-	-	-	-	-	1	0.38

Class interval 0.2 cm.

The middle width of the lowest sterile and fertile bracts, taken at a point halfway along the bract length, also tends to be greater in the entity herrei than in the entity spiralis. This difference is more marked in the basal fertile bracts, where in the majority of the samples of the entity spiralis, the middle width is 0.10 cm. or less, compared with 0.10 - 0.20 cm. in the majority of the samples of the entity herrei.

Correspondingly, higher length-breadth ratios, calculated by dividing the length of the bracts by the middle width, are found in the entity spiralis.

Pedicel length (See Table 89A and B)

This tends to be somewhat longer in the entity herrei than in the entity spiralis, but again there is some overlap between the two. In the entity spiralis, the basal flowering pedicel is 0.2 - 0.4 cm. long in most flowering specimens from Oudtshoorn and the small sample from the Ladismith-Barrydale Karoo, but it is more variable in the Calitzdorp sample. In most of the flowering inflorescences of the entity herrei, the basal pedicel is 0.4 - 0.8 cm. in length. The length most of the pedicels from the middle of flowering racemes of the entity spiralis is 0.2 cm. or less in specimens from Oudtshoorn, and more variable in the Calitzdorp sample. In inflorescences of the entity herrei middle flowering pedicel length ranges from 0.2 - 0.8 cm. in plants from Hoekplaas, while most pedicels from the middle of flowering racemes from Prince Albert are 0.4 - 0.6 cm. in length.

Summary.

Thus in inflorescence characters, the differences between the entities spiralis and herrei are slight. In the entity spiralis, peduncles tend to be longer and more slender, pedicels tend to be shorter and bracts tend to be narrower and slightly shorter than in the entity herrei, but there is considerable overlap in these measurements between the two. There are local variations in these measurements in populations of the entity spiralis from Oudtshoorn and Calitzdorp.

PERIANTH CHARACTERS (See Plate 27).

Mention was made in the introduction of the fact that the inflated tissue on either side of the mid rib of the outer tepals is transversely rugose in the entity spiralis and smooth or undulating in the entity herrei.

This rugosity in the entity spiralis is very marked indeed, taking the form of transverse wrinkles, but in herbarium specimens, however, it is sometimes difficult to distinguish perianths of this entity from specimens of the entity herrei when the swollen part of the tepal is undulating in appearance in the latter.

Three types of perianth inflation were observed in the entity herrei. (See Fig. 60). In the first and second types the base of the perianth tube is either the same diameter as or slightly smaller than the middle diameter of the perianth tube. In the first type, (A. in the diagram), the inflations are very slightly undulating, while in the second type, (B. in the diagram), the inflations are smooth. In the third type, (C. in the diagram), the base of the perianth is larger than the middle of the tube and the inflations are very marked and smooth. In no instance, however, is the perianth of the entity herrei as wrinkled as that of the entity spiralis.

All three types of perianth were found in both populations of the entity herrei and their frequency is given in Table 90.

The colour of the perianth in both entities is very similar. The midribs of the tepals are greenish, often with a beige tinge, while the inflated tissue on either side is white and the lobes are a clear yellow, which may be bright or pale, but is never cream or white.

Position of lobes in the open flower. (See Fig. 61)

This is very similar in the two entities. In most cases, the anterior outer lobe is at an angle of 30 - 60°, and the outer laterals and inner petals are at an angle of 30° or less.

Dimensions of lobes. (See Fig. 61)

The outer and inner lobes of the entity spiralis tend to be narrower than those of the entity herrei, being in most cases

Fig.60. Variation in shape of perianth tube in the entity herrei.

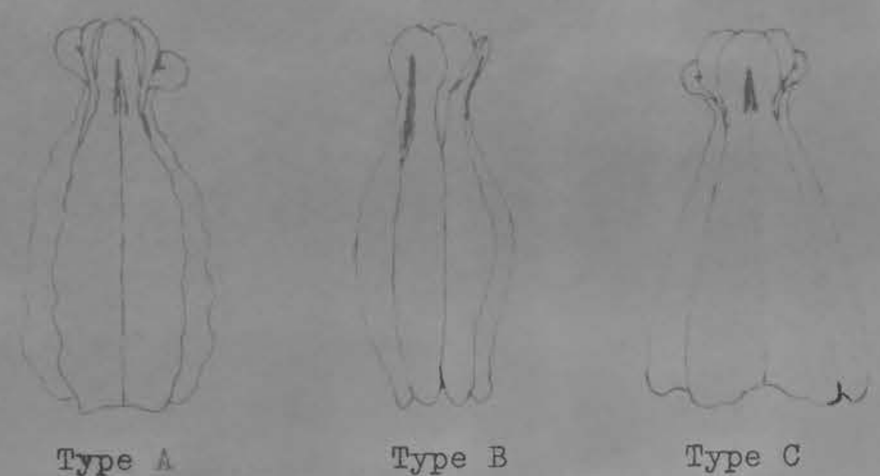


Table 90 Frequency of occurrence of perianth types in two population samples of the entity herrei.

Locality	Type of perianth A	B	C	Total number individuals
Hoekplaas R44	2	2	1	5
Prince Albert R46	4	2	1	7

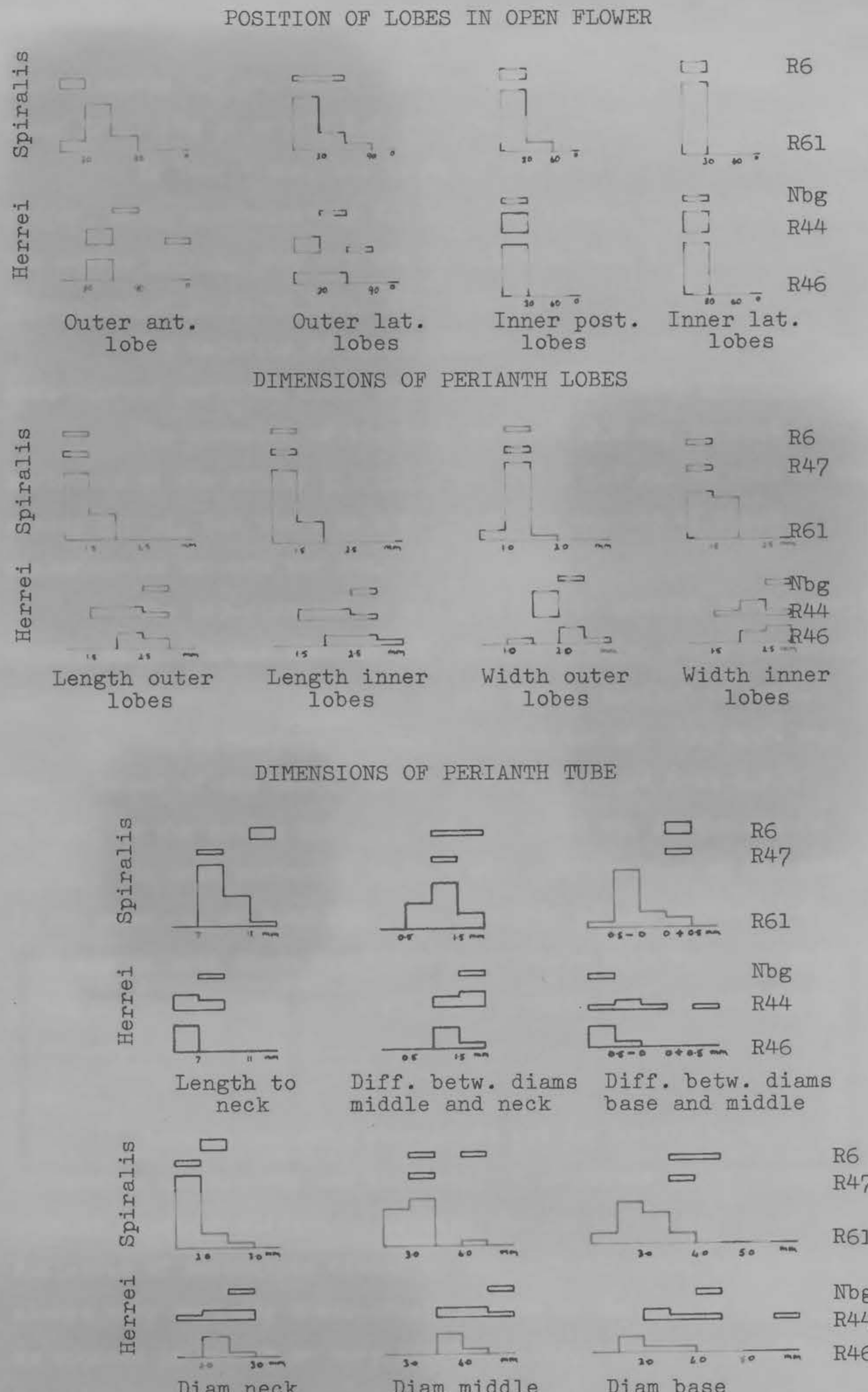


Fig.61. Variation in perianth characters in the entities <u>spiralis</u> and <u>herrei</u>.

approximately 1.5 mm. wide. In the entity <u>herrei</u>, the outer and inner lobes are generally 1.5 - 3.0 mm. in width.

In length too, the lobes of the entity <u>spiralis</u> tend to differ, being approximately 1.5 mm. long in most cases, while in the entity <u>herrei</u>, they are mostly 1.5 - 3.0 mm. in length.

<u>Dimensions of perianth tube</u> (See Fig. 61)

The majority of specimens of the entity <u>herrei</u> tend to have shorter perianth tubes than those of the entity <u>spiralis</u>.

The diameter of the neck is 1.5 - 2.0 mm. in most perianths of the entity <u>spiralis</u>, and 2.0 - 3.0 mm. in most of the entity <u>herrei</u>, but there is a considerable overlap of these measurements between the two.

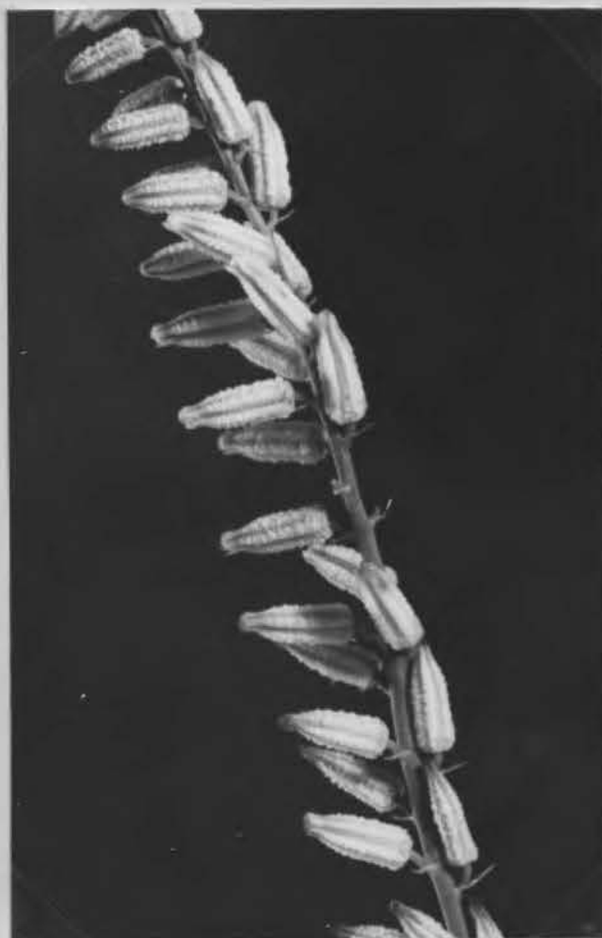
The mid-diameter of the perianth is greater in the entity <u>herrei</u> in most cases than in the entity <u>spiralis</u>, while the basal diameter is more variable, but on the whole, similar in both.

The difference between the diameter of the neck and the diameter of the middle of the perianth ranges from 0.5 - 2.0 mm. in the entity <u>spiralis</u> and 1.0 - 2.5 mm. in the entity <u>herrei</u>. In most perianths in both entities the base of the tube is the same as, or less than, the diameter of the middle of the tube and in both there are a few individuals with perianth tubes in which the basal diameter is slightly greater than the middle diameter.

<u>Summary</u>

Certain perianth characters are indicative of a difference between the two entities. A character which appears to show an absolute difference between the two is the nature of the inflation of parenchyma tissue of the perianth tube, this being always very markedly transversely rugose in the entity <u>spiralis</u>, as opposed to smooth or very slightly undulating in the entity <u>herrei</u>.

Other characters in which the entity <u>herrei</u> differs from the entity <u>spiralis</u>, but not completely, are the shorter tubes, the larger perianth lobes and the broader middle diameter of the perianth tube found in the majority of individuals.



Portion of an inflorescence of a specimen of the entity <u>spiralis</u> (X 1 approx.)

Types of perianth found in the entity <u>herrei</u>: in these examples the inflated tissue of the perianth tube is smooth.

A specimen of the entity <u>herrei</u> in which the tissue inflation of the perianth tube is undulating. As the flower withers, this tissue becomes flaccid and more wrinkled in appearance as seen in the flower on the right.

PLATE 27.

CHROMOSOME NUMBER

As has been mentioned, root squashes of plants of the entity *spiralis* gave a somatic chromosome count of 2n = 28, while in root squashes of plants of the entity *herrei* the somatic number was 2n = 14. Unfortunately it has not yet been possible to examine the meiotic behaviour in Pollen Mother Cell chromosomes of the entity *spiralis* to determine whether or not the plant is an auto- or an allo-polyploid.

CONCLUSION

In conclusion then, although the entities *spiralis* and *herrei* have in common the inflation of the outer tepals of the perianth, and have very similar inflorescence characters, their continued recognition as two distinct species seems justified, primarily on grounds of difference in chromosome number and on the difference in appearance of the inflated part of the perianth, this being far more rugose in the entity *spiralis*. Other characters in which the two differ, but which are more difficult to assess are the greater size and closer proximity to the epidermis of the bundle caps, and the more acuminate nature of the leaf apex in the entity *herrei*.

Accordingly these two entities are still referred to as *Astroloba spiralis* (L) Uitew. and *Astroloba herrei* Uitew.

AN INTERGENERIC HYBRID

between

ASTROLOBA RUGOSA AND HAWORTHIA MARGARITIFERA.

Haworth in his Supplementum of 1819 listed Apicra aspera, accompanied by the same description as in his Synopsis (1812), and two varieties thereof, α minor and β , "nearly twice as large". Following his account of this species is a description of a new species of Apicra - Apicra bicarinata with "cordate leaves with two keels ... scattered raised dark green tubercles on the under-surface and margins and keels frequently roughly tuberculate". There is no note as to the origin of this species, but there is a comment that this species is very similar to A.aspera, ("priori simillima..."), but nearly three times the size.

The account of leaf variation in populations of the species now referred to by the present author as A.rugosa showed that in all specimens, with one exception, leaf length ranged from 1.5 - 2.5 cm. In individual populations, most specimens had leaves either 1.5 - 2.0 cm, or 1.5 - 2.5 cm long.

The present author found a plant of unknown origin, labelled No. 7262, in the succulent collection at Kirstenbosch, with leaves 3.5 - 4.5 cm long, and numerous tubercles on the exposed part of the lower side, which did indeed resemble an enlarged specimen of A.rugosa. The flowers were actinomorphic and it seemed reasonable to recognise the plant as a specimen of A.bicarinata Haw.

There were also a number of herbarium specimens, (of which Hurling and Neil s.n., Nat. Bot. Gdns. 1942/28 (BOL) may be cited as representative), of plants resembling the plant No. 7262, collected by Hurling and Neil over several years from a locality four miles out of Montagu on the Baden road. These plants had been found growing with plants of A.rugosa and Haworthia margaritifera (L) Haw. Miss W. Barker, then working at the Bolus Herbarium, suggested that these plants were in fact hybrids between Haworthia margaritifera and Apicra aspera, as A.rugosa was then incorrectly known.

Subsequently the author found a number of plants which might be referred to as "bicarinata" in other succulent collections, all of unknown origin, save for specimens from Mr. H. Herre of Stellenbosch, which he said, he thought came from near Calitzdorp. To date, there are no known records of A.rugosa from this area. The author in a number of field trips in the area found only specimens of Astroloba spiralis (L.) Uitew. According to Mr. H. Hall of Kirstenbosch, the form Haworthia margaritifera which was found with A.rugosa and "bicarinata" is confined to the Western limits of the Little Karoo, and it has never been seen elsewhere by the present author.

A search of likely localities four miles out of Montagu on the Baden road, while producing numerous plants of A.rugosa, failed to reveal any plants of the suspected hybrid or Haworthia margaritifera.* However, plants of A.rugosa, the suspected hybrid, and the form of Haworthia margaritifera concerned were found in the garden of a farmhouse in this area. The present owner did not know of their origins but it is indeed possible that they came from karoid areas nearby.

Eventually, thanks to the efforts of Mr. J. Stayner of the Karoo gardens, Worcester, plants of the putative hybrid and its suspected parents were found growing together near Montagu on a farm Rietvlei No. 2, in one of the dry karoid valleys running parallel to the Baden-Baden one. In all, two plants of "bicarinata" were discovered in the area, one growing under a bush closely associated with a clump of Astroloba rugosa, the other also under a bush, a foot away from a plant of Haworthia margaritifera. (See Plate 28.). Both A.rugosa and H.margaritifera were occasional under bushes in this area.

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* Miss Barker described the plants of Haworthia as H.papillosa (Salm.) Haw., but they and similar plants have been identified by Mr. H. Hall of Kirstenbosch as H.margaritifera (L.) Haw. It seems to the present author that these two are probably a single species, but more field observations would be necessary to prove this. The nomenclature of the H.margaritifera complex is too confusing to allow the application of a varietal name to the plants concerned.

The Rietvlei No. 2 locality for the putative hybrid, X Astroworthia bicarinata. Above : Plants of X A. bicarinata growing next to plants of H. margaritifera; below : plants of X A. bicarinata growing next to plants of A. rugosa.

PLATE 28.

CYTOLOGICAL INVESTIGATION OF SUSPECTED HYBRID.

Root squashes of A.rugosa, H.margaritifera and of "bicarinata" plants from Riet Vlei No. 2, Mr. Malherbe of Robertson, and Kirstenbosch No. 7262, revealed in all cases, a haploid chromosome number of n = 7, with three short, and four long subterminal chromosomes, similar in appearance in all three. (See Plate 11).

Examination of chromosome pairing at metaphase of the first meiotic division in pollen mother cells showed complete pairing in the two preparations examined of A.rugosa from Rietvlei and H.margaritifera from the Kirstenbosch collection.

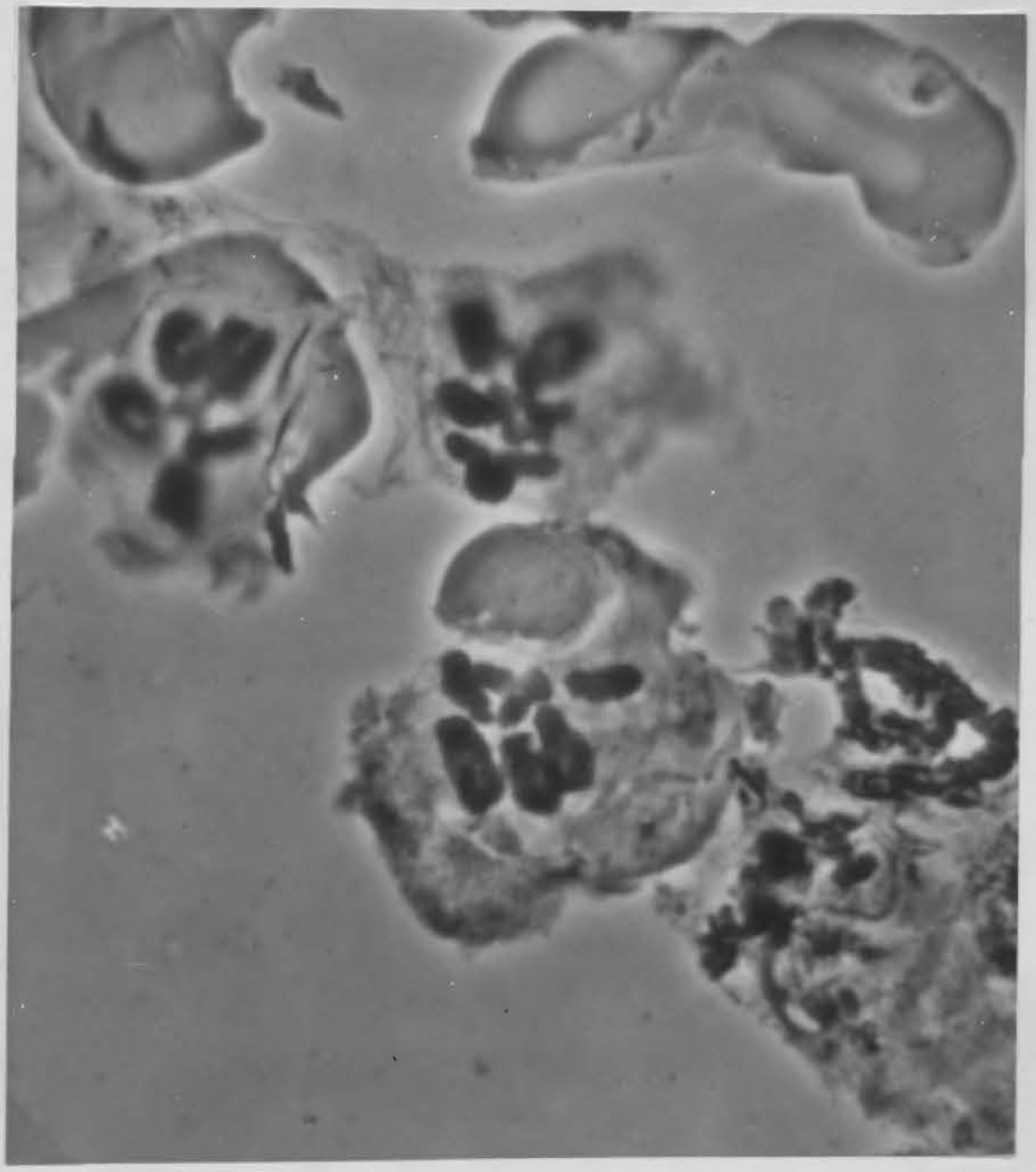
Pollen Mother Cell squashes from the "bicarinata" plant No. 7262 showed a complete lack of pairing between some of the long chromosomes in a few instances (See Plate 29 and Fig. 62). In one cell in which all long chromosomes showed complete pairing, there appeared to be lack of pairing between a pair of short chromosomes. Unfortunately at the time it was not possible to make a photographic record of this (See Fig. 63).

The number of cells in which the chromosome configurations were clearly visible at Metaphase I of meiosis in a P.M.C. squash of anthers from plant No. 7262, and the degree of lack of pairing is shown in Table 91.

Number of cells in which chromosome configuration visible at metaphase I	Complete pairing of chromosomes	Lack of pairing observed			Total no. cells in which incomplete pairing observed
		in one pair of short chromosomes	in one pair of long chromosomes	in two pairs of long chromosomes	
32	26	1	4	1	6

Table 91 SHOWING CHROMOSOME BEHAVIOUR IN METAPHASE I OF MEIOSIS IN P.M.C.'S OF "BICARINATA" No. 7262

In a preparation from the same inflorescence of slightly older anthers showing the end of Telophase I of meiosis, a number of cells had two large masses of nuclear material and one, rarely two, small masses of nuclear material. This was not seen at any stage in the



Pollen Mother cells of "bicarinata" plant No. 7262, at first Metaphase division of meiosis, one cell showing lack of pairing in one pair of long chromosomes.

PLATE 29.

Fig.62. Showing chromosome configuration at first metaphase division of meiosis in pollen mother cells of "bicarinata" plant No. 7262. All chromosomes paired in A - D, two univalents in E, four univalents in F. In both cases, lack of pairing is in long chromosomes.

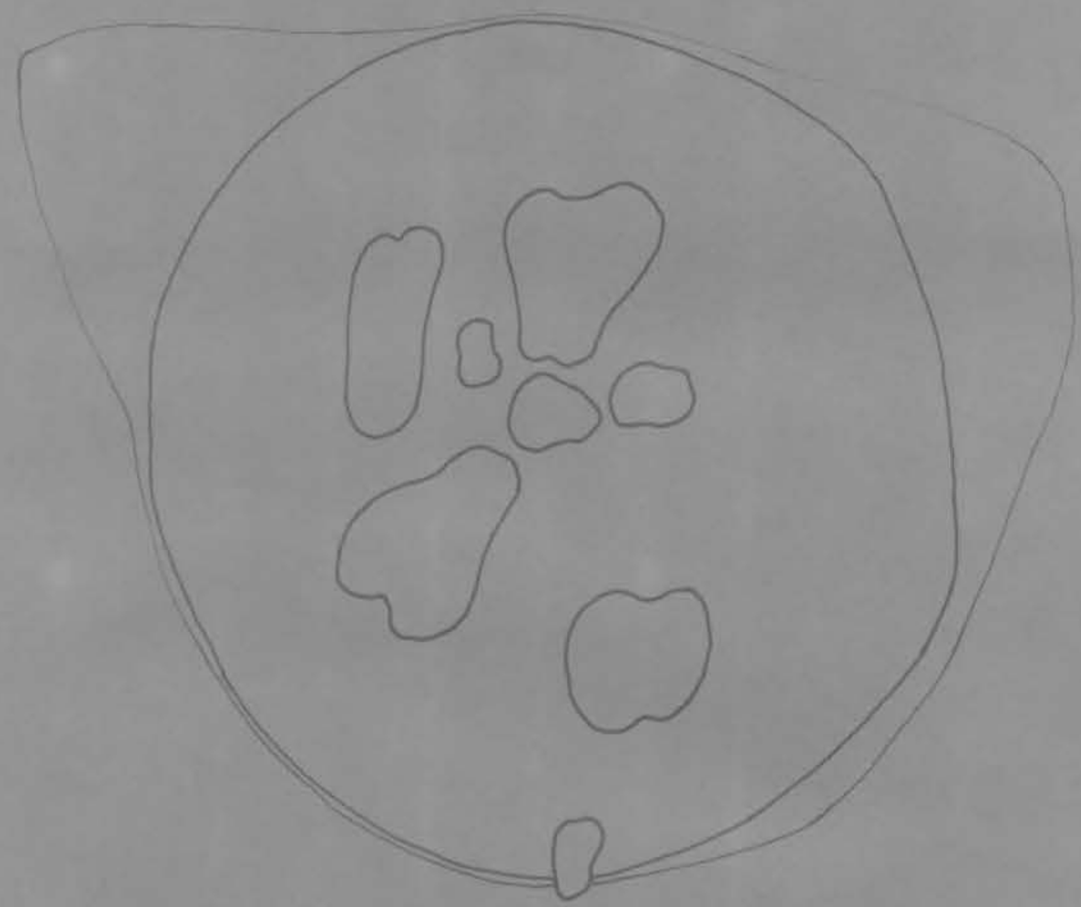


Fig.63. Pollen mother cell of "bicarinata" No. 7262 at first metaphase of meiosis, in which two short chromosomes appear as univalents.

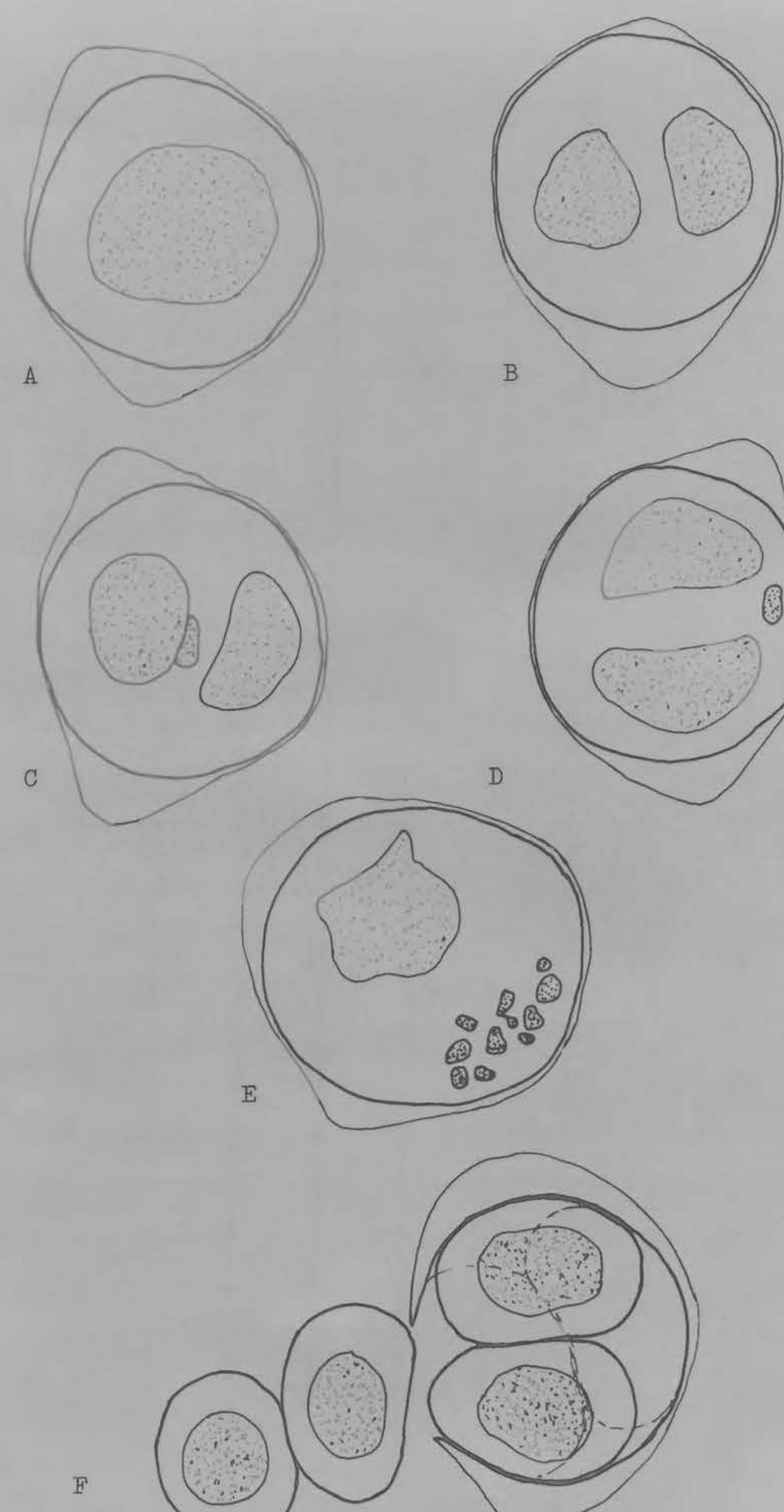


Fig.64. Pollen mother cells of "bicarinata" No. 7262.
A before first meiotic division; B at first telophase of meiosis; C and D at same stage, but with two nuclei and an additional mass of smaller nuclear material; E at same stage as B after colchicine treatment; F liberation of pollen grains.

division of P.M.C.'s in A.rugosa and H.margaritifera. It seems reasonable to suggest that these small masses of nuclear material arise as the result of lack of pairing of one or more pairs of chromosomes at meiotic metaphase I. (See Fig. 64).

Treatment with colchicine, where the anthers were placed in a 0.01% solution of colchicine for three hours before placing in fixitive, resulted in P.M.C.'s with a varying number of masses of nuclear material of irregular size at the stage when Telophase I of meiosis should have been completed. (See Fig. 64).

In the only good preparation of anthers from flowers of plants of "bicarinata" from Rietvlei, the P.M.C.'s were found to be at the stage of Telophase I of meiosis. Again some cells were observed to have one or two small masses of nuclear material in addition to two large nuclei. This is taken as evidence of lack of pairing in at least one of the pairs of chromosomes in some of the P.M.C. cells of this plant too.

The occasional lack of pairing in Metaphase I of meiosis between certain complementary chromosomes is indicative of a slight dissimilarity in the two chromosome complements of a cell. Such evidence is contributory towards the determination of the hybrid origin of the plant in question. (See Goodspeed 1954).

Apart from the recreation of the hybrid, the above is the only direct evidence in favour of "bicarinata" being a hybrid.

A comparison of vegetative and inflorescence characters does provide circumstantial evidence in further support of this. Plants of unknown origin from various succulent collections are included in this comparison. In the text they are designated as follows:-

Kirstenbosch No. 7262;
from the Karoo Gardens, R70;
from Mr. B. Carp, R71;
from Mr. Malherbe, R72; and
from Mr. H. Herre, R73.

Locality	Class range of measurements.						Total no. indiv.	Range actual measurement
	SPIRAL ANGLE. Class interval 10°							
	0°	10°	20°	30°	40°			o
	HAWORTHIA MARGARITIFERA							
Rietvlei R50b	-	-	-	1	2	-	3	30 - 40
	"ASTROWORTHIA BICARINATA."							
Rietvlei R50	-	1	1	-	-	-	2	10 - 18
K'bosch 7262	-	-	-	-	-	-	-	
Karoo Gdn's R70	-	1	-	-	-	-	1	8
Ex. B. Carp R71	-	-	1	-	-	-	1	13
Ex. Malherbe R72	-	-	-	-	-	Irreg.	1	Irregular
Ex. H. Heme R73	-	1	-	-	-	Irreg.	1	Irregular
	ASTROLOBA RUGOSA							
Rietvlei R50a	-	3	1	-	-	-	4	1 - 13
Montagu Area. R17,19,20, 23.	1	10	3	2	-	-	16	0 - 25

Locality				Total no. indiv.	Range actual measurement
	ANGLE OF LEAF WITH STEM. Class interval 20°				
	30°	50°			
	HAWORTHIA MARGARITIFERA				
Rietvlei R50b	3	-	-	3	20 - 30
	"ASTROWORTHIA BICARINATA"				
Rietvlei R50	-	3	-	3	40 - 50
Karoo Gdns R70	-	1	-	1	35 - 40
Ex B. Carp R71	1	-	-	1	25
Ex Malherbe R72	-	1	-	1	40
Ex H. Heme R73	-	2	-	2	30 - 50
	ASTROLOBA RUGOSA				
Rietvlei R50a	-	4	-	4	40 - 50
Montagu Area R17,19,20, 23	-	15	1	16	40 - 60

TABLE 92 Variation in spiral angle and angle of leaf with stem in field and garden specimens of H. margaritifera the suspected hybrid and A. rugosa.

Locality.	Class range of measurements.			Total no. indiv.	Range act measureme
	Curvature of leaf apices *				
	u	f	o		
	HAWORTHIA MARGARITIFERA				
Rietvlei R50b	3	-	-	3	u
	"ASTROWORTHIA BICARINATA"				
Rietvlei R50	-	2	-	2	f
Karoo Gdn's R70	1	-	-	1	u
Ex B. Carp R71	-	-	1	1	o
Ex Malherbe R72	-	1	-	1	f
Ex H. Heme R73	-	1	1	2	f - o
	ASTROLOBA RUGOSA				
Rietvlei R50a	-	2	2	4	f - o
Montagu Area R17,19, 20,23	-	2	14	16	f - o

Greatest width leaf. Class interval 0.25 cm.

Locality.	1.25	1.50	1.75	2.00	2.25	2.50	2.75		Total no. indiv.	Range act measureme cm.
	HAWORTHIA MARGARITIFERA									
Rietvlei R50b	-	-	1	-	1	1	-	-	3	1.6 - 2.
	"ASTROWORTHIA BICARINATA"									
Baden-Baden R58	-	-	2	-	-	-	-	-	2	1.7
Rietvlei R50	-	-	-	2	-	-	-	-	2	2.0
Hort K'bosch 7262	-	-	-	-	1	1	-	-	2	2.2 - 2.
Karoo Gdn's R70	-	-	-	-	-	-	-	1	1	2.8
Ex B. Carp R71	-	-	-	-	1	-	-	-	1	2.1
Ex Malherbe R72	-	-	-	1	-	-	-	-	1	1.8
Ex H. Heme R73	-	-	-	1	1	-	-	-	2	2.0 - 2.
	ASTROLOBA RUGOSA									
Rietvlei R50a	1	2	1	-	-	-	-	-	4	1.2 - 1.
Baden Rd R18	1	3	3	-	-	-	-	-	7	1.2 - 1.
Montagu Area R17,19, 20,23	2	17	7	1	-	-	-	-	27	1.1 - 1.

TABLE 93. **Variation in Curvature of leaf apices and greatest leaf width in field and garden specimens of _H. margaritifera_, the suspected hybrid and _A. rugosa._**

*(u = leaf apices curving upward, f = leaf apices following the angle of the leaf with the stem, o = leaf apices curving outward.)

Locality.	Class range of measurements.																Total no. indiv.	Range actual measurements.
	Leaf length. Class interval 0.50 cm.																	
	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5			cm.
	HAWORTHIA MARGARITIFERA																	
Rietvlei R50b	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	1	3	5.3 - 9.0
	"ASTROWORTHIA BICARINATA"																	
Baden-Baden R58	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	2	3.9 - 4.0
Rietvlei R50	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	2	3.5 - 4.6
Hort. K'bosch 7262	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	2	3.7 - 4.5
Karoo Gdn's R70	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	5.1
Ex B. Carp R71	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	3.3
Ex Malherbe R72	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	3.4
Ex H. Heme R73	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	2	3.9 - 4.6
	ASTROLOBA RUGOSA																	
Rietvlei R50a	-	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	4	2.0 - 2.4
Baden Rd. R18	-	3	4	-	-	-	-	-	-	-	-	-	-	-	-	-	7	1.7 - 2.2
Montagu Area R17,19 20,23	1	18	8	-	-	-	-	-	-	-	-	-	-	-	-	-	27	1.4 - 2.5

Locality.	Length-breadth ratio. Class interval 0.25 cm.													Total no. indiv.	Range actual measurements.
	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75			
	HAWORTHIA MARGARITIFERA														
Rietvlei R50b	-	-	-	-	-	-	-	1	-	-	1	-	1	3	2.70 - 3.96
	"ASTROWORTHIA BICARINATA"														
Baden-Baden R58	-	-	-	-	-	-	1	1	-	-	-	-	-	2	2.29 - 2.59
Rietvlei R50	-	-	-	1	-	-	1	-	-	-	-	-	-	2	1.75 - 2.28
Hort K'bosch 7262	-	-	-	1	1	-	-	-	-	-	-	-	-	2	1.68 - 1.96
Karoo Gdn's R70	-	-	-	-	1	-	-	-	-	-	-	-	-	1	1.82
Ex B Carp. R71	-	-	-	1	-	-	-	-	-	-	-	-	-	1	1.56
Ex Malherbe R72	-	-	-	-	1	-	-	-	-	-	-	-	-	1	1.89
Ex H. Heme R73	-	-	-	-	1	1	-	-	-	-	-	-	-	2	1.95 - 2.24
	ASTROLOBA RUGOSA														
Rietvlei R50a	-	-	3	-	1	-	-	-	-	-	-	-	-	4	1.43 - 1.83
Baden-Baden R18	1	2	2	2	-	-	-	-	-	-	-	-	-	7	1.00 - 1.69
Montagu Area R17,19,20,23	-	7	12	8	-	-	-	-	-	-	-	-	-	27	1.06 - 1.67

Locality.	Class range of measurements.												Total no. indiv.	Range actual measurements.
	Above					Below midlength								
		0	0	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25		cm.
HAWORTHIA MARGARITIFERA														
Rietvlei R50b	-	-	-	-	-	-	1	-	1	-	-	1	3	1.2bel - 2.5 bel
"ASTROWORTHIA BICARINATA"														
Baden-Baden R58	-	-	-	-	1	1	- -	-	-	-	-	-	2	0.7bel - 0.8bel
Rietvlei R50	-	-	-	1	1	-	- -	-	-	-	-	-	2	0.3bel - 0.6bel
Hoft K'bosch 7262	-	-	-	2	-	-	-	-	-	-	-	-	2	0.5bel
Karoo Gdn's R70	-	-	-	-	1	-	-	-	-	-	-	-	1	0.7bel
Ex B. Carp. R71	-	-	1	-	-	-	-	-	-	-	-	-	1	0.1bel
Ex. Malherbe R72	-	-	1	-	-	-	-	-	-	-	-	-	1	0.1bel
Ex H. Heme R73	-	-	-	-	2	-	-	-	-	-	-	-	2	0.7bel - 0.6bel
ASTROLOBA RUGOSA.														
Rietvlei R50a	-	2	2	-	-	-	-	-	-	-	-	-	4	0.0 - 0.1bel
Baden Rd. R18	3	3	1	-	-	-	-	-	-	-	-	-	7	0.1 ab - 0.1bel
Montagu Area R17,19,20, 23	7	10	9	1	-	-	-	-	-	-	-	-	27	0.1 ab - 0.3bel

Class interval 0.25 cm.

TABLE 95 Variation in position of widest part of leaf in relation to mid length in field and garden specimens of H. margaritifera, the suspected hybrid and A. rugosa.

(ab = above midlength, bel = below midlength).

B X $\frac{3}{4}$

A X $1\frac{1}{4}$

C X 1

Leafy shoots of A. rugosa (A); Astroworthia bicarinata (B) and H. margaritifera (C) (Scales approximate).

PLATE 30.

Locality.	Class range of measurements.				Total no. indiv.	Range actu measuremen
	.05	.10	.15			cm.
		HAWORTHIA MARGARITIFERA				
Rietvlei R50b	-	1	2	-	3	.10 - .
		"ASTROWORTHIA BICARINATA"				
Baden-Baden R58	-	2	-	-	2	.10
Rietvlei R50	-	2	-	-	2	.08 - .
Hort. K'bosch 7262	-	1	1	-	2	.08 - .
Karoo Gdn's R70	-	1	-	-	1	.09
Ex B. Carp. R71	1	-	-	-	1	.03
Ex Malherbe R72	-	1	-	-	1	.07
Ex H. Heme R73	-	2	-	-	2	.08 - .
		ASTROLOBA RUGOSA				
Rietvlei R50a	3	1	-	-	4	.05 - .
Baden Rd. R18	3	4	-	-	7	.04 — .
Montagu Area R17,19,20,23	13	13	-	-	26	.04 - .

Class interval 0.05 cm.

Table 96 VARIATION IN MUCRO LENGTH IN FIELD AND GARDEN SPECIMENS OF H. MARGARITIFERA, THE SUSPECTED HYBRID, AND A. RUGOSA.

COMPARISON OF VEGETATIVE CHARACTERS. (See Plates 30 and 31).

In growth habit, plants of H.margaritifera are acaulescent, the leaves forming a five farious rosette, while in both A.rugosa, as is typical in the genus Astroloba, and in "bicarinata" the plants are caulescent.

Leaf arrangement. (See Tables 92, 93)

H.margaritifera has somewhat imbricate, erect leaves, the apices of which curve upward, while A.rugosa has leaves more regularly five ranked and sub-erect, the apices of which follow the angle of the leaf with the stem, or, more frequently, curve outwards slightly. In "bicarinata", the spiral angle is 0 - 20°, the leaves are sub-erect in all cases save in R71, where they are erect, and the leaf apices follow the angle of the leaf or curve outward, except in R70, where they curve upward.

Leaf size and shape. (See Tables 93, 94, 95 and 96, and Plate 65)

H.margaritifera has leaves varying in length from 5 to 9 cm, and in width from 1.50 - 2.50 cm, while in A.rugosa, leaf length varies from 1.5 - 2.5 cm, and leaf width from 1.25 - 1.75 cm, being 1.25 - 1.50 cm in most cases. In "bicarinata", leaf length is

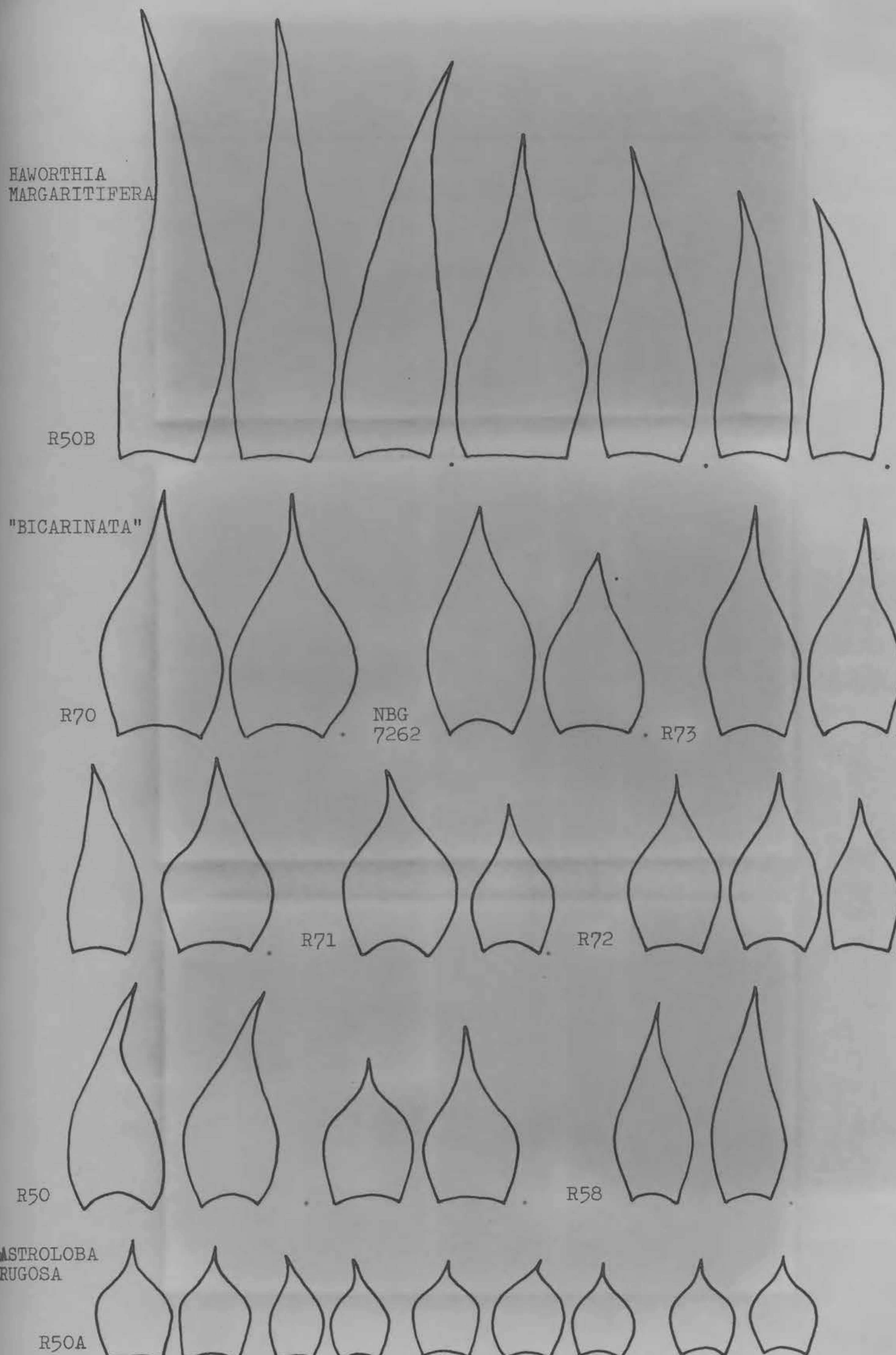


Fig.65. Variation in leaf shape in Haworthia margaritifera, "bicarinata", and Astroloba rugosa. (Sheathing part of leaf base excluded, dots indicate the number of leaves shown for each plant.)

A X 1½

B X 1

C X 1

A : Comparison of leaves of X Astroworthia bicarinata with leaf of A. rugosa (on right). Note double keel in right hand leaf of X A. bicarinata. B : Range of leaves in H. margaritifera; C : Range of leaves in X A. bicarinata. All leaves seen in ventral view.

PLATE 31.

3.0 - 5.0 cm, leaf width 1.50 - 3.0 cm. The narrowest leaves are thus found in H.margaritifera, with a length-breadth ratio of 2.50 - 4.00 in the specimens observed, while those of A.rugosa are considerably broader, with a length-breadth ratio of 1.00 - 1.75 in the great majority of cases. Length-breadth ratios in "bicarinata" range from 1.50 - 2.75.

The widest part of the leaf is 1.00 - 2.50 cm below the longitudinal half-way mark in H.margaritifera, and at the half-way mark or a few mm. above or below it in A.rugosa. In "bicarinata", the widest part of the leaf is at the half-way mark or up to 1.00 cm. below it.

The longest mucros are found in H.margaritifera, where in the specimens observed, they range from .10 - .13 cm in length. In A.rugosa, measurements range from .04 - .08 cm, while in "bicarinata" mucros range in length from .03 - .12 cm.

Thus in leaf arrangement and in the dimensions of the leaves, "bicarinata" is intermediate in character to H.margaritifera and A.rugosa.

Leaf Tubercles. (See Tables 97 and 98)

The largest and most prominent tubercles from the undersides of the leaves are found in H.margaritifera, where in diameter they range from 0.9 - 2.1 mm, and in height from 0.7 - 1.5 mm. In A.rugosa tubercle diameter and tubercle height both range from 0.1 - 0.3 mm. In "bicarinata", tubercles from the lower sides of the leaves vary from 0.1 - 0.7 mm in height, and from 0.3 - 0.5 in diameter, with the exception of No. 7262, which has the smallest, least prominent tubercles, (0.1 - 0.3 mm high and 0.1 - 0.3 mm wide), and R73, where the tubercle diameter ranges from 0.1 - 0.7 mm.

There is a slight tendency for the tubercles of the margins and keels to be smaller and less prominent, but the pattern of variation for all three is on the whole the same.

In H.margaritifera, the tubercles may be fairly evenly scattered, several sometimes merging together to form a larger compound tubercle of irregular shape, or they may be aggregated into transverse bands, 2.0 - 4.0 mm apart. These bands are not very well defined. The

Locality.	Class range of measurements.								Total no. plants.
	0.1	0.3	0.5	0.7	0.9	1.1	1.3	1.5	mm.
Tubercles from underside of leaf.									
HAWORTHIA MARGARITIFERA.									
Rietvlei R50b	-	-	-	-	2	3	2	2	3
"ASTROWORTHIA BICARINATA"									
Rietvlei R50	-	-	2	-	-	-	-	-	2
Hort. K'bosch No.7262	-	2	-	-	-	-	-	-	2
Karoo Gdns. R70	-	-	1	-	-	-	-	-	1
Ex.B. Carp R71	-	-	1	-	-	-	-	-	1
Ex. Malherbe R72	-	-	1	-	-	-	-	-	1
Ex. H. Herre R73	-	1	1	1	-	-	-	-	2
ASTROLOBA RUGOSA.									
Rietvlei R50a	-	4	-	-	-	-	-	-	4
Baden Rd. R18	-	7	-	-	-	-	-	-	7
Montagu dist. R17,19, 20,23	-	27	-	-	-	-	-	-	27
Tubercles of margins and keels.									
HAWORTHIA MARGARITIFERA.									
Rietvlei R50b	-	-	-	1	3	2	1	-	3
"ASTROWORTHIA BICARINATA"									
Rietvlei R50	-	-	2	-	-	-	-	-	2
Hort K'bosch No.7262	1	1	-	-	-	-	-	-	2
Karoo Gdns R70	-	-	1	-	-	-	-	-	1
Ex. B. Carp R71	-	-	1	-	-	-	-	-	1
Ex. Malherbe R72	-	1	-	-	-	-	-	-	1
Ex. H. Herre R73	-	2	-	-	-	-	-	-	2
ASTROLOBA RUGOSA.									
Rietvlei R50a	1	3	-	-	-	-	-	-	4
Baden Rd. R18	1	6	-	-	-	-	-	-	7
Montagu dist. R17,19, 20,23	10	17	3	-	-	-	-	-	27

Class interval 0.20 mm.

Table 97 VARIATION IN HEIGHT OF TUBERCLES IN H. MARGARITIFERA, THE SUSPECTED HYBRID AND A. RUGOSA.

(These Tables compiled in the same way as in the A. foliolosa). complex.

Locality.	Class range of measurements.											Total no. plants.
	0.1	0.3	0.5	0.7	0.9	1.1	1.3	1.5	1.7	1.9	2.1	mm.
						Tubercles from underside of leaf.						
						HAWORTHIA MARGARITIFERA.						
Rietvlei R50b	-	-	-	-	-	3	2	2	1	1	1	3
Rietvlei R50b												
						"ASTROWORTHIA BICARINATA."						
Rietvlei R50	-	2	2	1	-	-	-	-	-	-	-	2
Hort. K'bosch No. 7262	-	1	-	-	-	-	-	-	-	-	-	2
Karoo Gdns R70	-	-	-	1	-	-	-	-	-	-	-	1
Ex. B. Carp R71	-	1	1	1	-	-	-	-	-	-	-	1
Ex. Malherbe R72	-	-	1	1	-	-	-	-	-	-	-	1
Ex. H. Herre R73	-	1	2	1	-	-	-	-	-	-	-	2
						ASTROLOBA RUGOSA.						
Rietvlei R50a	-	4	-	-	-	-	-	-	-	-	-	4
Baden Rd. R18	1	7	-	-	-	-	-	-	-	-	-	7
Montagu Dist R17,19,20,23	-	27	-	-	-	-	-	-	-	-	-	27
						Tubercles of margins and keels.						
						HAWORTHIA MARGARITIFERA.						
Rietvlei R50b	-	-	-	-	1	3	1	1	1	1	1	3
						"ASTROWORTHIA BICARINATA."						
Rietvlei R50	-	-	2	-	-	-	-	-	-	-	-	2
Hort. K'bosch No. 7262	-	1	1	-	-	-	-	-	-	-	-	2
Karoo Gdns. R70	-	-	1	-	-	-	-	-	-	-	-	1
Ex. B. Carp R71	-	-	1	-	-	-	-	-	-	-	-	1
Ex. Malherbe R72	-	-	1	-	-	-	-	-	-	-	-	1
Ex. H. Herre R73	-	2	-	-	-	-	-	-	-	-	-	2
						ASTROLOBA RUGOSA.						
Rietvlei R50a	1	4	1	-	-	-	-	-	-	-	-	4
Baden Rd. R18	-	7	-	-	-	-	-	-	-	-	-	7
Montagu Dist. R17,19,20,23	5	25	-	-	-	-	-	-	-	-	-	27

Class interval 0.2 mm.

TABLE 98 Variation in diameter of tubercles in H. Margaritifera, the suspected hybrid, and A. Rugosa.

tubercles of the margins and keels are not smooth round protuberances, often having the appearance of a molar tooth.

In A.rugosa, as has been mentioned, the tubercles are fairly evenly distributed, ranging in density from about 5 per sq. 4 mm to 30 per sq. 4 mm, and tending to be arranged in poorly defined longitudinal groups of up to 6 tubercles.

In "bicarinata", the tubercles are also fairly evenly distributed, sometimes a few are aggregated into small irregularly shaped groups, and in some specimens, into longitudinal groups of up to 6 tubercles. Occasionally in both A.rugosa and "bicarinata", a few tubercles occur on the dorsal side of the leaf.

Thus in the nature of the leaf tubercles too, plants of "bicarinata" are intermediate in character between A.rugosa and H.margaritifera.

At this stage a comment on the epithet "bicarinata" is in place. Mention has been made elsewhere that in any one entity of the genus Astroloba, a few plants may be found with two keels on the underside of the leaf. This is no less the case in "bicarinata", where some double keeled leaves were observed on the shoots of No. 7262. In heavily tubercled leaves such as found in H.margaritifera and "bicarinata", the keel is not always apparent. Because it describes a condition by no means always present the name "bicarinata" is somewhat misleading.

In colour, the leaves of H.margaritifera and "bicarinata" are similar to those of A.rugosa, but the tubercles of H.margaritifera are always whitish, while in "bicarinata", they are more frequently concolorous or paler.

A note on leaf anatomy.

It has been mentioned that the outer walls of the epidermal cells from the upper part of the leaf are frequently papillate in A.rugosa. This is also the case in H.margaritifera and in "bicarinata". (See Fig. 8)

Summary.

From the foregoing it is clear that the vegetative characters of the plants referred to as "bicarinata" are intermediate between those of H.margaritifera and A.rugosa.

<u>COMPARISON OF INFLORESCENCE CHARACTERS</u>. (See Tables 99 - 106)

Pedicel and raceme lengths, and numbers of sterile bracts per peduncle, are very similar in all three, but, while no specimens of <u>A.rugosa</u> were found with branched inflorescences or unexpanded axillary raceme buds, all inflorescences examined of <u>H.margaritifera</u> were branched. In this connection it is of interest to note that in some specimens of <u>H.margaritifera</u> the axillary racemes branched again. All plants of "<u>bicarinata</u>" had branched inflorescences, or if not, unexpanded raceme buds in the axils of the sterile bracts.

The stoutest peduncles, 0.45 - 1.00 cm in diameter, at the base and 0.20 - 0.40 cm below the main raceme, are found in <u>H.margaritifera</u>. In <u>A.rugosa</u>, most of the Montagu specimens are 0.30 mm or less wide at the base, (with the exception of those from Baden-Baden, half of which are 0.30 - 0.45 cm in width), while the diameter of the peduncle below the raceme ranges from 0.10 - 0.30 cm, being 0.10 - 0.20 cm in most cases. In "<u>bicarinata</u>", peduncle bases range from 0.30 - 0.75 cm in width, while the diameter below the raceme is 0.10 - 0.30 cm with the exception of half the peduncles of No. 7262, which are thicker.

The length of the lowest sterile bract ranges from 0.6 - 1.0 cm, in all the <u>H.margaritifera</u> specimens examined, while most basal sterile bracts in <u>A.rugosa</u> are 0.40 - 0.6 cm. long. In the "<u>bicarinata</u>" inflorescences, basal sterile bract lengths of 0.40 - 1.05 cm are found, the longest occurring in No. 7262.

Basal fertile bract length ranges from 0.3 - 0.6 cm in <u>H.margaritifera</u>; from less than 0.3 to 0.5 cm, but with most bracts 0.3 - 0.4 cm long, in <u>A.rugosa</u>, and from less than 0.3 to 0.6 cm in all specimens of "<u>bicarinata</u>", except those of No. 7262, which are longer.

Sterile bracts with the greatest basal width tend to be found in inflorescences with the stoutest racemes, and in <u>H.margaritifera</u>, sterile bract bases range from 0.3 - 0.7 cm in width, while in "<u>bicarinata</u>" they are 0.2 - 0.7 cm wide,and in most inflorescences of <u>A.rugosa</u>, 0.2 - 0.3 cm wide.

Locality.	Class range of measurements.										Total no. indiv.	Range actual measurements.
	Peduncle length.											
	5	10	15	20	25	30	35	40	45			cm.
	HAWORTHIA MARGARITIFERA											
Ex. Hort K'bosch	-	-	-	-	-	1	-	1	2	-	4	29 - 41
	"ASTROWORTHIA BICARINATA"											
Baden-Baden R58	-	-	1	2	-	1	-	-	-	-	4	13 - 27
Rietvlei R50	-	-	2	-	1	1	-	-	-	-	4	14 - 27
Hort K'bosch 7262	-	-	-	2	3	1	-	1	-	-	7	19 - 36
Karoo Gdn's R70	-	-	1	-	1	-	-	-	-	-	2	12 - 24
Ex. B. Carp R71	-	-	-	1	1	-	-	-	-	-	2	19 — 25
Ex. H. Heme R73	-	-	-	1	1	1	1	-	-	-	4	17 - 33
	ASTROLOBA RUGOSA											
Baden-Baden R59,18,17	-	-	1	3	8	3	3	-	-	-	18	14 - 34
Montagu Area R19,20,23, Nbg	-	-	4	3	9	4	1	-	-	1	22	12 - 43
	Raceme Length.											
	HAWORTHIA MARGARITIFERA											
Ex Hort K'bosch	-	-	1	1	-	-	-	1	-	-	3	14 - 38
	"ASTROWORTHIA BICARINATA"											
Baden-Baden R58	-	-	-	3	2	-	-	-	-	-	5	17 - 23
Rietvlei R50	-	-	2	1	-	1	-	-	-	-	4	13 - 26
Hort K'bosch 7262	-	-	-	5	1	-	-	-	-	-	6	16 - 21
Karoo Gdn's R70	-	-	-	1	-	-	1	-	-	-	2	18 - 33
Ex. B. Carp R71	1	1	-	-	-	-	-	-	-	-	2	4 - 8
Ex. H. Heme R73	-	-	3	-	-	-	-	-	-	-		12 - 15
	ASTROLOBA RUGOSA											
Baden-Baden R59,18,17	-	4	6	6	1	-	-	-	-	-	17	9 - 22
Montagu Area R19,20,23 Nbg	1	10	5	3	-	2	-	-	-	-	22	9 - 27

TABLE 99 Variation in peduncle and raceme length in field and garden specimens of H. margaritifera, the suspected hybrid, and A. rugosa.

Degree of Branching of Inflorescences.

Locality	Indivs. with one or more branches to inflorescences	Indivs. with no branches, but unexpanded raceme buds in axils of sterile bracts	Total no. indiv.
	HAWORTHIA MARGARITIFERA		
Ex. Hort K'bosch	4	0	4
	"ASTROWORTHIA BICARINATA"		
Baden-Baden R58	4	0	5
Rietvlei R50	2	2	4
Hort K'bosch 7262	2	3	8
Karoo G'dns	0	1	2
Ex. B. Carp	0	2	2
Ex. H. Heme	2	2	4
	ASTROLOBA RUGOSA		
Baden-Baden R59,18	0	0	19
Montagu Dist R17,19,20,23 Nbg	0	0	22

Number of Sterile bracts

Locality	Class range of numbers			Total no. indiv.	Range actua no. bracts.
	HAWORTHIA MARGARITIFERA				
Ex. Hort K'bosch	-	2	2	4	3 - 5
	"ASTROWORTHIA BICARINATA"				
Baden-Baden R58	-	4	1	5	3 - 5
Rietvlei R50	-	4	-	4	3 - 4
Hort K'bosch 7262	-	7	-	7	3 - 4
Karoo Gdn's	-	1	1	2	3 - 5
Ex. B. Carp	-	2	-	2	3 - 4
Ex. H. Heme	1	3	-	4	2 - 4
	ASTROLOBA RUGOSA				
Baden-Baden R59,18	6	13	-	19	2 - 4
Montagu dist. R17,19,20,23 nbg	5	17	-	22	2 - 4

TABLE 100 Variation in degree of branching and number of sterile bracts in field and garden specimens of <u>H. margaritifera</u>, the suspected hybrid, and <u>A. rugosa</u>.

Locality.	Class range of measurements.						Total no. indiv.	Range actu measuremen
Width of base of peduncle. Class interval 0.15 cm.								
	0.30	0.45	0.60	0.75	0.90			cm.
HAWORTHIA MARGARITIFERA								
Ex. Hort K'bosch	-	1	-	1	1	1	4	0.45 - 0.
"ASTROWORTHIA BICARINATA"								
Baden-Baden R58	-	-	3	1	-	-	4	0.52 - 0.
Rietvlei R50	-	3	1	-	-	-	4	0.36 - 0.
Hort K'bosch 7262	-	-	6	1	-	-	7	0.47 - 0.
Karoo Gdn's R70	-	-	2	-	-	-	2	0.48 - 0.
Ex. B. Carp R71	-	1	1	-	-	-	2	0.39 - 0.
Ex. H. Herre R73	-	1	1	-	-	-	2	0.38 - 0.
ASTROLOBA RUGOSA								
Baden-Baden R59,18,17	8	9	-	-	-	-	17	0.22 - 0.
Montagu Area R19,20, 23 Nbg	19	3	-	-	-	-	22	0.23 - 0.

Locality.	Class range of measurements.					Total no. indiv.	Range actu measuremen
Width of peduncle below main raceme. Class interval 0.10 cm.							
	0.10	0.20	0.30	0.40			
HAWORTHIA MARGARITIFERA							
Ex. Hort K'bosch	-	-	2	2	-	4	0.27 - 0.
"ASTROWORTHIA BICARINATA"							
Baden-Baden R58	-	4	2	-	-	2	0.16 - 0.
Rietvlei R50	-	-	4	-	-	4	0.22 - 0.
Hort K'bosch 7262	-	-	3	4	-	7	0.25 - 0.
Karoo Gdn's R70	-	-	2	-	-	2	0.25 - 0.
Ex. B. Carp R71	-	-	2	-	-	2	0.21 - 0.
Ex. H. Herre R73	-	2	2	-	-	4	0.20 - 0.
ASTROLOBA RUGOSA.							
Baden-Baden R59,18,17	-	14	3	-	-	17	0.14 - 0.
Montagu Area R19,20, 23,Nbg	-	14	8	-	-	22	0.14 - 0.

TABLE 101 Variation in thickness of peduncle in field and garden specimens of H. margaritifera, the suspected hybrid and A. rugosa.

Locality.	Class range of measurements.							Total no. indiv.	Range actu measuremer

Length basal sterile bract. Class interval 0.20 cm.

	0.4	0.6	0.8	1.0	1.2			cm.
HAWORTHIA MARGARITIFERA								
Ex. Hort K'bosch	-	-	2	2	-	-	4	0.70 - 0
"ASTROWORTHIA BICARINATA"								
Baden-Baden R58	-	1	4	-	-	-	5	0.60 - 0
Rietvlei R50	1	2	-	1	-	-	4	0.40 - 0
Hort. K'bosch 7262	-	-	1	5	1	-	7	0.80 - 1
Karoo Gdn's R70	-	1	-	-	-	-	1	0.47
Ex. B. Carp R71	-	2	-	-	-	-	2	0.60
Ex. H. Herre R73	-	1	2	1	-	-	2	0.53 - 0
ASTROLOBA RUGOSA								
Baden-Baden R59,18,17	1	7	-	-	-	-	8	0.40 - 0
Montagu Area R19,20, 23, Nbg	-	3	1	-	-	-	4	0.47 - 0

Length basal fertile bract. Class interval 0.10 cm.

	0.3	0.4	0.5	0.6	0.7	0.8			
HAWORTHIA MARGARITIFERA									
Ex. Hort K'bosch	-	1	2	1	-	-	-	4	0.34 - 0
"ASTROWORTHIA BICARINATA"									
Baden-Baden R58	-	2	4	-	-	-	-	6	0.36 - 0
Rietvlei R50	-	-	4	-	-	-	-	4	0.43 - 0
Hort K'bosch 7262	-	-	-	-	2	3	1	6	0.70 - 0
Karoo Gdn's R70	1	-	-	-	-	-	-	1	0.24
Ex. B. Carp. R71	-	2	-	-	-	-	-	2	0.33 - 0
Ex. H. Herre R73	-	-	2	2	-	-	-	4	0.43 - 0
ASTROLOBA RUGOSA									
Baden-Baden R59,18,17	7	10	2	-	-	-	-	19	0.30 - 0

TABLE 102 Variation in bract length in field and garden specimens of H. margaritifera, the suspected hybrid and A. rugosa

Locality.	Class range of measurements.						Total no. indiv.	Range actual measurements.
Width base of basal sterile bract. Class interval 0.10 cm.								
	0.2	0.3	0.4	0.5	0.6			cm.
HAWORTHIA MARGARITIFERA.								
Ex. Hort. K'bosch	-	-	1	1	1	1	4	0.40 - 0.70
"ASTROWORTHIA BICARINATA"								
Baden-Baden R58	-	1	2	1	1	-	5	0.28 - 0.60
Rietvlei R50	-	-	3	-	-	1	4	0.35 - 0.63
Hort. K'bosch 7262	-	-	-	2	2	3	7	0.46 - 0.70
Karoo Gdn's R70	-	-	1	-	-	-	1	0.35
Ex. B. Carp. R71	-	-	-	2	-	-	2	0.45
Ex. H. Herre R73	-	1	1	2	-	-	4	0.30 - 0.50
ASTROLOBA RUGOSA								
Baden-Baden R59,18,17	1	6	1	-	-	-	8	0.18 - 0.36
Montagu Area R19,20, 23, Nbg	1	3	-	-	-	-	4	0.20 - 0.27
Width base of basal fertile bract. Class interval 0.10 cm.								
HAWORTHIA MARGARITIFERA								cm.
Ex. Hort K'bosch	-	2	1	1	-	-	4	0.28 - 0.45
"ASTROWORTHIA BICARINATA"								
Baden-Baden R58	-	6	-	-	-	-	6	0.28 - 0.30
Rietvlei R50	-	2	1	1	-	-	4	0.30 - 0.43
Hort. K'bosch 7262	-	-	-	5	1	-	6	0.43 - 0.60
Karoo Gdn's R70	-	1	-	-	-	-	1	0.30
Ex. B. Carp. R71	-	-	2	-	-	-	2	0.38 - 0.40
Ex. H. Herre R73	-	1	3	-	-	-	4	0.30 - 0.35
ASTROLOBA RUGOSA								
Baden-Baden R59,18,17	4	6	-	-	-	-	10	0.20 - 0.25
Montagu Area R19,20, 23, Nbg	2	3	-	-	-	-	5	0.20 - 0.30

TABLE 103 Variation in basal width of bracts in field and garden specimens of H. margaritifera, the suspected hybrid and A. rugosa.

Locality	Class range of measurements.					Total no. indiv.	Range actual measurements
	Basal sterile bract.						
	.05	.10	.15	.20			cm.
	HAWORTHIA MARGARITIFERA						
Ex. Hort K'bosch	-	2	-	-	-	2	0.07 - 0.08
	"ASTROWORTHIA BICARINATA"						
Baden-Baden R58	-	-	-	3	-	3	0.18 - 0.20
Rietvlei R50	-	1	1	-	-	2	0.07 - 0.13
Hort K'bosch 7262	-	-	-	5	1	6	0.16 - 0.23
Karoo Gdn's R70	-	1	-	-	-	1	0.10
Ex. B. Carp R71	-	-	2	-	-	2	0.13 - 0.15
Ex. H. Heme R73	-	1	1	-	-	2	0.10 - 0.15
	ASTROLOBA RUGOSA						
Baden-Baden R59,18,17	-	4	3	-	1	8	0.06 - 0.23
Montagu Area R19,20,23 Nbg	-	1	3	-	-	4	0.08 - 0.12
	Basal fertile bract.						
	HAWORTHIA MARGARITIFERA						
Ex. Hort K'bosch	1	1	-	-	-	2	0.05 - 0.07
	"ASTROWORTHIA BICARINATA"						
Baden-Baden R58	-	-	1	3	-	4	0.15 - 0.20
Rietvlei R50	-	1	-	1	-	2	0.10 - 0.18
Hort K'bosch 7262	-	-	2	1	2	5	0.15 - 0.23
Karoo Gdns R70	-	1	-	-	-	1	0.10
Ex. B. Carp R71	-	-	-	2	-	2	0.16 - 0.17
Ex. H. Heme R73	-	-	2	-	-	2	0.12 - 0.13
	ASTROLOBA RUGOSA						
Baden-Baden R59,18,17	-	7	3	-	-	10	0.07 - 0.12
Montagu Area R19,20,23 Nbg	-	2	3	-	-	5	0.08 - 0.13

TABLE 104 Variation in width of bracts taken half way along length of bract in field and garden specimens of H. margaritifera, the suspected hybrid and A. rugosa.

Locality.	Class range of measurements.							Total no. indiv.	Range actual measurements.
Basal Sterile Bract.									
	2	4	6	8	10	12			
HAWORTHIA MARGARITIFERA									
Ex. Hort. K'bosch	-	-	-	-	1	-	1	2	8.75 -12.14
"ASTROWORTHIA BICARINATA"									
Baden-Baden R58	-	2	1	-	-	-	-	3	3.33 - 4.16
Rietvlei R50	-	-	-	1	-	1	-	2	4.61 -11.85
Hort. K'bosch 7262	-	1	3	;	-	-	-	5	4.00 - 6.56
Karoo Gdn's R70	-	-	1	-	-	-	-	1	4.70
Ex. B. Carp R71	-	1	1	-	-	-	-	2	4.00 - 4.61
Ex. H. Herre R73	-	-	2	-	-	-	-	2	5.00 - 5.30
ASTROLOBA RUGOSA									
Baden-Baden R59,18,17	1	2	4	-	1	-	-	8	1.82 - 9.16
Montagu Area R19,20, 23, Nbg	-	-	4	-	-	-	-	4	4.33 - 5.87
Basal Fertile Bract.									
HAWORTHIA MARGARITIFERA									
Ex. Hort. K'bosch	-	-	-	-	2	-	-	2	8.57 -10.00
"ASTROWORTHIA BICARINATA"									
Baden-Baden R58	-	4	-	-	-	-	-	4	2.11 - 2.66
Rietvlei R50	-	1	1	-	-	-	-	2	2.72 - 4.50
Hort. K'bosch 7262	-	3	2	-	-	-	-	5	3.04 - 5.40
Karoo Gadn's R70	-	1	-	-	-	-	-	1	2.40
Ex. B. Carp. R71	1	1	-	-	-	-	-	2	1.94 - 2.18
Ex. H. Herre R73	-	2	-	-	-	-	-		
ASTROLOBA RUGOSA									
Baden-Baden R59,18,17	-	7	3	-	-	-	-	10	2.50 - 5.71
Montagu Area R19,20, 23 Nbg.	-	4	1	-	-	-	-	5	4.33 - 5.87

Class interval 0.20

TABLE 105 Variation in the length-breadth ratio of bracts in field and garden specimens of H. margaritifera, the suspected hybrid and A. rugosa.

Locality.	Class range of measurements.					Total no. indiv.	Range actu measuremen
Length flowering pedicel from base of raceme.							
	0.2	0.4	0.6	0.8			cm.
HAWORTHIA MARGARITIFERA							
Ex. Hort K'bosch	-	1	2	-	-	3	0.32 - 0.6
"ASTROWORTHIA BICARINATA"							
Baden-Baden R58	-	-	3	-	1	4	0.48 - 0.9
Rietvlei R50	-	-	1	2	-	3	0.48 - 0.6
Hort. K'bosch 7262	-	6	-	-	-	6	0.30 - 0.4
Karoo Gdn's R70	-	-	2	-	-	2	0.45 - 0.5
Ex. B. Carp R71	-	-	2	-	-	2	0.45 - 0.4
Ex. H. Herre R73	-	1	2	1	-	4	0.39 - 0.6
ASTROLOBA RUGOSA							
Baden-Baden R59,18,17	-	2	9	7		18	0.40 - 0.8
Montagu Area R19,20, 23 Nbg.	-	3	9	7	-	19	0.32 - 0.8
Length flowering pedicel from middle of raceme.							
	0.3	0.5	0.7	0.9			
HAWORTHIA MARGARITIFERA							
Ex. Hort. K'bosch	-	1	1	-	-	2	0.50 - 0.5
"ASTROWORTHIA BICARINATA"							
Baden-Baden R58	-	1	1	-	-	2	0.43 - 0.5
Rietvlei R50	-	3	1	-	-	4	0.32 - 0.5
Hort. K'bosch 7262	4	1	-	-	-	5	0.26 - 0.3
Karoo Gdn's R70	-	2	-	-	-	2	0.40 - 0.4
Ex. B. Carp. R71	-	2	-	-	-	2	0.38 - 0.4
Ex. H. Herre R73	-	3	-	-	-	3	0.37 - 0.4
ASTROLOBA RUGOSA							
Baden-Baden R59,18,17	1	11	3	-	1	16	0.30 - 0.9
Montagu Area R19,20 23 Nbg.	2	13	2	1	-	18	0.30 - 0.7
Length fruiting pedicel from base of raceme.							
	0.2	0.4	0.6	0.8			
HAWORTHIA MARGARITIFERA							
Ex. Hort. K'bosch	-	-	-	1	-	1	0.61
"ASTROWORTHIA BICARINATA"							
Baden-Baden R58	-	-	1	1	-	2	0.42 - 0.6
ASTROLOBA RUGOSA							
Baden-Baden R59,18, 7	-	-	-	-	1	1	0.89
Montagu Dist Nbg.	-	-	2	-	-	2	0.52 - 0.5

Class interval 0.20 cm.

TABLE 106 Variation in pedicel length in field and garden specimens of H. margaritifera, the suspected hybrid and A. rugosa.

There is less difference in the width of the base of the lowest fertile bract. This ranges from 0.2 - 0.5 in H.margaritifera, from 0.2 - 0.3 in A.rugosa and from 0.2 - 0.4 in all specimens of "bicarinata", except for a single specimen from Rietvlei, and all basal fertile bracts of No. 7262, which have a greater basal width.

With regard to the length-breadth ratios of the bracts, (the value for the breadth being taken half-way along the length of the bract), the samples for H.margaritifera are, unfortunately, small. In both specimens of this species, the length-breadth ratio of the lowest sterile and fertile bracts exceeds 8.0. In A.rugosa, the length-breadth ratio of the sterile bracts is somewhat variable, with a length-breadth ratio of 4.0 - 6.0 in most specimens, while the length-breadth ratio in most basal fertile bracts is 2.0 - 4.0. A similar pattern is observed in "bicarinata".

The length of basal flowering pedicels ranges from 0.3 - 0.6 cm in the H.margaritifera specimens examined, and from 0.2 - 0.8 cm, with most specimens 0.6 - 0.8 cm long, in A.rugosa. In "bicarinata" basal pedicels are 0.3 - 1.0 cm long, most being 0.4 - 0.6 cm in length, with the exception of No. 7262, where the basal flowering pedicels are shorter. Most flowering pedicels from the middle of the raceme are 0.3 - 0.5 cm long in all three, again with the exception of No. 7262, where they are shorter.

Mention should be made of the fact that peduncle and raceme axes, and pedicels are reddish brown or a glaucous green in A.rugosa, while in H.margaritifera and in "bicarinata" they are reddish brown in colour.

Summary.

Thus in inflorescence characters too, "bicarinata" is intermediate between H.margaritifera and A.rugosa, although the difference with regard to these between the two suspected parent species is, apart from branching of inflorescences slight. It is of interest to note how the "bicarinata" specimen No. 7262 differs from the other plants of "bicarinata" in thickness of peduncle below raceme, bract dimensions and pedicel length.

COMPARISON OF PERIANTH CHARACTERS. (See Figs. 66 and 67)

In the introductory survey, mention was made of the fact that the feature of a strongly bilabiate flower typical of the genus Haworthia, was not as marked in species such as H.margaritifera. In colour too, the flowers of H.margaritifera and the other species of Haworthia with less bilabiate perianths differ from the very bilabiate species. In the latter, the central vein of each tepal is a beige or glaucous green, the rest of the tepal including the lobes a glistening white. In H.margaritifera, on the other hand, the tubular part of the perianth has a faint yellowish beige tinge which becomes a glaucous reddish brown - green towards the base. The lobes are yellowish cream or cream, and the V of the vein endings is often slightly reddish brown.

The colour of the perianth of A.rugosa has already been described.

The colours of the perianth of "bicarinata" vary from those of H.margaritifera to those of A.rugosa. Flowers from the plant R73 had in some instances the outer tepals slightly inflated on either side of the midrib, as was observed in certain specimens of A.rugosa. The plant No. 7262 did differ slightly in the colour of the perianth, in that the veins of the tepals were green and the rest of the tepal including the lobes, white. Sometimes the white part of the perianth tube did have a pale beige tinge.

As previously, variation in perianth dimensions for H.margaritifera, A.rugosa and the suspected hybrid are shown in a series of histograms.

With regard to the position of the lobes in the open flower, it can be seen that the least open lobes are found in A.rugosa, the most open in H.margaritifera with those of "bicarinata" intermediate. As mentioned before, A.rugosa characteristically has all the inner lobes at an angle of 30° or less. This was not observed in any of the few H.margaritifera flowers examined, but in "bicarinata" is found to be the case for the inner posterior lobe of two flowers, and for the inner lateral lobes of about half the samples.

Lobe length, although short for the genus Haworthia, is longest in H.margaritifera, ranging from 2.0 - 3.0 mm for the outer lobes and 2.5 - 3.5 mm for the inner lobes. It is shortest, 1.0 - 2.0 mm for outer and inner lobes in A.rugosa, and intermediate in flowers of "bicarinata". Here, outer and inner lobes range from 1.5 - 2.5 mm, the inner in most cases being a little longer.

In width, the outer lobes of H.margaritifera tend tobe similar to those of A.rugosa, which are 1.0 - 1.5 mm in most cases. In "bicarinata", however, outer perianth lobes range from 1.0 - 2.0 mm in width.

The inner lobes of both H.margaritifera and A.rugosa are slightly wider than the outer, being 1.5 - 2.00 mm in most cases. In most of the "bicarinata" samples, the inner lobes are 1.5 - 2.00 mm wide, except for specimens from Rietvlei, in which the lobes are 2.0 - 2.5 mm in width, and the flowers of No. 7262, where width of the inner perianth lobes varies from 2.0 - 3.5 mm.

The length of the perianth tube varies from 9 - mm in the few specimens of H.margaritifera which were examined, to 7 - 11 mm in most flowers of A.rugosa and "bicarinata".

In all three, the neck of the perianth tube ranges from 1.5 - 3.0 mm, but it is most constricted, 1.5 - 2.5 mm, in specimens of A.rugosa.

The middle diameter of the perianth tube too, is least in the majority of A.rugosa specimens where it is 2.5 - 3.0 mm. In "bicarinata", the mid diameter is 2.5 - 3.5 mm in most flowers, while in H.margaritifera it varies from 2.5 - 4.0 mm.

The basal diameter of the perianth tube is broadest in H.margaritifera, where it is 4.0 - 5.0 mm. In A.rugosa it is 3.0 - 3.5 mm in most flowers, and 3.0 - 4.0 mm in most specimens of "bicarinata", slightly narrower bases being found in flowers of R73.

The difference between the diameters of the middle and the neck of the perianth tubes does not vary much in the three, but the difference between basal and mid diameter of the perianth tube is more variable. This is greatest in H.margaritifera, being 0.5 - 1.5 mm. In "bicarinata" the difference between basal and mid diameter varies from 0 - 1.0 mm.

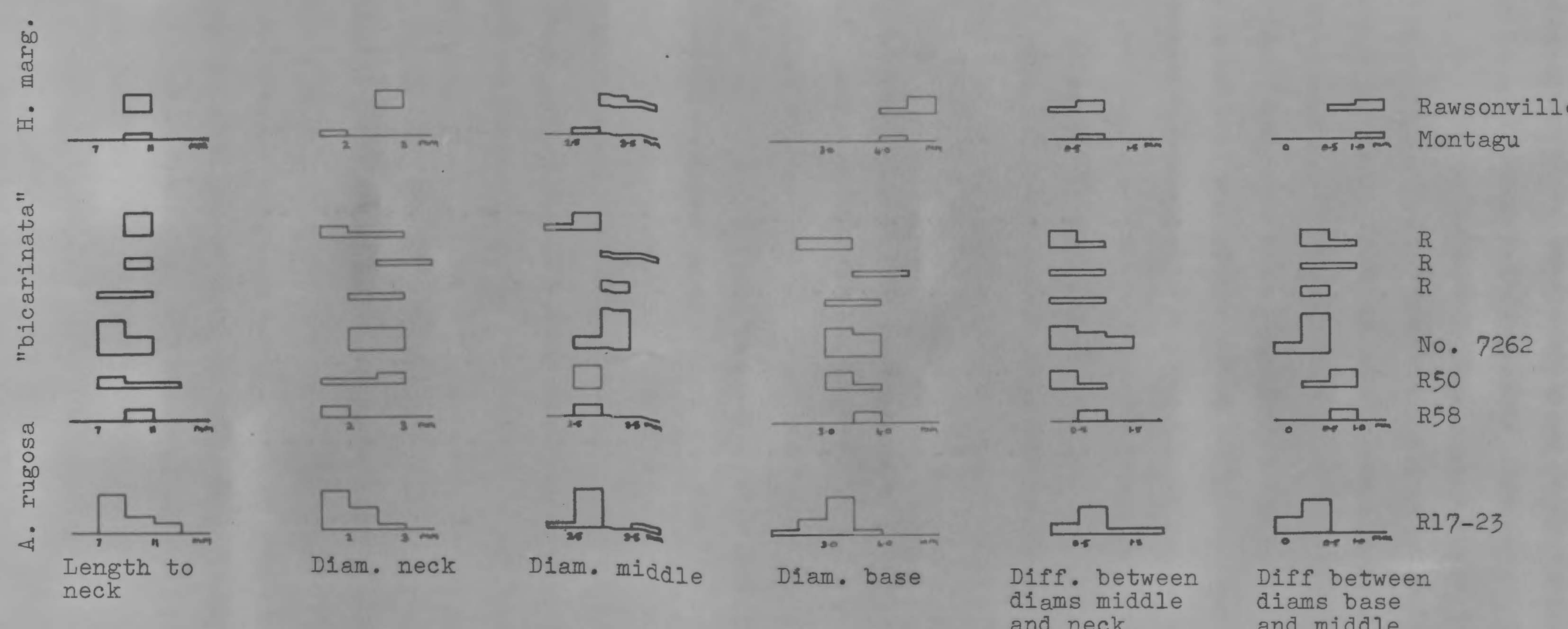
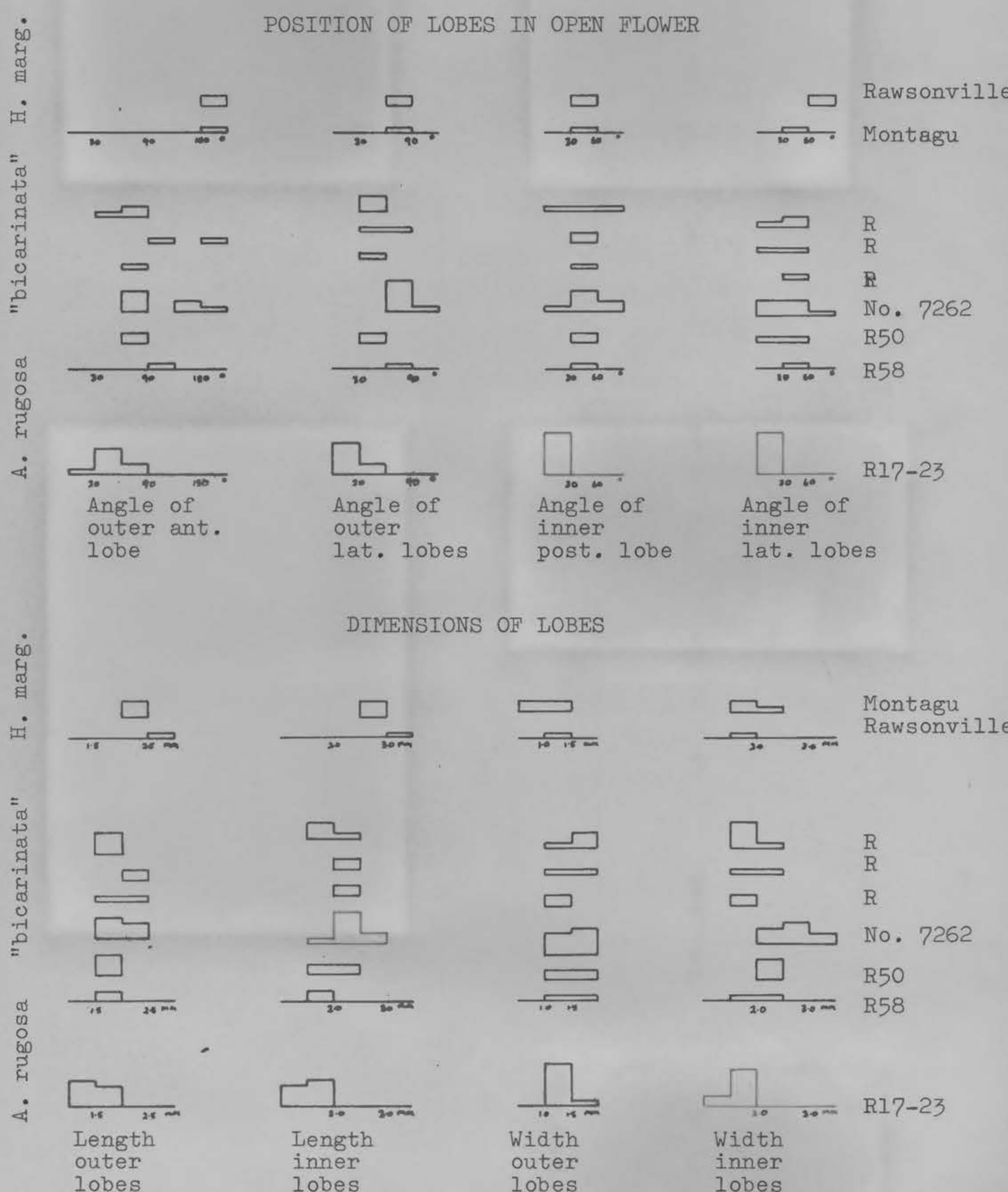


Fig.66. Variation in shape of perianth tube in H. margaritifera, "bicarinata" and A. rugosa.

Fig.67. Variation in position of lobes in the open flower and in the dimensions of the lobes in <u>H. margaritifera</u>, "<u>bicarinata</u>" and <u>A. rugosa</u>.



Showing the shape of the perianth in specimens of H. margaritifera.
(X 1)

B.

A and B: portions of inflorescences of "bicarinata" (X 1 approx). A, from the Karoo gardens, Worcester, R70; B, from Rietvlei No. 2, R50.

A.

Showing the perianth in a specimen of A. rugosa (X 1 approx.)

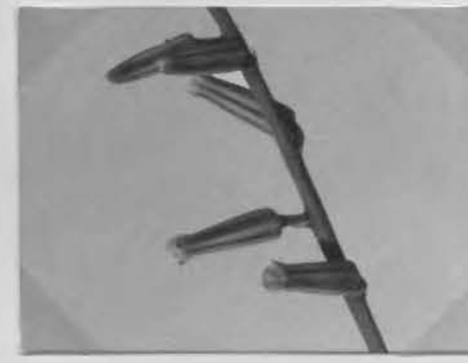


PLATE 32.

SUMMARY.

From the foregoing, "bicarinata" is shown to have perianth characters intermediate between those of H.margaritifera and A.rugosa. It is of interest to note the differences in perianth character between plant No. 7262 and the other smaples designated as "bicarinata".

CONCLUSION.

In conclusion, from the evidence of behaviour of the chromosomes in meiotic Metaphase I in P.M.C.'s, from the fact that "bicarinata" has vegetative, and floral characters intermediate between H.margaritifera and A.rugosa, and from the fact that all three have been found in the field growing in close proximity, it seems reasonable to consider the plants described as "bicarinata" as intergeneric hybrids between Haworthia margaritifera (L.) Haw. and Astroloba rugosa sp. nov. Roberts.

To date, there has been no valid description of a hybrid genus involving the genera Astroloba and Haworthia. Von Poellnitz (1943) mentioned the name "Apworthia" for such a genus, but included no diagnosis, so his name is invalid. He combined the old generic name Apicra with Haworthia.

The present author accordingly proposes the name x Astroworthia for intergeneric hybrids between Astroloba and Haworthia. Consequently, the hybrid in question is referred to as x Astroworthia bicarinata (Haw.) Roberts comb. nov.

A REVIEW OF THE TAXONOMIC LITERATURE ON THE GENUS ASTROLOBA.

Introduction:

Before embarking on a review of the subject, a comment on the difficulties encountered in dealing with taxonomic literature on Astroloba is appropriate.

Most of the species have been described from specimens in private succulent collections, the descriptions in most cases being based on a single plant. No records of herbarium type specimens have so far come to notice, and, except for a few cases, the type descriptions are unaccompanied by illustrations.

Although succulent collectors have, from the earliest days been in literary contact with one another, a study of the literature shows a lack of consistency and some confusion in the interpretation of certain species.

In a genus such as Astroloba where the facies of the constituent species is so similar, this is not surprising. A short Latin diagnosis without an illustration may easily apply to more than one species.

Except for Baker (1881, 1896) and Berger (1908), who, writing monographs on large sections of the Liliaceae, could not possibly approach the problem critically, most of the recent literature on Astroloba has been the work of amateur succulent enthusiasts, none of whom have seen the species in the field, or made population studies.

Early authors attached great importance to leaf arrangement; whether the leaves were in five straight rows, in five spirally twisted rows or imbricate. Since this varies from stem to stem and indeed occasionally on the same stem, it cannot be of primary taxonomic significance.

Taxonomic History of the genus:

The earliest known account of a species of Astroloba appears in Commelin's Praeludia (1703), as an "African aloe, erect, rotund with small rigid pointed leaves" which was given to the medical garden at Amsterdam by Daniel des Maretes, and "has produced no flowers or seeds". The accompanying illustration is a poor one, making identification of the plant in question impossible.

In his Species Plantarum, (1753) Linnæus described one species of Astroloba, Aloe spiralis, "with ovate acuminate, five ranked imbricate leaves" and "sessile ovate crennate flowers, the inner segments connivent".

Haworth (1804) was the author of the first monograph on the Aloe. He divided the group into Grandiflorae, Curviflorae and Parviflorae, the latter section including species today recognised as belonging to the genera Haworthia and Astroloba. It should be noted that Haworth placed many plants in these groups without having seen their flowers.

The Parviflorae were divided into the Acaules and the Rigidae, and including all the then known species pertaining to Astroloba, described from living plants in Haworth's collection.

Haworth's comments (1804 p.23) on variability in aloes: "...a predominant, but I believe an erroneous idea, that few of them are truly and originally distinct; but fluctuating and inconsistant if raised from seed", and on "the utter impracticability of their ever appearing in a 'hortus siccus', at least in any cognizable shape" are of some interest.

Duval (1809) separated the Genus Haworthia from Aloe on account of a bilabiate perianth: "Calyx petaloideus, rectus, superne revolutus in duo labia".

Willdenow (1811) unaware of Duval's new genus, established the genus Apicra from Aloe on the same grounds: "Corolla Monopetala ..... limbo sexpartito bilabiato ... Diese Gattung ist durch den besondern Bau der Blumenkrone von den eigentlichen Aloë Arten beim ersten Blick zu unterscheiden, ...". The name Apicra was chosen because the sap of these plants was not bitter like that of species of Aloe, and the genus was divided into Acaules and Caulescentes, the latter including six species recognised today as species or components of species of Astroloba. For three of these, A. imbricata, A. pentagona and A. bullulata, (sensu Willd.) the references cited include good illustrations of actinomorphic perianths. Thus Apicra Willd. 1811 and Haworthia Duval 1809 are synonomous.

Haworth (1812) included Duval's genus in his Synopsis, dividing Haworthia into several sections including "Caulescentes erectre ..... corollis cylindricus sub-erectis; limbo sub-regulari. An genus proprium?" The five species in this section are all components of the genus Astroloba as construed at present.

Haworth's Supplement (1819) contained the genus Haworthia as previously and, "Apicra. Willd. - Aloë aliorum" with "... perigonius petaloideus cylindricus, limbus regularis patulus, laciniis brevibus". He had not seen Willdenow's original description (loc.cit. p.50) and had misapplied the name Apicra to a new perfectly valid genus.

This mistake was perpetuated by subsequent authors, notably Baker and Berger who, while citing the genus as Apicra Willd. distinguished it from Haworthia on the grounds of short equal spreading perianth segments as opposed to a bilabiate condition.

Mention must here be made of Salm-Dyk's Monograph (1836-1863) in which he retained the old concept of the genus Aloe, as he had done previously in his Catalogue (1817). The genus was divided into Grandiflorae and Parviflorae, and the two groups of the latter "limbo bilabiato" and "limbo regulari" were equated with "Haworthia Duval" and "Apicra Haw".

Stearn (1936) proposed the conservation of the generic name Apicra Haw, suggesting "A. pentagona (Haw) Haw." as a lectotype on the grounds that: "Apicra Willd. (1811) is a synonym of Haworthia Duval (1809). In defining Apicra as a genus with a regular perianth unlike Haworthia, Haworth was really founding a new genus for which no alternative name exists". Technically, Haworth cited the epithet as "Apicra Willd."; as is shown elsewhere the interpretation of "Apicra pentagona (Haw.)" Haw. is a matter of some confusion.

It would have been far better to reject the name Apicra altogether, and substitute a new one. This was eventually done by Uitewaal (1947), who proposed the new and now accepted name of Astroloba, (Greek astron = star, lobos = lobe). However, for the type Uitewaal put forward the same species as had Stearn, an unwise choice, because of the confusion in the application of this epithet.

Taxonomic History of the different Species.

In view of the confusion arising from misinterpretation of specific diagnoses, accounts of the literature for the different species are given in some detail.

Species are dealt with individually or in their related groups. This has resulted in some repetition, but it is felt that for the sake of clarity, this is necessary.

ASTROLOBA SPIRALIS (L) Uitew. AND THE CONFUSION ARISING OUT OF THE INTERPRETATION OF ALOE PENTAGONA (Ait) Haw.

The author has shown that in her opinion the entities referred to as "spiralis", "smutsiana" and "hallii" should be treated as distinct species. While "spiralis" differs from "smutsiana" in perianth characters and chromosome number, in vegetative characters the two are very similar, so that it is often difficult to identify plants of either when they are not in flower.

"Hallii" has a smooth perianth in common with "smutsiana" and striations on the leaf underside which are sometimes found in plants of "smutsiana". However, many plants of "hallii" have tuberculate or spotted leaves in the field, which has never been observed in field populations of either "hallii" or "spiralis", although under cultivation a few plants of both did develop white blotches which were not raised. "Hallii" differs further from "smutsiana" in the keeled marginate nature of the leaf apices, never to date observed in the latter.

Although leaf arrangement is not of primary significance, the spiral angle tends to be lower, 0-10°, in most plants of "hallii" than in "smutsiana" and "spiralis" where it is more variable ranging from 0-30°.

Leaf length in field specimens of "hallii" ranges from 2.5 - 4.5 cm., while in field specimens of "smutsiana" and "spiralis" leaf length was 1.5 - 3.5 cm, very rarely 4.0 cm. Length-breadth ratios are 1.72 - 3.14 in plants examined of "hallii" and 1.30 - 2.30, and 1.57 - 2.90 in plants examined of "smutsiana" and "spiralis" respectively.

No branched inflorescences and only one peduncle with unexpanded axillary raceme buds were found in field specimens of "smutsiana", while branched inflorescences were occasional and unexpanded axillary raceme buds more frequent in "hallii". The length of the lowest flowering pedicels was 0.2 - 0.4 cm in most specimens of "smutsiana" and 0.3 - 0.6 cm in most specimens of "hallii" .

A review of the relevant taxonomic literature/shows and one herbarium specimen that at the time of the publication of Salm-Dyk's monograph (1836-1863), all three species were cultivated in Europe. Such a review also shows that extreme confusion existed over the identity of "hallii" and "smutsiana", and that in all likelihood, non-flowering material of "smutsiana" and "spiralis" was also confused.

In the following survey, the present author will show that the epithet "spiralis", as devised by Linnéus, may be readily applied to field specimens, so that this species may be referred to as Astroloba spiralis (L.) Uitew. With regard to the other two species, however, the present author will show that the nomenclature and applications thereof have been so confused that there has been no other choice but to select two completely new names for these two, which are accordingly referred to as Astroloba hallii Roberts sp. nov. and Astroloba smutsiana Roberts sp. nov.

Finally, before embarking upon what must be one of the most knotty taxonomic problems it was ever any taxonomist's task to unravel, it must be noted that under cultivation, succulent plants often become very turgid, and may look somewhat different from plants in the field. The development of white blotches on the leaves of some plants of A. spiralis and A. smutsiana under cultivation has already been mentioned.

It should also be noted here, apropos of the confusion over past nomenclature of all three, that photographs were seen of plants from green houses at Kew and Lucerne, labelled as "Apicra pentagona". These most resembled plants of either A. spiralis A. smutsiana, as did actual leaves sent from the Kew plants.

Aloe spiralis, a plant with "sessile* ovate crennate flowers, the inner segments connivent (and) ovate acuminate five-ranked imbricate leaves" was the first species of Astroloba to be described, by Linnéus (1753). Amongst the references cited, including Linnéus (1737, 1748) and Van Royen (1740), were two

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*Linnéus' use of the word sessile is rather loose. Save for some plants of A. foliolosa sub. sp. robusta Roberts, the flowers in Astroloba are all pedicellate.

works with illustrations of the plants described. One was Commelin's Praeludia (1703) with the poor illustration of a leafy shoot, the other, Dillenius' Hortus Elthamensis (1732). The latter has an excellent illustration depicting a plant with five-farious patent erect imbricate leaves and a spike of flowers, the perianth tubes of which are rugose on their outer surfaces. The plant of this illustration is readily associated with plants collected in the Little Karoo near Oudtshoorn, Calitzdorp and Ladismith. As before mentioned, the identity of the plant of Commelin's illustration is uncertain.

Linneus' Hortus Upsaliensis (1748) was unobtainable, but in the Hortus Cliffortianus (1737), he described the plant as an "Aloe with ovate acuminate leaves, which are imbricate and five ranked about the stem ... Plant covered with leaves so it is almost round. Scape erect rarely branched, flowers sessile, nearly erect, ovate with small limbs". As references he cited Commelin, Dillenius and Boerhaave's Index (1720).

Dillenius described the flowers as "..... monopetalous, tube entire, striate rough and crisp ... with six short yellow segments, the outer three larger, somewhat expanded, the edges slightly crenate, the inner segments smaller connivent and not crenate". In the last paragraph he made the interesting comment that other of these species were said to be in Holland "differentia vero non satis mihi liquet". He cited one reference, Boerhaave's Index which give only Commelin's descriptive phrase.

While the word "crena" means a rounded tooth or notch, in view of Dillenius' use of the word, and the glossary of terms in the Lichfield edition (1782) of the Systema Vegetabilium, it seems that by "floribus crenatis" Linneus was referring to the notched condition of the margins of the perianth lobes and not the rugosity of the corolla tube described and illustrated by Dillenius. (In the glossary of the Lichfield edition, the term "notched" is placed under the section "margin" and its Latin equivalent is given as "crenatum: the margin cut into nicks, without any reference to the extremeties").

Featherly (1954) defines the word crenate as being "said of a margin with rounded or blunt teeth". While the perianth lobes of Astroloba flowers are often minutely notched, this is not a prominent character, and it is very surprising that Linneus should have noted it and not the rugosity of the perianth tube in his first account of Aloe spiralis, if he had in fact seen flowering material.

Although Linnéus' account of Aloe spiralis in the Species Plantarum of 1753 makes no mention of a rugose perianth, because Dillenius' description of such a flower is cited, Aloe spiralis L. has to be identified as a plant with a rugose perianth.

There are no extant records of a Linnéan specimen of Aloe spiralis L., and it is very possible that when writing the Species Plantarum Linnéus had not seen flowering material of the plant he described as A. spiralis, and had simply quoted an inaccurately made summary of Dillenius' description from the Hortus Cliffortianus. That Linnéus must have seen vegetative material of what is now called Astroloba seems evident in view of his earlier references of 1737 and 1748. That these may have been plants other than A. spiralis is not unlikely.

However, in a note on Aloe spiralis in the Observationes of his Mantissa (1771), Linnéus changed the description from "sessile flowers" to "spicate muricate flowers". In the same account the leaves are, for the first time, described with "tricarinate apices". In the Lichfield glossary "murex'd", with the Latin equivalent "muricatus", is placed in the section "surface" and is given as "sprinkled with awl-shaped points". Also in the Observationes, Linnéus wrote that the leaf arrangement of Aloe spiralis was "six farious (not five farious) imbricate".

All Astrolobas have a leaf arrangement in multiples of five but this error was perpetuated in a number of subsequent accounts, including Houttyn (1773-1783), and Persoon's edition of the Systema Vegetabilium (1797), while Gmelin in his edition of the Systema Natura (1796) described the leaf arrangement as octofarious and omitted an account of the flower altogether. He cited an unobtainable reference "Knorr del nat 1.t.A.6".* Thunberg (1785-1794)writing of Aloe spiralis did not include an account of

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* Presumably Knorr, G.W. (1766-67). Deliciae Naturae Selectae etc. (2nd ed. 1778).

the flower and also described the leaves as "imbricate octofariis". The Lichfield edition of the Systema Vegetabilium included a description of the flowers as in the Mantissa but omitted any account of leaf arrangement.

Mention must be made of the account of Aloe spiralis in the eighth edition of Millers Garden Dictionary (1768) in which was noted a much larger "seminal variety" with thicker leaves and longer pedicels raised from seed". The only references cited were Linneus (1753) and Commelin (1703). There was no account of the floral morphology apart from Linneus' epithet "oval crenated flowers".

In 1789 appeared the first edition of the Hortus Kewensis by William Aiton. Apart from listing two new varieties of Aloe spiralis based on leaf arrangement : α imbricata "imbricated spiral Aloe" and β pentagona "5-sided spiral aloe", he added nothing to supplement previous descriptions, only noting that the species flowered in June and July and was cultivated in 1732 by James Sherard. As references, apart from the Species Plantarum*, Aiton cited Thunberg (1785) quoting "foliis octofarius ovatis" and Dillenius (1732), making no mention of a rugose perianth. As has been shown, the leaf arrangement in A. spiralis varies from a spiral angle of 0^{o} to one of 30^{o}, so that on grounds of the description alone, α imbricata and β pentagona cannot be recognised as valid varieties. To the best of the author's knowledge, there are no known herbarium specimens or drawings of specimens of these two varieties.

Both Aiton's new varieties were included in Willdenow's edition of the Species Plantarum (1799). Here epithets for Aloe spiralis from all available literature were listed.

The grouping of the references listed is of significance and for this reason they are given below in full:-

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* The Edition of the Species Plantarum cited by Aiton is a later one as he refers to p. 459. The author has seen no edition of the Species Plantarum other than the first but since the second Holmiae 1762-63) and third (Vindobonae 1764) editions were published before the Mantissa and Observationes (1771) it has been assumed that the description of Aloe spiralis in the edition cited by Aiton is unchanged.

"16. ALOE Spiralis.

A. sub caulescens, foliis imbricatis octofariis ovatis, floribus racemosis recurvis. Thunb. Diss. n. 14. Thunb. prod 61.

A. floribus spicatis ovatis muricatis crenatis : segmentis interioribus conniventibus. Mill. dict. n. 12. Knorr del. 1. tab. A.6.

α imbricata foliis spiraliter imbricatis. Ait. Kew. 1 p. 471

A. foliis caulinis sexfariis ovatis mucronatis. Syst. Veg. 278*.

A. foliis ovatis acuminatis caulinis quinquefariam imbricatis. Hort. Cliff. 132. Hort. Ups. 87. Roy lugdb. 23.

A. africana erecta rotunda folio parvo et in acumen acutissimum exeunte. Dill. elth. 16 t 13 f. 14. Comm. prael. 83 t 32.

β pentagona, foliis imbricatis. Ait. l.c. Houttyn Lin. Pfl. Syst.6. p.344.
Spiral förmige Aloe W.
Habitat in Africae campestribus.

Folia ovato subulata, mucronato-spinosa, apice tricarinata, sexfariam imbricata. Mant. 368."

Taken at its face value, one must assume that the term "muricatis" applies to the perianth of the species as a whole, as the flowers of the type are listed as "ovatis muricatis crenatis", while the Hortus Elthamensis (l.c.) is quoted for var imbricata, and the Mantissa (l.c.) for var pentagona, both references alluding to muricate flowers. In the Houttyn reference (l.c.) only the colour of the flowers, and not their texture or shape is described.

The edition of Miller's Dictionary cited by Willdenow must be later than the Eighth edition which makes no mention of

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*Presumably this refers to J.A. Murray's Edition of 1774.

a muricate flower for Aloe spiralis*. A glance at the leaf arrangement in the references cited by Willdenow shows the terms octofarious, sexfarious, quinquefarious and spirally imbricate. Houttyn (l.c.) quoting Linneus in the Mantissa, described the leaves of Aloe spiralis as being in "sechs Reihen am Stengel" while the reference is here placed under β pentagona after the phrase "foliis quinquefariam imbricatis"! The whole account and citation of references is thoroughly contradictory and in no way clarifies the position regarding the identification of the two varieties, or justifies their recognition.

The next illustrated account of Aloe spiralis appeared in the Plantes Grasses of De Candolle (1799) where the leaves are described as "imbricate octofariis", and the perianth tube as "transversely rugose on the outside". The drawing is poor and the perianth not well shown, but the specimen may also be readily associated with specimens collected in the Little Karoo, both in character and size. De Candolle cited the specimen as "Aloe spiralis imbricata. Ait. Kew. 1. p.471. n. 12 var. α " but made no mention at all of var β pentagona nor did he describe it elsewhere. Amongst other references included by De Candolle were Lamarck 1783: "Aloes cylindrique" var α ** (where the leaves were described as having "somewhat reddish

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* The Catalogues of the libraries at Kew and the British Museum of natural history give the following publications of the Gardners Dictionary after 1768.

1771 The Abridgement of the Gardners dictionary ... Sixth Edition, London (B.M. & Kew)

1785 Dictionnaire des Jardiniers ... traduit de l'anglais, etc. Paris, 8 vols. (Kew)

1790 Supplement ... par M. de Chazelles, Paris (Metz), 2 vols. (Kew).

1794 The Gardners Dictionary Ed. 7 revised and altered Dublin (Kew)

1807 The Gardners' and Botanists' Dictionary by T. Martyn. London 1807. 2 vols. (B.M. & Kew)

Only the 1768 Edition, listed as the Eighth edition has been seen by the present author.

** Var β is now a species of Haworthia.

apices" but an account of the nature of the perianth was omitted); and "Aloe perfoliata non spinosa". Wein. Phyt. Icon. 72 (1737-1745) next to which is De Candolle's comment : "b. pessime"; and Millers Dictionary.

Haworth (1804) raised Aiton's two varieties to specific level and, contrary to Article 52 of the present day International Rules, gave the name spiralis to a completely new species.

Aloe imbricata (Ait.) Haw. was described "with multifarious somewhat erect smooth unspotted leaves and a straight stem ... A. spiralis α imbricata Willd. Sp. Pl. 2 : 191, Ait. Kew 1 : 471, Aloe africana erecta rotunda Commel. Prael. t 32, Dill. Elth. t 13.f.14; Aloe spiralis Plantes Crasses : 55".

Aloe pentagona (Ait.) Haw. was described "with fivefarious patent smooth green leaves below occasionally spotted, stem a little straight very rarely sub twisted ... A. spiralis β pentagona Willd. Sp. Pl. 2 : 191, Ait. Kew. 1 : 471."

The name Aloe spiralis Haw. non L. was then given to what Haworth considered to be a totally new species: "With spirally quinquefarious, patent-smooth green leaves, below obscurely spotted; "... the plant so much twisted so as to make the ... leaves seem multifarious". He commented : "it is very much like Aloe pentagona but somewhat larger".

It is the nature of the leaf arrangement, and the spotting on the leaf undersurfaces that has been used to distinguish these three species, not the floral characters, of which there is no mention.

This is the first account in which the term "obsolete maculatis" is used to describe the upper portion of the leaf undersurface. The term maculate implies merely a spotting or blotching and does not indicate that these spots or blotches were slightly raised. As mentioned, occasional plants of A. spiralis L. and A. smutsiana sp. nov. have been observed, under cultivation, but not as yet in the field, to develop small white blotches on the leaf undersurface and these have so far never become raised or tuberculate.

Willdenow's account (1799 of __Aloe spiralis__ and its two varieties implied that all had crenate perianths, and one is compelled, at this stage, to assume that Haworth followed Willdenow's interpretation, although he did cite Dillenius (1732), the only reference mentioning a rugose perianth, under __Aloe imbricata__. Thus __Aloe imbricata__ (Ait.) Haw. may be regarded as a synonym of __Aloe spiralis__ L. (in the original sense), and therefore superfluous, while at this stage, __Aloe pentagona__ (Ait.) Haw. appears to differ from __A. imbricata__ (Ait.) Haw. only in insignificant characters. The name __Aloe spiralis__ Haw. is, by modern rules, invalid, but the species might, on account of size and maculate leaves, be identified as a specimen of __A. hallii__, however there is no definite proof of this.

The first illustration of a plant under the name "__Aloe pentagona__ Aiton" appeared in Jacquin's Fragmenta (1809). Apart from citation of authors, no references are given. The specimen described as __Aloe pentagona__ is shown with a branched inflorescence, the flowers of which have a smooth perianth, with creamy yellow spreading lobes, (the epithet "flavescentibus" is used in describing these). The leaves are "imbricate in five series, spreading ... broadly lanceolate, acuminate, pointed, rigid, thick, fleshy, entire ... smooth ..." and about 3.5 cm. in length. There is no mention of any spots on the leaf undersurface as given in Haworth's description of this species. The association of this specimen with plants collected in the field is open to considerable doubt. It could be identified either as a very large plant of __A. smutsiana__ sp. nov. or a non-tuberculate form of __A. hallii__ sp. nov. The inflorescence (here described as single or branched) is more frequently branched in __A. hallii__ than in __A. smutsiana__, but in the former species there are always, on any one plant, leaves with fine vein lines towards the apex of the leaf undersurface, and this is not mentioned in this text. Lines are shown on the leaf undersurface in the illustration, but these appear to be simply lines of shading. The leaf apex itself is "keeled marginate" in __A. hallii__ and "true marginate" in __A. smutsiana__. The drawing is insufficiently clear to show the leaf apex in any great detail. The suggestion, that it is more probably a poor illustration of a specimen of A. hallii is made with considerable hesitation, this being supported by the yellow tinge to the perianth lobes.

Aloe spiralis L. is also described by Jacquin, and here, because of the rugose nature of the perianth, there can be no doubt as to the identification of the specimen in the illustration. The leaves are given as "densely imbricate ... in no order ... lanceolate acuminate ... smooth, dark green", and about 3.5 cm. long. The inflorescence is described as single or branched, the perianth lobes "flavescens", although the yellow here is a much deeper colour than in the illustration of Aloe pentagona.

In Willdenow's Bemerkungen (1811), were included Apicra imbricata: (Aloe imbricata Haworth (1804); Aloe spiralis Willd. (1799, 1809); De Candolle (1799); Jacquin (1809); Aloe africana erecta rotunda, etc., Commelinus (1703) and Dillenius (1732)); Apicra spiralis : (Aloe spiralis Haworth (1804) and Species Plantarum ed. 2 (1762-63)), and Apicra pentagona (Aloe pentagona Haworth (1804), Jacquin (1809) and Willdenow (1799)).

Apart from Apicra imbricata ("corollis transversim rugosis") there are however, no floral descriptions. The descriptions of leaf arrangement and leaf character are similar to those of Haworth (1804) save for a few additions in Apicra spiralis : "foliis ... ovatis, apice trigonis".

Below the description of Apicra spiralis, Willdenow noted that according to Haworth, this was the true Aloe spiralis of Linneus which he had never found under cultivation, and that it looked very much like Apicra pentagona but the stem was more twisted, the leaves broader and often in straight rows. It should be noted that in this work, Willdenow cited Species Plantarum ed. 2 as a reference for Apicra spiralis.

A photograph of a herbarium specimen with inflorescence: "Apicra pentagona ... Willd. Mag. (1811) ... p.273 Hort. Bot. (See Plate 33) Berol. W" (Willdenow No. 6794 Mus. Bot. Berol) was available. The inflorescence is branched, the corolla tubes smooth and the leaves have a few tubercles on their undersurface. Willdenow's the leaf apex in any great detail. The suggestion, that it is more probably a poor illustration of a specimen of A. hallii is made with considerable hesitation, this being supported by the yellow tinge to the perianth lobes.

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Leafy shoot of <u>A. hallii</u> (X1½). A few white maculae visible on some of the leaves, keeled marginate apices visible in apical leaves. The leaves will dry with the darker bundle cap lines forming prominent ridges.

Leafy shoot of the herbarium specimen "Apicra pentagona" Willdenow No. 6794 from the Botanical Museum Berlin. Keeled marginate apices visible in some leaves, leaves have dried with the bundle cap lines forming a series of longitudinal ridges, and a few tubercles are present which roughly correspond to the bundle cap ridges. (X 1½).

PLATE 33.

description of 1811, however, did not describe the spots on the undersurface of the leaf as raised, which they are in this herbarium specimen. The tubercles and the size and nature of the leaf apices make this plant readily identifiable with plants collected near Koup and in the Northern foothills of the Swartberg, and described by the author as A. hallii sp. nov.

In the same year the second edition of the Hortus Kewensis, edited by W.T. Aiton, was published. Here Aloe spiralis "corollis transversim rugosis subsessilibus", (Aloe spiralis Decandolle (1799), Aloe spiralis α imbricata Willdenow (1799) and Millers' Garden Dictionary Edition 1, are cited as references), and Aloe pentagona "folius quinquefariam ... laeviusculis, corollis pedunculatis non rugosis", (with Aloe pentagona Haworth (1804), and Aloe spiralis β pentagona Willdenow (1799) listed as references) are described. According to this edition both species were cultivated in 1731 by Mr. Phillip Miller (cf the historic note in the first edition of the Hortus Kewensis (1789)).

Also in 1811, Ker published an illustrated account of Aloe pentagona in the Botanical magazine. As references Haworth (1804) and A. spiralis β pentagona Aiton (1789) and Willdenow (1799) "exclusa passim var α " were cited. Ker was the first author to write "We have been induced to consider the present plant as specifically distinct from Aloe spiralis not so much by the difference in the arrangement and expansion of the leaves, as by the total absence of the transverse wrinkles, so remarkable in the corolla of the latter". The specimen depicted had been sent to Kew by Haworth.

The leaves are described as "ovate-acuminate ... dark green, smooth or with very minute raised points (elevato-punctulatis) ... with the topmost ones smaller and now marked below with a few white tubercles not particularly raised (parum salientibus)".

The Lichfield edition(1782) gives "punctatum" as meaning "spinkled with hollow points", Featherly (1954) as "marked with dots, depressions or translucent glands" so the phrase "elevato-punctulatis" is somewhat confusing. All leaves of species of Astroloba do in fact have extremely minute depressions over the leaf above the stomatal apertures, but what Ker was describing is not quite clear. It is interesting that in the plant described, it is only the topmost leaves that are maculate.

The inflorescence is described as branched, and from the drawing, the lowest fertile bract is in length about 0.4 cm and the lowest pedicel about 0.8 cm. The perianth is described as "columnar-tubulosa", and the flowers in the illustration are larger and less constricted at the throat than those in the Jacquin work.

The leaf apices are poorly shown, and the leaves are very turgid so that the lower ones lie horizontal, but, apart from this and the long pedicels, it seems best to associate this plant with plants collected in the Ladismith-Barrydale Karoo, and in the Northern foothills of the Swartberg, and described as A. smutsiana sp. nov. The fact that only the upper leaves of the plant are spotted, the size of the inflorescence in the illustration and the cream lobes of the flowers are the grounds for this tentative association.

Haworth, in his Synopsis (1812) under the generic name Haworthia Duval included H. spiralis, H. pentagona and H. imbricata and added a fourth new species Haworthia spirella, "... with leaves spirally five farious, patent, lanceolate-acuminate, smooth palely green, somewhat bicarinate (subbicarinulatis) towards the apex; below apically with the slight keels sparsely spotted, the margins a little rough ... This is very similar to the preceding (H. spiralis) but is three times smaller, with narrower bicarinate leaves, the little keels with spots regularly marked". From this description, it is impossible to associate H. spirella with field specimens - it could be a small plant of either A. hallii or A. smutsiana.

This appears to be the first account in which the term "keel" is used in a description of the shape of the leaf towards the apex in cross section. Previously the matter was omitted, or the leaves were described as plane on the upper face, convex below; or the apex was described as being triangular, or tricarinnate (Linneus 1771). For the other three species apart from "foliis ... apecem versus carina semilaterali"* for H. spiralis, the descriptions are similar to those in his "New Arrangement" (1804). Below the description of H. pentagona is the rather obscure observation that "for twenty five years this plant with me has never become spiral but constantly produced its imbricated leaves in five rows. Nevertheless I have seen one plant which seems the same (and larger than spirella) that did produce them somewhat spirally ... From imbricata this and the two preceding species will be considered abundantly distinct; except indeed by such Botanists as still prefer to reduce sections into species, instead of grouping species into sections".

This time, Haworth described the flowers of H. imbricata as "Corollis rugosis" and commented : "Spiralis is a name now hardly tenable for a plant which has nothing spiral about it, and which moreover Linneus seems to have so named, from having confounded it with at least one or more, which might be spiral. The first edition of Hortus Kewensis divided these by the sub-specific names of imbricata and spiralis**and, as it is the practice of Botanists, when named varieties are elevated to the rank of species, to adopt their sub-specific names for specific ones; I have followed this rule ... I had also another plant ... for the name spiralis ... which may have been the very one Linneus had in view when he formed the name spiralis, or if not it, he may have had spirella or perhaps both : for his knowledge of these plants at that time, (unless he had seen their smooth flowers), would hardly have prompted him to make even varieties of them. Be this as it may, I have called the large spiral species spiralis; and have continued it".

This is the first mention of the nature of the perianth of H. spiralis and H. spirella sensu Haworth. It is strange that, despite the illustration in the Botanical Magazine, Haworth did not comment on the flowers of H. pentagona.

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* Cf keeled marginate apex of A. hallii?

** It seems that spiralis is a misprint and should read pentagona.

As a point of interest the dates of introduction into and flowering months under cultivation as given by Haworth are listed : for H. spiralis, before 1790, Aug. Sept.; for H. spirella, before 1808, Aug.; and for H. pentagona and H. imbricata 1731, June. July. (See fig. 17 for a comparison of flowering times in A. hallii, A. smutsiana and A. spiralis sensu the present author).

In 1812, the Botanical Magazine contained a well illustrated account of Aloe spiralis L. taken from a plant from Haworth's green house, with the observation that it flowered in August, but not as readily as Aloe pentagona.

In his Supplementum (1819) Haworth, now using the generic name "Apicra Willd.", divided Apicra pentagona into two varieties, α with the leaves always five farious and β torta, with the leaves "most often strongly spirally five farious". He observed that var β flourished at Kew but not var α -" the leaves of β are certainly diverse in shape and colour and also in substance. Perhaps a distinct (propria) species. Both varieties differ sufficiently from H. spiralis nobis which is twice as large or more and H. spirella nobis which is twice as small and distinct. β , is described from memory only but immediately after being seen."

Meanwhile Haworth had been in correspondence with Prince Salm-Dyk who, in his catalogue (1817), included Aloe imbricata Haw, Aloe spirella Haw. and Aloe pentagona with variety β spiralis (Haw) Salm-Dyk, all of which he had growing in his garden.

In 1821, Haworth included a note on Apicra pentagona in the Additamenta of his Revisiones, in which he described a var β torulosa of this species : "A. (spongy-flowered pentagonal) with sub-quinquefarious pale smooth green leaves, below sparsely spotted; the corolla with spongy torulose angles". Since he had already described var β torta in the Supplementum (1819) this was probably intended to be var γ . The plant in question was sent to him by Salm-Dyk earlier in the year.

The original Latin word "torus" meant a "protuberance" or "bulge", and why Haworth considered this a variety of A. pentagona is a mystery, since he commented that he had only heard of or seen a spongy corolla in A. imbricata and Aletride farinosa L, the perianth of his "Apicra pentagona Nob. l.c. (Aloe pentagona Bot. Magaz. 1338)" being smooth. According to him, this variety torulosa differed from A. imbricata in size and length. It is possible that var torulosa could have been a specimen of A. spiralis L. which Haworth identified as a variety of A. pentagona on account of its leaf arrangement, or it may possibly have been a hybrid between A. spiralis and some other species.

One feels that Haworth, although a prolific writer on the Aloinae, did not really grasp the fact that there might be variation of vegetative characters within a single species, and in the Astroloba group at any rate, he was not a good judge of the characters delimiting the different species.

Sprengel (1825) included "Aloe imbricata Haw.", (citing as a reference "A spiralis Cand.") and "A. spiralis" (citing as a reference "A. pentagona Jacque. Haw., spirella Haw.") The description of the former is similar to that of Haworth; the latter is described as "Caulescent, tortuous with five-farious patent spiral smooth leaves; below occasionally spotted". Was this species intended to be the same as the spiralis of Haworth?

The Schultz's (1829) listed Aloe imbricata Haw.; Aloe quinqueangularis which they raised to specific level from Haworth's Apicra pentagona β torulosa of 1821; A. spirella Haw.; A. spiralis Haw. and A. pentagona Haw. By modern rules of nomenclature, if a variety is raised to specific level, then the varietal name is adopted as a specific one if not already in use in a particular genus. Aloe quinqueangularis Schultes should therefore be referred to as Aloe torulosa (Haw.) Schultes.

Below the account of A. spiralis they mentioned that Salm-Dyk had a specimen named "A. spiralis", sent by Haworth "a pentagona nonnisi foliis magis spiralibus diversum"; while below the description of A. pentagona is the comment : "Jacquini planta haud ita paucis ab illa in Bot. Mag. abludere videtur.", the leaves of the former being lanceolate, acuminate and smooth on their under surface, while those of the latter were ovate acuminate, the under surfaces of the upper ones having a few whitish tubercles.

They quoted Salm-Dyk as saying of A. spirella : "... corolla hexagona cylindrica, angulis laevibus. Folia longiora magisque, quam in imbricata; hanc inter et pentagona media ..."

Salm-Dyk's Monograph (1836-1863) contained illustrated accounts of Aloe imbricata Haw., A. spirella Haw., A. spirella β quinqueangularis nob., A. pentagona Haw., and A. spiralis Haw. Although Salm-Dyk corresponded with Haworth, there is no evidence that he obtained any of these plants from Haworth.

Aloe imbricata is described with "perianthium ... verruculatum, verrucis spongiosis albis ad angulos crenulato-confluentibus validis, ... laciniae ... flavidae ..." Here "crenulato-rugosis" appears to apply to the outer surface of the perianth tube rather than the margins of the lobes. Salm-Dyk made the observation: "Linnaei Al. spiralis, cujus flores crenatos dicit, absque dubio huc referenda est".

Aloe spirella is now described with "perianthium .... ad angulos albidum, spogiose sub torulosum, laeviusculum nec rugosum ... laciniae ... alboviridulae". The tissue on either side of the midrib of the three outer tepals of the perianth tube is sometimes very slightly inflated in A. rugosa, but only in A. spiralis L and A. herrei Uitew. is this very marked and rugose. The illustration of the flower of A. spirella in the Monograph does not show a spongy perianth at all and the lobes, which are always a bright yellow in A. spiralis, are here described as a whitish green. Indeed, from the illustration the specimen appears most to approximate A. smutsiana. An observation follows the description to the effect that this species differs from its allies in its lower stature, and smaller, crowded, very patent multifarious leaves, and that the perianth tube, "oculo amarto", appears sub torulose at the angles; "sed non est rugosis aut crenulatus, ut in A. imbricata".

The illustration of A. spirella β quinqueangularis Nob. (which Salm-Dyk considered to be equal to A. pentagona β torulosa Haw.) shows a perianth with pale yellow lobes, but which is definitely rugose despite the note that " ... Flores, perianthium

... ut in specie." Salm-Dyk made the observation that for the very reason that the angles of the perianth tube were torulose he considered it to resemble A. spirella and had therefore judged it to be a variety of this species. It seems likely that the plant of the illustration is a hybrid, possibly between A. spiralis and A. smutsiana which could account for the slight degree of rugosity of the perianth. Both plants in the illustration have a few white spots on the under surface, described in the text as "punctis prominulis albis adspersa". If the plant described by Haworth as Apicra pentagona var torulosa was indeed from the same stock as that of the Salm-Dyk illustration, then its association with an illustration is established, and its possible identity deduced.

Technically, Aloe spirella β quinqueangularis Salm-Dyk should in any case be referred to as Aloe spirella β torulosa (Haw.) Salm-Dyk, and the Schultes were the first to use the epithet "quinqueangularis".

Below Salm-Dyk's account of A. pentagona (Ait.) Haw. is the observation that this species differed from the preceding species, (A. imbricata, A. spirella and A. spirella β quinqueangularis) in the exact "five-fariousness" of the leaves. Var torta (Haworth, 1819) "... non constans et vegetationes solum casus est,...." The illustration, save for the tubercles, most resembles a large very turgid specimen of A. smutsiana.

The description of Aloe spiralis adds nothing to previous accounts, except that the length of the leaf is given as 5.0 cm, (approximately), and the flowers are described as "brevissime pedicellati", as opposed to "breve pedicellati" or "pedicellati" for the preceding species. Salm-Dyk observed that this plant first described by Haworth and unknown to other Botanists, was closest to A. pentagona from which it differed in size and the spirally twisted ranks of leaves. The illustration shows a perianth which is more inflated at the base than the preceding species and born on a very short pedicel. The leaves are quite densely spotted on the under surface, and in the detailed drawing of the top part of one leaf the artist has painted them in very approximate longitudinal rows and included a few longitudinal white lines, but the exact nature of the apex is not clearly shown. It is indeed difficult to correlate this specimen with any plants collected in the field.

Kunth (1843), apart from maintaining A. pentagona β torta Haw. adopted Salm-Dyk's treatment of this section of the Aloe.

Baker (1881) recognised Apicra imbricata Haw. as a synonym of Aloe spiralis L. and reverted to the older, valid name.

Baker described Apicra pentagona Willd. as having leaves with one or two keels on the under surface and a few scattered white tubercles, an inflorescence often branching and a smooth perianth. He listed three varieties of this species, firstly var spirella, which was smaller than the type with more deltoid leaves, and incorporated H. spirella Haw. and Aloe spirella β quinqueangularis Salm-Dyk; and next, a new variety, var Wildenovii Baker which was larger than the type, and incorporated Aloe spiralis Haw. non. L. There is a misquoted reference here: "Salm-Dyk, Aloe, Sect. i. fig 3", which should of course read : " ... fig. 5". Included as the third variety of A. pentagona was var bullulata, formerly Aloe bullulata Jacq. but this misplacement is dealt with elsewhere. The flowers of the varieties were not described in this or in his next work on the Aloinae.

As has been shown, there is a good deal of similarity between the species identified by the present author as A. bullulata and A. hallii, and also, more superficially between A. hallii and A. smutsiana. One may reasonably consider that the species described by Baker as A. pentagona included all three. Apart from Baker's variety bullulata, however, one can suggest, only on grounds of size, which is insufficient evidence, that the type and var Wildenovii were probably specimens of A. hallii, and spirella was probably included in plants of A. smutsiana.

It is of great interest to note that in the introduction to this Synopsis, Baker mentioned that "a large number of Cape species have been discovered and imported, mainly by Mr. Thos. Cooper of Redhill, who travelled through the colony from 1858 to 1862 collecting for the late Mr. Wilson Saunders and the Royal Horticultural Society ... Very few of the Cape species which have ever been imported have been lost; ..."

In the Flora Capensis (1896-97), Baker enlarged upon the plants described. Apicra pentagona and its varieties, and A. spiralis were described from living cultivated plants, their South African localities being unknown. The leaves of A. pentagona were now described "with two obscure keels". There is some discrepancy in the descriptions of pedicels and fertile bracts for A. spiralis and A. pentagona. In Baker's Synopsis (1881), both species were described with "lanceolate deltoid bracts and pedicels .4 - .6 cm. long, while in the Flora Capensis, A. spiralis was described very short pedicels and ovate lanceolate bracts and A. pentagona with ovate bracts and pedicels as before!

Baker's key to the species of Apicra in the Flora Capensis was based entirely on leaf arrangement. An extract incorporating the above species is given below :-

"Leaves arranged in five straight or spirally twisted rows:
Leaves lanceolate deltoid .... (1) pentagona
....
Leaves multifarious, the spirals quite obliterated
Perianth rugose* .... (2) spiralis"

Berger (1908) maintained spirella and Willdenovii as sub species of A. pentagona, and of the perianth of spirella he wrote "ad angulos sub torulosus, sed laevis non rugosis". He described the leaves as being light green, sometimes reddish, obliquely keeled or sometimes bicarinate on the underside, with "punctis tuberculisve paucis albidis vix conspicuis irregulariter adspersa ...", and the inflorescence as simple or branched. Both A. pentagona and A. spiralis were mentioned as flowering in the old gardens of La Mortola, but no herbarium material of either was cited.

His key is more comprehensive than Bakers:

---

* This is actually printed "Perianth smooth" but it is an obvious misprint.

"A Folia dorso ± verrucosa vel papillosa.

....

B Folia dorso epapilloso, saepius inconspicue maculata, maculis parvis cartilagineis sed haud prominulis.

a Folia siccatione sulco-striata, nervis elevatis.

Perigonium extus verrucosum .... 5 A. spiralis

Perigonium extus laeve

1. Folia lanceolata deltoideo .... 6 A. pentagona

1. Folia stricte quinquefaria, interdum seriebus leviter tortis.

\+ Folio ca 40 mm. long and 15 mm. wide* typica

++ Folia ca 50 mm. long and 20 mm. wide Willdenovii

2. Folia spiraliter sub quinquefaria, ca 25 mm. longa .... spirella

Again the descriptions do not enable one to associate the varieties with certainty with either A. hallii or A. smutsiana. Berger restored A. bullulata to specific level. In his description he describes the leaf apices as "keeled marginate", and below is the comment that this species is well distinct from "A. pentagona Willd."

It may well be that the plants Berger described as "pentagona" were in fact all members of the species described by the present author as A. smutsiana. He included a poor illustration of "A. pentagona", which is shown with a few spots on the leaf undersurface and most resembles a very turgid, rather large, narrow leaved specimen of A. smutsiana.

The most recent person to write on the genus, Uitewaal, did not clarify matters. He published an account of the genus in Succulenta during the years 1936 - 1939, but it was not possible to obtain the issues in which A. pentagona was described. His key to the genus is however again based on leaf arrangement and shape and the relevant portion is given below:

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* Berger gave the leaf width as measured at the base.

....

"Leaves with the lower side unspotted or with single slightly raised flecks:

A. Leaves in 5 straight rows or slightly spiralled.

o leaves lanceolate deltoid .... pentagona

B. Leaves spirally 5 farious or imbricate

o perianth rugose, leaves more or less erect. spiralis

oo perianth smooth (slightly torulose in pentagona var spirella) older leaves more or less horizontal.

1) Plants 5 - 7.5 cm. in diam.

a. leaves lanceolate deltoid .... pentagona var spiralis

....

In his revision of the nomenclature (1947), Uitewaal took "Astroloba pentagona (Haw.) comb. nov. Uitew. syn. Aloe pentagona Haw." as the type species, a poor choice. Apart from the wrong citation, as Aiton was the author of the epithet "pentagona", the identity of Aloe pentagona (Ait.) Haw. as has been shown, is not at all certain. Under A. pentagona, Uitewaal listed three varieties, var spiralis from Aloe spiralis Haw, and including Baker's var Wildenovii; var spirella from Haworthia spirella Haw. and lastly var torulosa from Apicra pentagona β torulosa Haw.

Jacobsen followed this arrangement in the new edition of his Handbook of Succulent Plants (1960).

A short summary of the relevant stages in the taxonomic history of the plants described variously by the epithets "pentagona" and "spirella" is now given.

The epithet "pentagona" was first used by Aiton (1789) to describe a variety of A. spiralis L. The grounds for recognition of this variety were based solely on leaf arrangement, which in view of the present knowledge of the genus, is a character which, taken on its own, is certainly not one of sufficient significance to be used even in the delimitation of varieties.

Willdenow included A. spiralis var pentagona Aiton in his species Plantarum (1799), and his citation of references implied that it had a rugose perianth. Haworth (1804) raised this variety to specific level, citing both Aiton (1789) and Willdenow (1799) as references. Since he made no mention of perianth characters, Haworth gave no grounds to justify his recognition of A. pentagona as a species distinct from Aloe spiralis L.

The first illustration of a plant described as Aloe pentagona Haw. appeared in Jacquin's Fragmenta of 1809. The plant was shown to have a smooth perianth which at once separated it from A. spiralis L., which Haworth's and Aiton's descriptions had failed to do, their accounts being based solely on leaf characters.

The association of the plant of this illustration with field specimens is open to doubt. It could be a specimen of what the present author has described as A. smutsiana sp. nov. or of A. hallii sp. nov., the evidence being slightly more in favour of the latter.

The next illustration of a plant described as Aloe pentagona appeared in the Botanical Magazine of 1811, and again the association of this plant with field specimens is open to doubt, but it appears to be more probably a specimen of A. smutsiana.

The earliest known, and probably only herbarium specimen of a plant described as Aloe pentagona during this time, comes from Willdenow's collection in the Berlin Museum. This specimen, Willdenow No. 6794, has all the characteristics of what the present author has described as A. hallii sp. nov.! In 1811, Willdenow had also included an account of Aloe pentagona in his "Bemerkungen über die Gattung Aloe", which shed no light on the identity of this species.

Salm-Dyk's illustration of Aloe pentagona in his Monograph (1836-1864) appears to be that of a large specimen of A. smutsiana. Baker (1881 & 1896-97) probably included elements of both A. smutsiana and A. hallii in his concept of A. pentagona, for he listed as a variety of this species, A. bullulata Jacq. which is somewhat similar to A. hallii.

Berger (1908), on the other hand, appears to have confined his concept of A. pentagona solely to plants resembling A. smutsiana.

Thus, apart from the fact that none of the original descriptions by Aiton (1789) and Haworth (1804), give any grounds for the recognition of A. pentagona as a species distinct from A. spiralis L, there would appear to have been some confusion over the application of the epithet, plants of both A. smutsiana and A. hallii being referred to as A. pentagona.

In 1812, Haworth described a new species, Haworthia spirella, and again the poor description makes association with field specimens difficult. The first illustration of a plant described as Aloe spirella Haw. appeared in Salm-Dyk's Monograph (1836-1863), at least twenty years later. The plant in the illustration may be readily identified with A. smutsiana.

Both Baker (l.c.) and Berger (l.c.) reduced Aloe spirella (Haw.) Salm-Dyk to a variety of A. pentagona.

It is quite obvious that in the past specimens of A. smutsiana and of A. hallii have been confused.

There are no type herbarium specimens of Aloe pentagona Haw. or Haworthia spirella Haw. and no evidence that the plants described by subsequent authors in the past as "pentagona" or "spirella" were the same plants as, or off-shoots, of, the original specimens described by Aiton and Haworth. The similar facies of all species of the genus could easily result in confusion of interpretation of sparse specific epithets.

If the plant described as Aloe pentagona by Haworth could be definitely associated with plants described by the present author as Astroloba hallii sp. nov., then the grounds for associating Haworthia spirella Haw. with plants described by the present author as Astrolcba smutsiana sp. nov. would be very good, and there would be no need for a new name. However, it is just as likely that Haworth's original description of Aloe pentagona Haw. was applied to a plant of what the present author has called Astroloba smutsiana.

Because there is no evidence as to the nature of the original Aloe pentagona Haw., and because of the subsequent confusion over the application of this epithet, it is the strong opinion of the present author that, to avoid further confusion, the epithet "pentagona" should be abondoned altogether in the genus Astroloba. Accordingly the specific epithet hallii is proposed for plants of Astroloba which resemble the Willdenow herbarium specimen "Apicra pentagona". This name is after Mr. H. Hall of Kirstenbosch who first brought living plants of this species to the notice of the present author. (See Plate 33).

If Haworth,on the other hand intended his Aloe pentagona to apply to plants described by the present author as A. smutsiana then Aloe pentagona Haw. and Haworthia spirella Haw. as illustrated by Salm-Dyk are synonomous. Indeed Baker (l.c.) and Berger (l.c.) reduced Haworth's spirella to a variety of A. pentagona.

The present author feels most strongly that if the specific epithet "pentagona" is to be abolished in the genus Astroloba, then so must the epithet "spirella" be abandoned. Accordingly the specific epithet smutsiana is proposed for all plants of Astroloba which resemble Salm-Dyk's illustration of Aloe spirella (Haw.) Salm-Dyk. This is in honour of General Smuts, as it was the Smuts Memorial Foundation which gave the financial assistance necessary for this research.

The identity of the species Haworth described as Aloe spiralis in 1804 is still open to doubt, the only evidence as to its identity being that it was "very much like Aloe pentagona but somewhat larger" and later, (1812), that it was three times larger than H. spirella. The only illustration of Aloe spiralis sensu Haw. appeared in Salm-Dyk's Monograph (l.c.). It is difficult to associate the plant in the illustration with either A. hallii or A. smutsiana.

Baker (l.c.) replaced the incorrect epithet spiralis Haw. by the epithet "Wildenovii" and reduced this species to a variety of A. pentagona, and this arrangement was maintained by Berger (l.c.).

In neither A. hallii nor A. smutsiana is there any grounds for recognition of sub specific categories based on size. Further, since the nature of the original Aloe spiralis sensu Haw. is open to doubt, it is best to abandon the varietal epithet "Willdenovii" Baker as well.

ASTROLOBA ASPERA (Haw.) Uitew. AND ASTROLOBA RUGOSA sp. nov. Roberts.

Haworth (1804) in his "New Arrangement of the Genus Aloe" included in the Division Parviflorae, Section Rigidae, a new species Aloe aspera, "... with trifarious orbiculate-ovate acuminate leaves ... below markedly tuberculate ... Cape of Good Hope. Masson. This species is difficult to culture and will not long remain alive in Europe". Aloe aspera, listed as species number 27 follows after A. anomala, No. 24, A. viscosa No. 25, and A tortuosa No. 26, all species described with trifarious leaves. Aloe foliolosa, described with multifarious leaves is listed as number 28, while the other members of Astroloba then described with multifarious or five farious leaves are listed as numbers 20 to 23.

Willdenow (1811) repeated this arrangement when describing these as species of Apicra in his Bemerkungen, and Aiton (1811) in the second edition of the Hortus Kewensis also described the leaf arrangement of the plant Aloe aspera as trifarious.

In his synopsis, Haworth (1812) referred A. aspera to Haworthia, in the Section Caulescentes " ... corolla bilabiate...", together with other species recognised today as caulescent members of the genus Haworthia. In this work Haworth gave H. viscosa the English epithet "smooth triangular", and H. aspera the epithet "rough triangular". All species recognised today as members of Astroloba with imbricate, five farious or multifarious leaves were placed in the Section Caulescentes ... "corolla ... with sub-erect lobes."

Salm-Dyk (1817) in his Catalogue also listed Aloe aspera with trifarious leaves amongst species now recognised as belonging to Haworthia in a separate section from plants now recognised as members of Astroloba.

As has been shown, no species of Astroloba have trifarious leaves and without question the plant described as A. aspera by Haworth would today be placed in the genus Haworthia probably somewhere near H. nigra and H. viscosa, which would appear to be similar in size and habit. The flowers of both H. nigra and H. viscosa are strongly bilabiate.

In 1818 Haworth received from Prince Salm-Dyk a description of an inflorescence purporting to be that of the plant described as A. aspera. In this illustration the perianth was shown to be actinomorphic. Obviously the flowers came from a plant belonging to the genus now called Astroloba.

It is evident that the plant with trifarious leaves described by Haworth as A. aspera, must have been very similar in appearance to the plant of Salm-Dyk's which produced actinomorphic flowers.

It is from this that the confusion arose over the application of the epithet "aspera". Salm-Dyk had either never seen the plant described as "aspera" by Haworth when he listed it "with trifarious leaves" in his Catalogue, or, he had plants of both what are now described as rugosa and what Haworth described as aspera, and had not examined them carefully to see the differences in leaf arrangement, or he had only plants of rugosa but again had not paid attention to the leaf arrangement, simply quoting Haworth's description.

The present author collected a plant near Waterford in the Eastern Cape, which, apart from its trifarious leaf arrangement, resembled very closely in vegetative characters plants of Astroloba rugosa sp. nov. Roberts. The flowers of this specimen which was identified by Mr. Hall of Kirstenbosch as a form of Haworthia nigra (Haw.) Bak. were markedly bilabiate, resembling those of H. viscosa. (See Plate 34).

As a result of Salm-Dyk's communication, Haworth (1819) included the plant described as aspera as a species of Apicra in his Supplementum. He now described the adult leaves as "sub irregularly spirally trifarious" and included a description of the flower taken from Salm-Dyk's letter. He mentioned two varieties, α minor "sent by Van Marum in 1818", and β , "nearly twice as large ... growing at Kew".

At this stage, presumably, Haworth had not seen the flowers of these varieties and one must therefore consider them

<u>HAWORTHIA NIGRA</u> (Haworth) Baker ~~Uitewaal~~. Plants from near Waterford.

Below: Leafy shoot (X $1\frac{1}{5}$); apart from the much darker green coloration, trifarious leaf arrangement, and the slightly denser tuberculation, superficially, this species resembles <u>A. rugosa</u>.

Leafy shoot viewed from above showing trifarious leaf arrangement.

Right: Part of inflorescence (X 1 approx), the flowers are strongly bilabiate.

<u>H. nigra</u> was in fact, originally described by Haworth as a species of Apicra, "intermediate between <u>A. foliolosa</u> and <u>A. aspera</u>." (Haworth in Phil. Mag. and Jour. Lond. Edin. and Dublin <u>1824</u>:302 (1824)). The original <u>Aloe aspera</u> Haworth was probably a plant similar to <u>H. nigra</u>, if not in fact, actually a specimen of it.

as varieties of a species of Haworthia, although in his Revisiones, Haworth (1821) did comment that he did not possess var α , "neque (nisi parvam) β , ab. Illust. Pr. de Salm-Dyk". Here he also suggested that perhaps these two should be considered as separate species "ob tuberculorum nervorum differentiam".

In the field, in a single population of Astroloba rugosa, leaf length may range from 1.5 - 2.5 cm. and there is no justification for the recognition of varieties based upon size in this species, while in H. nigra, size is more variable. If the plant described as var. β was not a species of Haworthia, it is possible that it might have been a specimen of the intergeneric hybrid, Astroworthia bicarinata (Haw.) Roberts.

Sprengel (1825) and the Schultes (1829) both described Aloe aspera as having trifarious leaves.

Salm-Dyk (1836-1863) in his Monograph, however, described the leaves of Aloe aspera Haw as "spirally five ranked, 6-7 lin. long and wide ... with rough concolorous tubercles". The inflorescence was described as unbranched, with a "dirty pink" peduncle, and bracts three times shorter than the pedicels; the perianth as "obclavate-tubular, terete hexagonal, pale dirty pink, with regular open lobes". He mentioned that the plant was brought to England by Masson in 1795. However, apart from noting that Haworth's var. major was unknown to him, Salm-Dyk made no comment on the discrepancies in his present and all previous accounts of leaf arrangement.

All subsequent authors have incorrectly used Haworth's epithet "aspera" as pertaining to plants with five farious leaf arrangement and agreeing with Salm-Dyk's description of Aloe aspera. For this reason the present author proposes that the specific epithet "rugosa" be used instead and the species be described as Astroloba rugosa sp. nov. Roberts.

The variety β of "aspera" was included by Baker in his Synopsis (1881) and in the Flora Capensis, and it is of interest to examine his account. He described the leaf arrangement of "Apicra aspera" as multifarious, with the diameter of the leafy stem 2.5 cm., leaf length and width 1.3 - 1.8 cm. tubercles concolorous, inflorescence simple and pedicels 0.6 - 0.8 cm. long, while "var β major Haw." was described with a leafy stem 5.0 cm. in diameter, leaf length 2.0 - 2.5 cm, leaf width 1.7 cm, tubercles concolorous or white, inflorescence occasionally branched and pedicels 0.3 - 0.4 cm. long. In the Synopsis, he noted that the perianth in the species had obscurely bilabiate lobes, while in the Flora Capensis he did not describe the inflorescence of the variety. These appear to be accounts of living plants growing at Kew.

The fact that the inflorescence of var. major was described as occasionally branched suggests that this particular plant might well have been a small form of the Haworthia margaritifera X Astroloba rugosa hybrid.

Berger (1908), described the leaves of "Apicra aspera" as spirally five ranked, 1.2 - 1.4 cm. long and wide, and the pedicels as 0.5 - 0.7 mm. in length, with no mention of whether or not branching occurred in the inflorescence. He commented that he had not seen "var major", and cited as herbarium specimens : "Springbokkeel" (Drege 8655), and Marloth n. 4216. As mentioned earlier, the present author found no specimens of A. rugosa beyond the Montagu-Ladismith-Barrydale karoo and the northern foothills of the Swartberg. Apart from a dubious Marloth specimen from Graaff Reinet, the Drege specimen is the only known record for A. rugosa beyond this area, if indeed it is a reliable record.

"Astroloba aspera var major" was included in Uitewaal's revision of the nomenclature of Haworthia and Apicra (1947), but no description was given.

Apart from Bakers account of 1881 there is no clue as to what "var major" might be and, in view of the fact that leaf length in rugosa varies from 1.5 - 2.5 cm in individual field populations, there is no course but to abandon this variety for Astroloba rugosa.

THE TAXONOMIC HISTORY OF A. BULLULATA (JACQ.) UITEW. AND THE CONFUSION OVER THE IDENTIFICATION OF THIS SPECIES AND A. BICARINATA (HAW.) UITEW.

Aloe bullulata was first described by Jacquin in his Fragmenta (1809). This description, accompanied by an illustration is one of the more comprehensive and useful type descriptions of a species in the genus Astroloba.

The plant described by Jacquin was grown from seed sent from the Cape by "Schollio"*, and flowered in May and June. A summary of Jacquin's description follows.

In the juvenile stages the leaves are five ranked, becoming imbricate later on, "so that below it resembles Aloe pentagona and above Aloe spiralis". The stem is about a foot high, the leaves are rigid and ovate acuminate, the largest being about 5 cm. long and tubercled on the underside. The inflorescence is racemose, the flowers "vix bilabiatae", with a green perianth tube and short ovate patent lobes which are yellow with a green stripe. In the accompanying illustration, the leaf apices, while not shown with any clarity as keeled marginate, are broadly acuminate, and there are a variable number of fairly large discrete tubercles on the leaf underside, which in one leaf in particular, are arranged in rough transverse rows.

There is no doubt about associating this species with plants collected in the Ceres-Sutherland Karoo and near Matjesfontein. None of the specimens collected had a leaf length of 5 cm., but this is a difference which is probably attributable to cultivation.

Willdenow (1811) included the species as Apicra bullulata in his Bemerkungen and it was listed in Salm-Dyk's catalogue (1817).

Haworth (1819) described Apicra bullulata the "blistered" Apicra, in his Supplementum, with "spirally five farious imbricate, ovate acuminate leaves and below a few dark green tubercles. He commented that this species had "affinities with Aloe

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* Could this be F.A. Scholler (1718-1785) author of Flora Barbiensis?

spiralis* nob. Synopsis succ.(1812) in the frequent rough very hard tubercles of the margins and keels".

In his Supplementum, Haworth also included a new species, Apicra bicarinata: "with submultifarious cordate leaves, very hard and green, bicarinate; with scattered dark green raised tubercles below : with margins and keels frequently very roughly tuberculate". This description was followed by the comment that this species was very similar to "Apicra aspera", but "easily distinguished by being nearly three times as large, with a more intense colour and very hard irregularly roughly tuberculate margins and keels".

Although Haworth's species A. aspera has been shown to have been a species of Haworthia, it was obviously very similar in appearance to the species of Astroloba interpreted by Salm-Dyk as A. aspera Haw. The only plants in the field, which the present author has found to fit Haworth's description of "very similar to A. aspera, but ... nearly three times as large", are plants of the suspected hybrid between A. rugosa and H. margaritifera. A. bullulata and A. hallii, the other members of the genus with tuberculate leaves are very different in appearance. It is unlikely that Haworth would have described either of them as similar to A. aspera, or, if his A. bicarinata had in fact been a specimen of A. bullulata Jacq., that he would have failed to comment on its similarity to this species.

The Schultes (1829) and Kunth (1843) listed both bullulata and bicarinata as Aloes. It is of great interest that Salm-Dyk did not include Aloe bullulata or A. bicarinata in his Monograph, although he did mention that Aloe spirella "is easily separated from its relatives and especially A. bullulata".

Baker (1881) in his Synopsis, described bullulata as a variety of Apicra pentagona**, from which it differed in the

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* Haworthia spiralis was described "with patent ovate-acuminate leaves ... keeled on one side towards the apex ... below a few scattered spots". (Synopsis: 97 (1812)).

** Baker described the leaves of "Apicra pentagona (Haw.) Willd" as lanceolate deltoid, regularly five farious, 3.2-3.8 cm. long and 1.3-1.7 cm. broad, bright green, the margins scabrous .. with a few white tubercles scattered on the under surface."

spirally twisted leaf arrangement and in the frequent tubercles on the under surface, a poor distinction. It could be debated whether or not Baker was in fact describing plants of A. bullulata Jacq., but taken at its face value one must assume he was.

As has been shown, there has been considerable confusion over the identity of "Apicra pentagona", while there is a good deal of similarity between the species identified as A. bullulata and A. hallii by the present author. The fact that Baker did include bullulata in the species "pentagona" may be considered as further evidence that he was also including plants described by the present author as A. hallii sp. nov. in this complex. All his descriptions of "pentagona" and its varieties were evidently taken from living plants.

Baker also included an account of Apicra bicarinata Haw. He described the leaves as bikeeled, densely multifarious, lanceolate deltoid, 2-3 cm. long, about 1.2 cm. wide, with copious prominent whitish tubercles on the under-surface, which may be in rough transverse and vertical lines ... "cf. A. aspera the large variety". He noted a drawing at Kew in 1818 of a specimen sent by Dr. Mackrell and mentioned a plant of A. bicarinata he himself had seen collected by Cooper in the Orange Free State. One must doubt the accuracy of this locality.

In the Flora Capensis (1896), Baker mentioned that his description was taken from a drawing of Haworth's type made at Kew in 1818 and that the locality in South Africa was unknown. To date this painting has not been traced.

Bullulata was again listed as a variety of "A. pentagona" in the above-mentioned work.

Berger (1908) restored the specific status of what he considered to be A. bullulata. He described the leaves as imbricate, open, 3 cm. long and 1.3 cm. wide*,"ovate lanceolate acute, bright or pale green, below very oblique and acutely keeled, keel from above margin forming, with a few tubercles a little raised ... often brownish towards the margins and keels,

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* In his account of "A. pentagona" Berger gives the measurement of leaf width at the base. He does not indicate where the measurement of leaf width was taken in any other species described.

and terminating in a short sub-sharp mucro". Below is the observation that the flowers are yellowish "with green lines". He cited a specimen "S. Cape Marloth n. 4201", and noted that plants were sent to Kew in 1818 by Dr. MacKrell. He also mentioned an aquatint of this plant in the herbarium, which the present author has been unable to trace. Since these plants were sent to Kew in 1818, it is highly unlikely that they were in any way connected with the original plant of A. bullulata described by Jacquin.

This is the first mention in any description of what the present author has termed a keeled marginate apex. Below his account is the comment that this species is well distinct from "pentagona Willd.", and that the leaves have the keel on the right side. Obviously Berger did not handle sufficient material of this genus to appreciate that the side of the leaf on which the keel is situated may vary even on one plant.

Berger also included an account of Apicra bicarinata Haw. where he described the leaves as "ovate deltoid, 2 cm. long and 1.5 cm. wide, shortly acuminate, bright green ... below obliquely keeled (or bikeeled?*), with white tubercles on the under surface arranged roughly in transverse series, towards the margins and keels denticulate-rough". Below is the note that this species was brought to Kew in 1818 by Dr. Mackrell, and that there was a water colour of the plant at Kew.** Berger mentioned that Marloth had in a letter reported a record for A. bicarinata from Graaff Reinet. This locality must be viewed with some doubt. Berger commented that the species had more affinity with A. bullulata than with A. aspera; and that the plant in the picture at Kew had unicarinate not bicarinate leaves. He finally made the most important observation that the "keels ... simulate above a false margin".

A rather poor illustration of the plant described as "bicarinata" accompanies this account, in which the transverse grouping of the leaf tubercles is not shown, but the leaf apices

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* The question mark is Berger's.

** To date untraceable by the present author.

are shown as curving slightly to one side. The species described by Berger as A. bicarinata, although smaller than is typical, is obviously also A. bullulata Jacq. on the ground of the broad leaves, the keeled marginate apices, the way the apices curve to one side and the grouping of the tubercles into transverse bands.

Berger's account of two water colours at Kew of plants collected in 1818 by Dr. MacKrell, one purporting to be an illustration of the type of Haworth's A. bicarinata, presents a problem. Neither of Berger's descriptions of A. bullulata or A. bicarinata, nor his comments on the water colours, could be said to apply to a plant resembling A. aspera Haw. but three times the size. Baker mentions only one water colour at Kew, that of A. bicarinata, from which, according to his note in the Flora Capensis (l.c.), he made his description. He however, described the leaves as "obscurely bikeeled".

Were there perhaps three paintings at Kew? In his original description Haworth (1819) apart from noting that the plant grew at Kew, made no mention of any water colour.

Baker's interpretation of A. bicarinata is problematical. His description and comments could certainly apply to the present author's interpretation of A. bicarinata Haw., but cannot be so considered if he was in fact referring to one of the water colours mentioned by Berger, for it seems most reasonable to consider A. bullulata and A. bicarinata sensu Berger as synonomous with A. bullulata Jacq.

It does seem unlikely that the plants in the water colours described by Berger, with unicarinate leaves were the same as that described by Haworth as A. bicarinata, with two keels.

Berger also included an account of a new species, Apicra skinneri, which he obtained from Mr. W. Skinner of Thornton heath. His description of this species follows : "Leaves densely spiral ... erect patent, the older patent, 3 - 4 cm long, and 2.0 - 2.3 cm wide, widely ovate deltoid, acute and terminating in a sub pungent mucro, coriaceous ... bright green, the upper surface with a few scattered tubercles, more rarely smooth below ... obliquely keeled or bikeeled, sometimes the second keel simulating a margin from above, with numerous subconcolorous or whitish tubercles, scattered or in transverse or longitudinal series ... flowers unseen". Below is the comment that this plant has definite affinities with A. bullulata, but is robuster, the leaf wider, more tuberculate and patent. It is odd that Berger did not include an illustration of his new species.

This description most closely agrees with plants of the A. rugosa X H. margaritifera hybrid, where the upper surfaces of the leaves are often tuberculate, and the tubercles are far more numerous than in A. bullulata or A. hallii. The author has never seen leaves in which the apex is sometimes of the sort described above, but in most cases, the keel in mature leaves is very indistinct on account of the degree of tuberculation, and sometimes the apex is very narrowly acute - acuminate as seen in specimens from Rietvlei and the collection of Mr. B. Carp. It seems most reasonable to consider Apicra skinneri Berger as a synonym of Apicra bicarinata Haw.

Berger's key to these three species and "aspera" is given below:-

A. Leaves ± verrucose or papillose on the back.
- a) Leaves subrotund, dorsally semiglobose, convex keeled towards the apex, keel straight .... A. aspera
- b) Leaves greatly deltoid below acutely obliquely keeled. Keel above often forming a false margin.
  - α Leaves 30-40 mm. long.
    - i) Leaves deltoid ± 13 mm. wide few tubercles .... A. bullulat
    - ii) Leaves ovate-deltoid 20-33 mm. wide numerous tubercles .... A. skinneri
  - β Leaves 20 mm. long, tubercles numerous more conspicuous, sub irregularly distributed ..... A. bicarina

Marloth (1915) included a short description and an illustration of a flowering specimen of Apicra bullulata Jacq. from Verlaten Kloof at the Northern limits of the Ceres Sutherland Karoo. The shape of the leaf apex, the typical tuberculation pattern and the colour of the flowers are well shown.

Dr. Karl van Poellnitz (1930) described a new species, Apicra egregia, collected by a Mrs. van der Bijl near Oudtshoorn. His account is given as follows : "leaves 1.7 cm long, 1.5 cm wide at the base, strictly five farious or rarely sub-spirally five ranked, patent erect, ovate deltoid, towards the apex obliquely curved and a little in-curved, ending in a sharp brownish mucro, glaucous, dark green ... below obliquely keeled or rarely a little bikeeled and ornamented with shining green tubercles not regularly transversely seriate, single or a few congregated together ..."

He commented that this species differed from A. bicarinata Haw. especially in the glaucous-green leaves, which are very green below, with fewer tubercles not* ornamented in transverse series.

It is evident that von Poellnitz was comparing his new species with the "bicarinata" of Berger's description. Apart from the size of the leaf, von Poellnitz' rather general account might apply to small plants of either A. hallii or A. bullulata. The fact that the leaves were described as ovate deltoid, obliquely curved and a little in-curved towards the apex might be considered to correspond more with A. bullulata than with A. hallii, but on the other hand the colour of the leaves was described as glaucous, (which in the field at any rate, rarely applies to A. bullulata), and the tubercles were described as not being in transverse series, although this latter character is not always constant in A. bullulata. Von Poellnitz did not describe the apex as keeled marginate, nor mention the green vein lines on the under surface of the leaf typical of hallii.

Jacobsen (1935) in the first English edition of his book on succulent plants included an account of Apicra egregia in which the leaves were described as "sharply keeled to one side ... bluish green, often reddish, with a few green longitudinal

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* He used the emphatic word "haud"

stripes on the back, margins and keel rough cartilagenous". The accompanying photograph is very indistinct and could be of a plant of A. smutsiana or of A. hallii, both of which have characteristic green vein lines. The fact that the leaves were described as sharply keeled on one side, probably applies more to A. hallii than A. smutsiana.

An illustrated magazine article of von Poellnitz which appeared in 1937, clarified the identity of his Apicra egregia. The photograph of "Apicra egregia von P." is in fact of a plant readily associated with plants collected in the Ceres Sutherland Karoo. Apicra egregia von P. is thus a synonym of Apicra bullulata (Jacq.) Haw. In the photograph, a slight tendency for the tubercles to aggregate in transverse series is shown. In this description of the species, von Poellnitz described the arrangement of tubercles as "not or scarcely somewhat confluent, not or scarcely arranged in crosslines". He quoted Jacobsen's (l.c.) description of leaves with longitudinal green stripes and commented : "I do not understand this!" At least he had not confused plants of his "egregia" with plants of A. hallii.

Uitewaal (1938) in his series of articles on the genus Apicra in Succulenta, wrote an account of Apicra bullulata (Jacq.) Haw., A. skinneri Berger and A. egregia von Poellnitz. The specimen he described as A. bullulata came from a private collection, that he called A. skinnerii was sent from Winton nurseries, S. Africa under the name "Apicra Neillii", while the plant called A. egregia was collected by H. Herre from Verlaten Kloof and sent under the name A. bullulata.

Needless to say the plant referred to as"A.egregia" by Uitewaal, of which there is a photograph, is in fact a specimen of Apicra bullulata (Haw.) Jac. Uitewaal commented that von Poellnitz had written to him saying that, after visiting Jacobsen's succulent collection at Kiel, he felt that his A. egregia was identical with A. bicarinata Haw, but he had not investigated the matter further.

There are also photographs of the plants referred to as bullulata and skinnerii. There is little difference between them, both resembling plants of the suspected H. margaritifera X A. rugosa hybrid. Both therefore should be referred to by the epithet bicarinata Haw. It is very likely that the plant sent from Winton nurseries was one of those collected by Hurling and Neil from 1928-1931 along the Baden road near Montagu. (See page 300).

It is a reflection of Uitewaal's lack of understanding of the species of this genus that he should consider the two plants referred to by him as bullulata and skinneri as two separate species, and yet dismiss lightly the great difference between the specimen he called A. bullulata and that illustrated as such by Jacquin, by saying that Jacquin's drawing was "te schematisch"!

It is of interest to note Uitewaal's suggestion that figure 2 of Section One of Salm-Dyk's monograph, which is missing, was intended to be an illustration of Aloe bullulata.

In his revision of the nomenclature of Apicra, Uitewaal (1947) listed A. bullulata Jacq., A. skinnerii Berger, A. bicarinata Haw and A. egregia Poelln. all as species of Astroloba. Apart from the synonyms Skinnerii and egregia, there is little doubt that his interpretations of what constituted ~~the~~ A. bullulata and A. bicarinata differed from those of the original authors.

ASTROLOBA HERREI UITEW. AND A. DODSONIANA UITEW.

A new species of Astroloba A. herrei was described by Uitewaal in (1948), characterised by an ovate corolla in which the outer tepals are greatly inflated on either side of the midrib. Unfortunately it was not possible to obtain the original description, but from a later account with good photographs in Succulenta (1950), it appears that the original description of the perianth was not very satisfactory, and Uitewaal does not appear to have mentioned any similarity between the corolla of this species and that of A. spiralis (L) Uitew.

The species was described from plants collected by Mr. H. Herre of Stellenbosch near Uniondale and a collecting number (Stellenb. No. 5703) is given.

The photographs in the Succulenta account agree well with specimens found in the field near Uniondale and Prince Albert, and Astroloba herrei Uitew. is beyond doubt a good species.

In 1950 however, Uitewaal published a new species Astroloba dodsoniana described from a plant sent from a private collection in California! The photographs of the plant and a drawing of the flower also agree with plants in the populations of A. herrei found near Uniondale and Prince Albert! Astroloba dodsoniana Uitew. is unquestionably a synonym of A. herrei Uitew.! In his account of "A. dodsoniana", Uitewaal does comment that this "species may be compared with Astroloba herrei Uitew .. from which however it is easily distinguished by its more erect and more whitish leaves, which have only very inconspicuous lines on the back, and by its light margins and keel". Again this is an indic tion of lack of comprehension of variation within a species in this genus.

TAXONOMIC HISTORY OF THE FOLIOLOSA COMPLEX.

The first member of this complex to be described as a species was Aloe foliolosa, in 1804 by A.H. Haworth. The description was made from living plants in his own collection, which had been sent from the Cape by Francis Masson. He described Aloe foliolosa as having "multifarious very short, rounded ovate smooth bright green horizontal leaves"; and noted that "This is the least leaved of all Aloes; the leaves are at the same time the thinnest, the most numerous and the most crowded".

Aloe foliolosa was next mentioned in the second edition of the Hortus Kewensis (1811) with a note to the effect that it was introduced in 1795 and flowered for most of the summer. Willdenow (1811) in the same year, transferred the species to the genus Apicra and described the leaves as "multifarious, patent, rounded-ovate".

Also in 1811 an illustrated account of Aloe foliolosa by Gawlor (Ker) appeared in the Botanical Magazine. The illustration of the specimen, which was sent by Haworth, includes an unbranched flowering spike, and agrees well with specimens collected at various localities and identified as belonging to the entity foliolosa recognised by the present author. The leaves are shown in the illustration to be very patent. Subsequently Haworth (1912) transferred A. foliolosa to Duval's new genus Haworthia in his Synopsis.

Aloe foliolosa was next mentioned by Salm-Dyk (1817) in his Catalogue and again in his illustrated Monograph (1836-1863). Here the leaves were described as "very crowded, five farious densely arranged in a spiral, about 2 cm long and the same wide in the middle", the base being a little narrower, the apex acute; the younger leaves erect-patent, the older leaves very patent, straight, bright green --- very smooth and shiny", ("nitida"). The excellent illustration agrees well with small plants collected in the field, and referred by the present author to sub species foliolosa.

Also in the Monograph, and in the same section "Foliolosae", appeared an account of a new species, Aloe congesta. The description of leaf arrangement is similar to that for A. foliolosa, but the shape is given as being ovate-acute, the leaves about 3.7 cm. long ("sesquipollicem") and about 2.3 cm ("pollicem") wide at the ovate base from which the leaf is attenuate-acute. Again the leaves are described as bright green, very smooth and shiny. It is only in these two descriptions in his Monograph that Salm-Dyk uses the word "nitida" to describe the texture of the leaf surface. This agrees with the observations made by the present author on the nature of the epidermal cells and how they affect the texture of the leaf.

The illustration agrees well with plants collected from the marginal karoid areas near Cradock, Adelaide and Grahamstown. Here, the peduncle is described as unbranched.

Salm-Dyk noted that this plant flowered in September and October, and was brought to the Berlin Gardens in 1843. At first it was thought to be a more robust variety of Aloe foliolosa Haw. "Now however, it is considered quite distinct on the grounds of less rounded leaves, which are twice as broad, much longer and more crowded, and especially the wide, recurved and patent perianth lobes".

From the drawings, rough measurements for pedicel lengths are 0.4 cm for A. foliolosa and 0.3 cm for A. congesta, while fertile bract lengths are 0.5 cm and 0.7 cm for A. foliolosa and A. congesta respectively. It is difficult to determine the number of veins for the lower sterile bracts in the drawings of A. congesta, but this could be one vein in A. foliolosa.

In 1873 a new species, Aloe deltoidea was described by J.D. Hooker from a plant long cultivated at Kew, with no record of its introduction. Hooker (1873) wrote: "This singular succulent belongs to the same section of Aloe with A. foliolosa ... pentagona ... spirella, imbricata ... spiralis etc. of Haworth .... It differs from the first-named of these chiefly in size, and in the leaves not being spirally disposed except on the young shoots, though I should much doubt this character being of any value".

The diameter of the stem, the first time such a measurement is used, is given from leaf tip to leaf tip, (according to the illustration), as two inches. The leaves are described as most densely five fariously imbricate, horizontal, deltoid-ovate acuminate about 1.8-2.5 cm long and deep shining green, quite smooth and glabrous.

There is no mention of Salm-Dyk's Monograph, and from the illustration it is difficult to tell whether Hooker's Aloe deltoidea is similar to Salm-Dyk's Aloe congesta and therefore to plants from the Cradock-Grahamstown area, or whether it is similar to the third variety of this complex designated subsp. robusta by the present author. The peduncle is described as stout, and from the illustration it would appear that the lower flowers of the inflorescence are very shortly pedicellate, but it is impossible to see the number of veins in the bracts. Measurements taken from the single withered flower with a visible pedicel, give a pedicel length of 0.2 cm and a fertile bract length of 0.8 cm.

Of all the specimens referred to by the author as sub species congesta, only two had leaves 2.5 cm or less in length, while the great majority of specimens referred to by the author as sub species robusta had basal fertile bracts more than 0.8 cm long, and all had basal flowering pedicels less than 0.2 cm long. In view of the fact that the sub species in the Afoliolosa complex have been determined on grounds of diversity together with different geographical distribution it is best not to attempt to associate the Aloe deltoidea of Hooker's description definitely with either var congesta or var robusta.

In 1881, Baker listed all three species, A. deltoidea, A. congesta and A. foliolosa under Apicra in his synopsis. Following his description of Apicra deltoidea (Hook. fil.) Baker, he noted that it had been introduced in about 1865 by Cooper* and cited an herbarium specimen "C.B. Spei in lapidosis montis Zuurberg Bolus 2687".**

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* Thomas Cooper travelled in South Africa between 1859 and 1862.

** In Kew herbarium and seen by the author.

If the plant Baker described as A. deltoidea is indeed Hooker's Aloe deltoidea, then Aloe deltoidea Hooker is a synonym of Aloe congesta Salm-Dyk. This is the only evidence as to the identity of Hooker's deltoidea, and it could therefore be considered simply a specimen of sub species congesta.

Baker's comments on A. congesta and A. foliolosa are similar to those of previous authors. In 1889, Baker described a new species, Apicra turgida, "near Apicra deltoidea", and introduced into cultivation in 1872, specimens of which he had seen which had been collected in the Albany Division by Hutton. There appear to be no grounds for considering this at all distinct from A. congesta. There is mention of the pale green upper leaves "with several indistinct vertical ribs of darker green", presumably these are the vein lines.

In the Flora Capensis (1896) Baker enlarged on the locality of the specimen of A. deltoidea (Bolus 2687) giving it as "Stony places at Hell Poort 2,000 feet", which, as has been shown previously, is a locality well known to the present author for plants agreeing with Salm-Dyk's concept of A. congesta. There appears to be a misprint in the account of A. congesta where it says "leaves ... with spots or tubercles". It is certain that this should read "leaves ... without spots or tubercles".

Baker's key to these three species is very poor and is given below:-

"Leaves arranged in five straight or spirally twisted rows:
Leaves lanceolate-deltoid .... (1) pentagona
Leaves deltoid:
Upper leaves flat on the face .... (2) turgida
Upper leaves concave on the face .... (3) deltoidea
Leaves multifarious, the spirals quite obliterated:
....
Perianth smooth*
Leaves smooth on back and face:
Leaves deltoid .... (5) foliolosa
Leaves lanceolate-deltoid .... (6) congesta

* In the text there is a misprint which reads "Perianth rugose".

As has been seen, leaf arrangement is not of prime taxonomic importance, and the concavity of the upper faces of Astroloba leaves depends on turgidity, the greater the water supply, the fatter the leaves and the flatter the upper face. As clarified by Baker, none of these species warrant recognition as separate species.

Berger (1908) considered A. turgida a variety of Apicra deltoidea (Hook. f.) Bak., which differed from the typical form on account of the spirally arranged leaves. He created a second variety for this species, var intermedia, described from living plants, without locality, sent to him by Marloth, which he said differed in its smaller size. His key to these is given below:-

B. Leaves non papillate on the dosal surface, but often faintly spotted, the spots small and cartilagenous, but not prominent.

a) Dry leaves longitudinally furrowed with elevated nerves.

....

Leaves ovate-deltoid .... (7) A. congesta

b) Dry leaves smooth

α Leafy stem 3-5 cm in diam. ..... (8) A. deltoidea

1. Leaves strictly five farious .... A. deltoidea v. typica

11. Leaves more or less spirally five farious

1. Leafy stem 5 cm in diam .... A. deltoidea v. turgida

2. Leafy stem 3 cm in diam .... A. deltoidea v. intermedia

β Leafy stem graceful 2-2.5 cm in diam .. (9) A. foliolosa.

This key is of interest in that it incorporates an anatomical character - the prominent bundle caps mentioned previously, which cause the leaves to dry in a ridged manner. In the foliolosa complex, as mentioned earlier, prominent heavily lignified bundle caps are more typical of plants from the western populations described as sub species robusta by the present author, than of the more easterly populations of the plants now described as sub species congesta and foliolosa.

The character of leafy stem diameter is not a good one as it depends on leaf length, angle of leaf with stem and curvature of leaf apex. Altogether the key is highly unsatisfactory and fails to delimit the components of the foliolosa group with any success.

Specimens cited by Berger are of interest - under A. deltoidea (Hook. fil.) he mentions "Hellpoort (Bolus 2687) (K)" and "Laingsburg, Matjesfontein (Marloth in litt)". The latter specimens undoubtedly, on account of their locality, belong to the sub species robusta as construed by the present author. For var turgida he mentioned the same plant as Baker, and the unknown origin of var intermedia has already been noted. Again on the information given, var intermedia Berger cannot be associated with certainty with either sub species robusta or congesta of the foliolosa complex.

Under Apicra foliolosa Berger listed "Karoid slopes between Zwartkops and Sundays river at 330 - 600 m" .... Drege n 4184 ... Herb. Reichb. fil. in Herb. Caes. Pal Vindob"; Marloth 4204; and "Sundays river Thal. (Marloth in litt)". Under congesta Berger, noted that the plant was without locality from the Cape.

It would appear that Drege n 4184 is a misquotation and should read Zeyher 4184. A specimen with this number is in the Albany Museum and all the evidence on the label points to it being a Zeyher specimen. The original number "Aloe Harv. 1054" is crossed out which is typical of many Zeyher labels, the writing is similar and there is an illegible inscription in one corner which is found on a number of Zeyher labels and could not possibly be confused with any of Drege's labels. Consultation of Drege's notes on his travels (1844 p. 129-131) shows that for the collecting area IV C c, between the Zwartkops and Sundays river, apparently no Aloes or Apicras were collected. Further evidence for this specimen being a Zeyher one is found on reference to Drege's list of the collecting numbers of Zeyher, Ecklon and Drege (Linnaea 1847). All the Drege numbers listed under Aloe are in the 8,000's, while there are Zeyher numbers "4182 Aloe pulchra" and "4187 Aloe rigida". Although obviously not all the collecting numbers are listed, this is a further indication of the specimen being a Zeyher one. As a point of interest also on the herbarium sheet is another label identifying it as the "number quoted by Berger in the Pflanzenreich IV, 38 III, II 120".

The next author to discuss this complex was Uitewaal in the editions of Succulenta between 1937 and 1939. Unfortunately his notes on A. deltoidea and A. foliolosa were not available. In his notes (1939) on Apicra congesta (Salm) Bak he commented that it was in habit like A. deltoidea (Hook.f) Bak. and especially var turgida, mentionin that plants impoted by him under the name A. congesta were identical with A. deltoidea var turgida, and in his key treats A. turgida and A. deltoidea as one species. His key is given below:

"A. Plants more or less glaucous.

....

Plants slender about 3 cm in diam, pale bluish leaves narrow 2 cm long and 1.2 cm broad .... deltoidea v intermedia

B. Plants more or less a definite green.

Leaves unspotted on the underside or with single very faintly raised flecks.

A. Leaves in 5 straight rows or very slightly twisted.

....

oo Leaf deltoid .... deltoidea typ.

B. Leaves spirally twisted or imbricate

....

oo Perianth smooth, older leaves more or less patent

1) Plants 5-7½ cm in diam.

....

b) Leaves deltoid, sometimes ovate deltoid ....

deltoidea var turgida (also congesta)

2) Plants about 2 cm in diameter, leaf margins somewhat thickened .... foliolosa.

Again this key is unsatisfactory in that it is based on leaf arrangement, leaf colour and size, and the components of the *foliolosa* group are not successfully separated.

In his revision of the genus (1947), Uitewaal reduced *Apicra deltoidea var turgida* (Baker)Berger to *Astroloba congesta* (Salm.) Uitew., quoting von Poellnitz's opinion that *A. congesta* was a fattened form of *A. turgida*. Uitewaal still treated *A. deltoidea* (Hook.) Uitew. as a separate species on the grounds of leaf arrangement, although considering it very closely related to *A. congesta*. *Intermedia* was kept as a variety of *A. deltoidea*.

Mention must be made of Jacobsen's Handbook (1960) where *A. congesta*, and *A. deltoideae* with varieties *intermedia* and *turgida* are listed, and "*Astroloba turgida* (Baker) Jacobs .... Cape Province Albany"! For localities of *A. deltoidea* he gave Laingsburg, Matjesfontein, Albany district and Hellpoort. The photographs are poor but those of *A. deltoidea* in figs. 210 and 212 resemble specimens from Hellspoort.

In the light of the concepts of the entities in the *foliolosa* group as established by the present author, the group as a whole is treated as a single species, to be called *A. foliolosa* Haw. on grounds of priority. This species consists of three sub species, *foliolosa*, *congesta* (Salm-Dyk) Roberts and *robusta* sub sp. nov. Roberts. Incorporated in sub sp. *congesta* are *deltoidea** Hooker(as interpreted by Baker), and *turgida* Baker, while the identity of var *intermedia* Berger is open to doubt.

For the sake of convenience all the synonyms are listed above as epithets with their original authors, regardless of their former taxonomic rank.

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* Excluding specimens from Laingsburg and Matjesfontein included in *A. deltoidea* by Berger and Jacobsen, which belong to subsp. *robusta*.

TAXONOMIC ACCOUNT OF THE GENUS ASTROLOBA UITEW

ASTROLOBA Uitewaal in Succulenta 1947 (5): 53 (1947).

In part Haworthia Duval, Pl. Succ. in Hort Alencon.: 7 (1809), including only the species H. spiralis (Linnaeus) Duval.

In part Apicra Willdenow in Ges. Naturf. Fr. Berl. Mag. 5: 167 (1811) including only the species A. imbricata (Aiton) Willdenow; A. spiralis (Haworth) Willdenow; A. pentagona (Aiton)Willdenow; A. ballulata (Jacquin) Willdenow and A. foliolosa (Haworth) Willdenow.

Plants caulescent with adventitious roots at the base of the stem. Stem lengths of up to 50 cm. have been recorded in plants growing supported in bushes, but leafy shoots growing unsupported in the open are generally less than 30 cm. in height.

The leaves are basically deltoid in shape with a sheathing base which forms a complete sheath about the stem and is a few mm. wide at its narrowest part. However, the fleshly base of the leaf excluding the sheathing portion, is narrower than the leaf width at a point roughly half way along the leaf length, or, in the case of longer leaves, up to 1.0 cm. below the mid length.

The lower side of a fully developed leaf has a keel which is slightly to one side and extends from the leaf apex for up to two thirds of the leaf length. Both leaf margins and keel are tuberculate for up to two thirds of the leaf length from the apex.

The apex is acute acuminate ending in a short mucro. In some cases the margin of the leaf on the side of the keel loses its identity as a margin near the leaf apex and the keel then functions as a margin. Such an apex is referred to as a "keeled marginate apex", as opposed to a true marginate apex.

The leaves are alternate and spirally arranged, with a phyllotactic fraction of basically $\frac{2}{5}$. In most cases however, every sixth leaf is situated above the leaf formed five leaves before in such a way that the angle of the spiral between the two is not 720, but a varying number of degrees less. This angle is referred to as the spiral angle. The smaller the spiral angle, the more five ranked are the leaves, the larger it is, the more imbricate is the leaf arrangement.

The ventral side of the leaf may be tuberculate or smooth and the bundle caps of the vascular bundles on the ventral side sometimes show up as fine striations. The epidermal cells from the upper part of the leaf have greatly thickened outer walls. In section the outer surface of these cells may be very convex, giving the leaves a matt surface, or almost flat, in which case the leaves have a glossy sheen.

The inflorescences are axillary and racemose, and may be branched. The base of the peduncle is flattened and has two thin marginal wings, up to 1.0 cm. long and 0.1 - 0.2 cm. wide. Below the raceme, are a varying number of sterile bracts, and it is in the axils of these that the axillary racemes arise.

The flowers are pedicellate, rarely sessile, and arise in the axils of bracts. Sterile and fertile bracts are deltoid and membraneous, generally with one central vein, sometimes with several.

The perianth is tubular, and straight, about 1.0 cm. in length. The free lobes are 1.0 - 3.0 cm. long and broad and lie, when fully open in a more actinomorphic manner than in the genus Haworthia, where the three anterior lobes tend to group together curving downwards, and the three posterior lobes tend to curve upwards resulting in a bilabiate condition.

Each tepal has three central veins, surrounded by more densely pigmented cells than found in the rest of the tepal. The veins end in the lobes as an inverted V. In two species, the tissue on either side of the central veins is greatly inflated.

The fruit is a capsule.

The basic chromosome number is n = 7.

KEY TO THE SPECIES

1. Outer tepals of perianth tube with a very marked inflation of tissue on either side of the midrib.

 A. Inflation of the perianth tube very markedly transversely rugose. (The plants are tetraploid).

 ....A. spiralis

B. The inflated tissue of the perianth tube is smooth or slightly undulating, never markedly rugose. (The plants are diploid).

.... A. herrei

11. Outer tepals of perianth tube lacking a marked inflation of tissue on either side of the perianth tube. All species are diploid.

A. All, or most of the leaves with keeled marginate apices.

1. Leaves with longitudinal striations on the ventral side of the leaf, the vascular bundle caps lignified for the entire length of the leaf. (Tubercles or whitish maculae sometimes present on the lower side of the leaf). .... A. hallii

2. Leaves without longitudinal striations on the ventral side of the leaf, the vascular bundle caps unlignified at the leaf apex. (Tubercles present on some or all of the leaves of any one plant.)

.... A. bullulata

B. All leaves with true marginate apices.

1. Leaves always tuberculate........... A. rugosa

2. Leaves never tuberculate, occasionally white flecks present, or one or two elongated slightly raised concolourous patches on the under surface of the leaf.

a. Leaves with a matt surface............ A. smutsiana

b. Leaves with a glossy sheen............ A. foliolosa

Astroloba foliolosa (Haworth) Uitewaal

Leaf arrangement five ranked to imbricate, leaves erect to patent, leaf apices curving upwards to outwards. Leaf apex true marginate.

Leaf colour: Scheeles green, Lettuce green, Fern green, or spinnach green; often with a greyish tinge similar to willow green in subsp. robusta; margins and keels concolorous, paler or whitish; more frequently whitish in subsp. robusta.

Tubercles absent, but small elongated, very slightly raised concolorous patches occasionally present in some leaves in subsp. congesta, very rarely subsp. foliolosa; scattered whitish flecks occasionally observed on lower surfaces of leaves in subsp. robusta, apparently absent in the other two subspecies.

Epidermal cells with almost flat outer surfaces, which results in a glossy sheen on the leaves.

Dimensions of leaves and inflorescences vary according to the subspecies and are given in the accounts of these.

Colour of perianth: veins of tepals green with a glaucous or beige tinge, vein endings in lobes of same colour, sometimes with a pink tinge, rest of lobe white or cream, never yellow; tubular part of perianth on either side of midrib greenish white, or pale cream becoming greener towards the base.

Dimensions of perianth: length to neck, 5.8 - 9.9 mm., usually 6.0 - 9.0 mm; basal diameter of tube, 2.2 - 4.0 mm. usually 2.5 - 3.0 mm; basal diameter in size varies from upto 0.3 mm. greater than the middle diameter, to 1.6 mm. less than the middle diameter, usually it is 0 - 0.5 mm. less in diameter than the middle of the tube; dimensions of lobes: length of lobes, 1.4 - 3.00 mm. usually 1.5. - 3.0 long, the inner lobes sometimes slightly longer, width of outer perianth lobes: 1.2 - 3.0 mm. usually 1.5 - 2.0 mm; width of inner lobes; 1.5 - 4.0 mm., usually 2.0 - 3.0 mm.

In the open flower, the outer lobes usually curve back through an angle of 60°, often curving right back to lie parallel to the perianth tube.

This species differs from the other members of the genus in the almost flat outer walls of the epidermal cells, resulting in a leaf with a glossy sheen. Secondary points of difference are the short pedicels and long bracts of the inflorescence and the broad lobes of the perianth.

The three species sub are based on geographical distribution together with variations in leaf and inflorescence characters.

Aloe deltoidea Hooker fil. in Bot. Mag. 99 t.6071 (1873) and Aloe deltoidea var intermedia Berger in Pflanzenreich 4 (38):120 (1908) are clearly variants of A. foliolosa, but the descriptions are insufficiently detailed to ascribe them to any of the described varieties.

Subsp. foliolosa.

Aloe foliolosa Haworth in Trans. Lin. Soc. Lond. 7 : 7 (1804). Aiton, Hort. Kew., ii, 2 : 298 (1811); Ker in Bot. Mag. 33 t. 1352 (1811); Salm-Dyk, Cat. Rais. :9 (1817), and Monogr. Aloes : S2 fig. 4 (1836-1863).

Apicra foliolosa (Haworth) Willdenow in Ges. Naturf. Fr. Berl. Mag. 5 :274 (1811): Haworth, Suppl. Pl Succ. :64 (1819); Baker in Jour. Lin. Soc. Lond. 18:218 (1881), and in Flora Capensis 6 (2) : 331 (1896); Berger in Pflanzenreich 4 (38) : 120 (1908)

Haworthia foliolosa (Haworth) Haworth, Syn. Pl Succ.:99 (1812).

Astroloba foliolosa (Haworth) Uitewaal in Succulenta 1947 (5) : 54 (1947).

Leaves in five straight ranks to imbricate, spiral angle usually 10 -40^{o}; leaves patent erect to patent; leaf apices following angle of leaf with stem to curving outwards and downwards in the case of very patent leaves, usually curving outward.

Leaf length: 1.4 - 3.0 cm., usually 1.5 - 2.5 cm.; width of leaf at widest part: 0.9 - 2.1 cm. usually 1.0 - 1.5 cm.; length-breadth ratio: 1.02 - 2.12, usually 1.25 or less to 1.75; position of widest part of leaf: 0.1 cm. above to 0.4 cm. below mid-length, usually 0 - 0.25 cm. below mid-length: mucro length: 0.04 - 0.15 cm., usually 0.05 - 0.10 cm.

Numbers of vascular bundles with caps as seen in transverse section halfway along leaf length, for ventral side: 6.9 - 14.6 per cm., for dorsal side: 3.9 - 8.3 per cm.

Percentage lignification of bundle caps from ventral side of leaf seen as above, variable, 0 - 75%.

Peduncle length: 9 - 29 cm., usually 10 -20 cm.; raceme length: 6-19 cm., usually 10 - 15 cm.; width of base of peduncle at its widest part: 0.26 - 0.50 cm., usually 0.30 - 0.45 cm.; width of peduncel below first pedicel; 0.15 - 0.35 cm., usually 0.15 - 0.30 cm.

Branched inflorescences recorded in 6% of the specimens examined.

Basal sterile bract: length, 0.56 - 1.30 cm., usually 0.6 - 1.0 cm.; width of base, 0.15 - 0.60 cm., usually 0.15 - 0.45 cm., width half way along length, 0.08 - 0.36 cm., usually 0.10 - 0.20 cm.

Veins of basal sterile bract: bracts with three main veins to bracts with a single vein, usually bracts with one vein and two laterals which do not extend for the entire length of the bract.

Basal fertile bract: length, 0.40 - 0.90 cm., usually 0.40 - 0.80 cm.; width of base, 0.18 - 0.45 cm., usually 0.20 - 0.30 cm.; width half way along length, 0.06 - 0.22 cm., usually less than 0.10 - 0.20 cm.

Veins of fertile bracts: from base of raceme, bracts with one main vein and two laterals which do not extend for the entire length of the bract to bracts with one vein, usually bracts with one vein or one main vein and one basal lateral; from middle and top of raceme, bracts with one main vein and one basal lateral, or with a single vein.

Flowering pedicels: from base of raceme, 0.09 - 0.38 cm., usually 0.15 - 0.25 cm.; from middle of raceme, 0.08 - 0.32 cm., usually 0.10 - 0.20 cm.; fruiting pedicel from base of raceme, 0.14 - 0.37 cm.

<u>DISTRIBUTION</u>

Living specimens examined by the author*-

CAPE PROVINCE.

Graaff Reinet District: Valley of Desolation W. of Graaff Reinet, R29, R60; 10 mi. N. of Graaff Reinet on Middleburg road, R30;

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*Most specimens collected by the author are under cultivation at Kirstenbosch.

Cranmere Farm nr. Pearston, R34, 10 mi. S. pf Pearston on Waterford road R35. Jansenville District: Toekomst Farm nr. Waterford, R10; Toekomst Farm nr. Lake Mentz R36; nr. Lake Mentz village R37: Mount Stewart R13, 52a. Steytlerville District: Steytlerville R14,52b. Uitenhage District: Wolwefontein, R11; Baroe, R12; Springbokvlakte s.leg. s.n. in hort. K'bosch.

Herbarium records:-

CAPE PROVINCE.

Ladismith District: Between Ladismith and Laingsburg, N.S. Pillans 877 (BOL). Steytlerville District: Steytlerville, F. Paterson 40 (BOL); Uitenhage District: Addo Bush. F.R. Long 1175 (GRA) (PRE). Kleinpoort, Barker 5100 (NBG); Wolvefontein, s. leg. No. 27628 in Herb Bol. (BOL). Jansenville District; Waterford, Acocks 11997 (PRE). Graaff Reinet District: Graaff Reinet, H. Bolus 264 (BOL); Thode A 621 No. 17319 in Nat. Herb. (PRE); F. Frith s.n. No. H/3604/59 in Herb Kew (K); Kruidfontein, H. Bolus 264A (BOL); Kendrew, van der Berg s.n. Nat. Bot. Gdns. 540/23 (BOL); F. Frith s.n. H/3606/59 in Herb Kew (K).

ssp foliolosa

H/3606/59/4

District unknown, probably Uitenhage: Zwartkops - Sundays River, Zeyher 4184 (GRA); Koegakammaskloof Zeyher 1054 (GRA).

Without locality: s.leg. No. 27627 in Herb. Bol (BOL); Exhort s.leg. Nat. Bot. Gdns. 74/44 (NBG).

Subsp. congesta. (Salm-Dyk) Roberts comb. nov. et stat. nov.

Aloe congesta Salm-Dyk, Monogr. Aloes: 52 fig. 1 (1836-1863) - BASIONYM.

Apicra congesta (Salm-Dyk) Baker in Jour. Lin. Soc. Lond. 18:218 (1881), and in Flora Capensis 6 (2) : 333 (1896); Berger in Pfanzenreich 4 (38) : 118 (1908); Uitewaal in Succulenta 1939 (3) : 27 (1939).

Astroloba congesta (Salm-Dyk) Uitewaal in Succulenta 1947 (5) :54 (1947.

Apicra deltoidea (Hooker fil.) Baker sensu Baker in Jour. Lin. Soc. Lond. 18 : 217 (1881) and in Flora Capensis 6 (2) :

Basal sterile bract: length, 0.70 - 1.27 cm. usually 0.8 - 1.0 cm.; width of base, 0.30 - 0.75 cm. usually 0.45 - 0.60 cm; width halfway along length 0.14 - 0.48 cm. usually 0.15 - 0.30 cm.

Veins of basal sterile bract: bracts with three veins running full length of bract to bracts with a single vein, usually bracts with one main vein and two laterals which do not extend for the entire length of the bract.

Basal fertile bract: length, 0.50 - 0.95 cm. usually 0.6 - 0.8 cm. width at base, 0.28 - 0.58 cm. usually 0.35 - 0.45 cm; width halfway along length, 0.11 - 0.45 cm. usually 0.15 cm. - 0.30 cm.

Veins of fertile bracts: from base of raceme, variable, bracts with one main vein and two laterals which do not extend for the entire length of the bract, to bracts with one vein; from middle of raceme, as for basal fertile bracts, usually bracts with one main vein and one basal lateral or one vein only; from top of raceme, bracts with one main vein and one lateral or bracts with a single vein.

Flowering pedicels: from base of raceme, 0.07 - 0.40 cm. usually 0.15 - 0.25 cm; from middle of raceme, 0.05 - 0.28 cm. usually 0.10 - 0.20 cm.; fruiting pedicel from base of raceme, 0.06 - 0.38 cm.

DISTRIBUTION

Living specimens examined by the author:-

CAPE PROVINCE.

Albany District: Dikkop Vlakte, R40; Comins 2064; Helspoort R41; Krantz Drift, Comins 2063; nr. Alicedale, Comins s.n. Bedford District: S. of Adelaide on Grahamstown road, R38, R39. Cradock District: Rayner's Kop, R33; Cradock, R32, R53; 19 mi. N. Cradock on Middleburg road R31.

Herbarium Records :-

CAPE PROVINCE.

Albany District: Helspoort, R.A. Dyer 2096 (GRA); R.A. Dyer 975 (PRE); Rosenborth s.n. Stell. Un. Gdns. 7851 (BOL); H. Bolus 2687 (BOL) (K); Brakkloof, Acocks 12049 (PRE); Alicedale, Cruden 209 (GRA); Cradock District: Cradock, s.leg No. 27632 in Herb Bol

Continued on p.3

331 (1896); Berger in Pflanzenreich 4 (38) : 118 (1908), in part excluding specimens from Laingsburg and Matjesfontein cited in a letter from Marloth.

Apicra turgida Baker in Jour. Bot. 27 : 44 (1889) and in Flora Capensis 6 (2) : 330 (1896).

Apicra deltoidea var turgida (Baker) Berger in Pflanzenreich 4 (38) : 118 (1908).

Astroloba turgida (Baker) Jacobsen, Handbook Succ. Pl. (1) : 227 (1960).

Astroloba deltoidea (Hooker fil) Jacobsen, Handbook Succ Pl. (1) : 227 (1960), in part, excluding plants from Laingsburg and Matjesfontein.

Leaves in five straight rows to imbricate, spiral angle usually 10^{o} or less, to 20^{o}; leaves erect to patent-erect, usually sub-erect; leaf apices curving upwards to outwards, usually following the angle of the leaf with the stem.

Leaf length: 2.0 - 4.7 cm., usually 2.5 - 4.0 cm.; width of leaf at widest part: 1.4 - 2.8 cm., usually 1.5 - 2.3 cm.; length-breadth ratio: 1.39 - 2.33 cm., usually 1.50 - 2.00 cm.; position of widest part of leaf: 0.1 cm. above to 0.7 cm. below mid-length, usually 0.05 cm. below mid-length; mucro length: 0.05 cm. - 0.13 cm. usually 0.05 - 0.10 cm.

Numbers of vascular bundles with caps as seen in transverse section halfway along leaf length: for ventral side, 10.8 - 19.3 per cm., usually 12-15 per cm. for dorsal side 4.7 - 13.3 per cm.

Percentage lignification of bundle caps from ventral side of leaf seen as above, variable, 0 - 97%.

Peduncle length: 6 - 31 cm. usually 15-25 cm; raceme length; 8-25 cm., usually 10 - 20 cm; width of base of peduncle at its widest part: 0.32 - 0.80 cm. usually 0.35 - 0.60 cm; width of peduncle below first pedicel 0.20 - 0.42 cm. usually 0.15 - 0.13 cm.

Branched inflorescences recorded in a third of the specimens examined.

(BOL); Cunningham s.n. No. 27631 in Herb Bol (BOL); Mortimer, H. Davison s.n. Nat. Bot. Gdns. 187/15 (BOL); Rayners Kop, Acocks 11928 (PRE). Middleburg District: Rosmead, J.J. Bruwer s.n. No. 27629 in Herb Bol (BOL).

District unknown, probably Albany: Fish River Rand, Oct. 1896, s.leg s.n. (GRA).

Without locality: Ex hort. Weitz s.n. Nat. Bot. Gdns. 632/35 (NBG); s.leg Nat. Bot. Gdns. 71/44 (NBG), s.leg No. 27633 in Herb Bol (BOL).

Subsp robusta Roberts.

Differt a typo in pedunculo robustiori, floribus vulgo sessilibus vel brevissime pedicellatis, et bracteis subtendentibus eorumdem vulgo longioris cum tribus nervis centralibus.

TYPUS. CAPE PROVINCE. Prince Albert District, 5 mi. W. of Prince Albert, Roberts 64 (BOL)

Leaves in five straight rows to imbricate, spiral angle 10° or less, to 20°; leaves erect to patent-erect, usually sub-erect; leaf apices following angle of leaf with stem or curving outwards, usually curving outwards.

Leaf length: 1.8 – 4.0 cm. usually 2.0 - 3.0 cm.; width of leaf at widest part: 1.0 - 2.4 cm.; usually 1.3 - 2.0 cm.; length-breadth ratio: 1.26 - 2.22, usually 1.50 - 2.00; position of widest part of leaf: 0.2 cm. above to 0.7cm. below mid length, usually 0 - 0.5 cm. below mid-length; mucro length 0.03 cm - 0.20 cm., usually 0.05 - 0.15 cm.

Number of vascular bundles with caps as seen in transverse section half way along leaf length, from ventral side : 5.6 - 12.0 per cm., usually 6 - 12 per cm.; for dorsal side: 2.9 - 7.4 per cm., usually 3 - 6 per cm.

Percentage lignification of bundle caps from ventral side of leaf seen as above: 4 - 100%.

The bundle caps of this subspecies tend to be the largest and have the most heavily lignified sclereid walls in the A.foliolosa complex, resulting in a more frequent occurrence of faint darker green lines on the undersides of the leaves in this subspecies than in the subspecies foliolosa and congesta.

The leaves often have a greyish tinge similar to Willow green which has not been observed in subspecies foliolosa or dongesta and the margins and keels are more frequently whitish.

Usually, (only observed in this sub species) in at least 50% of each population, the plants have some or all of the leaves with a few white flecks on the lower surface.

Peduncle length: 5 - 22 cm., usually 5 - 15 cm.; raceme length: 5 - 33 cm. usually 5 - 15 cm; width of base of peduncle at its widest part : 0.42 - 1.10 cm. usually 0.45 - 0.75 cm.; width of peduncle below first pedicel: 0.28 - 0.73 cm., usually 0.30 - 0.45 cm.

Peduncle usually unbranched and rarely have unexpanded raceme buds been found in the axils of steril bracts.

Basal sterile bract: length, 0.75 - 2.15 cm., usually 1.00 - 1.40 cm.; width of base, 0.30 - 1.30 cm., usually 0.45 - 0.75 cm.; width half way along length, 0.17 - 0.52 cm., usually 0.20 - 0.40 cm.

Veins of basal sterile bract: bracts with 5 main veins to bracts with one main vein and two laterals which do not extend for the entire length of the bract, usually bracts with three main veins.

Basal fertile bract: length, 0.43 - 1.50 cm., usually 0.80 - 1.20 cm.; width at base, 0.30 - 0.80 cm., usually 0.40 -0.60 cm.; width half way along length, 0.16 - 0.40 cm., usually 0.20 - 0.30 cm.

Veins of fertile bracts : from base of raceme, bracts with three main veins to bracts with one vein, usually bracts with three main veins; from middle of raceme, variable, bracts with three main veins to bracts with a single vein; from top of raceme, bracts with three main veins to bracts with one vein, usually bracts with one main vein and one basal lateral, or only a single vein.

Flowering pedicels: from base of raceme, 0.00 - 0.18 cm., usually 0.00 - 0.05 cm.; from middle of raceme 0.00 - 0.05 cm., usually sessile; fruiting pedicel from base of raceme: 0.02 - 0.15 cm., usually 0.10 cm. or less.

DISTRIBUTION

Living specimens examined by the author:-

CAPE PROVINCE

Beaufort West District: Ft. of Molteno Pass Hall 2284; E. of Nelspoort on Murraysburg road, R28, R42. Laingsburg District: nr Whitehill, R57; 4 mi. N. Matjesfontein on Sutherland road, R56; E. of Laingsburg nr farm Rietfontein, R1; nr Spreeuwfontein Farm on Laingsburg-Ladismith road, R67; nr Whitehill, Oliver s.n.. Ladismith District: nr Rietvlei Farm on Laingsburg-Sevenweeks Poort road, R65. Prince Albert District: 5 mi. W. Prince Albert, R64; nr Klaarstroom, R27. Willowmore District: Koppies nr Miller, R8, R9, R45. Steytlerville District: Steytlerville, R15, R43.

Herbarium Records:-

CAPE PROVINCE sap robusta

Laingsburg District: Whitehill, s.leg.No.27630 in Herb. Bol (BOL); ?Matjesfontein, s.leg. Bartlet 349 (BOL). Beaufort West District: Beaufort West, s.leg. Nat.Bot.Gdns 3172/14 (BOL); N. of Beaufort West, L.E.Taylor 921 (BOL); Nelspoort, s.leg. Nat.Bot.Gdns. 1908/27 (BOL). Prince Albert District: R.Broom s.n. No.11652 in Herb Marloth (PRE). Willowmore District: Koppie nr Willowmore, C.L.Leipoldt 3062 (BOL); nr Miller, J.S.Rees s.n. Nat.Bot.Gdns. 1302/25 (NBG). Steytlerville District: Steytlerville, Dyer 4022 (PRE). Jansenville District: Lake Mentz, S.Schonland s.n. Aug.1921 (PRE); Waterford Acocks 11995 (PRE); Mount Stewart, Compton 20323 (NBG).

District unknown, probably Willowmore: Between Oudtshoorn and Willowmore, s.leg. Stell.Univ.Gdns. 7849 (BOL).

Without locality: Karoo Gardens Whitehill, Compton 7689 (NBG); F.Pat~~t~~erson 2160 (BOL).

Astroloba bullulata (Jacquin) Uitewaal in Succulenta 1947 (5): 53(1947).

Aloe bullulata Jacquin, Fragmenta t.109 (1809); Salm-Dyk, Cat.Rais.: 11 no.29 (1817); Schultes, Syst.Veg. 7 (1) : 660 (1829); Kunth, Enum. Pl.4 : 494 (1843).

Apicra bullulata (Jacquin) Willdenow in Ges. Naturf. Fr. Berl. Mag. 5 : 273 (1811); Haworth, Suppl. Pl. Succ. : 61 (1819); Berger in Pflanzenreich 4 (38) : 116 (1908); non Uitewaal in Succulenta 1938 (2) : 171 - 177 (1938).

Apicra pentagona var. bullulata (Jacquin) Baker in Jour. Lin. Soc. Lond. 18 : 217 (1881), & in Flora Capensis 6 (2) : 330 (1896).

Apicra bicarinata Haworth sensu Berger in Pflansenreich 4 (38) : 116 (1908).

Apicra egregia von Poellnitz in Fedde. Repert. 28 : 100 (1930), & in Desert Plant Life 9 (3) : 33 (1937); Uitewaal in Succulenta 1938 (2) : 171 - 177 (1938).

Astroloba egregia (von Poellnitz) Uitewaal in Succulenta 1947 (5) : 54 (1947).

Leaves in five straight rows to, rarely, imbricate, spiral angle usually 0 - 10°; leaves usually sub-erect, the leaf apex curving upwards, very frequently upwards and to one side, the side on which the keel is situated.

The leaf apex is keeled marginate.

Tubercles present on some or all of the leaves of any one plant; tubercles fairly prominent, about 1.0 mm. in diameter, each tubercle usually composed of an aggregation of smaller protuberances; tubercles few in number and irregularly scattered, or more numerous forming large aggregations, often grouped in rough transverse rows; tubercles never as numerous as in A. rugosa.

Leaf colour: Agathia Green, Pod Green, Veronese Green, Sap Green or Scheeles Green, frequently with a Garnet Brown overtone; tubercles concolorous, paler or whitish. Vein lines never present. Bundle caps apparently always unlignified towards the leaf apices.

Leaf length: 2.3-4.0 cm., usually 2.5-3.5 cm.; width of leaf at widest part 1.3-2.6 cm.; length-breadth ratio: 1.38-2.72, usually 1.50-1.75; position of widest part of leaf: 0.0-0.6 cm. below mid length, usually 0.0-0.5 cm. below midlength. Mucro length: 0.03-0.20 cm., usually 0.05-0.10 cm.

Peduncle length: 14 - 30 cm.; raceme length: 11 - 29 cm.; width of base of peduncle at its widest part: 0.44 - 0.56 cm.; usually 0.45 - 0.55 cm.; width of peduncle below first pedicel, 0.24 - 0.33 cm., usually 0.25 - 0.30 cm.

Branching of inflorescences: unexpanded raceme buds recorded in sterile bract axils of 20% of the specimens examined.

Number of sterile bracts per peduncle: 3 - 7; basal sterile bract: length, 0.42 - 0.73 cm., usually 0.50 - 0.70 cm.; width of base 0.26 - 0.40 cm., usually 0.25 - 0.30 cm.; width half way along length 0.08 - 0.23 cm.. Basal fertile bract: length 0.35 - 0.53 cm., usually 0.35 - 0.50 cm.; width of base 0.20 - 0.30 cm., width half way along length 0.08 - 0.16 cm., usually 0.10 - 0.15 cm..

Flowering pedicel: from base of raceme 0.30 - 0.53 cm., usually 0.40 - 0.60 cm.; from middle of raceme 0.29 - 0.47 cm., usually 0.30 - 0.45 cm.

Colour of perianth: midrib of tepals green often with a reddish brown tinge where the veins end in the lobes, and a glaucous brown tinge in the tubular part of the perianth; the tissue on either side of the veins in the tubular part of the perianth greenish white, often with a faint yellow-brown tinge; perianth lobes bright yellow to creamy yellow.

Dimensions of perianth: length of tube to neck, usually 8.0 - 11.0 mm.; basal diameter of tube usually 3.0 - 3.5 mm., and equal to, or up to, 0.3 mm. greater than the middle diameter; length of lobes usually 1.5 - 2.0 mm., width of outer lobes usually 1.5mm.; inner lobes slightly broader, usually 1.5 - 2.0 mm. in width.

DISTRIBUTION

Living specimens examined by the author:-

CAPE PROVINCE

Ceres District: 40 mi. N. of Ceres on Sutherland rd., R24.

Laingsburg District: 4 mi. N. of Matjesfontein R25, R55.

Herbarium Records:-

CAPE PROVINCE

Sutherland District: Verlatenkloof, H.Hall s.n. Nat.Bot.Gdns. 258/55 (NBG); Roggeveld Mts near Sutherland, J.D.Logan s.n. No.27635 in Herb.Bol.(BOL); Ceres District: Ceres Karoo, Stell.Univ.Gdns s.n.

No.27635 in Herb.Bol.(BOL); Laingsburg District: Between Ladismith and Laingsburg, s.leg. s.n. No.9363 in Herb. H.Bolus (BOL).

Astroloba hallii Roberts sp. nov.

Folia cum carina marginem ad apicem formante et vulgo sursum curvante, 2.7 cm. ad 5.8 cm. longa et 1.3 cm. ad 2.0 cm. lata in parte latissima; semper cum nervis fuscioribus longitudinalibus; cum maculis albicantibus vel tuberculis in numero variabilibus irrulariter vel in seriebus longitudinalibus secus nervis adspersis; muris exterioribus cellularum epidermalium inferiorum ex superiore dimidia foliae convexis; pileis fasiculorum vascularum lignificatis per longitudinem integram foliae; pedicellus florae ex base racemi 0.33 cm. ad 0.75 cm. longus et bractea subtendens eiusdem 0.30 cm. ad 0.54 cm. longa; perianthemum cum lobis flavis ad colorem floris lactis.

TYPUS. CAPE PROVINCE. Laingsburg District: Koup, Roberts 26 (BOL).

Aloe pentagona Jacquin, Fragmenta No.277 pl.111 (1809), may provide the earliest epithet applicable to this species but the identity of the species to which the epithet pentagona was originally applied, is very much open to doubt.

Leaves in five straight to spirally twisted rows, spiral angle usually 0 - 10^{o}; leaves erect to patent erect, usually suberect; leaf apices usually curving upwards, rarely following the angle of the leaf with the stem.

Keeled marginate apices occur in all, or the majority, of leaves of any one plant.

Whitish maculae or tubercles present on some of the leaves of plants in 88% of specimens examined; maculae, when present, usually few in number and irregularly scattered; tubercles not as prominent as in A.bullulata, and generally smaller since they are not of a compound nature; tubercles few in number and irregularly scattered, or more numerous and usually grouped in longitudinal rows corresponding to the vein lines; tubercles never as numerous as in A. rugosa.

Leaf colour: Agathia Green, Pod Green, Veronese Green or Sap Green; margins and keels darker, frequently reddish-brown towards the leaf apex; apical third of leaf may have a reddish tinge. Tubercles paler, usually darker, often with a reddish tinge.

Longitudinal vein lines always present, very obvious, darker green in colour, often with a reddish tinge towards the apex. Bundle caps lignified for entire length of leaf in all specimens examined.

Leaf length: 2.7 - 5.8 cm., usually 3.0 - 4.0 cm.; width of leaf at widest part 1.3 - 2.0 cm., usually 1.5 - 2.0 cm.; length breadth ratio: 1.72 - 3.14, usually 2.00 - 2.50; position of widest part of leaf: 0.30 - 1.30 cm. below mid length, usually 0.25 - 0.75 cm. below mid length; mucro length 0.05 - 0.15 cm.

Peduncle length: 18 - 31 cm.,usually 15 - 30 cm.; raceme length: 8 - 32 cm., usually 15 - 25 cm.; width of base of peduncle at its widest part: 0.39 - 0.90 cm., usually 0.45 - 0.60 cm.; width of peduncle below first pedicel: 0.17 - 0.44 cm., usually 0.20 - 0.40 cm.

Branching of inflorescence: branched inflorescences observed in 5% of specimens examined, unexpanded raceme buds in sterile bract axils in 35% of specimens examined.

Number of sterile bracts per peduncle: 3 - 14, usually 4 - 7; basal sterile bract: length 0.43 - 0.93 cm., usually 0.60 - 0.80 cm.; basal width 0.19 - 0.47 cm, usually 0.20 - 0.40 cm.; width half way along length 0.08 - 0.22 cm., usually 0.10 - 0.50 cm..

Basal fertile bract: length 0.30 - 0.54 cm., usually 0.30 - 0.50 cm.; basal width 0.19 - 0.40 cm., usually 0.20 - 0.30 cm.; width half way along length 0.07 - 0.13 cm., usually 0.10 cm.

Flowering pedicel: from base of raceme 0.33 - 0.75 cm., usually 0.40 - 0.50 cm.; from middle of raceme 0.24 - 0.59 cm., usually 0.30 - 0.40 cm.

Colour of perianth: as for A.bullulata, save that the lobes and tissue on either side of the midribs of the perianth tube are occasionally cream in colour. Dimensions of perianth are very similar to those of A. bullulata, save that the length of the tube to the neck is usually 9.0 - 11.0 mm., and the base of the tube, while usually equal to or up to 0.40 mm. greater than the middle diameter, is occasionally up to 0.30 mm. less than the middle diameter.

This species is close to A. bullulata from which it differs in the presence of very obvious vein lines on the under side of the leaf, and in the fact that the bundle caps are lignified for the entire length of the leaf. Further, the leaves tend to be narrower and the leaf apices more acute than in A. bullulata.

DISTRIBUTION.

Living specimens examined by the author:-

CAPE PROVINCE.

Laingsburg District: Koup, R26, R54; nr farm Rietvlei along Laingsburg-Sevenweeks Poort road, R48, R52.

Herbarium records:-

CAPE PROVINCE. hallii

Laingsburg District: 6 mi. from Laingsburg on rd to Ladismith W.F.Barker 109 (BOL); Between Ladismith and Laingsburg, s.leg. s.n. No.9363 in Herb.H.Bolus, No.27624 in Herb.Bol.(BOL); N. slopes of Swartberg, A.J.Joubert s.n. No.27623 in Herb.Bol.(BOL). Prince Albert District: Prince Albert, J.W.Matthews s.n. Nat.Bot. Gdns.3479/14 (BOL); J.Rennie s.n. Nat.Bot.Gdns.1418/28. Ladismith District: Ladismith, A.J.Joubert 97 (BOL).

Without locality: ex hort. s.leg. No.7983 in Herb.Marloth (PRE).

Astroloba smutsiana Roberts sp. nov.

Folia marginatis ad apicem, apicibus vulgo rectis vel recurvatis, 1.8 cm. ad 3.9 cm. longa, 1.0 cm. ad 2.0 cm. lata in parte latissima, plerumque nervis fuscioribus ad apicem visis; tubercula vel maculae nunquam in natura visis; muris exterioribus cellularum epidermalium inferiorum ex superiore dimidia foliae convexis; pedicellus florae ex base racemi 0.14 cm. ad 0.48 cm. longus et bractea subtendens eiusdem 0.27 cm. ad 0.60 cm. longa; perianthemum cum lobis colorem floris lactis habentis vel albis, nunquam flaventibus.

TYPUS. CAPE PROVINCE. Ladismith District: 24 mi. S. Ladismith on old Barrydale road, Roberts 3 (BOL).

Leaf arrangement variable ranging from leaves in five straight rows to imbricate; leaves sub-erect to patent erect, usually sub-erect, leaf apices following the angle of the leaf with the stem or curving outwards.

The leaf apex is true marginate.

No spots or tubercles, but one or more leaves with one to four elongated, slightly raised shiny patches observed in 16% of specimens examined.

Leaf colour similar to that of A. ballii; margins and keels concolorous or darker, rarely paler; leaf apices often with a reddish brown or garnet brown tinge; darker bundle cap lines visible, extending for a short distance from the apex in 84% of plants examined.

Leaf length: 1.8 - 3.9 cm., usually 2.0 - 3.0 cm.; leaf width at widest part: 1.0 - 2.0 cm., usually 1.25 - 1.50 cm.; length-breadth ratio: 1.14 - 2.31, usually 1.25 - 2.00; position of widest part of leaf, 0.0 - 0.6 cm. below mid length, usually 0.0 - 0.5 cm. below mid length; mucro length: 0.04 - 0.13 cm., usually 0.05 - 0.10 cm..

Peduncle length: 8 - 29 cm.; usually 10 - 20 cm.; raceme length: 8 - 25 cm., usually 10 - 20 cm.; width of base of peduncle: 0.22 - 0.42 cm., usually 0.25 - 0.40 cm.; width of peduncle below first pedicel: 0.11 - 0.24 cm., usually 0.15 - o.20 cm.

Branching of inflorescences: unexpanded raceme buds in axils of sterile bracts observed in 3% of specimens examined.

Number of sterile bracts per pedicel: 2 - 10 bracts, usually 3 - 6; basal sterile bract: length 0.42 - 1.05 cm., usually 0.40 - 0.80 cm.; width of base 0.15 - 0.37 cm., usually 0.20 - 0.30 cm; middle width half way along length: 0.05 - 0.15 cm., usually 0.05 - 0.10 cm..

Basal fertile bract: length 0.29 - 0.60 cm., usually 0.30 - 0.50 cm.; basal width 0.14 - 0.35 cm., usually 0.15 - 0.30 cm.; middle width 0.06 - 0.13 cm., usually 0.10 cm. or less.

Flowering pedicels: from base of raceme, length 0.14 - 0.48 cm., usually 0.20 - 0.40 cm.; from middle of raceme, length, 0.09 - 0.60 cm., usually 0.20 - 0.30 cm.; fruiting pedicels from base of raceme, length, 0.24 - 0.43 cm..

Colour of perianth: midribs of tepals pale green, tissue on either side of midribs in perianth tube a greenish cream becoming darker at the base of the tube, lobes of perianth white or cream, never yellow.

Dimensions of perianth: length of tube to neck, usually 9 - 11 mm.; basal diameter of tube usually approximately 3.0 mm.; from up to 0.4 mm. greater than the middle diameter to up to 0.4 mm. less, most frequently equal to or less than the middle diameter; length of lobes, approximately 1.5 mm., width of outer lobes usually 1.0 - 1.5 mm., inner lobes sometimes slightly broader.

This species has some affinity with <u>A. hallii</u>, from which it differs in the possession of a true marginate apex. Secondary points of difference are the absence of spots or tubercles in field populations, the usually shorter leaves, the more slender peduncles, the shorter pedicels, and the persistently white or cream perianth lobes.

References which may have been alluding to this species are: <u>Aloe pentagona</u> (Aiton) Haworth sensu Ker in Bot.Mag.33 t.1338 (1811); Salm-Dyk, Monogr.Aloes.: S1 fig.3 (1836-1863). <u>Aloe spirella</u> (Haworth) Salm-Dyk sensu Salm-Dyk Monogr.Aloes.: S1 fig.3 (1836-1863).

As has been shown, the identity of the original species described by these epithets is so much open to doubt, that the author has been forced to abandon them.

<u>DISTRIBUTION</u>.

Living specimens examined by the author:-

CAPE PROVINCE.

Ladismith District: 20-26 mi. S. of Ladismith on old Barrydale road, R3, R62a, R5, R62b; nr farm Rietvlei on the Laingsburg-Sevenweeks Poort road, R49. Laingsburg District: Rooineck Pass, R51. Riversdale District: Between Adamskraal and Ochertskraal, R63.

Herbarium records:-

CAPE PROVINCE,

Laingsburg District: Rooihoogte, P.Bond 259 (NBG).

Ladismith District: Ladismith, P.Ross-Frames s.n. Nat.Bot.Gdns. 2155/26 (BOL).

Astroloba rugosa Roberts sp. nov.

Aloe aspera Haworth sensu Salm-Dyk Monogr.Aloes.: S2 fig.2 (1836-1863); non Haworth in Trans. Lin. Soc. 7 : 6 (1804); non Aiton, Hort. Kew. ii 2 : 299 (1811); non Sprengel Syst. Veg. 2 : 69 (1825); nec Schultes Syst. Veg. 7 (1) : 651 (1825).

Apicra aspera (Haworth) Willdenow sensu Baker in Jour. Lin. Soc. Lond. 18 : 218 (1881); Berger in Pflansenreich 4 (38): 116 (1908); Haworth, Suppl. Pl. Succ.: 63 (1819) in part, excluding description of leafy shoot; non Willdenow in Ges. Naturf. Fr. Berl. Mag. 5 : 274 (1811).

Astroloba aspera (Haworth) Uitewaal sensu Uitewaal in Succulenta 1947 (5) : 53 (1947.

non Haworthia aspera (Haworth) Haworth, Syn. Pl. Succ. : 90 (1812).

Folia marginatis ad apicem, apicibus vulgo recurvatis, 1.4 cm. ad 2.5 cm. longa, 1.1 cm. ad 1.8 cm. lata in parte latissima, tuberculata, tuberculis ad usque 0.5 mm. diametro subregulariter et plus minusve in seriebus longitudinalibus dispersis, 5 usque ad 25 tuberculae in 4 mm^2 sed constans in eadem planta; muris exterioribus cellularum epidermalium inferiorum ex superiore dimidia foliae convexis, frequenter papillatis; pedicellus florae ex base racemi 0.2 cm. ad 0.9 cm. longus et bractea subtendens eiusdem 0.23 cm. ad 0.50 cm. longa; quodque trium tepalorum exteriorum quibus tubo corollae constituto aliquando in utraque latere nervae centralis cum parenchyma subinflata; lobis colorem floris lactis habentis vel albis.

TYPUS. CAPE PROVINCE. Montagu District: At the end of the Baden road, Roberts 18 (BOL).

The epithet "aspera" was originally applied by Haworth (1804), to a member of the genus Haworthia. Subsequently plants belonging to the genus Astroloba were incorrectly referred to by the epithet "aspera", and until the presentation of this thesis, the name was in common usage as pertaining to a species of the genus Astroloba.

The combination Astroloba aspera (Haw.) Uitew. is legitimate, but incorrect for it applies to an Haworthia, and the plants of Astroloba to which it has been applied are thus without a name.

Accordingly, the plants of Astroloba previously referred to by this epithet have to be treated as a new species.

Leaves in five straight rows to imbricate, spiral angle usually 0 - 10°, leaves usually suberect, leaf apices usually curving outwards.

Leaf apices of the true marginate type.

Tubercles present on the exposed parts of all leaves, tubercles fairly evenly distributed, but tending to be arranged in longitudinal series of up to six tubercles converging in a single longitudinal group, density of tubercles varies from approx. 5 per 4 mm. sq. to approx. 25 per 4 mm. sq., but degree of tuberculation the same for all leaves of any one plant; tubercles up to 0.5 mm. in diameter, generally less prominent in plants with a low tubercle density.

Leaf colour as for A.bullulata; tubercles typically concolourous.

The convex outer wall of epidermal cells in section frequently appears papillate.

Leaf length: 1.4 - 2.5 cm. usually 1.5 - 2.5 cm.; leaf width at widest part: 1.10 - 1.80 cm. usually 1.25 - 1.50 cm; length-breadth ratio : 1.00 - 1.83, usually 1.00 - 1.75; position of widest part of leaf: 0.2 cm. above mid length to 0.3 cm. below mid length usually 0.1 cm. above to 0.2 cm. below mid length; mucro length 0.04 - 0.10 cm.

Peduncle length: 10 - 43 cm. usually 15 - 25 cm.; raceme length: 5 - 27 cm., usually variable, 5 - 20 cm. ; width of base of peduncle: o.22 - 0.41 cm. usually 0.25 - 0.40 cm.; width of peduncle below raceme: 0.14 - 0.28 cm., usually 0.15 - 0.25 cm.

No branched inflorescences or unexpanded raceme buds in the axils of sterile bracts have been observed.

Number of sterile bracts : 2 - 4; basal sterile bract: length 0.40 - 0.80 cm., usually 0.40 - o.60 cm.; width of base, 0.18- 0.36 cm. usually 0.20 - 0.30 cm.; middle width halfway along length, 0.06 - 0.23 cm. usually 0.10 - 0.15 cm.

Basal fertile bract : length, 0.23 - 0.50 cm. usually 0.30 - 0.60 cm.; basal width, 0.20 - 0.30 cm.; middle width 0.07 - 0.17 cm. usually 0.10 cm.

Flowering pedicel: from base of raceme, length 0.20 - 0.90 cm. usually variable 0.30 - 0.80 cm.; from middle of raceme length 0.18- 0.92 cm., usually 0.30 - 0.50 cm.

Colour of perianth : midribs of tepals green with a beige or pink tinge; tissue on either side of the three outer tepals of perianth tube may be very slightly inflated, and is white or cream in colour, or with a faint pink or greenish tinge; lobes cream or whitish.

Dimensions of perianth tube: length of tube to neck, usually variable, 7.0 - 12.0 mm.; basal diameter of tube usually 2.5 - 3.5 mm., and usually up to 0.5 mm. greater than the middle diameter; lobe length approx. 1.5 mm; width of outer lobes approx. 1.5 mm.; inner lobes generally slightly broader, and 1.5 - 2.0 mm. in width.

This species differs from the other two members of the genus with tuberculate leaves in the possession of true marginate apices, and in the greater degree of tuberculation and in the more even distribution of the tubercles, and in the smaller size of the leaves. In tuberculation this species is very similar to the intergeneric hybrid <u>Astroworthia</u> X <u>bicarinata</u>, but it is of a smaller size.

DISTRIBUTION

Living specimens examined by the author :-

CAPE PROVINCE.

Montague District: Along the Baden road, R17, R18, R59; Along the Petersfontein road, R19, 20; near farm Brakwater along Dobbelaars Kloof road R21, R22; 2 mi. W of Montagu R23, near farm Rietvlei No.2, R50A. Ladismith District: Approximately 20 mi. S of Ladismith along old Barrydale road, R2; near farm Rietvlei along Laingsburg - Sevenweekspoort road, R66.

Herbarium records :-

CAPE PROVINCE. rugosa

Worcester District: 12 mi. SE of Touwsrivier, A.J.Joubert s.n. No.27636 in Herb. Bol. (BOL). Montagu District: Montagu A.J.Joubert s.n. Dec. 1932 (GRA); J. Neil s.n. No. 27637 in Herb. Bol. (BOL); Hurling and Neil s.n. No.27642 in Herb.Bol. (BOL); Kiesies Hoogte, Malang s.n. Nat. Bot. Gdns. 1687/22 (BOL); Montagu ex hort. Bonnievale Jan. 1937, N.J.S. van der Merwe 227 (BOL). Swellendam District: Bonnievale Jan. 1937, N.J.S. van der Merwe 226 (BOL); 6 mi. N of Barrydale, P. Ross-Frames s.n. Nat. Bot. Gdns. 2154/26 (BOL); Warmwaterberg, R. du Plessis s.n. No. 27639 in Herb, Bol. (BOL). Riversdale District: Riversdale E. Ferguson s.n. No.27641 in Herb. Bol. (BOL); Muiskraal, Compton & Lamb s.n. Nat. Bot, Gdns. 2306/27 (BOL). Ladismith District: van Wyksdorp, A.J. Joubert 111 (BOL); Ladismith, s.leg No. 27638 in Herb. Bol (BOL); A.J. Joubert s.n.27640 in Herb. Bol (BOL); Between Ladismith and Laingsburg, N.S. Pillans 857 (BOL). Graaff Rienet District: Graaff Rienet, s.leg No. 4202 in Herb. Marloth (PRE).

Astroloba herrei Uitewaal in Desert Plant Life 18 (3) (1948): & in Succulenta 1950 (4): 56-58 (1950.

Astroloba dodsoniana Uitewaal in Desert Plant Life 22 (3): 29-32 (1950).

Leaf arrangement varying from leaves in five straight rows to imbricate, leaves usually in five straight to spirally twisted rows; leaves sub-erect or patent-erect, typically sub-erect;

leaf apices curving upward to outward.

Leaf colour Paris green, Cyprus green, Veronese green or Podgreen; margins and keels concolourous or paler, leaf tip very rarely reddish; darker bundle cap lines always present, usually showing as very fine longitudinal ridges.

Leaf dimensions: length, 1.8 - 3.2 cm. typically 2.0 - 2.5 cm.; width at widest part, 0.9 - 1.6 cm., usually 1.0 - 1.5 cm.; length-breadth ratio, 1.44 - 2.42 ; position of widest part of the leaf, 0.1 cm. above to 0.5 cm. below mid lenth, usually 0.0 - 0.5 cm. below mid length; length of mucro, 0.07 - 0.18 cm. usually 0.50 - 1.0 cm. Leaf apex narrowly acuminate.

Inflorescence: peduncle length: 10 - 30 cm. usually 15-25 cm.; raceme length: 9 - 28 cm.; thickness of peduncle: at base, 0.40 - 0.60 cm., usually 0.40 - 0.55 cm.; below first pedicel, 0.20 - 0.32 cm., usually 0.20 - 0.30 cm.; branched inflorescences or unexpanded raceme buds in axils of sterile bracts to date unobserved; number of sterile bracts, 2 - 5 bracts, usually 2 - 4 bracts.

Dimensions of basal sterile bract: length, 0.70 - 1.10 cm.; width at base, 0.28- 0.50 cm., usually 0.30 - 0.50 cm.; width half way along length, 0.10 - 0.27 cm., usually 0.15 - 0.20 cm.

Dimensions of basal fertile bract : length, 0.60 - 1.10 cm. usually 0.60 - 0.80 cm.; width at base, 0.30 - 0.50 cm.; width half way along length, 0.08 - 0.24 cm., usually 0.10 - 0.20 cm.

Pedicel length: flowering pedicel, from base of raceme, 0.35 - 1.68 cm., usually 0.4 - 0.8 cm.; from middle of raceme, 0.23 - 1.10 cm., usually 0.4 - 0.6 cm.

Perianth tube with a very marked inflation of tissue on either side of the three outer tepals, this inflation may be smooth or slightly undulating; colour of perianth as for <u>A. spiralis.</u>

Dimensions of perianth: length of tube to neck , 7 - 9 mm.; basal diameter of tube usually 2.5 - 4.0 mm.; basal diameter equal to or up to 1.0 mm. less than the middle diameter, more rarely up to 1.0 mm. greater than the middle diameter; length of lobes, usually 1.5 - 3.0 mm.; width of outer lobes, usually 1.5 - 2.5 mm.; width of inner lobes usually 2.0 - 3.0 mm.

This species differs from A. spiralis in primarily the chromosome number and in the smooth or slightly undulating nature of the inflated tissue of the perianth tube. Other differences of a secondary nature are the very marked bundle cap lines which are always present, frequently existing as fine longitudinal ridges, and the narrowly acuminate nature of the leaf apices. The pedicels tend to be slightly longer in A. herrei.

DISTRIBUTION

Living specimens examined by the author :-

CAPE PROVINCE.

Uniondale District: at farm Hoekplaas N of Uniondale, R16 R44. Prince Albert District: 4 mi. from Prince Albert on Klaarstroom road, R46.

Herbarium records :-

CAPE PROVINCE.

Prince Albert District: Prince Albert, A. Erasmus s.n. No. 13698 in Herb. Marloth (PRE); Acocks 18412 (PRE); Krige s.n. No. 13009 in Herb. H. Bolus (BOL). herrei

Without locality. Ex hort. s. leg. Aug. 1950 (NBG); s.leg. No. 27648 in Herb. Bol. (BOL); s.leg. No. 52)5 in Nat. Herb. (PRE).

Astroloba spiralis (Linnaeus) Uitewaal in Succulenta 1947 (5) : 53 (1947.

Aloe spiralis Linnaeus Sp. Pl. : 322 (1753), & Mantissa : Obs. : 368 (1771); Aiton Hort. Kew. (i) 1 : 470 (1789); Willdenow Sp. Pl. 2 (1) : 191 (1799); De Candolle Plantes Grasses : 56 (1799); Jacquin, Fragmenta No. 226 pl.110 (1809); Aiton Hort. Kew (ii) 2 : 297 (1811); Ker in Bot. Mag. 35 pl. 1455 (1811).

Apicra spiralis (Linnaeus) Baker in Jour. Lin. Soc. Lond.

18 : 217 (1881), & in Flora Capensis 6 (2) : 331 (1896); Berger in Pflanzenreich 4 (38) : 117 (1908).

Haworthia spiralis (Linnaeus) Duval, Pl. Succ. in Hort. Alencon. : 7 (1809).

Aloe spiralis var imbricata Aiton, Hort. Kew. (1) 1 : 470 (1789); Willdenow, Sp. Pl. 2 (1) : 191 (1789).

Aloe imbricata (Aiton) Haworth in Trans. Lin. Soc. 7 : 7 (1804) nom. illegit., Salm-Dyk, Cat Rais. : 10 (1817), & Monogr. Aloes : S1 fig. 1 (1836 - 1863); Sprengel, Syst. Veg. 2 : 70 (1825); Schultes, Syst. Veg. 7 : 657 (1829).

Apicra imbricata (Aiton) Willdenow, in Ges. Naturf. Fr. Berl. Mag. 5 : 273 (1811).

Haworthia imbricata (Aiton) Haworth, Syn. Pl. Succ. : 98 (1812).

Leaf arrangement variable, in five straight ranks to imbricate; leaves erect or sub-erect, the apices following the angle of the leaf with the stem or curving outward, more usually, the former.

Leaf colour: typically Agathia green, Pod green, Veronese green, Sap green and Scheeles green; margins and keels generally concolorous or darker, the leaf apices sometimes slightly reddish brown; occasionally darker bundle caps lines visible on the exposed part of the leaf, extending from the leaf apex; these never show as fine longitudinal ridges.

Leaf dimensions: length, 1.9 - 4.2 cm., usually 2.0 - 3.0 cm; width at widest part, 1.0 - 1.8 cm., usually 1.0 - 1.5 cm.; length-breadth ratio, 1.57 - 2.90; position of widest part of leaf, 0.1 - 0.9 cm. below mid length, usually 0.1 - 0.5 cm. below mid length; length of mucro, 0.04 - 0.16 cm., usually 0.05 - 1.0 cm. Leaf apex acute acuminate.

Inflorescence : peduncle length : 16 - 39 cm., usually 25 - 30 cm.; raceme length: 8 - 36 cm., usually 10 - 25 cm.; thickness of peduncle: at base, 0.26 - 0.56 cm., usually

0.30 - 0.50 cm.; below first pedicel, 0.13 - 0.29 cm., usually 0.15 -0.25 cm.; branched inflorescences or unbranched inflorescences with unexpanded raceme buds in the axils of sterile bracts, very rarely observed; number of sterile bracts, 3 - 7 bracts, usually 3 - 6 bracts.

Dimensions of basal sterile bract : length, 0.52 - 1.40 cm., usually 0.7 - 1.1 cm.; width at base, 0.20 - 0.40 cm., usually 0.20 - 0.30 cm.; width half way along length 0.05 - 0.15 cm., usually 0.05 - 0.10 cm.

Length of flowering pedicel : from base of raceme, 0.20 - 0.80 cm., usually 0.20 - 0.40 cm.; from middle of raceme, 0.12 - 0.51 cm., usually 0.15 - 0.30 cm.

Perianth tube with a marked inflation of tissue on either side of the three outer tepals, this inflation is very rugose, the rugosity taking the form of pronounced transverse wrinkles; the midribs of the tepals are pale green with a glaucous or beige tinge, the inflated tissue is white and the lobes are always yellow, never white or cream.

Dimensions of perianth : length of tube variable, 7 - 13 mm.; basal diameter of tube usually 2.5 - 4.0 mm.; basal diameter equal to middle diameter, or up to 0.5 mm. more or less than the middle diameter; length of lobes, usually, 1.5 mm.; width of outer lobes, usually 1.5 mm.; width of inner lobes, usually 1.5 - 2.0 mm.

DISTRIBUTION.

Living specimens examined by the author :-

CAPE PROVINCE

Ladismith District : 23 mi. S of Ladismith on old Barrydale road, R6; 8 mi. S of Calitzdorp R48. Oudtshoorn District: 4 mi. out of Oudtshoorn on Friesland road, R7, R61.

Herbarium specimens :-

CAPE PROVINCE:

Ladismith District: Ladismith, A.J. Joubert s.n. No.27626 in Herb. Bol. (BOL). Oudtshoorn District: W.F. Barker 5096 (NBG);

s.leg No. 6510a in Herb. Marloth (PRE); s.leg. No. 27625 in Herb. Bol. (BOL); W. Taylor s.n. Jan. 1916 (GRA); Taylor s.n. Nat. Bot. Gdns. 130/16 (BOL); De Rust, P. Ross-Frames s.n. Nat. Bot. Gdns. 2525/27 (NBG)(BOL). Graaff Rienet District: Graaff Rienet, Marloth 5112 in Herb Marloth (PRE).

Without locality: Little Karoo H. Herre s.n. Stell. Un. Bdns. 11 (BOL); Ex hort. s.leg. Nat. Bot. Gdns. 343/16 (BOL); sent from Port Elizabeth s.leg. No. 6510b in Herb. Marloth (PRE).

NOMINA REJICIENDA

Aloe spiralis var pentagona Aiton, Hort.Kew.(i) 1 : 470 (1789); Willdenow, sp. Pl.2 (1) : 191 (1799).

Aloe pentagona (Aiton) Haworth in Trans.Lin.Soc. 7 : 7 (1804); Jacquin, Fragmenta No.277 pl.111 (1809); Ker in Bot. Mag. 33 t 1138 (1811); Aiton, Hort.Kew (ii) 2 : 298 (1811); Salm - Dyk, Cat. Rais. : 10 (1817), & Monogr. Aloes.: Sl fig.4 (1836 - 1863); Schultes, Syst.Veg. 7 (1) : 659 (1825).

Apicra pentagona (Aiton) Willdenow in Ges. Naturf. Fr. Berl. Mag. 5 : 273 (1811); Haworth, Suppl. Pl. Succ.: 62 (1819); Baker in Jour.Lin.Soc. Lond. 18: 217 (1881); & in Flora Capensis 6 (2) : 330 (1896); Berger in Pflanzenreich 4 (38) : 117 (1908).

Haworthia pentagona (Aiton) Haworth, Syn. Pl. Succ. : 97 (1812).

Astroloba pentagona (Aiton) Uitewaal in Succulenta 1947 (5) :53, 54 (1947), ex err. Haworth nota.

Apicra pentagona var torta Haworth, Suppl. Pl. Succ. :62 (1819)

Aloe pentagona var torta (Haworth) Kunth, Enum. Pl. 4 : 495 (1843)

Haworthia spirella Haworth, Syn. Pl. Succ. : 97 (1812).

Aloe spirella (Haworth) Salm - Dyk, Cat. Rais. : 10 (1817), & in Monogr. Aloes : Sl fig.3 (1836 - 1863); Schultes Syst.Veg. I (1) : 658 (1829).

Apicra pentagona var spirella (Haworth) Baker in Jour. Lin. Soc. Lond. 18 : 217 (1881), & in Flora Capensis 6. (2) :330 (1896); Berger in Pflanzenreich 4 (38) : 118 (1908).

Astroloba pentagona var spirella (Haworth) Uitewaal in Succulenta 1947 (5) : 54 (1947).

Aloe spiralis Haworth non Linnaeus, in Trans. Lin. Soc. 7 : 7 (1804) nom. illegit; Sprengel, Syst. Veg. 2 : 70 (1825); Schultes, Syst. Veg. 7 (1) : 659 (1829); Salm - Dyk Monogr. Aloes. : Sl fig. 3 (1836 - 1863).

Apicra spiralis (Haworth) Willdenow in Ges. Naturf. Fr. Berl. Mag. 5 : 273 (1811); Haworth, Suppl. Pl. Succ. : 64 (1819).

Haworthia spiralis (Haworth) Haworth, Syn. Pl. Succ. : 97 (1812).

Aloe pentagona var spiralis (Haworth) Salm - Dyk, Cat. Rais. : 10 (1817).

Astroloba pentagona var spiralis (Haworth) Uitewaal in Succulenta 1947 (5) : 54 (1947), ex err. Salm - Dyk nota.

Apicra pentagona var Wildenovii Baker in Jour. Lin. Soc. Lond. 18 : 217 (1881), & in Flora Capensis 6 (2) : 330 (1896); Berger in Pflanzenreich 4 (38) : 117 (1908).

As has been shown in the account of the taxonomic history, there appears to have been some confusion in the past over the correct application of the epithet "pentagona" and consequently over the correct application of the epithet "spirella". Following Article 69 of the International Code, which states: "A name must be rejected if it is used in different senses and so has become a long and persistent source of error.", the present author has rejected all combinations for the genus which include the epithets "pentagona" (Aiton) and "spirella" (Haworth).

The epithet "spiralis" Haworth is at the outset invalid because it is predated by the epithet "spiralis" Linnaeus. As has been shown, there is also some uncertainty over the interpretation of "spiralis" Haworth, and its synonym "Wildenovii" Baker.

INCERTAE SEDIS

Apicra pentagona var torulosa Haworth, Revisiones
:201, 202 (1821)

Astroloba pentagona var torulosa (Haworth) Uitewaal in
Succulenta 1947 (5) : 54 (1947)

Aloe quinquangularis Schultes, Syst. Veg. 7 (1) : 658 (1829)

Aloe spirella var quinquangularis (Schultes) Salm - Dyk,
Monogr. Aloes. : Sl fig. 3b (1836 - 1863).

×ASTROWORTHIA Roberts hybrid. gen. nov. (= Astroloba x Haworthia)

Genus propositus includens hybridas inter species generum "Astrolobae Uitew. et Haworthiae Duval; descriptio ut in una sola hybrida cognita, Astroworthia x bicarinata (Haw) Roberts comb. nov.

Plantae caulescentes foliis imbricatis tuberculatis; perigonium cylindricum lobis subregularis ad vix bilabiatis.

The International Committee for Botanical Nomenclature has not yet reached a decision on the method of description of genera composed of intergeneric hybrids. It is the opinion of the present author that hybrid genera should continue to receive official recognition especially when the constituent hybrids are found in the field as in this instance. It does seem, however, that a Latin diagnosis should not be necessary, for the hybrids will vary in appearance depending upon the parents. For example, a cross between a species of Astroloba and a member of the truncata group of Haworthia might be completely different in appearance to x A. bicarinata, possessing acaulescent leaves and bilabiate flowers. Von Poellnitz's name Apworthia was, however, not recognised on the grounds that it lacked a Latin diagnosis.

X Astroworthia bicarinata (Haworth) Roberts comb. nov.

(Astroloba rugosa Roberts x Haworthia Margaritifera (Linnaeus) Haworth.)

Apicra bicarinata Haworth Suppl. Pl. Succ. : 63, 64 (1819); Baker in Jour. Lin. Soc. Lond. 18 : 29 (1881) & in Flora Capensis 6 (2) : 332 (1896); non Berger in Pflanzenreich 4 (38) : 116 (1908).

Aloe bicarinata (Haworth) Schultes, Syst. Veg. 7 (1) : 652 (1829); Kunth Enum. Pl. 4 : 496 (1843).

Apicra skinneri Berger in Pflanzenreich 4 (38) : 116 (1908).

Apicra bullulata sensu Uitewaal in Succulenta 1938 (11) : 171 - 177 (1938) non (Jacquin) Willdenow in Ges. Naturf. Fr. Berl. Mag. 5:173(1819).

Plants acaulescent up to 10 cm.high; leaf arrangement: leaves in five straight ranks to irregularly imbricate, erect to suberect, usually the latter, leaf apices curving upwards to outwards.

Leaves tuberculate, the tubercles numerous, 0.1 - 0.7 mm. in height and 0.3 - 0.5 mm. in diameter; fairly evenly distributed sometimes a few aggregated into small irregular groups, sometimes into longitudinal groups of up to 6 tubercles.

Leaf keel not always distinct, occasionally two keels present.

Leaf colour: Agathia green, Podgreen, Veronese green, Sap green or Scheeles green, frequently tinged with Garnet brown; tubercles concolorous or paler.

Leaf dimensions: length, 3.3 - 5.1 cm; width at widest part, 1.7 - 2.3 cm; length-breadth ratio, 1.68 - 2.59; position of widest part of leaf in relation to mid-length, 0.1 - 0.8 cm. below mid length; mucro length, 0.03 - 0.12 cm.

Inflorescence: length of peduncle, 12 - 36 cm; length of raceme, 4 - 33 cm; thickness of peduncle: at base, 0.36 - 0.73 cm; below first pedical, 0.16 - 0.37 cm; inflorescences usually either branched or with unexpanded raceme buds in the axils of the sterile bracts; number of sterile bracts, 2 - 5.

Dimensions of basal sterile bract: length, 0.40 - 1.05 cm; width at base, 0.28 - 0.70 cm; width half way along length 0.07 - 0.23 cm.

Dimensions of basal fertile bract: length, 0.33 - 0.81 cm; width at base, 0.28 - 0.60 cm; width half way along length, 0.10 - 0.23 cm.

Length of flowering pedicel: from base of raceme, 0.30 - 0.95 cm; from middle of raceme, 0.26 - 0.57 cm.

Colour of perianth: midribs of tepals pale green, with a glaucous or beige tinge, vein endings in lobes often with a reddish tinge; tissue of the tube on either side of the veins whitish, yellowish beige or with a green or pinkish tinge, becoming darker towards the base of the tube; lobes whitish, cream or yellowish cream; sometimes tube with a very slight inflation of tissue on either side of the midribs of the three outer tepals.

Dimensions of perianth tube: length, 7 - 13 mm; diameter of base, 2.5 - 4.5 mm; basal diameter, 0 - 1.5 mm greater than the middle diameter; dimensions of lobes: length, outer lobes, 1.5 - 2.5 mm; length, inner lobes, 1.5 - 3.0 mm; width outer lobes, less than 1.5 to 2.0 mm; width inner lobes, 1.5 - 3.5 mm.

DISTRIBUTION.

Living specimens seen by the author:-

CAPE PROVINCE.

Montagu District: On farm Riet Vlei No.2 nr Montagu; R50; From farm garden on Baden road nr Montagu, R.58.

Without locality: Ex hort. Kirstenbosch No.7262; Ex Karroo Gardens, Worcester, R 70; Ex hort. B.Carp, R 71; Ex hort. Malherbe, R 72; Ex hort. Stell.Univ.Gdns. leg H.Herre R 73.

Herbarium records:-

CAPE PROVINCE.

Montagu District: Montagu, Hurling & Neil No.1375 in Herb.Marloth (PRE); 4 m out of Montagu on the Baden road, Hurling & Neil s.n. Nat. Bot. Gdns. 1942/28 (BOL); Montagu, Hurling & Neil s.n. No.21338 (BOL); on farm Rietvlei nr Montagu, Roberts 50 (BOL).

REFERENCES

Acocks, J. P. H. (1953). Veld Types of South Africa. Botanical Survey of South Africa Memoir No. 28.

Aiton, W. (1789). Hortus Kewensis 1 : 470.

Aiton, W. T. (1811). Hortus Kewensis 2 : 297-299.

Baker, J. G. (1881). A Synopsis of Aloineae and Yuccoideae. Jour. Lin. Soc. Lond. 18 : 216-219.

Baker, J. G. (1889). New petalloid monocotyledons from the Cape Colony. Jour. Bot. 27 : 44.

Baker, J. G. (1896). Liliaceae : Apicra. Flora Capensis 6 (2) : 329-332.

Berger, A. (1908). Apicra. Pflanzenreich 4 (38) Liliaceae-Asphodeloideae - Aloineae 5 Apicra : 115-120.

Boerhaave, H. (1720). Index alter Plantarum quae in Horto Academico Lugduno Batavia aluntur 2 : 131 n.33.

British Colour Council and Royal Horticultural Society (1938). Horticultural colour chart.

Commelin, C. (1703). Praeludia Botanica : 83 t. 23.

Duval, H. A. (1809). Plantae Succulentarum in Horto Alenconio. : 7.

De Candolle, A. P. (1799). Plantes Grasses 1 : 56.

Dillenius, J. J. (1732). Hortus Elthamensis : 16 t. 13 fig. 14.

Esau, K. (1953). Plant Anatomy.

Esau, K. (1960). Anatomy of Seed Plants.

Featherly, H. I. (1954). Taxonomic Terminology of the Higher Plants. Iowa State College Press.

Ferguson, N. (1926). The Aloinae : a cytological study, with especial reference to the form and size of chromosomes. Phil. Trans. Roy. Soc. Lond. Series B 215 : 225-253.

Goodspeed, T. H. (1954). The Genus Nicotiana.

Guillamin, A. (1954). Cact. and Succ. Jour. 9 : 76. (Not seen).

Haworth, A. H. (1804). A New Arrangement of the Genus Aloe. Trans. Lin. Soc. 7 : 1-7.

Haworth, A. H. (1812). Synopsis Plantarum Succulentarum. : 90-99.

Haworth A. H. (1819). Supplementum Plantarum Succulentarum. : 50, 60-65.

Haworth, A. H. (1821). Revisiones Plantarum Succulentarum : 200-303.

Hooker, J. D. (1873). Aloe deltoidea. Curtis' Bot. Mag. 99 : t 6071.

Houttyn, F. (1773 - 1783). Pflanzen System 6 : 344.

Jacobsen, H. (1935). Handbook of Succulent Plants : 41 fig. 42.

Jacobsen, H. (1960). Handbook of Succulent Plants. (1) : 226-229.

Jacquin, N. J. (1809). Fragmenta Botanica. n.225, t.109; n.226, t.110; n.227, t.111.

Ker, J. B. (1811). Aloe pentagona. Curtis' Bot. Mag. 33 : t.1338.

Ker, J. B. (1811). Aloe foliolosa. Curtis' Bot. Mag. 33 : t.1352.

Ker, J. B. (1811). Aloe foliolosa. Curtis' Bot. Mag. 33 : t.1352.

Knorr, G. W. (1766 - 1767). Deliciae Naturae Selectae, etc. 1 : t A6. (Not seen).

Kondo, N. and Megata, M. (1943). Seiken Ziho 2 : 69-82. (Not seen).

Kunth, C. S. (1843). Ennumeratio Plantarum 4 : 493-496

Lamarck, J. B. P. A. de M. de (1783). Aloes cylindrique. Encyclopedie Methodique Botanique. 1 : 89 n.19.

Lanjouw, J. Ed. (1961). International Code of Botanical Nomenclature : 50.

Linnaeus, C. (1737). Hortus Cliffortianus. : 132.

Linnaeus, C. (1748). Hortus Upsaliensis. : 87. (Not seen).

Linnaeus, C. (1753). Species Plantarum. : 322.

Linnaeus, C. (1771). Mantissa Plantarum : Observationes in species plantarum. : 368.

Linnaeus, C. (ed. Murray trans. Lichfield Soc. 1782). A System of Vegetables. 1.

Linnaeus, C. (ed. Gmelin 1796). Systema Naturae. 2 : 563

Linnaeus, C. (ed. Persoon 1797). Systema Vegetabilium. : 360 n.5.

Linnaeus, C. (ed. Willdenow 1799). Species Plantarum. 2 (1) : 191 n.16.

Linnaeus, C. (ed. Sprengel 1825). Systema Vegetabilium. 2 : 69-70.

Linnaeus, C. (ed. Schultes 1829). Systema Vegetabilium. 7 (1) : 656-660.

Marloth, R. (1915). Flora of South Africa. 4 : 87, pl. 21.

Marloth, R. (1932). Flora of S. Africa. 3 (2) : 318.

Marshak, A. (1934). Chromosomes and Compatability in the Aloinae. Amer. Jour. Bot. 21 : 592-597.

Miller, P. (1768). Gardener's Dictionary. Aloe n.12.

Muir, J. (1929). The Vegetation of the Riversdale Area. Botanical Survey of South Africa, Memoir No. 13.

Resende, F. (1937). Planta. 26 : 757-807. (Not seen).

Riley, H. P. (1959). Polyploidy in Gasteria and Haworthia. Bull. Torrey. Bot. Club. 86 (2) : 81-87.

Riley, H. P. (1961). Chromosome numbers in Gasteria, Astroloba and hybrids. Jour. S. Afr. Bot. 27 (1) : 65-71.

Rowley, G. D. (1954). Nat. Cactus and Succ. Jour. 9 : 76. (Not seen).

Royen, A. van (1740). Florae Leydensis ... in Horto Academico Lugduno Batavio aluntur. (Not seen).

Salm-Reifferscheid-Dyk, J. (1817). Catalogue raissoné des espèces et variétés d'Aloes, etc. : 7, 9, 10.

Salm-Reifferscheid-Dyk, J. (1836 - 1863). Monographia genera Aloes et Mesembrianthemum. : S1 and 2.

Sato, D. (1937). Cytologia, Fujii Jub. Vol. : 80-95. (Not seen).

Sato, D. (1942). Jap. Jour. Bot. 12 : 57-161. (Not seen).

Stearn, W. T. (1939). Conservation of the name Apicra. Cactus Jour. 8 (2) : 28.

Thunberg, C. P. (1785). Dissertationes Academicae Upsaliensis 2 : 183 n.14.

Thunberg, C. P. (1794). Prodromus Plantarum Capensium. : 61.

Uitewaal, A. J. (1936). Het Geslacht Apicra. A.pentagona. Succulenta 1936. (Not seen).

Uitewaal, A. J. (1937). Het Geslacht Apicra. A.deltoidea and A.folidosa. Succulenta 1937 (Aug.). (Not seen).

Uitewaal, A. J. (1938). Het Geslacht Apicra. A.bullulata, A.skinneri and A.egregia. Succulenta 1938 (11) : 171-177.

Uitewaal, A. J. (1939). Het Geslacht Apicra. A.spiralis, A.congesta, A.rubriflora en sleutel tot het geslacht. Succulenta 1939 (3) : 25-30.

Uitewaal, A. J. (1947). Revisie van de nomenclatuur der genera Haworthia en Apicra. Succulenta 1947 (5) : 51-54.

Uitewaal, A. J. (1950). Astroloba herrei Uitew. Succulenta 1950 (4) : 56-58.

Uitewaal, A. J. (1950). Astroloba dodsoniana Uitew. sp. nov. Desert Plant Life 22 (3) : 29-31.

Uitewaal, A. J. (1953). The Generic Name Astroloba Uitew. Cactus and Succulent Journal of Great Britain. 15 (3) : 56-57.

von Poellnitz, K. (1930). Apicra egregia von Poellnitz sp. nov. Feddes Repert. 28 : 100.

von Poellnitz, K. (1937). Four little known South African Succulent Plants. Desert Plant Life. 9 (3) : 33.

von Poellnitz, K. (1943). Jour. Roy. Hort. Soc. 68 : 259. (Not seen).

Weather Bureau (1950). Climate of South Africa (2), Rainfall Statistics. Publication W.B. 20 Pretoria.

Weinman, J. W. (1737 - 1745). Phytanthoza Iconographia, etc. : 72. b. (Not seen).

Willdenow, C. L. (1809). Enummeratio Plantarum Horti Regii Botanici Berolinensis. : 384.

Willdenow, C. L. (1811). Bemerkungen über die Gattung Aloë. Ges. Naturf. Fr. Berl. Mag. 5 : 273, 274.

Locality.	Height of plant.	Spiral angle.	Angle of leaf with stem.	Curvature of leaf apex.
	CM.	°	°	
		A. FOLIOLOSA subsp. FOLIOLOSA.		
Steytlerville R14	9	19	60	o
	10	17	80	d
	10	30	70	o
	10	36	65	o*
	10	33	75	d
	10	19	65	o
	11	13	80	o
	11	9	70	d
	11	23	65	o
	13	28	80	o
	13	22	70	o
	14	24	70	o
	17	30	75	o
	18	28	55	o
	-	33	80	d*
Mount Stewart R13	7	26	75	o
	14	30	80	o?
	14	24	70	o
	15	40	70	o
	-	24	75	o
	-	33	70	o
	-	33	70	o
	-	7	65	o
Wolwefontein R11	8	45	80	o
	12	36	85	o
	12	33	80	o*
	12	30	80	o
	13	23	60	f
	14	33	85	o
	14	40	70	o
	17	-	80	o*
	-	18	80	o*
	-	36	75	f
Baroe R12	11	21	65	f
Waterford R10	11	30	70	f
	11	30	80	o
	15	-	60	o
	18	36	85	o
Lake Mentz R36,37	7	-	70	o
	8	36	70	d
	8	16	75	o
	10	30	80	d
	12	30	65	o*
	14	36	70	f
	14	30	75	d
	15	30	80	o*
	16	22	70	o
	20	17	80	o
	22	24	70	o
	27	45	60	f
	30	20	60	o*
	-	23	70	d
	-	36	75	o
	-	30	75	o*
nr. Pearston R34	9	20	60	o*
	10	29	70	o

Appendix Table 1 LEAF ARRANGEMENT IN FIELD POPULATION SAMPLES OF ASTROLOBA (f = following angle of leaf with stem; u = upward; us = upwards & sideways in the direction of the keel; o = outward; d = downwards, in the case of very patent leaves; * = curvature only slight.)

Locality.	Height of plant.	Spiral angle.	Angle of leaf with stem.	Curvature of leaf apex.
	cm.	°	°	
	A. FOLIOLOSA subsp. FOLIOLOSA Contd.			
Graaff Reinet R29	10	33	75	f
	11	17	75	o
	12	10	85	o
	15	9	70	o
	16	-	65	f
	-	33	80	o
	-	24	70	o
	-	30	65	o
	-	7	65	o*
	-	21	65	f
	-	28	70	o
	-	14	70	o
	-	16	65	f
	-	9	80	o*
	-	33	80	o
	-	20	70	o
	A. FOLIOLOSA subsp. CONGESTA.			
Krantz Drift Commins 2063	6	17	60	f
	14	1	60	o *
	14	4	60	o*
Dikkop Vlakte R40	11	41	35	f
	20	41	40	o*
	21	20	40	o*
	25	13	40	f
Helspoort R41	9	-	45	f
	11	-	50	f
	12	27	55	f
	13	23	35	f
	13	-	55	f
	13	8	55	f
	13	15	40	u*
	14	-	40	f
	14	36	45	f
	18	26	40	o*
	18	36	40	f
S. of Adelaide R38,39	11	15	60	o
	11	5	30	f
	11	17	60	o
	12	10	45	f
	12	11	60	o
	17	13	45	f
	17	10	50	u
	19	15	50	o
	24	15	35	f
	-	12	50	o*
	-	10	40	f
	-	15	35	o
	-	15	50	o*
	-	20	45	f
	-	20	35	f
	-	9	60	o
Rayners Kop R33	15	20	60	f
	17	15	50	o*

Appendix Table 1. contd. LEAF ARRANGEMENT IN FIELD POPULATION SAMPLES OF ASTROLOBA.

Locality.	Height of plant.	Spiral angle.	Angle of leaf with stem.	Curvature of leaf apex.
	cm.	o	o	
		A. FOLIOLOSA subsp. CONGESTA. Contd.		
Rayners Kop R33 (contd.)	20	10	40	f
	-	5	45	f
	-	10	60	f
	-	20	40	u
	-	10	30	f
	-	10	40	f
	-	20	45	u
	-	-	40	f
Cradock R32	9	23	40	f
	11	25	35	f
	13	20	55	f
	13	21	40	o*
	13	22	60	f
	14	10	60	f
	15	15	60	o*
	16	18	35	o*
	17	9	50	f
	-	20	70	f
	-	28	40	f
	-	8	35	f
	-	9	30	f
	-	19	40	u*
N. of Cradock R31	8	29	50	o*
	8	20	40	f
	12	33	40	o*
	13	9	45	f
	16	13	40	f
	-	20	40	f
		A. FOLIOLOSA subsp. ROBUSTA.		
Miller R8	13	3	150	o
	14	7	40	o*
	17	20	35	o*
	18	4	45	f
	20	11	45	o*
	21	4	45	f
	-	9	40	o*
	-	2	50	o
	-	3	40	o*
	-	10	55	o
	-	0	50	o*
	-	6	50	o*
	-	2	45	f
	-	10	40	o
	-	2	40	o
Nelspoort R28	12	23	50	o
	12	6	45	f
	13	34	35	f
	13	24	40	o*
	17	36	55	o
	20	13	40	o*
	20	28	50	o*
	-	16	35	o*
	-	36	35	f
	-	32	35	o

Appendix Table 1 contd. LEAF ARRANGEMENT IN FIELD POPULATION SAMPLES OF ASTROLOBA contd.

Locality.	Height of plant.	Spiral angle.	Angle of leaf with stem.	Curvature of leaf apex.
	CM.	o	o	
		A. FOLIOLOSA subsp. ROBUSTA. Contd.		
Nelspoort R28 (Contd.)	-	35	50	o*
	-	40	50	o*
	-	34	35	o*
Klaarstroom R27	15	28	40	f
E. of Laingsburg R1	15	19	50	o
Prince Albert R64	12	15	50	o*
	-	10	40	f
	-	15	45	o*
	-	12	50	o
	-	2	40	o*
	-	4	45	o
	-	4	50	o*
	-	10	55	o*
	-	3	40	o*
Steytlerville R15	6	1	45	f
	6	16	40	o
	7	16	45	o*
	7	13	40	o*
	8	2	45	f
	8	25	50	o
	8	10	40	f
	8	16	40	f
	9	16	40	f
	10	11	40	o*
	10	18	50	o
	11	6	45	o*
	11	8	45	f
	15	2	45	o
	-	5	45	o*
	-	15	30	f
	-	3	40	o
	-	18	50	o
Ft. Molteno Pass Hall 2284	12	-	60	o*
	13	-	70	o
	14	20	70	o
	15	20	70	o
	16	20	60	o
	16	23	70	o*
	-	30	60	o*
	-	5	75	d
		A. SMUTSIANA.		
Ladismith/Barrydale R3	7	15	45	o
	9	8	45	o
	10	36	50	o
	11	18	50	o
	11	36	40	o*
	11	15	50	o*
	11	10	40	o
	12	30	40	o*
	13	21	45	o

Appendix Table 1 **contd. LEAF ARRANGEMENT IN FIELD POPULATION SAMPLES OF ASTROLOBA contd.**

Locality.	Height of plant.	Spiral angle.	Angle of leaf with stem.	Curvature of leaf apex.
		A. SMUTSIANA. (Contd.)		
Ladismith/Barrydale R5	7	14	40	o*
	8	27	50	o
	10	7	40	f
	11	24	45	o
	11	10	40	o
	11	18	60	o
	12	15	50	o*
	12	30	50	o*
	12	23	45	f
	12	40	55	o
	13	16	35	f
	14	3	45	o*
	18	24	40	f
	19	12	45	f
	20	7	40	f
	-	22	45	f
	-	20	50	o
	-	10	45	o
Laingsburg/Sevenweeks Poort R49	10	11	55	o
	13	14	55	o
	18	20	55	o
	-	33	50	o
	-	13	30	f
Rooinek Pass R51	11	27	50	f
	12	26	60	f
	14	18	50	o
	15	33	40	f
	16	14	45	f
	17	33	40	f
	20	33	50	f
	20	28	40	o*
	20	2	60	o
	21	28	40	f
	-	20	40	o*
	-	24	40	o
	-	28	40	f
	-	30	50	o*
		HYBRID BETWEEN A. SMUTSIANA & A. RUGOSA.		
Ladismith/Barrydale R4	12	11	45	o
	14	11	40	o
	-	15	40	o
		A. HALLII.		
Laingsburg/Sevenweeks Poort R48	10	10	45	u
	12	10	50	u
	13	5	45	u
	-	15	55	u
	-	5	40	u
	-	10	50	u
	-	0	40	u
	-	5	50	f
Koup R26	23	10	35	u
	24	0	30	u

Appendix Table 1 contd. LEAF ARRANGEMENT IN FIELD POPULATION SAMPLES OF ASTROLOBA contd.

Locality.	Height of Plant.	Spiral angle.	Angle of leaf with stem.	Curvature of leaf apex.
	cm.	o	o	
		A. HALLII. (Contd.)		
Koup R26 (contd.)	-	8	40	u
	-	7	30	u
	-	5	45	u
	-	16	20	u
	-	0	30	u*
	-	5	40	u*
	-	5	30	u
	-	10	40	u*
	-	5	45	u*
	-	13	50	f
	-	5	30	u*
	-	10	50	u*
	-	10	35	u
	-	2	45	f
		A. BULLULATA.		
Ceres/Sutherland Rd R24	5	20	50	us
	6	8	40	us
	22	2	50	us
	-	7	55	us
	-	3	50	us
	-	4	50	us
	-	10	50	us
	-	11	40	us
	-	9	40	u
	-	4	50	u
	-	7	40	u
	-	10	40	us
	-	8	50	us
	-	1	50	u
	-	2	40	u
4 Miles W. Matjesfontein R25	8	0	45	us
	8	5	40	us
	9	8	50	us
	11	8	40	us
	24	2	35	us
	30	21	40	us
	-	5	40	us
	-	2	45	us
	-	2	40	us.
		A. RUGOSA.		
Ladismith/Barrydale R2	8	14	40	o
	16	20	50	o
Karoid areas near Montague R17 - 23	8	2	40	f
	11	6	40	o
	12	1	45	o
	12	10	40	o
	14	6	50	o
	14	16	45	o*
	14	10	40	f
	15	19	50	o
	18	9	40	o
	21	4	60	o
	25	10	45	o

Appendix Table 1 contd. LEAF ARRANGEMENT IN FIELD POPULATION SAMPLES OF ASTROLOBA Contd.

Locality.	Height of plant.	Sprial angle.	Angle of leaf with stem.	Curvature of leaf apex.
	cm	o	o	
		A. RUGOSA. (Contd.)		
Karoid areas near Montague R17-23 (contd.)	-	4	45	o
	-	22	50	o
	-	25	40	o
	-	13	50	o
	-	0	45	o
Rietvlei No. 2 R50a	26	1	40	f
	-	9	40	f
	-	7	40	o
	-	13	50	o
		A. HERREI.		
Farm Hoekplaas nr Uniondale R16	6	30	40	o
	9	30	45	o
	20	30	50	o
	-	20	55	o
	-	30	40	o
	-	20	45	o
	-	30	40	o
	-	10	40	o*
	-	20	60	f
Prince Albert R46	9	10	40	f
	10	15	35	u
	13	10	40	u
	13	15	40	u
	17	10	40	f
	19	12	40	f
	-	10	45	f
	-	15	40	u
	-	10	40	u*
	-	15	40	o
		A. SPIRALIS.		
Oudtshoorn R7	6	10	40	f
	7	10	40	o*
	7	5	30	o
	8	-	50	o
	8	10	40	f
	9	21	25	u
	9	33	45	f
	9	16	45	f
	9	0	35	o*
	11	27	30	f
	12	24	35	f
	16	24	45	o*
	20	30	50	f
	-	14	45	o*
	-	10	40	f
	-	10	35	f
	-	26	35	f
	-	20	40	o*
Calitzdorp R47	12	7	30	f
	13	36	30	f
	13	21	35	f
	13	22	30	f
	13	18	45	f
	17	17	25	f

Appendix Table 1 Cont. LEAF ARRANGEMENT IN FIELD POPULATION SAMPLES OF ASTROLOBA.

Locality.	Length	Width widest part	Width leaf base	Distance of widest part from base.	Side on which Keel situated	Keel length	Mucro length.	Length breadth ratio
	cm.	cm.	cm.	cm.		cm.	cm.	
				A. FOLIOLOSA subsp. FOLIOLOSA.				
Graaff Reinet R29	3.0	1.8	1.0	1.1	R	1.8	0.15	1.67
	2.4	1.9	1.0	1.1	L	1.5	0.11	1.29
	2.4	1.7	1.0	1.1	L	1.3	0.08	1.40
	2.3	1.8	0.9	1.0	R	1.4	0.11	1.28
	2.3	1.6	0.9	1.1	L	1.3	0.12	1.42
	2.3	1.5	0.9	1.0	L	1.3	0.12	1.59
	2.3	1.6	0.8	1.0	L	1.2	0.08	1.42
	2.2	1.4	0.9	0.9	R	1.3	0.10	1.57
	2.2	1.7	0.9	0.9	L	1.2	0.07	1.25
	2.2	1.7	1.0	0.9	R	1.4	0.09	1.28
	2.2	1.5	0.9	1.0	L	1.3	0.12	1.59
	2.1	1.7	0.8	0.9	L	1.3	0.09	1.27
	2.1	1.4	0.9	1.0	L	1.2	0.10	1.50
	2.0	1.3	0.8	0.9	L	1.3	0.09	1.54
	2.0	1.4	0.7	0.9	R	1.4	0.07	1.41
	1.9	1.4	0.8	0.9	L	1.1	0.08	1.37
	1.9	1.4	0.7	0.8	L	1.2	0.06	1.43
	1.9	1.5	0.7	0.9	L	1.3	1.10	1.25
	1.9	1.5	0.8	0.8	R	1.3	0.09	1.31
Near Pearston R34,35	1.9	1.3	0.8	0.8	R	1.2	0.07	1.53
	1.7	1.4	0.5	0.8	R	0.8	0.10	1.80
near Waterford Toekomst Farm R10	1.9	1.6	0.9	0.9	R+L	1.0	0.08	1.20
	1.8	1.3	0.7	0.7	R	1.0	0.05	1.35
	1.7	1.4	017	0.8	R	1.2	0.11	1.21
	1.7	1.5	0.9	0.8	R	1.2	0.10	1.14
	1.5	1.5	0.6	0.7	L	0.9	0.08	1.02
	1.4	1.0	0.4	0.6	R	0.8	0.05	1.40
near Lake Mentz R36,37	2.4	2.1	1.2	1.0	L	1.2	0.11	1.15
	2.2	2.1	1.4	1.1	R	1.2	0.14	1.07

Appendix Table 2 LEAF DIMENSIONS IN POPULATION SAMPLES OF ASTROLOBA. (All measurements are an average of those for several leaves taken from each plant.)

Locality.	Length	Width widest part	Width leaf base	Distance of widest part from base	Side on which Keel situated.	Keel length	Mucro length.	Length breadth ratio
	cm.	cm.	cm.	cm.		cm.	cm.	
				A. FOLIOLOSA subsp. FOLIOLOSA. (Contd.)				
near Lake Mentz R36, 37 (Contd.)	2.2	1.5	0.7	1.0	L	1.2	0.11	1.43
	2.1	1.7	1.0	1.1	L	1.0	0.08	1.22
	1.9	1.5	1.0	0.9	R	1.1	0.10	1.27
	1.7	1.4	0.9	0.9	L	1.0	0.10	1.19
	1.6	1.2	0.7	0.8	L	0.8	0.10	1.39
	1.6	1.5	0.8	0.8	R+L	0.9	0.10	1.07
	1.5	1.4	0.6	0.9	L	0.8	0.10	1.07
	1.5	1.2	0.5	0.6	R	0.9	0.10	1.26
	1.4	1.1	0.5	0.7	L	0.8	0.07	1.28
	1.4	0.9	0.5	0.6	L	0.8	0.05	1.55
	1.4	1.0	0.4	0.6	R	0.8	0.07	1.44
	1.4	1.1	0.5	0.7	L	0.8	0.05	1.23
near Wolwefontein R11	2.2	1.5	0.8	1.0	L	1.3	0.06	1.50
	2.1	1.6	0.8	1.1	R+L	1.2	0.08	1.34
	2.1	1.4	0.8	0.9	R	1.2	0.12	1.56
	1.9	1.4	0.7	0.9	L	1.2	0.12	1.42
	1.9	1.5	0.9	1.0	L	1.1	0.08	1.26
	1.9	1.4	0.5	0.8	L	0.9	0.07	1.37
	1.8	1.2	0.9	0.9	R	1.o	0.07	1.46
	1.7	1.3	0.8	0.9	L	1.0	0.09	1.31
	1.7	1.2	0.8	0.8	L	1.1	0.10	1.42
	1.7	1.5	0.7	0.8	R+L	0.8	0.10	1.12
	1.7	1.3	0.6	0.8	R	1.0	o.1	1.29
near Mount Stewart *(From Baroe) R12,13	2.5	1.5	0.9	1.0	L	1.5	0.13	1.70
	2.5	1.4	0.7	1.1	L	1.4	0.11	1.82
	2.4	1.1	0.7	1.1	R	1.3	0.11	2.14
	*2.2	1.6	0.8	1.1	L	1.3	0.09	1.40
	2.1	1.4	0.8	1.0	R	0.9	0.09	1.47

Appendix Table 2 LEAF DIMENSIONS IN POPULATION SAMPLES OF ASTROLOBA (Contd.)

Locality.	Length	Width widest part	Width leaf base	Distance of widest part from base	Side on which Keel situated.	Keel length	Mucro length.	Length breadth ratio
	cm.	cm.	cm.	cm.		cm.	cm.	
				A. FOLIOLOSA subsp. FOLIOLOSA. (Contd.)				
near Mount Stewart (Contd.)	1.9	1.6	0.9	1.0	L	1.1	0.07	1.19
	1.9	1.3	0.8	0.8	R	1.2	0.10	1.42
	1.8	1.1	0.8	0.8	L	1.2	0.09	1.60
	1.7	1.3	0.8	0.8	R	1.1	0.07	1.28
Steytlerville R14	2.5	1.5	0.9	1.0	R+L	1.4	0.11	1.71
	2.4	1.3	0.7	1.1	R	1.5	0.11	1.92
	2.3	1.7	1.0	0.9	R	1.4	0.11	1.35
	2.3	1.4	0.9	1.1	L	1.5	0.07	1.63
	2.3	1.4	0.8	1.0	R	1.4	0.06	1.61
	2.2	1.2	0.7	0.9	R	1.3	0.12	1.81
	2.1	1.8	1.1	1.0	L	1.2	0.08	1.19
	2.2	1.5	1.1	1.0	R	1.5	0.1	1.48
	2.2	1.3	0.8	1.0	R	1.2	0.09	1.72
	2.0	1.6	1.0	0.9	R	1.5	0.10	1.28
	2.0	1.6	0.8	1.0	L	1.2	0.06	1.32
	2.1	1.4	0.7	1.0	R	1.4	0.10	1.49
	2.0	1.4	0.8	0.9	L	1.2	0.11	1.48
	2.0	1.3	0.9	1.1	R	1.1	0.06	1.51
	2.0	1.3	0.7	0.9	R	1.0	0.05	1.57
	2.0	1.2	0.7	1.0	R	1.3	0.08	1.63
	1.9	1.3	0.6	1.0	L	1.0	0.05	1.43
	1.9	1.1	0.6	0.9	L	1.3	0.06	1.69
	1.8	1.1	0.6	0.8	R	1.1	0.07	1.62
	1.8	1.2	0.7	0.9	R	1.2	0.09	1.50
	1.8	1.2	0.6	0.9	L	1.1	0.11	1.50
	1.8	1.2	0.8	0.8	L	1.1	0.11	1.53
	1.8	1.2	0.7	0.8	L	1.0	0.09	1.57
	1.8	1.4	0.7	0.8	L	1.1	0.06	1.23
	1.8	1.4	0.8	0.9	R	1.1	0.09	1.30
	1.8	1.3	0.7	0.9	L	1.2	0.09	1.40

Appendix Table 2 LEAF DIMENSIONS IN POPULATION SAMPLES OF ASTROLOBA (Contd.)

Locality.	Length	Width widest part	Width leaf base	Distance of widest part from base	Side on which Keel situated	Keel length	Mucro length.	Length breadth ratio
	cm.	cm.	cm.	cm.		cm.	cm.	
			A. FOLIOLOSA subsp. FOLIOLOSA. (Contd.)					
Steytlerville (Contd.)	1.8	1.2	0.7	0.8	L	1.1	0.10	1.49
	1.8	1.2	0.8	0.8	L	1.3	0.07	1.52
	1.7	1.2	0.8	0.8	R	1.0	0.09	1.45
	1.7	1.4	0.7	0.9	R+L	0.9	0.05	1.18
	1.7	1.2	0.6	0.8	L	1.1	0.04	1.40
	1.7	1.2	0.7	0.9	R	1.1	0.09	1.44
	1.6	1.2	0.6	0.8	L	1.0	0.05	1.31
			A. FOLIOLOSA subsp. CONGESTA.					
19 miles north of Cradock near Knutsford R31	3.5	2.1	1.4	1.3	L	1.9	0.12	1.67
	3.2	1.6	1.0	1.2	R	1.8	0.1	2.03
	3.0	1.6	1.1	1.1	R	2.0	0.09	1.90
	2.9	1.7	1.0	1.1	R+L	1.9	0.08	1.76
	2.9	1.8	0.8	1.1	R+L	1.8	0.08	1.63
	2.7	1.7	1.1	1.1	L	1.6	0.12	1.61
	2.6	1.7	1.0	1.1	L	1.4	0.12	1.50
Cradock R32	4.0	2.1	1.3	1.7	R	2.3	0.10	1.91
	3.8	1.8	1.0	1.7	R+L	2.4	0.10	2.14
	3.6	2.1	1.4	1.4	R	2.2	0.07	1.73
	3.6	2.1	1.4	1.6	L	2.1	0.07	1.70
	3.5	1.7	1.1	1.6	R	2.0	0.08	2.03
	3.3	1.7	1.0	1.2	L	1.7	0.08	1.94
	3.3	2.0	1.1	1.4	L	1.7	0.09	1.63
	3.3	1.8	1.1	1.3	L	2.0	0.09	1.81
	3.2	1.7	1.0	1.3	L	1.9	0.09	1.85
	3.1	1.4	0.9	1.1	L	2.0	0.13	2.21
	2.9	1.6	1.0	1.4	R	1.8	0.09	1.80
	2.8	1.7	1.1	1.3	R	1.8	0.10	1.70
	2.7	1.6	1.0	1.3	L	1.7	0.08	1.69
	2.7	1.8	1.3	1.2	R	1.6	0.06	1.51
	2.5	1.5	0.9	1.1	R+L	1.4	0.05	1.63

Appendix Table 2 LEAF DIMENSIONS IN POPULATION SAMPLES OF ASTROLOBA (Contd.)

Locality.	Length	Width widest part	Width leaf base	Distance of widest part from base	Side on which Keel situated.	Keel length	Mucro length.	Length breadth ratio
	cm.	cm.	cm.	cm.		cm.	cm.	
				A. FOLIOLOSA subsp. CONGESTA. (Contd.)				
near Rayners Kop R33	4.6	2.3	1.6	1.8	R	2.5	0.11	2.00
	4.5	1.9	1.4	1.6	R	2.6	0.1	2.33
	4.0	2.2	1.5	1.6	R	2.6	0.09	1.82
	4.0	2.4	1.4	1.6	R	2.1	0.65	1.66
	3.7	1.9	1.2	1.5	R	2.2	0.08	1.95
	3.5	1.9	1.2	1.4	R	2.2	0.06	1.89
	3.5	2.1	1.4	1.5	L	2.1	0.08	1.68
	3.4	2.1	1.5	1.5	R	1.9	0.06	1.62
	3.4	2.0	1.6	1.6	L	1.9	0.07	1.74
	2.9	2.1	1.4	1.4	R+L	1.7	0.08	1.39
12 to 18 miles from Adelaide on Grahamstown Rd. R38,39	4.4	2.8	1.8	1.9	L	2.8	0.08	1.58
	4.2	2.5	1.7	1.8	R	2.8	0.09	1.71
	3.7	2.2	1.4	1.8	R+L	2.3	0.05	1.72
	3.7	2.7	1.7	1.8	L	2.2	0.07	1.35
	3.4	1.9	1.2	1.6	R	1.9	0.10	1.76
	3.3	2.2	1.5	1.4	L	2.2	0.08	1.50
	3.3	1.8	1.2	1.6	L	1.9	0.10	1.81
	3.1	1.8	1.1	1.4	R	2.0	0.10	1.72
	3.0	1.8	1.1	1.3	R+L	1.9	0.09	1.68
	3.0	1.7	1.1	1.2	L	2.1	0.07	1.74
	2.9	2.1	1.2	1.4	L	1.6	0.08	1.39
	2.8	1.9	1.1	1.3	R	1.6	0.08	1.51
	2.8	1.9	1.0	1.2	L	1.6	0.07	1.39
	2.7	1.7	1.0	1.2	L	1.7	0.06	1.59
	2.7	1.7	1.0	1.3	L	1.6	0.08	1.59
Hellspoort R40	4.4	1.9	1.4	1.8	R	2.4	0.09	2.32
	4.0	2.2	1.4	1.4	L	2.2	0.10	1.80
	3.7	1.9	1.4	1.4	L	2.3	0.07	1.92
	3.7	2.0	1.2	1.3	L	2.1	0.09	1.87

Appendix Table 2 LEAF DIMENSIONS IN POPULATION SAMPLES OF ASTROLOBA (Contd.)

Locality.	Length	Width widest part	Width leaf base	Distance of widest part from base	Side of which Keel situated.	Keel length	Mucro length.	Length breadth ratio
	cm.	cm.	cm.	cm.		cm.	cm.	
			A. FOLIOLOSA subsp. CONGESTA (Contd.)					
Hellspoort R40 (Contd.)	3.6	2.1	1.4	1.3	R+L	2.0	0.07	1.71
	3.5	1.8	1.0	1.3	R+L	2.0	0.06	2.00
	3.5	1.7	1.1	1.4	L	2.1	0.10	2.12
	3.4	2.4	1.7	1.4	L	2.0	0.09	1.40
	3.4	1.7	1.1	1.3	R	1.8	0.10	2.03
	3.3	2.3	1.6	1.4	R	1.9	0.09	1.44
Dikkop Vlakte R41	4.7	2.8	1.8	1.7	R	2.7	0.12	1.66
	4.7	2.6	1.7	1.7	R	2.6	0.13	1.82
	4.2	2.4	1.7	1.8	R	2.5	0.09	1.75
	4.1	2.3	1.6	1.8	R	2.4	-	1.78
	3.9	2.2	1.5	1.7	R+L	2.0	0.05	1.77
Krantz Farm Albany	2.8	1.9	1.0	1.2	R+L	1.4	0.06	1.46
District Commins 2063	2.0	1.4	0.7	1.1	L	1.1	0.05	1.46
			A. FOLIOLOSA subsp. ROBUSTA.					
Base of Molteno Pass Hall 2284	2.3	1.5	0.9	1.0	L	1.5	0.10	1.53
	2.3	1.5	0.9	1.0	L	1.4	0.07	1.53
	2.2	1.5	0.9	1.0	L	1.2	0.07	1.47
	2.2	1.4	0.8	1.1	R	1.4	0.06	1.57
	2.2	1.4	0.8	0.9	L+R	1.5	0.07	1.57
	1.8	1.1	0.7	0.9	L	1.2	0.04	1.64
Nelspoort R27	3.9	2.0	1.0	1.5	L	2.1	0.11	1.93
	3.8	1.7	1.1	1.3	R	2.2	0.20	2.21
	3.7	1.9	1.1	1.4	R	2.0	0.13	1.92
	3.6	2.0	1.1	1.4	L	2.1	0.10	1.80
	3.6	1.8	1.0	1.1	R	2.1	0.17	2.00
	3.5	2.0 4	1.3	1.4	L	2.1	0.13	1.80
	3.4	2.1	1.5	1.4	L	1.7	0.14	1.67

Appendix Table 2 leaf dimensions in population samples of astroloba (Contd.)

Locality.	Length	Width widest leaf part	Width widest leaf base	Distance of widest part from base	Side on which Keel situated.	Keel length	Mucro length.	Length breadth ratio
	cm.	cm.	cm.	cm.		cm.	cm.	
			A. FOLIOLOSA subsp. ROBUSTA. (Contd.)					
Nelspoort R27 (Contd.)	3.2	2.0	1.1	1.3	L	2.2	0.10	1.67
	3.3	1.7	1.0	1.2	R	1.8	0.14	1.91
	3.2	1.9	1.3	1.2	L	1.7	0.10	1.68
	3.2	1.6	1.2	1.2	L	1.8	0.85	2.00
	3.1	1.8	1.3	1.3	R&L	1.7	0.12	1.67
	3.0	1.6	0.9	1.2	R	1.7	0.14	1.94
	2.6	1.7	1.1	1.1	R&L	1.5	0.10	1.51
4 miles N.W. of Matjesfontein R56	2.8	1.6	1.0	1.0	R	1.5	0.05	1.77
	2.4	1.5	0.8	1.3	R	1.2	0.05	1.60
	2.4	1.4	1.0	0.9	L	1.4	0.05	1.68
near Geelbek R1	2.7	1.4	0.9	1.1	R&L	1.6	0.53	1.92
20 miles S.E. of Laingsburg near farm Spreeufontein R67	3.0	1.9	1.0	1.2	L	1.5	0.04	1.58
	2.7	1.7	0.8	1.0	L	1.1	0.05	1.59
	2.5	1.8	0.9	1.2	R	1.3	0.06	1.39
	2.5	1.8	1.0	1.4	R	1.1	0.05	1.39
	2.4	1.9	1.0	1.2	L	1.4	0.03	1.26
	2.4	1.8	0.8	1.1	R	1.2	0.05	1.33
Prince Albert R64	3.7	2.4	1.4	1.6	L	1.8	0.04	1.54
	3.5	2.0	1.3	1.5	R	1.6	0.05	1.80
	3.5	1.9	1.1	1.3	R	1.8	0.05	1.87
	3.3	1.7	1.0	1.3	L	1.6	0.04	1.91
	3.2	1.8	1.0	1.3	L	1.9	0.03	1.76
	3.1	1.5	0.9	1.4	R	1.6	0.03	2.06
	2.9	1.5	1.0	1.3	L	1.6	0.04	1.93
	2.8	1.8	1.1	1.2	L	1.6	0.06	1.50
	2.8	1.4	0.9	1.1	R	1.5	0.06	1.96
	2.6	1.8	1.3	1.5	R	1.6	0.05	1.80

Appendix Table 2 LEAF DIMENSIONS IN POPULATION SAMPLES OF ASTROLOBA (Contd.)

Locality.	Length.	Width widest part	Width leaf base	Distance of widest part from base	Side on which Keel situated.	Keel length	Mucro length.	Length breadth ratio
	cm.	cm.	cm.	cm.		cm.	cm.	
			A. FOLIOLOSA subsp. ROBUSTA. (Contd.)					
Klaarstroom R27	4.0	2.1	1.8	1.6	L	2.1	0.10	1,91
	4.0	1.8	1.3	1.6	L	2.1	0.10	2,22
near Miller R8,9	3.9	2.1	1.1	1.6	L	2.3	0.13	1,84
	3.9	2.0	1.0	1.5	L	2.1	0.15	1,95
	3.7	2.0	1.1	1.7	L	2.3	0.05	1.90
	3.6	2.2	1.1	1.6	L	2.0	0.11	1.67
	3.6	2.1	1.1	1.4	L	2.1	0.11	1,73
	3.4	2.2	1.1	1.3	R	2.0	0.11	1.47
	3.3	1.8	0.9	1.2	R	1.9	0.06	1.83
	3.3	2.0	0.9	1.3	R	1.8	0.10	1.67
	3.2	1.9	1.0	1.1	L	1.8	0.08	1.73
	3.1	1.9	0.9	1.3	R	2.0	0.07	1.63
	3.1	1.5	0.9	1.4	L	1,8	0.10	2.07
	3.0	2.4	1.2	1.3	L	1.7	0.10	1.25
	3.0	1.9	1.0	1.2	L	1.8	0.10	1.58
	2.9	1.5	0.7	1.2	R+L	1.6	0.08	1.93
	2.9	1.9	1.1	1.4	L	1,6	0.04	1,48
	2.9	1.5	0.9	1.2	R	1.7	0.08	1.87
	2.8	1.8	1.0	1.3	L	1.5	0.1	1.56
	2.6	1.7	1.0	1.1	R	1.5	0.10	1.53
Steytlerville R15	3.5	2.0	1.1	1.5	L	1.9	0.11	1.75
	3.0	1.9	1.0	1.1	L	1.8	0.10	1.55
	2.9	1.7	0.9	1.2	R	1.9	0.12	1.76
	2.8	1.7	1.0	1.1	L	1.7	0.10	1.70
	2.8	1.5	0.9	0.9	R	1.8	0.15	1.87
	2.8	1.5	0.8	1.0	L+R	1.7	0.10	1.90
	2.7	1.8	1.1	1.1	L	1.6	0.13	1.50
	2.7	1.7	1.0	1.1	L	1.7	0.05	1.64

Appendix Table 2 LEAF DIMENSIONS IN POPULATION SAMPLES OF ASTROLOBA (Contd.)

Locality.	Length.	Width widest part	Width leaf base	Distance of widest part from base	Side on which Keel situated.	Keel length	Mucro length.	Length breadth ratio
	cm.	cm.	cm.	cm.		cm.	cm.	
				A. FOLIOLOSA subsp. ROBUSTA. (Contd.)				
Steytlerville R15 (Contd.)	2.7	1.5	0.9	1.2	R	1.6	0.12	1.80
	2.7	1.4	0.7	1.0	R	1.7	0.18	1.92
	2.7	1.3	0.7	1.0	R+L	1.4	0.09	2.09
	2.6	2.0	1.2	1.1	L	1.8	0.12	1.33
	2.6	1.7	1.0	1.1	L	1.7	0.09	1.56
	2.5	1.6	1.1	1.0	R	1.5	0.10	1.53
	2.5	1.6	0.9	1.1	L	1.3	0.12	1.53
	2.4	1.8	0.9	1.1	R	1.4	0.11	1.33
	2.3	1.6	1.0	1.0	L	1.5	0.13	1.47
	2.3	1.6	0.8	0.8	R	1.3	0.09	1.51
	2.3	1.4	0.9	1.0	R	1.5	0.10	1.65
	2.1	1.3	0.8	0.9	L	1.3	0.85	1.55
				A. BULLULATA.				
Ceres/Sutherland Rd. R24	4.0	1.5	1.3	1.4	R	1.9	0.10	2.72
	3.7	2.3	1.3	1.5	L	1.9	0.10	1.64
	3.5	2.3	1.1	1.5	R	2.0	-	1.52
	3.4	1.5	1.0	1.3	R	1.4	0.15	2.23
	3.3	2.2	1.7	1.2	R	1.6	0.20	1.54
	3.3	1.5	1.1	1.3	R+L	1.8	0.11	2.17
	3.2	2.1	1.2	1.4	L	1.7	0.10	1.56
	3.2	1.8	1.1	1.1	R+L	1.5	0.11	1.77
	3.2	2.3	1.0	1.4	R	1.7	0.09	1.42
	3.2	2.0	1.4	1.3	R	1.9	0.09	1.60
	3.1	1.9	1.2	1.3	L	1.8	0.06	1.63
	3.0	1.8	1.0	1.2	L	1.7	0.09	1.70
	2.4	1.6	0.9	1.2	R	1.3	0.09	1.52
	2.3	1.4	0.8	1.1	R	1.5	0.08	1.64
	2.3	1.3	0.8	0.9	R	1.4	0.09	1.70

Appendix Table 2 LEAF DIMENSIONS IN POPULATION SAMPLES OF ASTROLOBA (Contd.)

Locality.	Length.	Width widest part	Width leaf base	Distance of widest part from base	Side on which Keel situated.	Keel length	Mucro length.	Length breadth ratio
	cm.	cm.	cm.	cm.		cm.	cm.	
			A. BULLULATA. (Contd.)					
4 miles W. of Matjesfontein R25	4.0	2.6	2.0	1.6	R+L	2.7	0.07	1.52
	3.7	2.0	1.1	1.6	L	2.5	0.08	1.90
	3.5	2.1	1.3	1.4	R	2.3	0.09	1.69
	3.4	2.4	1.6	1.5	L	1.7	0.08	1.45
	3.4	2.4	1.1	1.6	L	2.4	0.11	1.38
	3.1	1.9	1.3	1.5	R	2.2	0.03	1.63
	3.0	2.1	1.2	1.4	R	2.0	0.10	1.46
	2.8	1.6	1.1	1.2	L	1.9	0.08	1.75
	2.8	2.0	1.0	1.3	L	2.0	0.06	1.41
Ex. Hort	2.9	2.3	1.0	1.3	R	2.1	-	1.28
	2.6	1.6	0.9	1.1	L	1.6	0.07	1.60
			A. HALLII.					
Koup R26	5.8	1.9	1.0	1.6	L	3.2	0.15	3.14
	4.3	2.1	1.3	1.4	L	2.7	0.11	2.05
	4.3	1.8	1.2	1.3	R	2.6	0.11	2.46
	4.2	2.04	1.3	1.4	R+L	2.4	0.11	2.15
	4.2	1.8	1.6	1.3	L	2.1	0.11	2.37
	4.2	1.6	1.0	1.6	L	2.2	0.11	2.64
	4.1	1.9	1.3	1.5	L	2.6	0.09	2.13
	4.0	1.9	1.4	1.4	L	2.5	0.11	2.08
	3.6	1.6	0.9	1.2	L	2.1	0.10	2.29
	3.5	1.8	1.0	1.5	R	1.9	0.06	1.94
	3.4	2.0	1.2	1.3	R	2.2	0.08	1.74
	3.4	1.6	0.9	1.1	L	1.9	0.12	2.17
	3.2	1.4	0.9	1.1	R	2.0	-	2.37
	3.1	1.6	1.0	1.1	L	2.1	0.08	2.00
	3.0	1.4	0.9	1.2	R	2.0	0.09	2.22
	2.8	1.6	0.9	1.2	L	1.8	0.09	1.72
	2.7	1.3	0.7	1.0	R	1.4	0.05	2.08

Appendix Table 2 LEAF DIMENSIONS IN POPULATION SAMPLES OF ASTROLOBA (Contd.)

Locality.	Length.	Width widest part	Width leaf base	Distance of widest part from base	Side on which Keel situated.	Keel length	Mucro length.	Length breadth ratio
	cm.	cm.	cm.	cm.		cm.	cm.	
			A. HALLII. (Contd.)					
nr. Farm Rietvlei on Laingsburg/Sevenweeks-poort Rd. R48	3.5	1.7	1.0	1.4	L	2.0	0.08	2.03
	3.4	1.7	1.0	1.4	L	1.9	0.12	2.06
	3.4	1.7	1.1	1.2	R	2.2	0.12	1.91
	3.4	1.6	1.0	1.2	R	2.1	0.13	2.09
	3.4	1.6	0.9	1.2	L	1.8	0.09	2.18
	3.1	1.3	0.7	1.0	R	1.6	0.10	2.39
	3.1	1.3	0.9	1.1	L	1.7	0.11	2.48
	3.1	1.4	0.9	1.1	L	1.9	0.10	2.14
	3.1	1.4	1.0	1.0	L	2.0	0.10	2.22
			A. SMUTSIANA.					
nr. Farm Rietvlei on Laingsburg/Sevenweeks-poort Rd. R49	2.2	1.4	0.7	1.0	L	1.3	0.06	1.59
	2.2	1.4	0.8	0.9	R+L	1.3	0.07	1.59
	2.0	1.0	0.7	0.9	R	1.2	0.05	2.00
	1.9	1.3	0.7	0.9	R	0.9	0.08	1.48
	1.8	1.2	0.8	0.9	L	1.0	0.07	1.49
Rooinek Pass R51	3.1	1.6	0.9	1.2	R	2.0	0.05	1.96
	3.1	1.9	1.3	1.2	R+L	1.8	0.07	1.59
	3.1	1.5	1.0	1.1	R+L	2.0	0.07	2.07
	3.0	1.4	1.0	1.4	R	1.5	0.9	2.19
	2.9	1.6	1.0	1.2	L	1.7	0.5	1.76
	2.9	1.6	0.9	0.9	L	1.7	0.06	1.76
	2.8	1.7	1.0	1.3	R	1.3	0.08	1.67
	2.7	1.2	0.8	1.1	L	1.4	0.08	2.23
	2.4	1.4	0.9	1.1	R	1.5	0.06	1.59
	2.4	1.3	0.9	1.1	L	1.4	0.08	1.85
	2.3	1.2	0.8	1.0	R	1.1	0.05	1.84
	2.3	1.3	0.7	0.9	R	1.3	0.08	1.74
	2.2	1.5	0.9	1.0	L	1.5	0.08	1.46
	2.1	1.3	0.8	0.9	L	1.1	0.07	1.58

Appendix Table 2 LEAF DIMENSIONS IN POPULATION SAMPLES OF ASTROLOBA (Contd.)

Locality.	Length.	Width widest part	Width leaf base	Distance of widest part from base	Side on which Keel situated.	Keel length	Mucro length.	Length breadth ratio
	cm	cm.	cm.	cm.		cm.	cm.	
			A. SMUTSIANA (Contd.)					
Ladismith/Barrydale Rd. R3	2.7	1.4	0.8	1.2	R	1.4	0.10	1.93
	2.7	1.5	0.9	1.2	L	1.4	0.10	1.83
	2.7	1.7	1.0	1.1	L	1.7	0.10	1.62
	2.7	1.6	0.9	1.1	R	1.5	0.10	1.71
	2.6	1.8	1.0	1.2	R	1.4	0.08	1.49
	2.5	1.6	1.0	1.1	R+L	1.4	0.09	1.58
	2.5	2.0	0.9	1.2	R	1.4	0.08	1.27
	2.5	1.6	0.9	1.1	L	1.4	0.06	1.51
	2.4	1.7	0.7	1.0	L	1.5	0.10	1.38
	2.2	1.7	1.1	1.1	L	1.2	0.08	1.29
	2.2	1.4	0.7	1.0	L	1.3	0.06	1.59
	2.2	1.4	0.8	0.9	R+L	1.3	0.07	1.56
	2.2	1.3	0.7	0.9	R	1.0	0.12	1.63
	2.1	1.8	1.0	1.1	R	1.1	0.05	1.14
	2.1	1.4	0.7	0.9	R+L	1.3	0.16	1.46
	2.1	1.3	0.7	0.9	R	1.1	0.06	1.61
	2.0	1.0	0.7	0.9	R	1.2	0.05	2.11
	1.9	1.3	0.7	0.9	R	0.9	0.09	1.48
	1.9	1.4	0.8	0.8	L	1.2	0.09	1.35
	1.9	1.5	1.1	1.0	R	1.1	0.07	1.27
	1.9	1.5	0.8	0.9	R	1.0	0.10	1.23
	1.8	1.2	0.8	0.9	L	1.0	0.07	1.49
Ladismith/Barrydale Rd. R5	3.1	1.5	1.0	1.1	R+L	2.0	0.07	2.02
	3.1	1.9	1.3	1.2	R+L	1.8	0.07	1.59
	3.1	1.6	0.9	1.2	R	2.0	0.05	1.96
	3.0	1.4	1.0	1.4	R	1.5	0.09	2.11
	3.0	1.8	1.5	1.4	R	1.4	0.10	1.67
	3.0	1.5	-	1.2	L	1.5	0.10	1.97
	2.9	1.6	0.9	0.9	L	1.7	0.06	1.76
	2.8	1.7	1.0	1.3	R	1.3	0.08	1.67

Appendix Table 2 LEAF DIMENSIONS IN POPULATION SAMPLES OF ASTROLOBA (Contd.)

Locality.	Length	Width widest part	leaf base	Distance of widest part from base	Side on which Keel situated.	Keel length	Mucro length.	Length breadth ratio
	cm.	cm.	cm.	cm.		cm.	cm.	
			A. SMUTSIANA (Contd.)					
Ladismith/Barrydale Rd. R5 (Contd.)	2.8	1.6	1.0	1.2	L	1.7	0.05	1.79
	2.8	1.2	-	1.1	R	1.7	0.13	2.30
	2.8	1.4	0.7	1.0	R+L	1.6	0.12	2.01
	2.7	1.2	0.8	1.0	L	1.4	0.08	2.23
	2.4	1.3	0.9	1.1	L	1.4	0.08	1.85
	2.4	1.4	0.9	1.1	R	1.8	0.07	1.59
	2.4	1.6	0.8	1.0	L	1.2	0.10	1.50
	2.4	1.8	1.4	1.1	R+L	1.4	0.08	1.32
	2.3	1.2	0.8	1.0	R	1.1	0.05	1.84
	2.3	1.3	-	0.9	L	1.5	0.10	1.74
	2.2	1.4	0.9	0.9	L	1.2	0.12	1.60
	2.2	1.3	0.8	0.8	L	1.3	0.10	1.73
	2.2	1.5	0.9	1.0	L	1.5	0.08	1.46
	2.2	1.3	0.7	0.9	R	1.3	0.08	1.72
	2.1	1.3	0.8	0.9	L	1.1	0.03	1.58
Between Adamskraal and Ochertskraal R63	3.9	1.9	1.3	1.5	R	2.2	0.09	2.05
	3.8	1.6	1.2	1.3	L	1.5	0.06	2.31
	3.5	1.9	1.2	1.3	R	2.2	0.05	1.84
	2.9	1.5	0.9	1.3	R	1.8	0.06	1.93
	2.6	1.7	1.1	1.2	L	1.4	0.05	1.53
	2.3	1.3	0.8	1.0	R	1.4	0.04	1.74
			HYBRID BETWEEN A. SMUTSIANA & A. RUGOSA					
Ladismith/Barrydale Rd. R4.	2.0	1.5	0.7	0.9	L+R	1.2	0.07	1.30
	2.0	1.3	0.7	0.8	R	1.3	0.07	1.53

Appendix Table 4 **LEAF DIMENSIONS IN POPULATION SAMPLES OF ASTROLOBA (Contd.)**

Locality.	Length.	Width widest part	leaf base	Distance of widest part from base	Side on which Keel situated.	Keel length	Mucro length.	Length breadth ratio
	cm.	cm.	cm.	cm.		cm.	cm.	
				A. RUGOSA.				
Upper Baden R17	2.2	1.3	0.8	1.0	R	1.2	0.06	1.69
	2.0	1.4	0.8	1.1	R	1.0	0.06	1.43
	2.0	1.5	0.8	0.9	R	0.9	0.06	1.33
	1.9	1.8	0.9	1.0	R	1.1	0.06	1.06
	1.9	1.5	0.7	1.0	R	1.0	0.06	1.27
	1.7	1.6	0.8	1.0	L	0.8	0.05	1.06
	1.4	1.3	0.7	0.8	L	0.8	0.05	1.08
4 miles out of Montagu on Baden Rd R18	2.2	1.6	0.9	1.1	R	1.1	0.07	1.38
	2.2	1.5	0.7	1.2	R	1.3	0.06	1.47
	2.2	1.4	0.7	1.1	R	1.1	0.06	1.57
	2.1	1.7	1.0	1.1	R	1.1	0.04	1.24
	1.8	1.5	0.8	1.0	R	1.0	0.07	1.20
	1.7	1.2	0.7	0.8	R	0.8	0.05	1.69
	1.7	1.7	1.1	1.0	R+L	1.0	0.05	1.00
nr. Pietersfontein R19	2.5	1.7	1.0	1.2	R	1.1	0.05	1.47
	2.2	1.3	0.8	1.0	L	1.2	0.06	1.69
	2.2	1.3	0.7	1.0	R	1.1	0.07	1.69
	2.2	1.4	0.9	1.1	R	1.0	0.05	1.57
	2.0	1.3	0.8	1.0	L	1.1	0.06	1.54
	1.9	1.4	0.8	1.0	R+L	0.9	0.05	1.36
	1.8	1.3	0.8	0.8	L	1.0	0.05	1.39
	1.7	1.1	0.7	0.9	L	0.8	0.05	1.55
nr. Pietersfontein R20	2.1	1.7	0.9	1.1	L	1.2	0.09	1.24
	1.8	1.4	0.08	1.0	L	0.9	0.10	1.29
Dobbelaarskloof Rd. R21	2.3	1.6	1.0	1.0	R	1.5	0.04	1.44
	2.3	1.3	0.8	1.1	R	1.2	0.04	1.77
	2.3	1.4	1.0	1.1	L	1.3	0.05	1.64

Appendix Table 2 LEAF DIMENSIONS IN POPULATION SAMPLES OF ASTROLOBA (Contd.)

Locality.	Length.	Width widest part	Width leaf base	Distance of widest part from base	Side on which Keel situated	Keel length	Mucro length.	Length breadth ratio
	cm.	cm.	cm.	cm.	cm.	cm.	cm.	
				A. RUGOSA. (Contd.)				
Dobbelaarskloof Rd. R21 (Contd.)	2.1	1.4	0.9	1.0	R	1.0	0.05	1.50
	1.9	1.3	0.7	0.9	L	1.0	0.07	1.46
	1.9	1.3	0.8	0.9	L	0.9	0.07	1.46
	1.8	1.2	0.7	0.9	R+L	0.9	0.06	1.50
Dobbelaarskloof Rd. R22	2.2	1.4	1.0	1.1	R+L	1.2	0.05	1.57
	2.2	1.4	0.9	1.2	L	1.0	0.06	1.57
	2.2	1.5	0.8	1.2	L	1.1	0.05	1.47
	2.0	1.5	1.0	1.0	R	1.0	0.05	1.33
	2.0	1.5	0.8	1.0	R	1.0	0.08	1.33
	1.7	1.1	0.6	0.9	L	0.8	0.04	1.55
	1.6	1.3	0.8	1.0	L	0.8	0.06	1.23
2 miles out of Montagu at Baden turn off R23	2.2	1.7	1.0	1.0	R	1.1	0.05	1.29
	2.1	1.7	1.1	1.0	L+R	1.2	0.06	1.53
	2.0	1.5	0.8	1.3	L	0.9	0.08	1.33
	2.0	1.2	0.7	1.0	R	1.0	0.05	1.67
	1.9	1.3	0.7	1.0	L	1.0	0.05	1.46
	1.9	1.6	0.7	1.0	L	0.8	0.08	1.19
	1.9	1.4	0.8	1.1	R+L	0.9	0.04	1.34
	1.9	1.3	0.9	0.8	L	0.9	-	1.46
	1.7	1.6	0.9	1.0	R+L	0.8	0.05	1.06
	1.6	1.5	0.8	1.0	L	0.9	0.04	1.07
Farm Rietvlei no. 2 R50A	2.4	1.6	1.1	1.1	R	1.3	0.06	1.50
	2.2	1.2	0.7	1.0	L	1.1	0.05	1.83
	2.0	1.4	0.9	1.0	R	0.9	0.05	1.43
	2.0	1.4	0.8	1.0	R	1.0	0.05	1.43
Ladismith/Barrydale R2	2.0	1.4	0.8	0.9	L	1.0	0.04	1.43
	1.9	1.5	0.8	1.0	R	1.0	0.05	1.27

Appendix Table 2 LEAF DIMENSIONS IN POPULATION SAMPLES OF ASTROLOBA (Contd.)

Locality.	Length	Width widest part	Width leaf base	Distance of widest part from base	Side on which Keel situated	Keel length	Mucro length.	Length breadth ratio
	cm.	cm.	cm.	cm.		cm.	cm.	
				A. RUGOSA. (Contd.)				
Ladismith/Barrydale R2 (Contd.)	1.8	1.4	0.8	0.8	R	0.9	0.05	1.27
	1.8	1.5	0.9	0.8	L	0.8	0.06	1.20
	1.7	1.4	0.7	0.7	L	0.8	0.05	1.21
				A. SPIRALIS.				
Oudtshoorn R7,61	4.2	1.5	1.2	1.4	L	2.9	0.04	2.90
	3.7	1.3	1.0	1.0	R+L	2.3	0.16	2.82
	3.6	1.3	1.0	1.0	L	2.5	0.13	2.70
	3.5	1.3	1.0	1.5	L	1.8	0.08	2.60
	3.3	1.3	0.9	1.2	L	1.8	0.07	2.54
	3.0	1.4	1.1	1.1	R	2.1	0.10	2.19
	3.0	1.4	0.8	1.0	L	2.1	0.14	2.19
	3.0	1.5	0.9	1.0	R+L	1.9	0.12	1.95
	2.9	1.2	0.8	1.0	L	1.9	0.09	2.37
	2.9	1.2	0.9	1.0	R	1.9	0.15	2.37
	2.8	1.2	0.9	0.9	R	2.0	0.13	2.33
	2.8	1.2	1.0	1.1	L	1.8	0.07	2.33
	2.7	1.3	1.0	1.1	L	1.9	0.09	2.02
	2.5	1.0	0.8	0.8	L+R	1.6	0.10	2.47
	2.5	1.0	0.7	0.9	L	1.7	0.14	2.44
	2.4	1.2	1.0	0.8	L	1.6	0.09	1.96
	2.4	1.2	0.8	1.0	R	1.6	0.11	2.00
	2.4	1.5	1.1	1.0	R	1.5	0.07	1.64
	2.3	1.0	0.7	0.7	R	1.5	0.09	2.18
	2.2	1.1	0.9	0.9	R	1.4	0.12	2.00
	2.2	1.2	0.8	0.8	L	1.2	0.07	1.86
	2.2	1.2	0.9	0.8	L	1.3	0.06	1.90
	1.9	1.0	0.7	0.7	R	1.3	0.10	1.85
Ladismith-Barrydale Rd. R6	3.0	1.8	1.5	1.4	R	1.4	0.10	1.67

Appendix Table 2 LEAF DIMENSIONS IN POPULATION SAMPLES OF ASTROLOBA (Contd.)

Locality.	Length.	Width widest part	Width leaf base	Distance of widest part from base	Side on which Keel situated	Keel length	Mucro length	Length breadth ratio
	cm.	cm.	cm.	cm.		cm.	cm.	
				A. SPIRALIS. (Contd.)				
Calitzdorp R47	3.4	1.5	1.1	1.1	L	2.0	0.06	2.41
	2.7	1.5	1.1	1.0	R	1.6	0.06	1.86
	2.6	1.5	1.2	1.1	R+L	1.4	0.08	1.71
	2.6	1.3	0.9	1.1	R+L	1.5	0.05	2.06
	2.5	1.3	0.8	1.0	L	1.5	0.07	1.92
	2.4	1.5	1.0	1.1	R+L	1.2	0.08	1.57
				A. HERREI.				
Farm Hoekplaas nr. Uniondale R16	3.2	1.6	0.8	1.4	L	1.6	0.16	2.03
	2.6	1.5	0.8	1.2	R+L	1.4	0.18	1.67
	2.3	1.3	0.7	1.1	L	1.3	0.09	1.80
	2.2	1.2	0.7	0.9	R	1.2	0.12	1.78
	2.2	1.1	0.5	1.0	R	1.1	0.12	1.96
	2.1	1.3	0.7	1.0	L	1.2	0.08	1.62
	2.1	1.1	0.6	1.0	L	1.2	0.09	1.87
	2.1	1.4	0.8	1.1	L	1.1	0.10	1.44
	2.1	1.3	0.8	1.0	R	1.1	0.10	1.68
	1.8	1.2	0.7	1.0	L	1.0	0.09	1.46
Prince Albert R46	2.9	1.4	1.0	1.0	L	1.8	0.10	2.00
	2.7	1.3	0.8	1.0	R	1.5	0.12	2.08
	2.7	1.4	1.0	1.0	R+L	1.5	0.11	1.98
	2.5	1.0	0.8	1.2	R	1.3	0.13	2.42
	2.5	1.3	0.9	1.1	R	1.5	0.11	2.00
	2.5	1.4	1.0	1.1	L	1.5	0.07	1.75
	2.5	1.1	0.9	0.9	R	1.4	0.10	2.21
	2.4	1.0	0.8	1.0	R	1.8	0.08	2.40
	2.4	1.1	1.0	0.9	L	1.5	0.10	2.09
	2.3	1.3	0.8	1.0	L	1.2	0.10	1.76
	2.1	0.9	0.7	0.8	L	1.2	0.09	2.28

Appendix Table 2 LEAF DIMENSIONS IN POPULATION SAMPLES OF ASTROLOBA (Contd.)

Locality	Length	Width widest part	Width leaf base	Distance of widest part from base	Side on which Keel situated.	Keel length	Mucro length	Length breadth ratio
	cm.	cm.	cm.	cm.		cm.	cm.	
LEAVES FROM KEW GARDENS.								
"Apicra pentagona"	3.6	1.4	1.0	0.8	R	1.9	0.03	2.52
	3.0	1.2	0.9	0.8	L	1.8	-	2.50

Locality.	Lowest Fertile Bract length	middle -width.	basal -width.	Lowest Sterile Bract length	middle -width.	basal -width.	Pedicel Length Flowering Basal	Flowering middle	Fruiting basal	No. of sterile bracts.	Peduncle Width at base	below raceme.	Length Peduncle	Raceme	No. of side branches
							A. FOLIOLOSA subsp. FOLIOLOSA.								
Graaff Reinet R60	0.40	0.13	0.32	0.56	0.17	0.37	0.16	0.13	-	4	0.33	0.17	16.0	12.0	0
	0.40	0.12	0.28	0.70	0.15	0.32	0.17	0.14	-	6	0.33	0.15	14.0	15.0	0
	0.45	0.17	0.30	0.57	0.17	0.40	0.18	0.16	0.32	5	0.48	0.29	21.0	9.0*	0
	0.45	0.06	0.25	0.62	0.11	0.20	-	0.17	0.37	4	0.30	0.22	9.0	16.0	0
	0.45	0.17	0.40	0.70	0.30	0.554	-	0.12	0.24	3	0.42	0.24	17.0	20.0	0
	0.46	0.15	0.32	0.68	0.13	0.40	0.19	0.15	-	6	0.30	0.19	15.0	13.0	0
	0.50	0.13	0.24	0.60	0.14	0.20	0.17	-	-	5	0.28	0.17	16.0	8.0*	0
	0.50	0.17	0.35	0.70	0.20	0.30	0.14	-	-	4	0.40	0.20	18.0	10.0	0
	0.50	0.10	0.28	0.70	0.29	0.42	0.28	0.19	-	6	0.35	0.27	15.0	13.0*	0
	0.50	0.20	0.35	0.70	0.23	0.30	0.30	0.23	-	4	0.34	0.19	21.0	13.0	0
	0.50	0.20	0.30	0.72	0.30	0.41	0.26	0.17	-	4	0.42	0.23	22.0	16.0	0
	0.52	0.10	0.33	0.65	0.09	0.34	-	-	0.24	4	0.37	0.25	14.04	16.0	0
	0.52	0.13	0.30	0.70	0.22	0.32	0.23	0.17	-	5	0.34	0.23	19.0	18.0	0
	0.52	0.14	0.30	0.85	0.14	0.55	-	0.21	0.25	7	0.40	0.18	19.0	10.0*	1b
	0.53	0.13	0.28	0.75	0.18	0.42	0.22	0.22	-	3	0.41	0.26	23.0	15.0*	0
	0.55	0.17	0.25	0.75	0.16	0.32									
	0.55	0.13	0.27	-	-	-	-	0.15	0.23	5	0.39	0.21	13.0	16.0	0
	0.55	0.17	0.37	0.73	0.16	0.35									
	0.56	0.18	0.35	0.83	0.22	0.40	0.18	0.11	-	7	0.40	0.24	15.0	13.0	0
	0.60	0.18	0.30	-	-	-	-	-	0.26	5	0.4	0.28	16.0	18.0	0
	0.60	0.17	0.35	0.71	0.23	0.51	0.21	0.14	-	5	0.39	0.23	23.0	6.0*	0
	0.60	0.18	0.37	0.77	0.22	0.34	0.24	0.19	-	5	0.33	0.23	18.0	15.0	0
	0.60	0.17	0.31	0.80	0.20	0.38	0.34	0.18	-	5	0.38	0.26	20.0	16.0	0
	0.60	0.22	0.30	0.80	0.20	0.39	0.16	0.19	0.24	6	0.37	0.19	15.0	16.0	0
	0.60	0.13	0.30	0.85	0.15	0.45	0.27	0.19	-	7	0.44	0.22	17.0	15.0	1b
	0.62	0.17	0.30	-	-	-	-	-	0.38	4	-	0.23	15.0	11.0	0
	0.62	0.15	0.30	-	-	-	-	-	0.22	5	0.39	0.25	15.0	10.0	0
	0.62	0.12	0.30	0.62	0.26	0.37	0.16	0.14	-	3	0.34	0.15	19.0	13.0	0

Appendix Table 3 DIMENSIONS OF INFLORESCENCE IN POPULATION SAMPLES OF ASTROLOBA. (* indicates inflorescence was not properly developed, or was damaged; b indicates the number of branches; a indicates the number of unexpanded raceme buds in the axils of the sterile bracts).

Locality.	Lowest Fertile Bract length-	middle width.-	basal width.	Lowest Sterile Bract length-	middle width.-	basal width.	Pedicel Length Flowering basal-	middle	Fruiting basal	No. of sterile bracts.	Peduncle Width at base	below raceme	Length Peduncle-	Raceme	No. of side branches
	cm.	cm.	cm.	cm.	cm.	cm	cm.	cm.	cm.	em.	cm.	cm.	cm.	cm.	
						A. FOLIOLOSA subsp. FOLIOLOSA. (Contd.)									
Graaff	0.64	0.15	0.35	0.60	0.17	0.25	-	0.18	0.29	5	0.37	0.26	17.0	16.0	0
Reinet R60	0.65	0.11	0.22	0.72	0.17	0.40	0.22	0.18	-	5	0.37	0.21	22.0	24.0	0
(Contd.)	0.65	0.17	0.30	0.90	0.20	0.35	0.20	0.10	-	4	0.41	0.23	16.0	17.0	0
	0.70	0.15	0.35	0.82	0.18	0.20	0.20	0.08	-	3	0.34	0.16	23.0	14.0	0
	0.75	0.18	0.32	0.85	0.17	0.32	-	0.19	0.29	4	0.40	0.20	18.0	10.0	0
Wolwefontein	0.57	0.22	0.13	-	-	-	0.23	0.18	-	-	-	0.25	-	17.0	0
R11	0.65	-	-	-	-	-	0.30	0.25	-	5	0.40	0.35	19.0	12.0	0
	0.70	-	-	-	-	-	0.30	0.20	-	6	0.38	0.30	28.0	14.0	0
Mount	0.53	0.10	0.29	0.70	0.13	0.33	0.38	0.32	-	4	0.34	0.21	15.0	6.0*	0
Stewart R13,	0.60	-	-	-	-	-	0.15	0.10	-	-	0.42	0.30	19.0	8.0	0
52b	0.62	0.11	0.30	-	-	-	-	-	-	-	-	-	-	-	-
	0.62	0.10	0.28	0.86	0.15	0.35	0.17	0.13	-	8	0.32	0.23	13.0	6.0	0
	0.62	0.15	0.30	0.90	0.15	0.33	-	-	-	-	-	-	-	-	0
	0.70	0.10	0.30	1.20	0.14	0.43	-	-	-	-	-	-	-	-	-
	0.73	0.11	0.28	0.93	0.15	0.28	-	-	-	-	-	-	-	-	-
Baroe R12	0.90	-	-	-	-	-	0.32	0.25	-	2	0.50	0.30	18.0	9.0*	1b
Steytlerville	0.50	0.06	0.30	-	-	-	-	0.13	0.28	6	0.48	0.29	18.0	18.0	0
R14,R43a	0.50	0.10	0.20	0.70	0.08	0.30	0.09	-	0.14	5	0.27	0.23	22.0	11.0*	0
	0.52	0.10	0.28	-	-	-	0.15	0.12	-	6	0.26	0.23	11.0	-	0
	0.55	0.13	0.20	0.85	0.14	0.30	0.26	0.16	-	3	0.38	0.25	14.0	14.0	0
	0.55	0.10	0.30	1.00	0.08	0.30	-	0.12	0.27	6	0.47	0.25	23.0	10.0*	0
	0.60	0.10	0.25	1.05	0.16	0.25	0.18	0.10	-	-	-	-	-	-	-
	0.61	0.10	0.25	0.70	0.12	0.22	0.20	0.16	-	4	0.33	0.20	16.0	7.0*	0
	0.61	0.07	0.30	0.90	0.12	0.32	0.29	0.20	-	5	0.35	0.23	11.0	8.0*	0
	0.62	0.10	0.25	0.70	0.12	0.22	-	0.09	0.19	5	0.32	0.25	16.0	-	0
	0.70	0.06	0.28	-	-	-	-	0.15	0.25	5	0.29	0.23	14.0	13.0	0
	0.70	0.08	0.28	-	-	-	0.14	0.08	-	3	0.34	0.20	16.0	-	0

Appendix table 3 DIMENSIONS OF INFLORESCENCE IN POPULATION SAMPLES OF ASTROLOBA (Contd.)

Locality.	Lowest Fertile Bract length	middle width.	basal width.	Lowest Sterile Bract length	middle width.	basal width.	Pedicel Length Flowering basal	Flowering middle	Fruiting basal	No. of sterile bracts.	Peduncle Width at base	Peduncle Width below raceme.	Length Peduncle	Length Raceme	No. of side branches.
	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.		cm.	cm.	cm.	cm.	
A. FOLIOLOSA subsp. FOLIOLOSA. (Contd.)															
Steytlerville R14, R43a (Contd)	0.70	0.17	0.28	0.75	0.17	0.28	-	0.10	-	-	-	-	-	-	-
	0.70	0.07	0.20	0.80	0.09	0.22	0.22	0.17	-	5	0.32	0.24	15.0	8.0*	0
	0.70	0.07	0.30	0.85	0.12	0.30	0.30	0.24	-	5	0.39	0.25	12.0	10.0	0
	0.70	0.17	0.30	0.85	0.20	0.30	0.26	0.16	-	3	0.38	0.25	14.0	14.0	0
	0.70	0.12	0.30	0.92	0.16	0.33	0.14	-	-	-	-	-	-	-	-
	0.70	0.10	0.30	1.00	0.12	0.30	0.24	0.19	-	8	0.38	0.28	17.0	-	0
	0.70	0.10	0.3o	0.03	0.12	0.30	0.20	0.17	-	4	0.38	0.28	16.0	12.0	0
	0.70	0.10	0.23	1.15	0.12	0.40	-	0.10	-	-	-	-	-	-	1a
	0.75	0.10	0.25	1.15	0.12	0.30	0.24	0.23	-	10	0.38	0.26	21.0	9.0*	0
	0.85	0.08	0.40	1.25	0.20	0.50	0.20	0.16	-	7	0.42	0.30	15.0	13.0	0
	-	-	-	0.93	0.10	0.28	-	-	-	-	-	-	-	-	-
Springbok Vlakte nbg 171/59	0.75	-	0.30	0.75	-	0.35	0.14	0.09	-	5	0.47	0.23	17.0	-	0
	0.46	0.11	0.22	0.71	0.13	0.24	0.19	0.14	-	7	0.26	0.16	14.0	7.0*	0
Herbarium Specimens.															
Addo Bush	0.45	0.08	0.20	-	-	-	0.14	-	-	5	0.21	0.15	14.0	9.0*	0
	-	-	-	-	-	-	0.18	0.07	-	-	0.27	0.18	-	-	-
Koegakammas Kloof	0.60	0.06	0.20	0.90	0.10	0.30	0.18	0.15	-	3	0.39	0.21	20.0	7.0*	0
Swartkops/ Sundays	0.50	0.08	0.18	1.00	0.10	0.24	0.25	-	-	4	0.27	0.20	16.0	9.0*	0
Kleinpoort	0.70	0.10	0.24	0.90	0.20	0.30	0.28	0.20	-	5	0.37	0.24	21.0	16.0	0
	0.83	0.08	0.20	1.30	0.10	0.22	0.23	0.15	-	7	0.41	0.25	20.0	12.0	1a
	0.85	0.14	0.20	1.00	0.18	0.42	0.28	0.20	-	4	0.32	0.25	18.0	19.0	1b

Appendix table 3 DIMENSIONS OF INFLORESCENCE IN POPULATION SAMPLES OF ASTROLOBA (Contd.)

Locality.	Lowest Fertile Bract length	middle width.	basal -width.	Lowest Sterile Bract length	middle width.	basal -width.	Pedicel Length Flowering basal	Flowering middle	Fruiting basal	No. of sterile bracts.	Peduncle Width at base	Peduncle Width below raceme.	Length Peduncle	Length Raceme	No. of side branches.
	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.		cm.	cm.	cm.	cm.	
							A. FOLIOLOSA subsp. FOLIOLOSA. (Contd.)								
Herbarium Specimens (Contd.)															
Steytlerville	0.73	0.10	0.26	1.05	0.10	0.20	0.15	-	-	5	0.37	0.17	10.0	11.0	0
Kruidfontein	0.60	0.10	0.30	0.75	0.10	0.30	0.20	0.15	-	4	0.30	0.21	18.0	8.0*	0
	-	-	-	0.75	0.08	0.20	0.29	-	-	-	-	-	-	-	-
Waterford	0.75	0.08	0.23	1.00	0.36	0.60	0.15	0.10	-	5	0.36	0.17	13.0	6.0*	0
	-	-	-	-	-	-	-	-	0.20	3	0.29	0.24	20.0	12.0	0
Graaff-Reinet	0.63	0.10	0.22	-	-	-	0.14	-	-	3	0.28	0.22	14.0	11.0	0
	0.50	Op10	0.28	0.70	-	-	0.08	-	-	5	0.30	0.20	13.0	5.0*	0
nr. Laingsburg?	0.60	0.14	0.25	0.95	0.10	0.36	-	-	-	-	-	-	-	-	-
	0.55	0.12	0.30	0.70	0.10	0.30	0.15	0.07	-	4	0.34	0.25	10.0	12.0	0
	0.55	0.10	0.30	0.80	0.12	0.30	-	-	-	-	-	-	-	-	-
							A. FOLIOLOSA subsp. CONGESTA.								
Cradock R32,53	0.65	0.16	0.30	0.88	0.27	0.50	0.17	0.11	-	5	0.47	0.28	27.0	18.0	2a
	-	-	-	-	-	-	0.25	0.18	-	5	0.47	0.30	25.0	15.0*	-
	-	-	-	-	-	-	0.18	0.14	-	5	0.41	0.23	27.0	15.0	0
	-	-	-	-	-	-	0.30	0.20	-	5	0.75	0.40	30.0	18.0*	-
	-	-	-	-	-	-	0.25	0.20	0.33	5	0.54	0.29	24.0	19.0	-
	-	-	-	-	-	-	-	-	0.10	5	0.504	0.30	17.0	15.0	-
	-	-	-	-	-	-	0.21	0.20	0.24	5	0.48	0.24	28.0	16.0	-
	-	-	-	-	-	-	-	-	0.24	7	0.55	0.30	19.0	13.0	-
	-	-	-	-	-	-	-	-	0.36	6	0.70	0.30	29.0	8.0*	-
	-	-	-	-	-	-	-	-	0.26	5	0.59	0.38	25.0	24.0*	5a
	-	-	-	-	-	-	0.40	0.23	-	5	0.61	0.30	16.0	17.0*	3a
	-	-	-	-	-	-	-	0.20	0.28	5	0.60	0.27	23.0	18.0	5a
	-	-	-	-	-	-	-	0.24	0.29	7	0.65	0.37	30.0	18.0*	7a
	-	-	-	-	-	-	0.28	0.21	-	5	0.47	0.24	25.0	11.0*	-

Appendix Table 3 DIMENSIONS OF INFLORESCENCE IN POPULATION SAMPLES OF ASTROLOBA (Contd.)

Locality.	Lowest Fertile Bract length	middle width.	basal width.	Lowest Sterile Bract length	middle width.	basal width.	Pedicel Length Flowering basal	Flowering middle	Fruiting basal	No. of sterile bracts.	Peduncle Width at base	below raceme.	Length Peduncle	Raceme	No. of side branches.
	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.		cm.	cm.	cm.	cm.	
						A. FOLIOLOSA subsp. CONGESTA. (Cont.)									
S. of	0.50	0.13	0.42	-	-	-	-	-	0.28	2	0.42	0.23	21.0	22.0	0
Adelaide	0.52	0.15	0.43	-	-	-	-	-	0.20	2	0.47	0.25	21.0	20.0	0
R38,39	0.58	0.20	0.47	-	-	-	-	-	0.24	2	0.41	0.24	21.0	21.0	2a
	0.60	0.22	0.40	0.90	0.28	0.55	0.17	0.09	-	3	0.49	0.42	16.0	16.0	2b
	0.63	0.20	0.40	-	-	-	0.35	0.20	0.38	5	0.55	0.24	20.0	19.0	5a
	0.65	0.15	0.37	0.75	0.14	0.65	0.30	0.28	-	3	0.65	0.27	27.0	21.0	2b
	0.67	0.16	0.39	-	-	-	-	-	0.18	2	0.37	0.23	16.0	13.0	0
	0.70	0.13	0.40	-	-	-	0.22	-	-	2	0.39	0.23	18.0	12.0*	2a
	0.70	0.14	0.42	-	-	-	-	-	0.36	3	0.55	0.29	24.0	10.0*	0
	0.70	0.13	0.45	-	-	-	0.24	0.17	-	5	0.42	0.30	23.0	12.0	0
	0.70	0.20	0.40	0.72	0.26	0.50	0.17	0.09	-	2	0.44	0.23	21.0	15.0	2a
	0.70	0.12	0.37	0.75	0.20	0.43	0.24	0.15	0.26	6	0.43	0.25	27.0	16.0	3a
	0.70	-	-	0.83	-	-	0.20	0.18	-	4	0.54	-	-	-	0
	0.70	0.18	0.40	0.85	0.20	0.72	-	-	0.20	2	0.50	0.26	22.0	15.0	2ab
	0.75	0.22	0.34	-	-	-	-	-	0.34	4	0.42	0.23	22.0	17.0	1a
	0.75	0.18	0.42	0.85	0.15	0.50	-	-	0.20	3	0.57	0.28	24.0	22.0	3a
	0.75	0.11	0.41	0.90	0.16	0.60	0.17	0.10	-	4	0.47	0.30	30.0	18.0	4a
	0.80	0.17	0.40	0.90	0.20	0.43	-	-	0.23	3	0.44	0.28	21.0	12.0*	2a
	0.82	0.18	0.37	0.27	0.17	0.53	0.15	0.14	-	6	0.44	0.26	21.0	10.0	1a
	0.90	0.28	0.42	9.00	0.17	0.60	-	-	0.25	2	0.45	0.34	26.0	25.0	2b
	-	-	-	-	-	-	-	-	0.20	2	0.55	0.26	20.0	19.0	2b
	-	-	-	-	-	-	-	-	0.26	4	0.39	0.23	27.0	-	0
	-	-	-	-	-	-	-	-	0.24	3	-	-	17.0	17.0	3a
	-	-	-	-	-	-	0.25	0.14	-	4	0.64	0.27	20.0	23.0	3a
	-	-	-	-	-	-	0.17	0.14	0.23	3	0.60	0.27	31.0	-	3b
	-	-	-	-	-	-	0.14	0.10	-	2	0.45	0.23	18.0	15.0	2a
	-	-	-	-	-	-	-	-	0.20	3	0.60	0.34	27.0	11.0*	3b
	-	-	-	-	-	-	-	-	0.20	7	0.45	0.27	22.0	15.0*	5a
	-	-	-	-	-	-	-	-	0.22	2	0.44	0.23	24.0	18.0	0
	-	-	-	-	-	-	0.23	0.19	0.33	5	0.50	0.34	24.0	12.0*	0

Appendix table 3 DIMENSIONS OF INFLORESCENCE IN POPULATION SAMPLES OF ASTROLOBA (Contd.)

Locality.	Lowest Fertile Bract length	middle width.	basal width.	Lowest Sterile Bract length	middle width.	basal width.	Pedicel Length Flowering basal	Flowering middle	Fruiting basal.	No. of sterile bracts.	Peduncle Width at base	Peduncle Width below raceme.	Length Peduncle	Length Raceme	No. of side branches.
	CM.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.		cm.	cm.	cm.	cm.	
							A. FOLIOLOSA subsp. CONGESTA. (Contd.)								
Hellpoort	0.55	-	0.45	0.80	-	0.60	0.13	0.09	-	5	0.32	0.30	6.0	16.0	2b
R41	0170	0.23	0.37	0.75	0.28	0.45	0.10	0.07	0.10	4	0.39	0.24	19.0	12.0*	4a
	0.70	0.25	0.40	0.90	0.25	0.40	0.07	0.06	0.09	3	0.37	0.24	18.0	-	2ab
	0.70	0.28	0.45	0.90	0.45	0.70	-	0.09	0.11	3	0.49	0.30	18.0	12.0	3b
	0.72	-	0.35	1.00	-	0.40	0.24	0.14	-	4	0.60	0.28	14.0	15.0	1b
	0.73	0.20	0.34	0.90	0.17	0.35	-	0.13	0.20	4	0.37	0.23	12.0	14.5	1b
	0.76	0.35	0.40	0.80	0.30	0.70	-	0.14	0.28	3	0.53	0.31	14.0	12.0	3b
	0.78	0.25	0.38	0.80	0.20	0.40	-	0.08	0.10	2	0.39	0.25	16.0	12.0	2a
	0.80	0.22	0.35	-	-	-	-	0.07	0.06	2	0.54	0.28	22.0	19.0	2a
	0.80	0.25	0.40	0.92	0.48	0.60	-	0.08	0.08	4	0.40	0.25	17.0	11.5	4a
	0.80	-	0.45	1.10	-	0.60	0.25	0.17	-	4	0.69	0.32	17.0	17.0	4a
	0.83	0.20	0.43	1.10	0.25	0.56	0.16	0.12	-	5	0.70	0.35	20.0	14.0	4a
	0.90	-	0.46	0.95	-	0.60	-	-	0.16	2	0.77	0.37	23.0	15.0	2b
	0.95	0.34	0.40	1.20	0.35	0.70	-	0.10	0.16	5	0.75	0.34	21.0	17.0	5b
Dikkop	0.70	0.25	0.45	0.85	0.30	0.60	0.08	0.14	-	2	0.73	0.33	16.0	9.0*	2a
Vlakte	0.80	0.25	0.40	0.76	0.30	0.50	0.19	0.13	-	2	0.50	0.29	17.0	15.0	2a
R40	0.80	0.28	0.35	0.85	0.30	0.60	0.14	0.14	-	3	0.59	0.20	25.0	11.0	3b
	0.83	0.40	0.43	1.00	0.46	0.75	-		0.27	3	0.50	0.34	14.0	17.0	3b
	0.85	0.40	0.50	0.90	0.40	0.70	-	-	0.30	3	0.59	0.31	15.0	20.0	3b
	0.90	0.25	0.58	0.90	0.23	0.70	-	0.12	0.14	2	0.80	0.38	18.0	11.0	2b
	-	-	-	-	-	-	0.20	0.10	-	3	0.64	0.30	20.0	11.0	3a
Herbarium Specimens.															
Hellpoort	0.45	0.16	0.40	0.70	0.28	0.42	0.17	0.13	-	3	0.38	0.25	19.0	15.0	0
	0.50	0.25													
	0.70	0.16	0.30	-	-	-	-	-	-	-	-	-	-	-	-
	0.80	0.28	0.40	0.95	0.33	0.47	0.18	0.15	-	5	0.42	0.17	19.0	12.0	3b
	0.80	0.20	0.36	0.95	0.20	0.40	0.14	0.10	-	3	0.55	0.20	21.0	7.0*	2b

Appendix table 3 DIMENSIONS OF INFLORESCENCE IN POPULATION SAMPLES OF ASTROLOBA (Contd.)

Locality.	Lowest Fertile Bract length	middle width.	basal width.	Lowest Sterile Bract length	middle width.	basal width.	Pedicel Length Flowering basal	Flowering middle	Fruiting basal	No. of sterile bracts.	Peduncle Width at base	Peduncle Width below raceme.	Length Peduncle	Length Raceme	No. of side branches.
	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	
							A. FOLIOLOSA subsp. CONGESTA. (Contd.)								
Herbarium Specimens (Contd.)															
Cradock	0.63	0.20	0.28	-	-	-	0.16	-	-	5	0.45	0.20	9.0	8.0	-
Raynerskop	-	-	-	-	-	-	-	0.09	0.15	-	0.28	0.21	17.0	11.0	-
Mortimer	0.50	0.23	0.34	-	-	-	0.14	0.09	-	4	0.33	0.23	22.0	18.0	-
Brakkloof	0.60	0.23	0.33	-	-	-	0.15	-	-	2	0.30	0.25	18.0	18.0	-
Alicedale	-	-	-	-	-	-	0.18	0.07	-	2	0.31	0.20	22.0	20.0	2ab
							A. FOLIOLOSA subsp. ROBUSTA.								
Foot of	0.43	0.22	0.50	0.75	0.30	0.40	-	-	0.05	3	-	0.30	12.0	11.5	0
Molteno Pass	0.55	0.28	0.45	0.80	0.23	0.50	0.12	-	-	3	-	0.38	15.5	13.5	0
Hall 2284	0.65	0.25	0.52	0.90	0.30	0.60	0.07	-	-	4	-	0.35	15.5	19.0	0
	0.70	0.20	0.42	0.80	0.28	0.52	0.07	-	0.13	2	-	0.29	12.5	9.0	0
	0.70	0.20	0.40	0.95	0.25	0.46	-	-	0.10	3	-	0.30	12.5	11.0	0
	0.70	-	-	1.05	-	-	0.13	0.05	-	3	0.58	-	-	-	0
	0.70	0.18	0.35	1.20	0.25	0.50	-	-	0.14	3	-	0.37	16.0	9.5	0
	0.72	0.28	0.40	0.80	0.28	0.50	0.10	-	-	2	-	0.30	8.5	9.0	0
	0.73	0.23	0.42	0.95	0.17	0.45	-	-	0.15	3	-	0.30	6.5	11.5	0
	0.75	0.22	0.50	0.98	0.22	0.45	-	-	0.14	3	-	0.38	12.0	11.5	0
	0.80	0.25	0.55	1.15	0.25	0.50	-	-	0.05	2	-	-	-	-	0
	0.90	0.14	0.40	1.20	0.17	0.48	-	-	0.08	4		0.38	15.0	15.0	0
	0.90	0.17	0.55	1.35	0.23	0.68	-	-	0.04	4	-	0.46	10.0	13.5	0
	0.95	0.25	0.58	1.00	0.22	0.55	0	-	-	2	0.50	0.38	12.0	9.5	0
	0.95	0.17	0.55	1.35	0.23	0.68	-	-	0.05	4	0.57	0.40	15.0	12.0	0
	1.00	0.18	0.55	1.20	0.18	0.66	-	-	0.07	2	-	0.30	10.0	10.0	0
	0.72	0.28	0.43	-	-	-	-	-	-	-	-	-	-	-	0

Appendix table 3 DIMENSIONS OF INFLORESCENCE IN POPULATION SAMPLES OF ASTROLOBA (Contd.)

Locality.	Lowest Fertile Bract length	middle width.	basal width.	Lowest Sterile Bract length	middle width.	basal width.	Pedicel Length Flowering basal	Flowering middle	Fruiting basal	No. of sterile bracts.	Peduncle Width at base	Peduncle Width below raceme.	Length Peduncle	Length Raceme	No. of side branches.
	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.		cm.	cm.	cm.	cm.	
						A. FOLIOLOSA subsp. ROBUSTA. (contd.)									
Nelspoort	0.95	0.25	0.45	1.40	0.22	0.55	0	0	-	5	0.57	0.37	14.0	6.0	0
	1.00	0.30	0.50	1.40	0.30	0.55	0.02	0	-	4	0.61	0.30	16.0	16.0	0
	1.05	0.30	0.45	1.20	0.37	0.45	0.04	0.02	-	3	0.42	0.33	11.0	10.0	0
	1.05	0.33	0.50	1.40	0.52	0.78	0	0	-	4	0.60	0.45	14.0	20.0	0
	1.10	0.30	0.40	1.15	0.20	0.50	0	0	-	2	0.59	0.26	8.0	12.5	0
	1.10	0.27	0.50	1.40	0.30	0.50	0.18	0.03	-	4	0.68	0.40	12.5	16.0	0
	1.10	0.25	0.45	1.45	0.31	0.62	0	0	-	7	0.63	0.34	11.0	13.0	0
	1.10	0.30	0.45	2.00	0.35	0.60	0	0	-	5	0.60	0.35	11.5	12.0	0
	1.15	0.25	0.45	1.60	0.20	0.60	0.09	0.03	-	3	0.58	0.41	8.5	7.5	0
	1.15	0.30	0.62	2.00	0.50	1.30	0	0	-	4	0.60	0.40	16.5	20.0	0
	1.20	0.23	0.40	1.50	0.20	0.55	0.05	0.02	-	9	0.64	0.28	21.0	9.5	0
Whitehill	1.00	0.28	0.57	1.20	0.37	0.75	0.05	0	-	2	0.64	0.44	13.5	18.0	0
	1.05*	0.17	0.73	1.45	0.27	0.80	0.06	0.03	-	3	0.83	0.58	14.5	17.0	1a
	1.10	0.23	0.55	1.35	0.37	0.80	0	0	--	3	0.64	0.46	11.5	18.0	0
	1.12	0.25	0.68	1.58	0.20	0.70	0.06	0.02	-	4	0.75	0.66	10.0	23.0	0
	1.15	0.28	0.65	1.55	0.30	0.87	0.03	0	-	3	0.84	0.48	12.5	10.0	0
	1.23	0.30	0.75	1.70	0.28	0.72	0.03	0	-	4	1.10	0.65	18.0	16.5	0
	1.30	0.30	0.75	1.85	0.28	0.70	0.10	0.03	-	5	0.94	0.60	16.0	16.0	0
	1.35	0.25	0.80	1.70	0.35	0.80	0.03	0	-	3	0.95	0.58	13.5	16.5	0
	1.50	0.25	0.73	2.15	0.32	0.95	0.13	0.07	-	4	0.67	0.59	17.0	15.0	1a
near Geelbek	0.83	0.25	0.45	1.05	0.23	0.55	0	0	-	4	0.57	0.40	12.5	12.5	0
R1	0.94	0.25	0.47	1.14	0.30	0.52	0	0	-	3	0.61	0.40	13.5	10.5	0
Prince	0.75	0.18	0.50	1.15	0.17	0.50	-	0.02	0.05	4	0.64	0.40	14.0	11.0	0
Albert R64	0.75	0.20	0.50	1.15	0.21	0.54	0.02	0	0.06	4	0.74	0.42	15.5	12.5	1a
	0.80	0.21	0.55	1.20	0.20	0.60	0.05	0.02	-	4	0.60	0.45	13.0	12.0	1a
	0.84	0.37	0.53	1.10	0.32	0.85	0	0	-	5	0.76	0.54	19.0	20.0	0

Appendix table 3 DIMENSIONS OF INFLORESCENCE IN POPULATION SAMPLES OF ASTROLOBA (Cont.)

Locality.	Lowest Fertile Bract length	middle width.	basal -width.	Lowest Sterile Bract length	middle width.	basal -width.	Pedicel Length Flowering basal	Flowering middle	Fruiting basal	No. of sterile bracts.	Peduncle Width at base	Peduncle Width below raceme.	Length Peduncle	Length Raceme	No. of side branches.
	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.		cm.	cm.	cm.	cm.	
						A. FOLIOLOSA subsp. ROBUSTA (Contd.)									
Prince Albert R64 (Contd.)	0.90	0.20	0.48	1.15	0.30	0.65	0.06	0	-	4	0.76	0.44	17.0	8.0	0
	0.92	0.27	0.50	1.15	0.30	0.75	-	0	0.07	5	0.65	0.46	20.5	14.5	0
	0.93	0.20	0.65	1.20	0.30	0.72	-	-	0.05	4	0.90	0.54	14.0	26.0	0
	0.95	0.23	0.52	1.20	0.32	0.87	-	-	0.03	4	0.57	0.35	13.5	12.0	0
	0.95	0.29	0.55	1.20	0.38	0.70	0.02	0	-	3	0.60	0.36	11.0	14.0	1a
	0.95	0.30	0.60	1.30	0.40	0.80	0.02	0	-	5	0.75	0.58	17.5	10.0	0
	0.95	0.20	0.50	1.45	0.40	0.71	0	0	-	7	0.74	-	12.5	12.0	0
	1.05	0.21	0.60	1.25	0.23	0.45	0.05	0	0.07	3	0.75	0.47	13.0	18.0	0
	1.05	0.20	0.60	1.35	0.20	0.65	0.04	0	-	4	0.84	0.51	12.0	13.0	0
	1.05	0.20	0.40	1.35	0.26	0.41	0.05	0.02	-	6	0.66	-	13.5	8.0	0
	1.05	0.19	0.40	1.40	0.17	0.60	0.07	0.02	-	7	0.76	0.50	15.0	14.5	0
	1.10	0.20	0.60	1.30	0.30	0.80	-	0.04	0.12	5	0.63	0.48	16.0	11.5	0
	1.10	0.25	0.75	1.40	0.26	0.70	0.02	0	0.06	5	1.10	0.65	16.0	33.0	0
	1.10	0.22	0.42	1.45	0.23	0.50	-	0.02	0.05	6	0.67	0.49	13.0	13.0	0
	1.10	0.17	0.43	1.45	0.22	0.70	0	0	-	5	1.09	0.69	12.0	5.0	0
	1.10	0.20	0.60	1.55	0.22	0.83	0	0	-	6	0.97	0.64	14.0	7.5	0
	1.15	0.17	0.60	1.45	0.17	0.60	0.04	0	-	5	0.92	-	11.0	16.5	0
	1.20	0.17	0.65	1.45	0.26	0.70	0.02	0	0.04	8	1.09	0.73	15.0	14.5	1a
	1.30	0.20	0.62	1.34	0.20	0.62	0.06	0.02	-	3	0.75	0.54	10.0	20.0	0
	1.35	0.33	0.56	1.85	0.30	0.60	0.02	0	0.05	5	1.05	0.73	10.0	30.0	1a
near Miller R45	1.0	0.30	0.45	1.10	0.35	0.50	0.04	0	-	5	0.33[s]	-	6.0	5.0	0
	1.05	0.28	0.45	1.50	0.30	0.55	0.07	0.02	-	5	0.66	-	9.0	5.5	0
	1.05	0.32	0.50	1.65	0.45	0.60	0.03	0	-	5	0.40[s]	0.23[s]	5.5	4.5	0
	1.10	0.33	0.55	1.40	0.50	0.60	0.02	0	-	5	0.47	0.29	7.5	12.5	0
	1.10	0.35	0.50	1.45	0.40	0.50	0.03	0	-	5	0.51	0.30	8.0	12.0	0
	1.20	0.25	0.50	1.30	0.23	0.48	0.09	0	-	5	0.66	0.29[s]	11.0	13.0	0
	1.30	0.30	0.50	1.70	0.40	0.55	0.03	0	-	4	0.60	0.38	7.0	9.5	0
Steytlerville R43	0.70	0.27	0.53	1.00	0.30	0.46	-	0.02	0.07	5	0.70	0.40	10.0	10.5	0
	0.72	0.25	0.45	1.10	0.23	0.60	-	0	0.04	5	0.52	0.32	10.0	0.95	0

Appendix Table 3 DIMENSIONS OF INFLORESCENCE IN POPULATION SAMPLES OF ASTROLOBA (Contd.)

Locality.	Lowest Fertile Bract length	middle width.	basal width.	Lowest Sterile Bract length	middle width	basal width.	Pedicel Length Flowering basal	Flowering middle	Fruiting basal	No. of sterile bracts.	Peduncle Width at base	below raceme.	Length Peduncle	Raceme	No. of side branches.
	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	c	cm.	cm.	cm.	cm.	
							A. FOLIOLOSA subsp. ROBUSTA (Contd.)								
Steytlerville	0.83	0.34	0.50	1.20	0.30	0.60	0	0	-	7	0.50	-[s]	9.0	6.0	0
R43 (Contd.)	0.85	0.35	0.50	1.00	0.40	0.55	0.05	0	-	5	0.50	0.30[s]	5.3	8.0	0
	0.87	0.33	0.48	1.20	0.30	0.40	0.04	0	-	4	0.50	0.22	7.0	7.0	0
	0.90	0.32	0.55	1.30	0.38	0.70	0	0	0.02	7	0.67	0.38	7.3	6.5	0
	0.95	0.30	0.60	1.15	0.20	0.50	0.04	0	-	2	0.69	0.40	9.0	15.0	0
	0.95	0.30	0.65	1.20	0.30	0.50	-	0	0.04	5	0.82	0.46	8.5	13.0	0
	1.00	0.30	0.61	1.30	0.20	0.50	0.04	0	-	7	0.70	0.32	13.5	12.0	0
	1.05	0.30	0.55	1.40	0.28	0.65	0.02	0	-	5	0.70	0.35	5.5	10.0	0
	1.05	0.30	0.50	1.40	0.30	0.60	0.06	0.03	0.07	4	0.50	0.34	5.0	10.0	0
	1.05	0.28	0.60	1.70	0.35	0.70	-	0.02	0.07	5	0.69	0.37	13.0	21.0	0
	1.08	0.33	0.60	1.60	0.40	0.77	-	0.03	0.06	4	0.72	0.45	10.0	14.0	0
	1.10	0.30	0.55	1.40	0.30	0.60	0.08	0.03	-	5	0.72	0.28	9.5	11.5	0
	1.10	0.40	0.50	1.50	0.35	0.60	-	0.04	0.14	3	0.58	0.32	11.0	13.5	0
	-	-	-	-	-	-	-	-	0.09	-	-	0.50	-	-	0
	-	-	-	-	-	-	-	-	0.06	-	-	0.40	-	-	0
	-	-	-	-	-	-	-	-	0.45	-	-	0.45	-	-	0
	-	-	-	-	-	-	-	-	0.05	-	-	0.29	-	-	0
	-	-	-	-	-	-	-	-	0.02	-	-	0.30	-	-	0
	-	-	-	-	-	-	-	-	0.04	-	-	0.35	-	-	0
	-	-	-	-	-	-	-	-	0.08	-	-	0.28	-	-	0
Herbarium Specimens.															
Beaufort	0.70	0.20	0.30	0.90	0.20	0.30	0	0	-	5	0.50	0.24	10.0	17.0	0
West	0.75	0.28	0.40	0.95	0.20	0.35	0	0	-	5	0.47	0.20	15.5	14.0	0
	1.00	0.20	0.40	1.15	0.28	0.35	0	0	-	5	0.65	0.45	11.5	7.5	0
Matjesfon-tein	0.75	0.26	0.40	1.00	0.28	0.30	0	0	-	5	0.58	0.26	15.0	9.0	0

Appendix Table 3 DIMENSIONS OF INFLORESCENCE IN POPULATION SAMPLES OF ASTROLOBA (Contd.)

Locality.	Lowest Fertile Bract length	middle width	basal width	Lowest Sterile Bract length	middle width	basal width	Pedicel Length Flowering basal	Flowering middle	Fruiting basal	No. of sterile bracts.	Peduncle Width at base	Peduncle Width below raceme.	Length Peduncle	Length Raceme	No. of side branches.
	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.		cm.	cm.	cm.	cm.	
							A. FOLIOLOSA subsp. ROBUSTA. (Contd.)								
Herbarium Specimens (Contd.)															
near White-hill	1.00	0.16	0.40	1.30	0.20	0.50	-	-	0.1	3	0.55	0.30	14.5	9.0	0
	1.05	0.30	0.40	1.45	0.30	0.60	0	0	-	3	0.61	0.29	9.5	7.0	0
	-	-	-	-	-	-	-	-	-	-	0.80	-	-	-	-
	1.35	0.28	0.43	1.35	0.20	0.40	0	0	-	4	0.56	0.35	8.0	11.0	0
Prince Albert	0.92	0.20	0.40	1.10	0.20	0.35	0	0	-	5	0.70	0.32	12.0	21.0	0
Willowmore	1.00	0.24	0.44	1.80	0.30	0.60	0	0	-	8	0.80	0.38	8.5	10.5	0
	0.82	0.30	0.48	1.00	0.30	0.50	0.08	0.04	-	3	0.53	0.27	12.0	14.5	0
Mt. Stewart	-	-	-	-	-	-	-	-	-	4	0.50	0.29	9.5	10.0	0
	-	-	-	-	-	-	-	-	-	2	0.50	0.28	10.0	8.0	0
Steytlerville	0.70	0.23	0.40	-	-	-	0.05	0.02	-	4	0.58	0.29	6.0	5.0*	0
	0.75	0.28	0.55	1.10	0.20	0.40	0.05	0.03	-	4	0.43	0.25	9.0	9.0	0
Waterford	-	-	-	-	-	-	-	-	-	-	0.83	-	-	-	0
Lake Mentz	0.90	0.20	0.40	1.40	0.50	0.62	0	0	-	4	1.20	0.35	8.5	10.5	0
	-	-	-	-	-	-	-	-	-	-	1.29	-	-	-	-
							A. SMUTSIANA.								
23 miles from	0.30	0.13	0.20	0.50	0.10	0.22	0.48	0.35	-	6	-	0.19	-	18.0	0
Ladismith on	0.30	0.10	0.30	0.57	0.13	0.30	0.18	0.13	-	4	0.38	0.20	14.0	7.0*	0
old Barrydale	0.30	0.08	0.24	0.70	0.10	0.28	0.32	0.23	-	3	0.30	0.15	19.0	11.0	0
Rd. R3,62A	0.35	0.09	0.22	0.42	0.10	0.22	0.24	0.22	-	3	0.23	0.11	17.0	6.0*	0
	0.36	0.12	0.22	0.45	0.15	0.21	0.14	0.36	-	4	0.24	0.12	14.0	8.0	0
	0.37	0.08	0.17	0.43	0.08	0.15	0.32	0.26	-	4	0.28	0.15	14.0	13.0	0

Appendix Table 3 DIMENSIONS OF INFLORESCENCE IN POPULATION SAMPLES OF ASTROLOBA (Contd.)

Locality.	Lowest Fertile Bract length	Lowest Fertile Bract middle width.	Lowest Fertile Bract basal width.	Lowest Sterile Bract length	Lowest Sterile Bract middle width.	Lowest Sterile Bract basal width.	Pedicel Length Flowering basal	Pedicel Length Flowering middle	Pedicel Length Fruiting basal	No. of sterile bracts.	Peduncle Width at base	Peduncle Width below raceme.	length Peduncle	length Raceme	No. of side branches
	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.		cm.	cm.	cm.	cm.	
							A. SMUTSIANA. (Contd.)								
23 miles from	0.37	0.10	0.22	0.57	0.13	0.22	0.26	0.16	0.27	6	0.27	0.17	15.0	13.0	0
Ladismith on	0.39	0.10	0.19	0.65	0.12	0.30	0.40	0.26	0.40	10	0.34	0.20	23.0	15.0	0
old Barrydale	0.40	0.08	0.24	0.66	0.10	0.30	0.34	0.28	0.40	7	0.42	0.23	29.0	16.0	0
Rd. R3,62a	0.40	0.12	0.21	0.75	0.06	0.37	0.40	0.23	-	7	0.35	0.24	28.0	14.0	0
(Contd.)	0.41	0.08	0.22	0.60	0.05	0.20	0.42	0.60	-	6	0.30	0.20	20.0	17.0	0
	0.45	0.11	0.22	0.59	0.07	0.23	0.48	0.30	-	6	0.30	0.19	22.0	17.0	0
	0.45	0.08	0.22	0.62	0.08	0.20	0.28	0.19	-	5	0.33	0.23	10.0	23.0	0
	0.47	0.08	0.20	0.61	0.08	0.22	0.40	0.34	-	4	0.33	0.23	20.0	16.0	0
	0.50	0.08	0.22	0.62	0.08	0.20	0.33	0.22	-	4	0.28	0.20	21.0	17.0	0
	0.52	0.07	0.21	0.88	0.06	0.23	0.40	0.32	-	5	0.39	0.24	20.0	15.0	0
	0.52	0.10	0.25	0.90	0.13	0.30	0.25	0.23	0.32	6	0.28	0.20	13.0	17.0	0
	0.54	0.08	0.30	0.51	0.09	0.25	0.26	0.22	-	4	0.39	0.24	10.0	9.0	0
	0.60	0.06	0.24	0.82	0.14	0.28	0.23	0.22	-	5	0.40	0.20	8.0	9.0	0
	-	-	-	0.65	0.08	0.22	0.23	0.21	0.24	8	0.30	0.18	14.0	12.0	0
	-	-	-	-	-	-	0.24	0.17	-	4	0.37	0.18	13.0	14.0	2a
26 miles from	0.29	0.10	0.17	1.00	0.15	0.29	0.25	0.22	0.25	6	0.32	0.17	14.0	13.0	0
Ladismith on	0.30	0.10	0.20	0.58	0.12	0.30	0.15	0.09	-	3	0.38	0.16	17.0	10.0	0
old Barrydale	0.33	0.10	0.20	0.55	0.09	0.24	0.37	0.30	-	4	0.37	0.12	19.0	16.0	0
Rd. R5,62b	0.33	0.11	0.26	0.70	0.12	0.30	0.26	0.19	-	5	0.35	0.19	18.0	12.0	0
	0.35	0.09	0.19	0.64	0.09	0.23	0.35	0.25	-	5	0.22	0.16	14.0	11.0	0
	0.35	0.10	0.21	0.72	0.14	0.25	0.21	0.20	0.25	6	0.36	0.27	12.0	12.0	0
	0.36	0.10	0.30	0.62	0.10	0.28	0.35	0.28	-	6	0.33	0.20	25.0	10.0	0
	0.37	0.08	0.34	0.70	0.08	0.32	0.35	0.27	-	6	0.33	0.18	28.0	11.0	0
	0.40	0.07	0.20	0.58	0.10	0.27	-	0.26	0.36	6	0.30	0.20	17.0	16.0	0
	0.40	0.08	0.14	0.65	0.06	0.18	0.25	0.20	-	5	0.25	0.20	20.0	18.0	0
	0.42	0.09	0.20	0.64	0.08	0.22	0.36	0.23	0.43	5	0.31	0.20	21.0	18.0	0
	0.45	0.08	0.22	0.76	0.10	0.20	0.32	0.26	0.32	7	0.37	0.20	13.0	17.0	0
	0.48	0.08	0.29	0.55	0.07	0.22	0.40	0.35	-	6	0.32	0.19	28.0	8.0	0
	0.51	0.07	0.20	0.80	0.12	0.27	-	0.19	0.30	6	0.35	0.23	17.0	18.0	0
	0.52	0.08	0.23	1.05	0.07	0.25	0.32	0.23	-	5	0.34	0.20	16.0	16.0	0
	0.58	0.10	0.30	0.85	0.11	0.25	0.30	0.20	-	7	0.30	0.19	23.0	14.0	0

Appendix Table 3 DIMENSIONS OF INFLORESCENCE IN POPULATION SAMPLES OF ASTROLOBA (Contd.)

Locality.	Lowest Fertile Bract Length-	middle width	basal -width.	Lowest Sterile Bract length-	middle width.	basal -width.	Pedicel Length Flowering basal-	middle	Fruiting basal	No. of sterile bracts.	Peduncle Width at base	below raceme.	Length Peduncle-	Raceme	No. of side branches.
	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.		cm.	cm.	cm.	cm.	
							A. SMUTSIANA (Contd.)								
26 miles from Ladismith on old Barrydale Rd. R5,62b (Contd.)	-	-	-	-	-	-	0.29	0.19	-	4	-	0.19	1710	13.0	0
	-	-	-	-	-	-	0.29	0.24	-	2	0.31	0.19	20.0	25.0	0
							PUTATIVE HYBRID BETWEEN A. RUGOSA AND A. SMUTSIANA.								
23 miles from Ladismith on Old Barrydale rd.	0.38	0.11	0.19	0.48	0.10	0.23	0.37	0.29	-	2	0.30	0.18	24.0	12.0	0
	0.66	0.06	0.25	0.95	0.08	0.30	0.28	0.20	-	7	0.35	0.23	23.0	21.0	0
	0.76	0.08	0.20	1.40	0.05	0.30	0.34	0.18	-	6	0.38	0.25	25.0	12.0	0
							A. HALLII.								
20 miles E. of Laingsburg nr. farm Rietvlei R52	0.30	-	0.25	0.60	-	0.30	0.53	-	-	6	0.39	0.31	19.0	22.0	0
	0.33	0.10	0.20	0.62	0.14	0.26	0.42	0.34	-	9	0.44	0.24	31.0	16.0	0
	0.36	0.07	0.26	0.72	0.13	0.25	0.35	0.35	-	8	0.49	0.24	28.0	14.0	0
	0.38	0.08	0.19	0.80	0.10	0.19	0.56	0.40	-	8	0.47	0.20	27.0	24.0	0
	0.43	0.10	0.20	0.65	0.14	0.23	0.50	0.40	-	5	0.53	0.23	32.0	21.0	0
	0.43	0.10	0.20	0.73	0.13	0.23	0.63	0.49	-	6	0.49	0.20	27.0	21.0	0
	0.43	0.13	0.22	0.80	0.10	0.30	0.40	0.37	-	6	0.39	0.17	23.0	13.0	1a
	0.44	0.13	0.24	0.73	0.10	0.40	0.42	0.38	-	5	0.56	0.27	27.0	16.0	1a
	0.48	0.12	0.25	0.63	0.12	0.25	0.65	0.50	-	5	0.49	0.23	32.0	23.0	0
	0.48	-	0.25	0.65	-	0.38	0.69	0.47	-	6	0.57	0.25	29.0	18.0	0
Koup R54	0.30	0.12	0.23	0.52	0.18	0.36	0.57	0.55	-	6	0.54	0.33	15.0	15.0	0
	0.30	0.11	0.28	0.57	0.15	0.36	0.60	0.59	-	10	0.60	0.36	24.0	15.0	0
	0.35	-	0.30	0.50	-	0.32	0.46	0.37	-	4	0.48	0.29	20.0	18.0	0
	0.35	-	-	-	-	-	0.50	0.40	-	7	0.50	0.28	20.0	17.0	0
	0.35	-	0.30	0.43	-	0.30	0.44	0.40	-	7	0.60	0.30	19.0	16.0	0
	0.35	0.12	0.25	0.75	0.12	0.27	0.49	0.46	-	7	0.50	0.38	18.0	23.0	2a
	0.35	-	0.25	0.60	-	0.30	0.45	0.35	-	8	0.59	0.32	19.0	17.0	0

Appendix Table 3 DIMENSIONS OF INFLORESCENCE IN POPULATION SAMPLES OFASTROLOBA (Contd.)

Locality	Lowest Fertile Bract length	middle width.	basal width.	Lowest Sterile Bract length	middle width.	basal width.	Pedicel Length Flowering basal	Flowering middle	Fruiting basal	No. of sterile bracts.	Peduncle Width at base	below raceme.	Length Peduncle	Length Raceme	No. of side branches.
	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.		cm.	cm.	cm.	cm.	
							A. HALLII. (Contd.)								
Koup R54 (contd.)	0.42	0.07	0.25	0.55	0.08	0.30	0.40	0.39	-	3	0.73	0.40	8.0	32.0	0
	0.43	0.10	0.20	0.93	0.18	0.47	0.42	0.35	-	14	0.67	0.38	16.0	19.0	14a
	0.45	0.10	0.20	0.60	0.13	0.26	0.50	0.33	-	5	0.45	0.29	11.0	12.0	0
	0.45	-	0.22	0.60	-	0.22	0.75	0.48	-	6	0.47	0.29	22.0	20.0	0
	0.45	0.10	0.30	0.65	0.08	0.40	0.35	0.28	-	3	0.56	0.30	18.0	13.0	0
	0.45	0.08	0.23	0.68	0.11	0.43	0.47	0.40	-	3	0.64	0.39	18.0	28.0	0
	0.45	0.10	0.20	0.75	0.15	0.28	0.48	0.36	-	4	0.56	0.30	19.0	20.0	0
	0.46	0.08	0.24	0.63	0.10	0.40	0.39	0.30	0.41	6	0.85	0.38	23.0	31.0	2b
	0.50	-	0.30	0.67	-	0.45	0.45	0.40	-	5	0.80	0.35	31.0	21.0	0
	0.50	0.10	0.21	0.75	0.15	0.24	0.39	0.35	0.47	6	0.52	0.30	11.0	14.0	1a
	0.50	-	0.25	0.75	-	0.40	0.68	0.40	-	5	0.55	0.35	24.0	19.0	1a
	0.50	-	0.30	0.77	-	0.44	0.37	0.35	-	7	0.70	0.30	31.0	18.0	0
	0.50	0.10	0.32	0.83	0.12	0.35	0.68	0.57	-	9	0.67	0.38	16.0	19.0	0
	0.52	-	0.40	0.85	-	0.40	0.48	0.42	-	6	0.90	0.44	21.0	25.0	2a
	0.53	0.14	0.25	0.70	0.20	0.30	0.53	0.46	0.53	5	0.64	0.40	26.0	24.0	2a
	0.53	0.08	0.30	0.72	0.09	0.38	0.49	0.45	-	5	0.51	0.37	13.0	24.0	1a
	0.54	0.10	0.20	0.70	0.22	0.30	-	0.45	0.48	4	0.68	0.34	21.0	24.0	2a
Ex. Hort.	-	-	-	-	-	-	-	-	-	-	0.60	-	30.0	17.0	-
	-	-	-	-	-	-	-	-	-	-	0.55	-	28.0	21.0	-
Herbarium Specimens.															
Prince Albert	0.30	-	0.15	-	-	-	0.33	0.24	-	4	-	-	9.0	8.0	0
Ex. Hort	0.75	0.10	0.30	1.10	0.13	0.40	0.30	0.25	-	5	-	-	27.0	13.0	1b,a
							A. BULLULATA.								
Matjesfontein R55	0.35	0.12	0.23	0.57	0.16	0.30	0.37	0.30	0.39	4	0.44	0.24	20.0	24.0	0
	0.35	0.13	0.22	0.65	0.21	0.35	0.49	0.35	-	7	0.57	0.24	28.0	15.0	0

Appendix Table 3 DIMENSIONS OF INFLORESCENCE IN POPULATION SAMPLES OF ASTROLOBA (Contd.)

Locality.	Lowest Fertile Bract length	middle width.	basal -width.	Lowest Sterile Bract length	middle width.	basal -width.	Pedicel Length Flowering basal	Flowering middle	Fruiting basal	No. of sterile bracts.	Peduncle Width at base	Peduncle Width below raceme.	Length Peduncle	Length Raceme	No. of side branches.
	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.		cm.	cm.	cm.	cm.	
							A. BULLULATA (Contd.)								
Matjesfontein R55 (Contd.)	0.40	0.14	0.24	0.55	0.16	0.25	0.48	0.30	-	5	0.50	0.28	20.0	27.0	0
	0.42	0.08	0.25	0.57	0.10	0.28	0.41	0.40	0.42	5	0.49	0.33	14.0	20.0	0
	0.43	0.16	0.23	0.60	0.18	0.30	0.53	0.47	-	5	0.56	0.30	22.0	29.0	1a
	0.45	0.15	0.30	0.55	0.13	0.40	0.49	0.40	-	3	0.54	0.25	17.0	11.0	1a
	0.45	0.10	0.20	0.73	0.23	0.27	0.53	0.45	-	7	0.55	0.27	30.0	24.0	0
	0.47	0.15	0.25	0.65	0.15	0.26	0.52	0.47	-	5	0.49	0.32	18.0	28.0	0
	0.48	0.08	0.20	0.73	0.08	0.27	0.53	0.45	-	7	0.55	0.27	30.0	24.0	0
Ex. Hort	0.35	-	0.20	0.60	-	-	0.45	-	-	4	-	-	-	-	0
	-	-	-	-	-	-	0.40	-	-	-	0.80	-	-	-	-
Herbarium Specimens.															
Verlaten Kloof	0.53	-	-	0.70	-	-	0.45	-	-	5	-	0.30	18.0	26.0	0
Ceres Karoo	0.37	-	-	0.42	-	-	0.38	0.29	-	3	-	-	19.0	17.0	0
Between Laingsburg & Ladismith	0.35	-	-	0.55	-	-	0.38	-	-	6	-	-	18.0	26.0	0
	0.35	-	-	0.70	-	-	0.30	-	-	4	-	-	17.0	13.0	0
	0.38	-	-	0.55	-	-	-	-	-	-	-	-	15.0	11.0	0
							A. RUGOSA X A. SMUTSIANA. cont.								
Hybrid R4	-	-	-	-	-	-	0.40	0.30	-	3	0.25	0.16	26.0	15.0	0
	-	-	-	-	-	-	0.45	-	-	-	0.28	-		-	-
	-	-	-	-	-	-	0.50	0.40	-	3	0.32	0.15	16.0	7.0	0
	-	-	-	-	-	-	0.50	0.30	-	2	0.32	0.18	21.0	17.0	0

Appendix Table 3 DIMENSIONS OF INFLORESCENCE IN POPULATION SAMPLES OF ASTROLOBA (Contd.)

Locality.	Lowest Fertile Bract length	middle width.	basal width.	Lowest Sterile Bract length	middle width.	basal width.	Pedicel Length Flowering basal	Flowering middle	Fruiting basal	No. of sterile bracts.	Peduncle Width at base	below raceme.	Length Peduncle	Raceme	No. of side branches.
	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.		cm.	cm.	cm.	cm.	
						A. SPIRALIS.									
Oudtshoorn R68	0.32	0.08	0.22	0.98	0.08	0.39	-	0.20	0.30	7	0.34	0.16	17.0	15.0	0
	0.42	0.12	0.20	0.52	0.08	0.40	0.20	0.19	-	4	0.26	0.14	26.0	16.0	0
	0.42	0.10	0.22	1.05	0.10	0.22	-	0.14	0.25	5	0.35	0.18	28.0	18.0	0
	0.45	0.07	0.25	0.73	0.07	0.23	-	0.17	0.30	3	0.27	0.15	28.0	22.0	0
	0.50	0.10	0.20	0.55	0.10	0.23	-	0.20	0.30	5	0.29	0.17	32.0	17.0	0
	0.54	0.10	0.25	0.82	0.13	0.32	0.26	0.17	-	4	0.37	0.17	16.0	14.0	0
	0.55	0.08	0.22	0.64	0.15	0.20	-	0.16	0.23	4	0.33	0.17	28.0	22.0	0
	0.55	0.09	0.23	0.73	0.07	0.20	0.25	0.14	-	5	0.27	0.13	26.0	13.0	0
	0.55	0.10	0.28	0.86	0.10	0.25	-	0.20	0.37	4	0.40	0.22	34.0	20.0	0
	0.58	0.08	0.23	0.70	0.08	0.22	-	0.15	0.20	3	0.35	0.18	28.0	17.0	0
	0.59	0.06	0.20	0.70	0.09	0.22	-	0.15	0.17	4	0.35	0.16	26.0	23.0	0
	0.60	0.08	0.23	-	-	-	-	0.25	0.44	6	0.56	0.25	36.0	36.0	2a
	0.60	0.08	0.27	0.90	0.12	0.35	0.18	0.20	-	5	0.41	0.20	28.0	22.0	0
	0.63	0.07	0.24	0.80	0.08	0.23	0.23	0.19	-	4	0.35	0.14	23.0	18.0	0
	0.63	0.09	0.28	0.86	0.09	0.26	-	0.20	0.26	3	0.37	0.19	29.0	24.0	0
	0.64	0.07	0.26	1.05	0.08	0.38	-	0.23	0.28	6	0.44	0.23	37.0	19.0	0
	0.67	0.09	0.23	-	-	-	-	0.18	0.28	5	0.42	0.17	24.0	21.0	0
	0.70	0.07	0.23	1.04	0.08	0.23	0.39	0.38	-	6	0.45	0.20	29.0	22.0	0
	0.72	0.10	0.30	0.70	0.10	0.20	0.18	0.15	-	4	0.50	0.20	35.0	18.0	0
	0.75	0.06	0.23	1.30	0.08	0.27	0.34	0.38	-	6	0.45	0.20	29.0	22.0	0
	0.80	0.09	0.28	0.62	0.12	0.30	0.28	0.18	0.32	5	0.44	0.23	39.0	23.0	0
	0.86	0.07	0.25	1.40	0.05	0.27	0.34	0.27	-	5	0.49	0.24	33.0	23.0	0
	-	-	-	0.96	0.10	0.27	0.33	0.24	-	7	0.55	0.22	39.0	31.0	0
	-	-	-	-	-	-	0.34	0.30	-	6	0.55	0.25	38.0	33.0	1a
Calitzdorp R64	0.47	0.10	0.25	0.95	0.08	0.25	-	0.51	0.70	7	0.40	0.24	29.0	21.0	0
	0.48	0.23	0.35	0.78	0.13	0.26	0.80	0.46	0.82	5	0.45	0.29	30.0	20.0	3a
	0.50	0.10	0.30	0.77	0.11	0.30	0.78	0.46	-	4	0.44	-	33.0	13.0	3a
	0.55	0.05	0.18	0.53	0.08	0.30	-	-	0.20	5	-	-	28.0	10.0	0
	0.60	0.07	0.20	-	-	-	0.17	0.13	-	4	-	-	28.0	12.0	0
	0.60	0.57	0.28	0.80	0.12	0.32	-	0.17	0.29	5	-	0.19	25.0	13.0	0
	-	-	-	-	-	-	0.46	0.37	-	6	-	-	19.0	23.0	-

Appendix Table 3 DIMENSIONS OF INFLORESCENCE IN POPULATION SAMPLES OF ASTROLOBA (Contd.)

Locality.	Lowest Fertile Bract length	middle width.	basal width.	Lowest Sterile Bract length	middle width.	basal width.	Pedicel Length Flowering basal	Flowering middle	Fruiting basal	No. of sterile bracts.	Peduncle Width at base	Peduncle Width below raceme.	Length Peduncle	Length Raceme	No. of side branches.
	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm	cm.	cm.	cm.	cm.	
							A. SPIRALIS. (Contd.)								
26 miles S.	0.57	0.10	0.23	0.67	0.10	0.23	0.38	0.30	-	5	0.28	0.14	25.0	8.0	0
of Ladismith	-	-	-	1.0	-	-	0.50	0.43	-	7	0.35	0.24	33.0	21.0	0
R6	-	-	-	1.0	-	-	0.40	0.35	-	7	0.30	0.22	33.0	18.0	0
Herbarium specimens.															
Oudtshoorn	0.50	0.26	0.08	0.75	0.20	0.08	0.29	0.21	-	5	-	-	22.0	15.0	0
	0.65	0.20	0.07	-	-	-	-	-	0.39	6	-	0.19	33.0	21.0	0
	0.60	0.20	0.06	-	-	-	0.27	0.20	-	6	-	0.18	22.0*	14.0	0
	0.60	0.14	0.06	1.00	-	-	0.20	-	-	4	0.35	0.17	19.0	-	0
	-	-	-	-	-	-	-	-	0.30	-	-	0.23	22.0	-	0
	-	-	-	-	-	-	0.33	0.30	-	-	-	0.21	21.0	11.0	0
	-	-	-	-	-	-	-	0.26	0.39	-	-	0.20	24.0	15.0	0
	0.40	0.10	0.04	0.95	0.28	0.08	0.29	0.25	-	6	-	0.17	33.0	14.0	0
	0.50	0.20	0.06	0.90	0.26	0.10	0.22	0.31	-	5	-	0.19	25.0	15.0	0
	0.60	0.20	0.06	0.75	0.20	0.06	0.42	0.24	-	5	-	0.23	28.0	-	0
De Rust	0.70	0.25	0.07	1.10	0.28	0.10	-	0.27	0.38	7	-	0.19	34.0	21.0	0
Little Karoo	0.35	0.14	0.06	-	-	-	0.22	0.12	-	4	-	0.18	16.0	15.0	0
Graaff Reinet(?) no. 5112 in herb. Marloth (PRE)	0.65	0.20	0.04	1.40	0.40	0.14	0.25	0.24	-	4	-	0.19	25.0	14.0	0
"Sent from Port Elizabeth No. 6510b in herb Marloth (PRE)	0.62	0.30	0.06	0.95	0.35	0.08	0.28	0.10	-	-	-	-	-	-	0

Appendix Table 3 DIMENSIONS OF INFLORESCENCE IN POPULATION SAMPLES OF ASTROLOBA (Contd.)

Locality.	Lowest Fertile Bract middle length	-width.	basal -width.	Lowest Sterile Bract middle length	-width.	basal -width.	Pedicel Length Flowering basal	-middle	Fruiting basal	No. of sterile bracts.	Peduncle Width at base	below raceme.	Length Peduncle	-Raceme	No. of side branches.
	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.		cm.	cm.	cm.	cm.	
							A. SPIRALIS (Contd.)								
Ex. Hort	0.60	0.20	0.06	0.90	0.20	0.08	0.23	0.21	-	7	-	0.13	22.0*	10.0	0
							A. HERREI.								
Uniondale R44	0.60	0.24	0.35	0.70	0.20	0.35	0.80	0.70	-	2	0.58	0.28	25.0	13.0	0
	0.60	0.15	0.30	1.0	0.20	0.50	0.50	0.40	-	4	0.44	0.23	22.0	15.0	0
	0.65	0.20	0.30	0.804	0.20	0.30	-	-	-	-	-	-	-	-	-
	0.65	0.16	0.30	0.90	0.27	0.30	0.35	0.23	-	5	0.43	0.23	20.0	-	0
	0.72	0.18	0.45	1.00	0.20	0.40	0.60	0.55	-	3	0.42	0.26	10.0	18.0	0
	0.75	0.15	0.35	0.90	0.15	0.35	0.45	0.45	-	3	0.48	0.23	19.0	-	0
	0.75	0.15	0.35	-	-	-	0.95	0.70	-	1	0.50	0.27	18.0	9.0	0
	0.75	0.10	0.40	-	-	-	0.78	0.65	-	-	-	-	-	28.0	-
Prince Albert R46	-	-	-	-	-	-	-	-	2.0	-	-	0.32	-	25.0	-
	0.60	0.18	0.35	0.75	0.14	0.32	0.58	0.48	-	3	0.49	0.27	23.0	-	0
	0.60	0.13	0.30	0.82	0.20	0.45	0.68	0.53	-	4	0.52	0.27	19.0	14.0	0
	0.62	0.18	0.35	0.70	0.20	0.30	0.69	0.64	-	2	0.48	0.29	22.0	-	0
	0.62	0.12	0.30	0.80	0.15	0.35	0.63	0.55	-	3	0.50	0.25	19.0	-	0
	0.63	0.17	0.30	0.80	0.14	0.30	0.60	0.50	-	3	0.50	0.20	20.0	-	0
	0.65	0.23	0.43	0.80	0.20	0.50	-	-	-	3	0.48	0.20	22.0	-	0
	0.70	0.16	0.30	0.75	0.20	0.30	0.64	-	-	3	0.59	0.26	30.0	-	0
	0.75	0.15	0.35	1.00	0.14	0.28	0.50	0.47	-	2	0.48	0.29	18.0	-	0
	0.77	0.18	0.40	0.92	0.15	0.40	0.80	0.56	-	3	0.60	0.30	24.0	-	0
	0.85	0.13	0.45	1.10	0.15	0.45	0.94	-	-	2	0.40	0.38	26.0	-	0
Herbarium Specimens.															
Prince Albert	0.70	0.08	0.40	1.08	0.10	0.40	-	-	-	-	-	-	-	-	-
	0.75	0.12	0.45	-	-	-	1.02	0.85	-	-	-	0.28	-	19.0	-
	0.75	0.12	0.48	-	-	-	1.18	0.96	-	-	-	0.39	-	26.0	-
	0.80	0.17	0.45	0.95	0.10	0.50	1.68	1.10	-	-	-	0.26	-	24.0	-

Appendix Table 3 DIMENSIONS OF INFLORESCENCE IN POPULATION SAMPLES OF ASTROLOBA (Contd.)

Locality.	Lowest Fertile Bract length	meddle width.	basal width.	Lowest Sterile Bract length	middle width.	basal width.	Pedicel Length Flowering basal	Flowering middle	Fruiting basal	No. of sterile bracts.	Peduncle Width at base	Peduncle Width below raceme.	Length Peduncle	Length Raceme	No. of side branches.
	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.		cm.	cm.	cm.	cm.	
							A. HERREI. (Contd.)								
Herbarium Specimens. (Contd.)															
Prince Albert	0.70	0.10	0.40	-	-	-	-	-	-	-	-	-	-	-	-
	0.72	0.16	0.30	-	-	-	0.63	0.44	-	2	-	0.25	20.0*	14.0	0
	0.85	0.15	0.40	0.90	0.23	0.40	0.79	0.39	-	2	-	0.20	22.0	-	0
	1.00	0.10	0.45	1.10	0.10	0.40	0.89	0.58	-	-	-	0.30	-	23.0	-
	1.10	0.16	0.50	-	-	-	-	-	-	-	-	-	-	-	-
S. Loc. No. 5205 (PRE)	0.90	0.16	0.40	-	-	-	0.70	0.55	-	1	-	0.26	11.0	20.0	0
Ex. Hort Nbg.	0.70	0.10	0.30	1.10	0.30	0.50	0.60	-	-	3	0.32	0.20	16.0	-	0
	0.80	0.20	0.30	1.00	0.08	0.30	0.70	-	-	2	0.30	0.28	16.0	17.0	0
Ex. Hort No. 27648 (BOL)	0.68	0.14	0.40	0.90	-	-	-	0.57	0.83	3	0.37	0.29	21.0	15.0	0

Appendix Table 3 DIMENSIONS OF INFLORESCENCE IN POPULATION SAMPLES OF ASTROLOBA.

Locality.	Lowest Fertile Bract length.	Lowest Fertile Bract middle width.	Lowest Fertile Bract basal width.	Lowest Sterile Bract length.	Lowest Sterile Bract middle width.	Lowest Sterile Bract basal width	Pedicel Length Flowering basal	Pedicel Length Flowering middle	Pedicel Length Fruiting basal	No. of sterile bracts.	Peduncle Width at base	Peduncle Width below raceme.	Length Peduncle	Length Raceme	No. of side branches.
	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.		cm.	cm.	cm.	cm.	
							A. RUGOSA.								
Pietersfontein R19,20	0.23	-	-	-	-	-	0.75	0.72	-	3	0.40	0.25	29.0	27.0	0
	0.28	-	-	-	-	-	0.40	0.30	-	4	0.23	0.18	14.0	9.0	0
	0.30	-	-	-	-	-	0.55	0.50	-	3	0.30	0.23	18.0	9.0	0
	0.32	-	-	-	-	-	0.32	-	-	3	0.25	0.20	14.0	5.0	0
	0.35	-	-	-	-	-	0.52	0.38	-	3	0.30	0.20	27.0	13.0	0
	0.36	-	-	-	-	-	0.80	0.50	-	4	0.[illegible]	0.22	20.0	9.0	0
	0.40	-	-	-	-	-	0.80	0.70	-	4	0.30	0.23	21.0	10.0	0
	0.40	-	-	-	-	-	0.48	0.48	-	3	0.28	0.20	12.0	8.0	0
	0.40	0	-	-	-	-	0.64	0.55	-	2	0.25	0.23	15.0	10.0	0
	0.50	-	-	-	-	-	0.80	-	-	2	0.30	0.20	22.0	8.0	0
Baden-Baden Area R17,18, 59	0.30	0.12	0.25	0.48	0.12	0.25	0.80	0.44	-	2	0.24	0.15	24.0	16.0	0
	0.30	0.12	0.23	-	-	-	0.70	0.37	-	2	0.26	0.15	23.0	13.0	0
	0.30	0.08	0.23	0.40	0.08	0.24	0.63	0.55	-	3	0.26	0.15	34.0	10.0	0
	0.30	0.08	0.22	0.48	0.12	0.36	0.65	0.51	-	3	0.34	0.17	28.0	16.0	0
	0.30	-	-	-	-	-	0.60	0.50	-	3	0.28	0.20	33.0	22.0	0
	0.30	-	-	-	-	-	0.60	-	-	2	-	-	33.0	15.0	0
	0.30	-	-	-	-	-	0.62	0.50	-	2	0.32	0.20	20.0	12.0	0
	0.31	-	-	-	-	-	0.45	0.40	-	3	0.33	0.25	19.0	11.0	0
	0.32	0.09	0.20	0.53	0.12	0.27	0.71	-	-	4	0.35	0.17	23.0	4.0	0
	0.32	0.07	0.20	0.42	0.23	0.25	-	0.92	0.89	4	0.32	0.17	29.0	20.0	0
	0.35	-	-	-	-	-	0.75	0.50	-	3	0.22	0.19	25.0	11.0	0
	0.38	0.10	0.20	0.48	0.10	0.18	0.60	0.55	-	3	-	-	24.0	9.0	0
	0.38	0.08	0.20	-	-	-	0.49	0.40	-	3	0.35	0.14	23.0	0.10	0
	0.40	0.12	0.22	0.45	0.10	0.22	0.49	0.42	-	3	0.37	0.17	22.0	16.0	0
	0.40	0.07	0.25	0.55	0.06	0.25	0.46	-	-	3	0.41	0.19	26.0	3.0*	0
	0.40	-	-	-	-	-	0.40	0.40	-	3	0.35	0.20	21.0	13.0	0
	0.40	-	-	-	-	-	0.50	0.40	-	4	0.28	0.26	30.0	10.0	0
	0.43	-	-	-	-	-	0.60	0.50	-	2	0.30	0.23	20.0	18.0	0
	0.45	-	-	-	-	-	0.40	0.30	-	2	0.26	0.20	14.0	16.0	0

Appendix Table 3 DIMENSIONS OF INFLORESCENCE IN POPULATION SAMPLES OF ASTROLOBA. (Contd.)

Locality.	Lowest Fertile Bract length.	middle -width.	basal -width.	Lowest Sterile Bract length	middle -width.	basal -width.	Pedicel Length Flowering basal	-middle	Fruiting basal	No. of sterile bracts	Peduncle Width at base	below raceme.	Length Peduncle	-Raceme	No. of side branches.
	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.		cm.	cm.	cm.	cm.	
							A. RUGOSA. (Contd.)								
2 miles out	0.28	-	-	-	-	-	0.45	0.35	-	3	0.25	0.19	24.0	6.0	0
of Montagu	0.35	-	-	-	-	-	0.35	-	-	2	0.28	0.20	18.0	-	0
R23	0.35	-	-	-	-	-	0.51	0.40	-	4	0.28	0.19	23.0	7.0	0
	0.35	-	-	-	-	-	0.60	0.48	-	2	0.30	0.25	31.0	27.0	0
	0.35	-	-	-	-	-	0.75	-	-	3	0.27	0.20	25.0	10.0	0
	0.40	-	-	-	-	-	0.60	0.40	-	3	0.30	0.22	22.0	11.0	0
	0.50	-	-	-	-	-	0.65	0.49	-	4	0.30	0.27	26.0	18.0	0
"Montagu Dist"															
K'bosch Hort	0.32	0.10	0.25	0.52	0.12	0.27	-	0.46	0.52	4	0.28	0.17	24.0	11.0	0
	0.32	0.13	0.28	0.58	0.12	0.20	0.45	0.30	-	3	0.29	0.18	21.0	14.0	0
	0.33	0.08	0.20	-	-	-	0.50	0.44	-	2	0.27	0.14	21.0	11.0	0
	0.38	0.11	0.20	0.47	0.08	0.27	-	0.50	0.55	3	0.37	0.19	30.0	16.0	0
	0.40	0.12	0.30	0.65	0.12	0.25	0.80	0.57	-	3	0.37	0.20	43.0	16.0	0
Dobbelaars															
Kloof R21,22	0.30	-	-	-	-	-	0.50	-	-	3	0.40	0.28	21.0	8.0	0
	0.31	-	-	-	-	-	0.47	-	-	4	0.28	0.19	20.0	5.0	0
	0.33	0.09	0.23	0.48	0.10	0.28	0.54	0.48	-	4	0.33	0.17	25.0	12.0	0
	0.35	-	-	-	-	-	0.30	-	-	3	0.26	0.15	13.0	-	0
	0.37	-	-	-	-	-	0.55	0.45	-	3	0.25	0.20	25.0	11.0	0
	0.40	-	-	-	-	-	0.90	0.68	-	4	0.27	0.22	26.0	15.0	0
	0.45	-	-	-	-	-	0.80	0.55	-	2	0.26	0.21	24.0	15.0	0
	0.45	-	-	-	-	-	0.60	0.55	-	4	0.30	0.22	26.0	16.0	0
	0.49	-	-	-	-	-	0.85	0.65	-	2	0.34	0.20	26.0	12.0	0
23 miles out	0.30	-	-	0.45	-	-	-	-	-	2	-	-	-	-	-
of Ladismith	0.31	0.10	0.23	0.56	0.16	0.30	-	-	-	-	-	-	-	-	-
on old Barry-	0.35	0.15	0.28	0.45	0.11	0.28	-	-	-	-	-	-	-	-	-
dale Rd. R2	0.37	0.17	0.22	0.57	0.14	0.24	-	-	-	-	-	-	-	-	-
	0.40	0.13	0.28	0.60	0.16	0.35	0.35	0.28	-	4	0.30	0.20	24.0	-	0

Appendix Table 3 DIMENSIONS OF INFLORESCENCE IN POPULATION SAMPLES OF ASTROLOBA (Contd.)

Locality.	Lowest Fertile Bract length.	middle width.	basal width.	Lowest Sterile Bract length.	middle width.	basal width.	Pedicel Length Flowering basal	Flowering middle	Fruiting basal	No. of sterile bracts.	Peduncle Width at base	Peduncle Width below raceme.	Length Peduncle	Length Raceme	No. of side branches.
	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.		cm.	cm.	cm.	cm.	
							A. RUGOSA. (Contd.)								
23 miles out of Ladismith on old Barrydale Rd. R2	0.40	0.13	0.30	0.60	0.12	0.30	0.49	0.40	-	3	0.27	0.16	17.0	9.0	0
	0.42	0.15	0.25	0.58	0.12	0.28	0.46	0.34	-	3	0.30	0.20	23.0	13.0	0
	0.45	0.13	0.23	0.56	0.16	0.33	0.36	0.32	-	4	0.34	0.23	24.0	13.0	0
	0.45	0.15	0.28	0.80	0.15	0.28	0.44	0.30	-	4	0.40	0.16	17.0	13.0	0
	-	-	-	-	-	-	0.40	0.35	-	3	0.28	0.18	27.0	17.0	0
Herbarium Specimens.															
"Graaff Reinet (?) No.4202 in herb. Marloth (PRE)	0.48	0.07	0.23	0.80	0.06	0.25	0.54	0.37	-	4	-	0.22	9.0*	24.0	0
	-	-	-	-	-	-	0.42	0.28	-	5	-	0.24	17.0*	17.0	0
Bonnievale, v.d. 226 (BOL)	0.50	0.08	0.23	-	-	-	0.73	0.58	-	2	0.25	0.10	17.0	19.0	0
Barrydale Nbg 2154/26 (BOL)	0.35	0.09	0.25	-	-	-	0.22	0.26	-	2	0.25	0.13	17.0	8.0	0
	-	-	-	-	-	-	0.46	0.39	-	3	-	-	15.0	6.0	0
	-	-	-	-	-	-	0.20	0.18	-	3	0.23	0.09	18.0	6.0	0
Muiskraal	0.40	0.08	0.26	-	-	-	-	-	0.53	3	-	0.13	18.0	9.0	0
	-	-	-	-	-	-	0.27	0.20	-	3	-	0.07	-	-	0
Ladismith	0.35	0.13	0.25	0.48	0.12	0.23	0.47	0.39	-	2	-	0.10	16.0	7.0	0
Betw. L'smith & Laingsburg	0.45	0.08	0.23	0.75	0.13	0.20	0.55	0.30	-	5	0.22	0.17	26.0	11.0	0
	-	-	-	-	-	-	0.50	0.39	-	2	-	0.14	13.0	-	0
	-	-	-	-	-	-	0.74	-	-	-	-	-	-	-	-
Ex. Hort NBG 1396/28(BOL)	0.45	0.10	0.25	0.65	0.10	0.23	0.30	0.27	-	2	-	0.09	10.0*	5.0	0

Appendix Table 3 DIMENSIONS OF INFLORESCENCE IN POPULATION SAMPLES OF ASTROLOBA (Contd.)

locality.		PERIANTH TUBE Length to Neck	Diameter Neck	Diameter Middle	Diameter Base	LOBES Length Outer	Length Inner	Width Outer	Width Inner	GYNAECIUM Length Overy	Style	DIFFERENCE BETWEEN DIAMETER OF Middle and Neck	Base and Middle	ANGLE OF OPEN LOBES Ant. Outer-Lats.	Outer	Post. Inner	Inner-Lats.
		CM.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	o	O	o	o
							A. FOLIOLOSA Subsp. FOLIOLOSA.										
Steytlerville R52a	a	.87	.25	.31	.28	.17	.17	.15	.20	.43	.50	.06	-.03	35	20	30	20
	a	.86	.24	.33	.32	.15	.17	.15	.20	.48	.50	.09	-.01	70	30	50	30
	a	.84	.26	.33	.30	.20	.20	.15	.23	.40	.33	.07	-.03	60	40	30	30
	a.	.82	.23	.31	.28	.17	.17	.17	.24	.39	.32	.08	-.03	50	50	50	50
	a	.81	.25	.29	.28	.17	.17	.17	.23	.35	.37	.04	-.01	60	40	40	40
	a4	.80	.29	.32	.32	.20	.20	.17	.22	.44	.49	.03	0	80	60	55	55
	a	.76	.25	.33	.27	.17	.16	.16	.24	.38	.39	.08	-.06	60	40	40	40
	a	.75	.28	.32	.30	.18	.18	.18	.25	.38	.38	.04	-.02	90	70-60	50	50
	a	.74	.22	.29	.29	.15	.17	.15	.22	.43	.33	.07	0	30	10	S	S
	a	.70	.20	.32	.27	.17	.18	.18	.22	.39	.40	.12	-.05	40	30	30	30
Mount Stewart R52b	a	.81	.22	-	.24	.19	.18	.17	.17	.32	.46	.-	-	-	-	-	-
	a	.80	.28	.37	.30	.17	.18	.17	.21	.40	.41	.09	-.07	35	15	20	S
	a	.73	.20	.26	.26	.14	.14	.13	.15	.30	.35	.06	0	-	-	-	-
Wolwefontein R11	a	.78	.23	.37	.28	.20	.20	.17	.20	.37	.29	.14	-.09	-	-	-	-
Lake Mentz R36	a	.75	.25	.30	.28	.18	.18	.18	.21	.35	.22	.05	-.02	90	90	40	20
	a	.70	.23	.30	.25	.20	.18	.20	.22	-	-	.07	-.05	-	-	-	-
Springbok Vlakte Nbg 171/59	c	.78	.22	.28	.27	.19	.20	.18	.25	.36	.43	.06	-.01	50	20	70	45
	c	.76	.21	.28	.24	.19	.20	.20	.22	.35	.40	.07	-.04	60	60	70	40
Graaff Reinet R60	a	.99	.34	.40	.40	.20	.24	.18	.24	.50	.26	.06	0	180	90	75	60
	a	.93	.27	.36	.34	.20	.23	.14	.30	.46	.47	.09	-.02	60	60	50	40

Appendix Table 4 DIMENSIONS OF PERIANTH IN POPULATION SAMPLES OF ASTROLOBA (a=Flowered in situ; b,c,d & f = flowered at Kirstenbosch in 1960,61,62 & 64 respectively; s, referring to the lobes, means that they are more or less straight, often slightly inwardly hooded.)

Locality.		PERIANTH TUBE Length to Neck	Diameter Neck	Middle	Base	LOBES Length Outer	Inner	Width Outer	Inner	GYNAECIUM Length Ovary	Style	DIFFERENCE BETWEEN DIAMETER OF Middle and Neck	Base and Middle	ANGLE OF OPEN LOBES Ant. Outer-Lats.	Outer-Lats.-Post.	Inner	Inner-Lats.
		cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	°	°	°	°
								A. FOLIOLOSA Subsp. FOLIOLOSA (Contd.)									
Graaff Reinet R60 (Contd.)	a	.86	.29	.38	.37	.20	.23	.20	.30	.50	.23	.09	-.01	110	80	60	30
	a	.85	.26	.35	.33	.18	.20	.15	.26	.40	.37	.09	-.02	40	40	50	30
	a	.85	.26	.35	.33	.20	.22	.15	.23	.36	.20	.09	0.02	60	60	60	30
	a	.85	.23	.30	.28	.20	.20	.14	.25	.34	.40	.07	-.02	70	60	60	40
	a	.85	.29	.38	.33	.20	.22	.20	.25	.40	.35	.09	-.05	80	70	80	45
	a	.85	.27	.34	.29	.20	.25	.20	.30	.44	.32	.07	-.05	80	75	50	35
	a	.83	.20	.29	.37	.23	.27	.20	.35	.43	.37	.19	-.02	60	50	30	20
	a	.83	.32	.37	.30	.20	.22	.15	.25	.33	.38	.05	-.07	75	60	45	30
	a	.83	.23	.28	.30	.18	.20	.12	.27	.40	.53	.05	.02	80	80	60	35
	a	.83	.27	.34	.35	.20	.20	.20	.27	.33	.45	.07	.01	60	60	50	40
	a	.82	.26	.34	.30	.20	.22	.17	.28	.40	.32	.08	-.04	60	70	70	40
	a	.82	.27	.35	.32	.20	.20	.15	.25	.44	.38	.08	-.03	105	80	90	60
	a	.80	.26	.34	.30	.20	.23	.16	.30	.39	.28	.08	-.06	105	95	90	55
	a	.78	.27	.38	.35	.19	.19	.17	.25	.38	.35	.11	-.03	90	85	80	70
	a	.76	.30	.43	.35	.20	.22	.20	.25	.34	.30	.13	-.08	100	85	90	70
	a	.68	.23	.28	.28	.17	.20	.16	.25	.36	.32	.05	0	100	85	90	50
								A. FOLIOLOSA Subsp. CONGESTA.									
Cradock R32	a	.90	.25	.32	.28	.19	.20	.16	.20	.35	.16	.07	-.04	60	60	30	30
	a	.90	.30	.40	.30	.20	.20	.20	.23	.40	.15	.10	-.10	-	-	-	-
	a	.90	.30	.40	.30	.20	.22	.20	.24	.40	.18	.10	-.10	60	60	60	60
	a	.90	.30	.35	.30	.20	.20	.18	.22	.40	.40	.05	-.05	60	60	30	30
	c	.83	.28	.37	.36	.18	.20	.20	.27	.38	.43	.09	-.01	80	90	70	40
	c	.80	.28	.37	.37	.18	.20	.20	.23	.40	.40	.09	0	60	70	50	30
	a	.70	.29	.43	.27	.18	.18	.20	.22	.32	.22	.14	-.16	90	90	30	30
	a	.70	.25	.32	.25	.20	.20	.17	.23	.30	.20	.07	-.07	-	-	-	-
Rayners Kop R33	a	.75	.32	.35	.32	.21	.22	.20	.26	.28	.25	.03	-.03	110	110	110	110
	a	.75	.30	.32	.30	.19	.20	.20	.25	.40	.27	.02	-.02	110	110	60	60

Appendix Table 4 DIMENSIONS OF PERIANTH IN POPULATION SAMPLES OF STROLOBA.

Locality.		PERIANTH TUBE Length of Neck-Neck		PERIANTH TUBE Diameter Middle-Base		LOBES Length Outer-Inner		LOBES Width Outer-Inner		GYNAECIUM Length Overy-Style		DIFFERENCE BETWEEN DIAMETER OF Middle and Neck	DIFFERENCE BETWEEN DIAMETER OF Base and Middle	ANGLE OF OPEN LOBES Ant. Outer-Lats.	ANGLE OF OPEN LOBES Outer-Lats.	ANGLE OF OPEN LOBES Post. Inner-Lats.	ANGLE OF OPEN LOBES Inner-Lats.
		cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	o	o	o	o
								A. FOLIOLOSA Subsp. CONGESTA. (Contd.)									
Rayners Kop R33 (Contd.)	a	.75	.27	.32	.30	.20	.20	.19	.24	.38	.20	.05	-.02	90	90	30	60
	a	.75	.32	.38	.30	.16	.20	.17	.22	.40	.40	.06	-.08	60	60	40	40
	a	.70	.28	.38	.30	.16	.19	.15	.23	.40	.37	.10	-.08	30	30	S	S
	a	.70	.28	.30	.25	.19	.20	.18	.28	.30	.30	.02	-.05	40	40	S	S
	a	.70	.27	.30	.29	.20	.20	.18	.23	.30	.40	.03	-.01	30	30	S	S
	a	.70	.31	.36	.31	.20	.20	.20	.29	.40	.30	.05	-.05	180	180	50	50
Helspoort R41	b	.79	.29	.34	.30	.23	.27	.20	.32	.38	.25	.05	-.04	60	60	40	S
	b	.77	.29	.34	.29	.22	.24	.20	.25	.35	.28	.05	-.05	120	100	70	70
	b	.77	.28	.35	.30	.23	.25	.20	.30	.40	.28	.07	.05	80	80	S	S
	b	.73	.24	.29	.24	.18	.22	.20	.30	.40	.30	.05	-.05	-	-	-	-
	b	.68	.24	.29	.27	.19	.22	.18	.28	.40	.30	.05	-.02	-	-	-	-
	b	.65	.25	.33	.28	.21	.21	.17	.23	.40	.35	.08	-.05	80	60	10	S
	b	.62	.24	.29	.28	.20	.20	.18	.22	.40	.32	.05	-.01	60	50	10	S
	b	.60	.28	.32	.28	.21	.21	.16	.25	.36	.20	.04	-.04	90	80	30	S
	b	.58	.23	.29	.24	.20	.20	.16	.23	.35	.30	.06	-.05	80	60	S	S
Dikkop Vlakte R40	b	.70	.36	.39	.35	.23	.24	.20	.28	.40	.25	.03	-.04	60	60	60	60
	b	.67	.29	.33	.30	.20	.20	.20	.29	.35	.17	.04	-.03	60	40	S	S
	b	.65	.28	.30	.27	.20	.21	.20	.29	.35	.25	.02	-.03	90	80	S	S
	b	.65	.28	.36	.27	.28	.28	.22	.30	.45	.30	.08	-.09	30	90	90	90
	b	.64	.35	.38	.34	.25	.28	.22	.28	.40	.35	.03	-.04	-	-	-	-
Krantz Drift Commins 2063	a	.75	.27	.28	.22	.20	.20	.20	.24	.40	.16	.01	-.06	-	-	-	-
								A. FOLIOLOSA Subsp. ROBUSTA									
Steytlerville R43	a	.96	.29	.29	.30	.25	.32	.20	.30	.38	.25	0	.01	140	90	60	60
	a	.85	.28	.32	.32	.28	.30	.20	.30	.40	.25	.04	0	135	135	60	60

Appendix Table 4 DIMENSIONS OF PERIANTH IN POPULATION SAMPLES OF ASTROLOBA (Contd.)

Locality.		PERIANTH TUBE Length to Neck	PERIANTH TUBE Diameter Neck	PERIANTH TUBE Diameter Middle	PERIANTH TUBE Diameter Base	LOBES Length Outer	LOBES Length Inner	LOBES Width Outer	LOBES Width Inner	GYNAECIUM Length Ovary	GYNAECIUM Length Style	DIFFERENCE BETWEEN DIAMETER OF Middle and Neck	DIFFERENCE BETWEEN DIAMETER OF Base and Middle	ANGLE OF OPEN LOBES Ant. Outer-Lats.	ANGLE OF OPEN LOBES Outer-Lats.-Post.	ANGLE OF OPEN LOBES Post.-Inner-Lats.	ANGLE OF OPEN LOBES Inner-Lats.
		CM.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	o	o	o	o
A. FOLIOLOSA Subsp. ROBUSTA (Contd.)																	
Steytlerville R43 (Contd.)	a	.82	.27	.27	.28	.30	.30	.30	.28	.40	.23	0	.01	140	-	-	-
	a	.80	.30	.34	.32	.30	.35	.22	.33	.30	.21	.04	-.02	-	-	-	-
	a	.79	.32	.34	.32	.30	.37	.30	.40	.42	.23	.02	-.02	105	70	70	70
	a	.78	.28	.32	.32	.30	.36	.26	.36	.45	.35	.02	0	150	130	130	130
	a	.74	.27	.32	.33	.30	.32	.20	.30	.35	.30	.05	.01	180	170	45	45
	a	.70	.30	.34	.30	.28	.30	.20	.27	.35	.15	.04	-.04	40	40	40	40
	a	.58	.22	.26	.23	.23	.24	.20	.30	.28	.25	.02	-.03	80	50	50	50
8 miles East of Laingsburg R1	a	.78	-	.34	-	.20	.40	.19	.32	-	-	-	-				
	a	.73	.27	.27	.30	.20	.30	.20	.30	.30	.27	0	.03	90	120	120	120
	a	.72	.28	.30	.30	.19	.30	.20	.30	.35	.30	.02	0	90	120	120	120
	a	.70	.26	.29	.29	.20	.30	.20	.30	.30	.23	.03	0	90	90	90	90
	a	.70	.26	.28	.28	.17	.25	.18	.25	.30	.30	.02	0	100	100	100	100
Nelspoort R42	a	.90	.26	.34	.30	.25	.27	.20	.30	.35	.25	.08	-.04	110	90	90	70
	a	.85	.25	.30	.30	.20	.23	.18	.23	.37	.20	.05	0	80	60	60	60
	a	.80	.30	.38	.30	.25	.28	.22	.30	.40	.28	.08	-.08	100	80	80	80
	a	.79	.29	.37	.30	.28	.30	.20	.28	.40	.25	.08	-.07	-	-	-	-
	a	.77	.30	.35	.33	.30	.30	.20	.27	.30	.23	.05	-.02	80	100	100	50
	a	.70	.28	.33	.30	.30	.31	.20	.29	.35	.18	.05	-.03	-	-	-	-
	a	.70	.26	.30	.28	.20	.25	.20	.26	.30	.23	.04	-.02	50	30	30	30
	a	.70	.23	.30	.27	.23	.23	.20	.30	.35	.25	.07	-.03	100	80	80	80
	a	.66	.25	.30	.27	.21	.23	.20	.22	.35	.30	.05	-.03	40	40	40	40
A. SMUTSIANA.																	
Ladismith-Barrydale Rd R3,62a	b	1.21	.27	.36	.37	.18	.18	.15	.15	.35	.45	.09	.01	-	-	-	-
	b	1.19	.23	.28	.28	.17	.17	.17	.18	.40	.40	.05	0	-	-	-	-
	b	1.17	.24	.29	.29	.16	.15	.16	.18	.37	.40	.05	0	-	-	-	-
	c	1.15	.20	.35	.33	.15	.10	.15	.15	.38	.45	.15	-.02	40	40	40	40
	b	1.14	.28	.37	.34	.15	.15	.13	.15	.35	.60	.09	-.03	-	-	-	-

Appendix Table 4 DIMENSIONS OF PERIANTH IN POPULATION SAMPLES OF ASTROLOBA (Contd.)

Locality.		PERIANTH TUBE Length to Neck	PERIANTH TUBE Diameter Neck	Middle	Base	LOBES Length Outer	Inner	LOBES Width Outer	Inner	GYNAECIUM Length Ovary	Style	DIFFERENCE BETWEEN DIAMETER OF Middle and Neck	Base and Middle	ANGLE OF OPEN LOBES Ant. Outer-Lats.	Outer	Post.	Inner Inner-Lats.
		cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	o	o	o	o
								A. SMUTSIANA. (Contd.									
Ladismith-	b	1.10	.25	.34	.34	.15	.10	.15	.15	.42	.40	.09	0	-	-	-	-
Barrydale Rd	c	11 0	.20	.29	.27	.15	.13	.13	.17	.32	.50	.09	-.02	15	40	40	40
R3,62b(Contd.)	c	1.10	.20	.28	.28	.15	.15	.14	.18	.32	.50	.08	0	55	45	45	45
	c	1.10	.24	.35	.31	.15	.15	.10	.18	.40	.42	.09	.04	10	40	40	40
	c	1.00	.24	.28	.28	.13	.14	.17	.18	.40	.55	.04	0	-	-	-	-
	c	.96	.20	.28	.28	.15	.16	.15	.17	.35	.52	.08	0	80	60	45	20
	c	.95	.25	.29	.29	.15	.15	.19	.19	.38	.43	.04	0	65	40	50	20
	a	.90	.20	.30	.30	.15	.13	.15	.15	.40	.40	.10	0	65	60	60	40
	a	.90	.23	.28	.30	.15	.12	.15	.13	.32	.57	.05	.02	80	60	70	40
	a	.88	.20	.32	.29	.15	.15	.13	.13	.32	.54	.12	-.03	40	60	45	20
	a	.88	.22	.34	.34	.15	.15	.13	.14	.35	.38	.12	0	40	30	30	15
	a	.84	.20	.28	.29	.15	.15	.13	.15	.36	.50	.08	.01	65	70	45	20
	a	.86	.20	.37	.37	.13	.15	.12	.15	.38	.46	.17	0	-	-	-	-
Ladismith-	b	1.10	.23	.30	.33	.13	.15	.15	.17	.30	.55	.07	.03	-	-	-	-
Barrydale Rd	b	1.10	.20	.32	.32	.14	.15	.14	.15	.30	.40	.12	0	-	-	-	-
R5,62b	b	1.08	.24	.32	.32	.15	.15	.15	.16	.35	.35	.08	0	-	-	-	-
	a	1.04	.20	.28	.30	.15	.16	.12	.14	.50	.50	.08	.02	45	65	30	20
	a	1.03	.23	.32	.30	.15	.15	.12	.15	.56	.62	.09	-.02	55	40	20	20
	c	1.02	.19	.31	.30	.12	.13	.10	.15	.35	.40	.11	-.01	-	-	-	-
	a	1.02	.23	.34	.32	.15	.15	.13	.14	.44	.35	.11	-.02	60	60	60	25
	c	1.00	.22	.29	.30	.13	.13	.11	.17	.30	.35	.07	.01				
	c	1.00	.20	.30	.29	.13	.14	.10	.17	.28	.40	.10	-.01	-	-	-	-
	c	1.00	.19	.30	.29	.13	.13	.10	.15	.25	.30	.11	-.01	55	60	60	20
	a	1.00	.20	.32	.30	.15	.15	.10	.12	.46	.30	.08	-.02	60	20	60	15
	a	.98	.23	.39	.38	.15	.15	.15	.16	.40	.40	.16	-.01	-	-	-	-
	a	.97	.24	.41	.38	.15	.15	.13	.16	.37	.37	.17	-.03	80	60	45	20
	a	.96	.23	.30	.33	.15	.11	.15	.15	.47	.49	.07	..03	50	30	30	20
	a	.89	.23	.32	.30	.16	.16	.12	.15	.44	.37	.09	-.02	10	10	10	S
	a	.83	.20	.30	.27	.13	.14	.10	.14	.25	.35	.10	-.03	30	20	30	15

Appendix Table 4 DIMENSIONS OF PERIANTH IN POPULATION SAMPLES OF ASTROLOBA (Contd.)

		PERIANTH TUBE				LOBES				GYNAECIUM		DIFFERENCE BETWEEN DIAMETER OF		ANGLE OF OPEN LOBES			
		Length to		Diameter		Length		Width		Length		Middle and	Base and				
Locality.		Neck-Neck		Middle-Base		Outer-Inner		Outer-Inner		Ovary-Style		Neck	Middle	Ant. Outer-Lats.	Outer	Post.-Inner	Inner-Lats.
		cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	o	o	o	o
						HYBRID BETWEEN A. SMUTSIANA & A. RUGOSA.											
Ladismith-Barrydale Rd. R2	c	1.27	.23	.29	.32	.16	.15	.15	.18	.37	.45	.06	.003	45	45	45	45
	c	1.25	.23	.29	.32	.15	.15	.15	.18	.35	.55	.06	.03	-	-	-	-
	c	1.24	.23	.29	.32	.16	.14	.15	.18	.35	.35	.06	.03	-	-	-	-
	c	1.20	.23	.28	.32	.16	.15	.14	.18	.35	.40	.05	.04	50	40	30	30
	b	1.20	.23	.28	.30	.15	.15	.16	.17	.40	.55	.05	.02	-	-	-	-
	b	1.20	.20	.27	.30	.18	.15	.15	.18	.35	.30	.09	..01	-	-	-	-
	b	1.20	.24	.29	.29	.18	.16	.16	.18	.40	.48	.05	0	-	-	-	-
	b	1.20	.25	.29	.33	.17	.17	.15	.17	.40	.45	.044	.04	-	-	-	-
	b	1.10	.23	.28	.30	.14	.14	.14	.16	.34	.50	.05	.02	60	60	50	30
	b	1.10	.24	.28	.28	.15	.13	.15	.15	.30	.60	.04	0	55	60	40	25
	c	1.10	.28	.37	.36	.18	.18	.17	.17	.42	.70	.09	-.01	-	-	-	-
	c	1.00	.25	.36	.35	.17	.17	.15	.17	.39	.65	.11	-.01	-	-	-	-
	b	.92	.19	.29	.28	.28	.18	.18	.15	.17	.38	.45	-.01	50	20	40	10
								A. RUGOSA.									
23 Miles South of Ladismith R2	b	1.20	.23	.32	.35	.18	.15	.15	.19	.40	.35	.09	.03	-	-	-	-
	b	1.20	.25	.33	.37	.16	.16	.15	.20	.35	.50	.08	.04	-	-	-	-
	b	1.20	.25	.30	.35	.15	.15	.15	.19	.40	.40	.09	.01	-	-	-	-
	b	1.18	.19	.28	.30	.18	.14	.13	.19	.35	.40	.09	.02	S4	20	S	S
	b	1.18	.20	.27	.32	.17	.15	.12	.19	.37	.42	.07	.05	S	10	S	S
	b	1.14	.21	.28	.30	.15	.14	.14	.17	.40	.30	.07	.02	-	-	-	-
	b	1.10	.23	.27	.30	.15	.15	.15	.18	.40	.30	.04	.03	-	-	-	-
	a	1.05	.23	.28	.30	.15	.15	.14	.16	.40	.48	.05	.02	-	-	-	-
	b	.96	.23	.30	.33	.15	.16	.15	.17	.39	.28	.07	.03	50	30	20	15
	b	.90	.20	.30	.32	.15	.15	.15	.18	.32	.23	.10	.02	30	20	10	S
	b	.90	.23	.30	.34	.16	.18	.16	.20	.42	.30	.07	.04	35	20	10	10
	b	.90	.20	.33	.34	.16	.16	.14	.17	.38	.38	.07	.01	50	30	20	10
	b	.85	.23	.27	.29	.17	.17	.15	.19	.43	.31	.04	.02	20	15	20	15
	b	.83	.21	.29	.32	.17	.17	.15	.17	.37	.30	.08	.03	40	20	20	20

Appendix Table 4 DIMENSIONS OF PERIANTH IN POPULATION SAMPLES OF ASTROLOBA (Contd.)

Locality.		PERIANTH TUBE Length to Neck	Diameter Neck	Diameter Middle	Diameter Base	LOBES Length Outer	Length Inner	Width Outer	Width Inner	GYNAECIUM Length Ovary	Length Style	DIFFERENCE BETWEEN DIAMETER OF Middle and Neck	Base and Middle	ANGLE OF OPEN LOBES Ant. Outer	Outer Lats.	Post. Inner	Inner Lats.
	cm.	cm.	cm.	cm.	dm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	o	o	o	o
								A. RUGOSA. (Contd.)									
nr. Ladismith Nbg. 428/58	b	.80	.20	.28	.30	.15	.15	.15	.18	.32	.23	.08	.02	60	50	10	10
Koo R17-23	a	1.25	.25	-	.32	-	-	-	-	.32	.25	-	-	-	-	-	-
	a	1.20	.25	-	.35	-	-	-	-	.45	.45	-	-	-	-	-	-
	b	1.05	.20	.37	.38	.14	.15	.14	.19	.29	.26	.17	.01	-	-	-	-
	b	.98	.22	.30	.33	.18	.18	.15	.17	.28	.37	.08	.03	70	30	20	20
	c	.93	.20	.30	.32	.15	.17	.15	.18	.30	.40	.10	.02	60	55	15	30
	b	.90	.20	.28	.31	.15	.15	.14	.15	.37	.37	.08	.03	50	20	10	S
	a	.90	.24	-	.28	.18	.16	.17	.20	-	-	-	-	-	-	-	-
	b	.86	.20	.25	.25	.16	.17	.15	.18	.28	.37	.05	0	50	20	10	10
Koo Nbg 452/58	b	.85	.26	.30	.30	-	-	-	-	-	-	.04	0	35	15	10	10
	b	.79	.20	.30	.34	.15	.15	.15	.18	.36	.32	.10	.04	20	10	S	S
	c	.78	.20	.30	.30	.15	.14	.13	.15	.24	.23	.10	0	40	15	15	S
	c	.73	.19	.30	.32	.16	.16	.13	.18	.27	.30	.11	.02	70	40	30	10
								A. HALLII.									
Approx. 20 miles East of Laingsburg R52	a	.78	.21	.28	.28	.15	.18	.16	.18	.30	.29	.07	0	40	30	20	10
	a	.78	.25	.30	.32	.16	.15	.15	.21	.39	.45	.05	.02	35	40	20	10
	a	.84	.23	.30	.29	.16	.15	.14	.16	.34	.28	.07	-.01	-	-	-	-
	a	.90	.25	.30	.32	.18	.18	.15	.16	.38	.44	.05	.02	50	40	40	20
	a	.95	.25	.35	.32	.18	.18	.21	.24	.44	.35	.10	-.03	35	45	80	10
	a	1.00	.28	.35	.34	.17	.17	.20	.25	.40	.41	.07	-.01	35	40	80	20
	a	1.00	.28	.40	.42	.19	.17	.19	.25	.50	.50	.12	.02	40	30	25	15
	a	1.02	.27	.40	.43	-	-	-	-	.54	.59	.13	.03	30	30	20	10
	a	1.05	.27	.41	.42	.16	.15	.16	.24	.46	.33	.14	.01	20	S	S	S

Appendix Table 4 DIMENSIONS OF PERIANTH IN POPULATION SAMPLES OF ASTROLOBA (Contd.)

Locality.		PERIANTH TUBE Length to Neck	Neck	Diameter Middle	Base	LOBES Length Outer	Inner	Width Outer	Inner	GYNAECIUM Length Ovary	Style	DIFFERENCE BETWEEN DIAMETER OF Middle and Neck	Base and Middle	ANGLE OF OPEN LOBES Ant. Outer-Lats.	Outer-Lats.-Inner-Lats. (Outer)	Post. Inner-Lats.	Inner
		cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	°	°	°	°
								A. HALLII. (Contd.)									
Koup	a	.85	.24	.30	.30	.18	.18	.13	.16	.37	.32	.06	0	60	30	40	20
	a	.90	.30	-	.32	.16	.20	.16	.20	.32	.60	-	-	5	90	40	40
	a	.90	.28	-	.33	.15	.20	.15	.20	.32	.60	-	-	-	-	-	-
	a	.94	.25	.34	.34	.18	.18	.13	.16	.39	.62	.09	0	60	40	60	20
	a	.95	.26	-	.30	-	-	-	-	-	-	-	-	45	45	10	10
	a*	.95	.27	-	.42	.18	.15	.15	.20	.40	.35	-	-	-	-	-	-
	d	.96	.26	.37	.37	.18	.19	.18	.20	-	-	.11	0	-	-	-	-
	a	.97	.23	.32	.35	.17	.18	.14	.18	.44	.40	.09	.03	60	30	40	10
	a	.99	.23	.30	.34	.17	.18	.15	.22	.41	.38	.07	.04	90	70	10	10
	a	1.00	.27	-	.35	-	-	-	-	-	-	-	-	-	-	-	-
	a	1.00	.28	-	.35	-	-	-	-	-	-	-	-	-	-	-	-
	a	1.00	.23	.33	.32	.16	.18	.13	.18	.41	.44	.10	-	60	30	40	15
	d	1.00	.27	.40	.40	.21	.22	.20	.25	-	-	.13	0	-	-	-	-
	a	1.04	.24	.32	.34	.18	.18	.15	.20	.47	.58	.08	.02	80	60	35	20
	a	1.05	.26	.36	.35	.16	.17	.13	.19	.44	.65	.10	-.01	85	65	65	20
	a	1.06	.23	.36	.40	.18	.18	.15	.18	.45	.40	.13	.04	50	30	20	10
	a	1.06	.24	.38	.40	.20	.20	.16	.18	.45	.37	.14	.02	45	40	20	10
	a**	1.10	.30	-	.32	.14	.16	.12	.16	.43	.45	-	-	90	90	45	45
	a	1.10	.23	.34	.35	.17	.18	.13	.18	.44	.56	.11	.01	60	50	45	15
	a	1.10	.26	.37	.36	.17	.19	.15	.22	.47	.60	.11	-.01	75	65	70	25
	d	1.13	.24	.34	.35	.18	.22	.17	.20	-	-	-	-	-	-	-	-
							A. BULLULATA.										
Matjesfontein R55	a	1.00	.24	.41	.41	.18	.18	.13	.16	.47	.65	.17	0	47	47	30	20
	a	.98	.25	.41	.44	-	-	-	-	-	-	.16	.03	-	-	-	-
	a	.95	.25	-	.32	.16	.18	.15	.19	.40	.40	-	-	-	-	-	-
	a	.94	.24	.33	.35	.18	.18	.13	.19	.35	.46	.09	.02	50	35	30	20
	a	.92	.25	.35	.38	.17	.14	.17	.18	.40	.43	.10	.03	90	80	50	40
	a	.90	.23	.31	.32	.15	.17	.14	.18	142	.52	.08	.01	85	60	50	35

Appendix Table 4   DIMENSIONS OF PERIANTH IN POPULATION SAMPLES OF ASTROLOBA (Contd.)

Locality.		PERIANTH TUBE Length to Neck	PERIANTH TUBE Neck	PERIANTH TUBE Diameter Middle	PERIANTH TUBE Diameter Base	LOBES Length Outer	LOBES Length Inner	LOBES Width Outer	LOBES Width Inner	GYNAECIUM Length Ovary	GYNAECIUM Length Style	DIFFERENCE BETWEEN DIAMETER OF Middle and Neck	DIFFERENCE BETWEEN DIAMETER OF Base and Middle	ANGLE OF OPEN LOBES Ant. Outer	ANGLE OF OPEN LOBES Outer-Lats.	ANGLE OF OPEN LOBES Post. Inner	ANGLE OF OPEN LOBES Inner-Lats.
		cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	o	o	o	o
										A. BULLULLATA. (Contd.)							
Matjesfontein	a	.89	.24	.33	.34	.17	.18	.13	.18	.43	.59	.08	.02	30	20	30	10
R55 (Contd.)	a	.83	.23	.30	.32	.16	.18	.13	.17	.36	.55	.07	.02	80	70	50	30
	a	.80	.23	.29	.32	.15	.17	.13	.17	.40	.55	.06	.03	85	60	70	50
Worcester Karoo Gdns. Dec. 1959		1.20	.25	-	.30	.19	.20	.18	.20	.40	.32	-	-				
								A. HERREI.									
Nbg. no. number	b	.80	.30	.50	.44	.30	.30	.23	.30	.32	.20	.20	-.06	65	40	S	S
Hoekplaas	a	.80	.30	.50	.56	.23	.25	.20	.24	.40	.20	.20	.06	50	30	S	S
Farm N.W.	a	.72	.24	.42	.42	.18	.16	.18	.20	.37	.28	.18	0	125	90	S	S
of Uniondale	a	.70	.25	.40	.35	.20	.18	.20	.23	.37	.18	.15	-.05	-	-	-	-
R44	a	.70	.20	.40	.33	.25	.24	.20	.25	.40	.27	.20	-.07	50	25	S	S
	a	.64	.27	.42	.40	.27	.28	.20	.28	.30	.20	.15	-.02	40	20	S	S
Prince Albert	a	.70	.26	.37	.34	.25	.32	.24	.30	.30	.20	.11	-.03	50	S	S	S
R46	a	.67	.25	.40	.30	.25	.27	.23	.28	.38	.15	.15	-.10	60	60	S	S
	a	.66	.25	.45	.36	.30	.25	.30	.25	.40	.30	.20	-.09	45	45	S	S
	a	.65	.25	.39	.29	.27	.28	.23	.29	.30	.15	.14	-.10	-	-	-	-
	a	.57	.25	.37	.30	.25	.22	.15	.25	.30	.15	.12	-.07	40	30	10	10
								A. SPIRALIS.									
Calitzdorp R47	f	.87	.20	.35	.38	.15	.15	.12	.15	-	-	.15	.03	-	-	-	-

Appendix Table 4 DIMENSIONS OF PERIANTH IN POPULATION SAMPLES OF ASTROLOBA (Contd.)

Locality.		PERIANTH TUBE Length to Neck	Diameter Neck	Diameter Middle	Diameter Base	LOBES Length Outer	Length Inner	Width Outer	Width Inner	GYNAECIUM Length Ovary	Length Style	DIFFERENCE BETWEEN DIAMETER OF Middle and Neck	Base and Middle	ANGLE OF OPEN LOBES Ant. Outer	Outer-Lats.	Post. Inner	Inner-Lats.
		cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	o	o	o	o
A. SPIRALIS. (Contd.)																	
26 miles South	c	1.14	.24	.41	.42	.15	.12	.14	.14	.40	.64	.17	.01	30	30	S	S
of Ladismith	c	1.13	.22	.34	.37	-	-	-	-	.40	.60	.12	.03	30	40	S	S
R6																	
Oudtshoorn	*	1.19	.28	-	.40	.19	.19	.16	.15	.39	.50	-	-	-	-	-	-
R61	c	.98	.23	.34	.34	.15	.15	.14	.15	.40	.46	.11	0	50	30	20	10
	a	.98	.19	.30	.33	.15	.15	.12	.15	.47	.54	.11	.03	-	-	-	-
	a	.97	.20	.30	.31	.15	.15	.13	.16	.38	.26	.10	.01	50	S	S	S
	a	.94	.20	.35	.32	.15	.15	.10	.15	.35	.35	.15	-.03	40	30	30	20
	a	.93	.20	.35	.35	.15	.15	.15	.20	.40	.34	.15	0	20	30	30	20
	a	.92	.17	.35	.32	.16	.17	.14	.18	.34	.53	.18	-.03	60	50	30	30
	a	.90	.19	.34	.30	.15	.15	.12	.15	.32	.34	.15	-.04	80	70	50	20
	a	.90	.18	.35	.27	.14	.14	.10	.18	.30	.28	.17	-.07	-	-	-	-
	a	.85	.19	.30	.25	.15	.15	.12	.17	.35	.32	.11	-.05	50	30	30	15
	a	.84	.20	.30	.27	.16	.15	.12	.16	.36	.40	.10	-.03	.55	30	20	15
	a	.83	.20	.35	.30	.15	.15	.13	.15	.30	.40	.15	-.05	90	55	20	10
	a	.83	.23	.43	.38	.16	.16	.11	.14	.29	.30	.20	-.05	-	-	-	-
	a	.82	-	-	-	-	-	-	-	.35	.32						
	a	.77	.19	.27	.27	.15	.15	.11	.14	.32	.40	.08	0	45	30	30	25
	a	.76	.19	.29	.26	.16	.15	.13	.17	.30	.27	.10	-.03	70	50	30	10
	a	.75	.23	.34	.30	.15	.18	.14	.18	.32	.28	.11	-.04	10	10	10	S
	a	.74	.18	.32	.28	.14	.14	.11	.15	.31	.39	.14	-.04	40	20	35	20
	a	.73	.19	.26	.24	.15	.14	.11	.15	.30	.20	.07	-.02	35	20	20	10

* Ex Karoo Gardens, Worcester, Dec. 1959.

Appendix Table 4 DIMENSIONS OF PERIANTH IN POPULATION SAMPLES OF ASTROLOBA (Contd.)

Locality.	Leaf width.	No. vasc. bundles seen in T.S. Ventral	Dorsal	No. of bundles per cm.(B) ventral	Dorsal	Mean of B. for each plant. Ventral	Dorsal
	cm.						
			Subsp. CONGESTA.				
Cradock R32	2.1	40	30	19.05	14.29	-	-
	2.5	44	31	17.60	12.40	18.33	13.34
	2.5	47	-	18.76	-	-	-
	2.4	43	26	17.92	10.83	17.01	10.42
	2.3	37	23	16.09	10.00	-	-
	2.3	33	23	14.33	10.00	15.04	10.26
	1.9	30	20	15.75	10.50	-	-
	1.8	26	16	14.44	8.89	15.38	8.96
	1.9	31	17	16.31	8.95	-	-
	2.1	28	15	13.40	7.14	14.94	7.74
	2.0	31	14	15.50	7.00	-	-
	2.2	35	20	15.92	9.09	-	-
	1.9	30	19	15.75	10.00	14.82	9.17
	1.8	25	15	13.89	8.33	-	-
	1.9	28	16	14.73	8.42	14.28	7.57
	1.9	29	13	15.26	6.84	-	-
	2.0	27	14	13.50	7.00	-	-
	2.0	27	16	13.50	8.00	-	-
	1.8	25	19	13.89	10.56	13.25	9.16
	1.5	20	12	13.33	8.00	-	-
	1.9	24	17	12.63	8.95	-	-
	2.3	26	18	11.31	7.83	13.15	8.66
	2.0	30	19	15.00	9.50	-	-
	2.0	26	15	13.00	7.50	12.29	6.65
	1.9	22	11	11.58	5.80	-	-
	2.1	27	18	12.86	8.57	12.18	8.29
	2.0	23	16	11.50	8.00	-	-
	2.0	23	16	11.50	8.00	12.07	8.35
	1.9	24	17	12.63	6.70	-	-
	1.9	22	16	11.58	8.22	11.88	8.46
	2.3	28	20	12.17	8.70	-	-
	2.0	23	11	11.50	6.50	10.84	6.05
	2.1	22	11	10.52	6.50	-	-
	2.1	22	10	10.52	5.15	-	-
S. of Adelaide R38,39	2.5	39	29	15.60	11.60	14.32	9.93
	2.3	30	19	13.04	8.26	-	-
	2.5	36	25	14.40	10.00	13.93	9.42
	2.6	35	23	13.46	8.85	-	-
	1.9	25	11	13.15	5.79	13.46	4.71
	1.8	24	7	13.33	3.89	-	-
	1.8	25	8	13.89	4.44	-	-
	2.6	32	22	12.30	8.44	11.86	7.79
	2.1	24	15	11.43	7.14	-	-

Appendix Table 5 SHOWING THE NUMBER OF VASCULAR BUNDLES WITH BUNDLE CAPS AS SEEN IN TRANSVERSE SECTION HALF WAY ALONG THE LONGITUDINAL AXIS OF LEAVES IN A. FOLIOLOSA COMPLEX.

Locality.	Leaf width.	No. vasc. bundles seen in T.S. Ventral	Dorsal	No. of bundles per cm.(B) Ventral	Dorsal	Mean of B. for each plant. Ventral	Dorsal
			Subsp. CONGESTA (Contd.)				
S. of Adelaide R38,39 (Contd.)	2.4	31	19	12.67	7.92	11.69	7.71
	2.5	24	16	9.60	6.40	-	-
	2.5	32	22	12.80	8.80	-	-
	2.5	29	25	11.60	10.00	-	-
	1.9	22	12	11.58	6.32	11.47	5.66
	2.2	25	11	11.36	5.00	-	-
Helspoort R41	2.4	31	22	12.93	9.17	12.77	9.15
	2.3	29	21	12.61	9.13	-	-
	2.4	28	17	11.67	7.08	12.33	7.04
	2.0	26	14	13.00	7.00	-	-
Dikkop R40	2.9	45	38	15.51	13.10	14.96	12.15
	2.5	36	28	14.40	11.20	-	-
	2.8	39	33	14.25	11.79	13.79	11.64
	2.7	36	31	13.33	11.48	-	-
Alicedale Commins 2063	2.0	24	20	12.00	10.00	12.59	10.69
	2.2	29	25	13.19	11.37	-	-
	2.2	29	22	13.19	10.00	13.35	10.75
	2.0	27	23	13.50	11.50	-	-
			Subsp. ROBUSTA.				
Molteno Pass Hall 2284	1.5	18	11	12.00	7.4	-	-
	1.6	18	11	11.25	6.88	-	-
	1.6	18	9	11.25	5.75	-	-
	1.8	20	10	11.09	5.56	-	-
	1.8	19	8	10.56	4.44	-	-
	1.8	18	11	10.00	6.11	-	-
Nelspoort R28	1.8	17	8	9.44	4.44	-	-
	2.4	20	13	8.33	5.42	-	-
E. of Laingsburg R1	1.4	16	7	11.43	5.00	10.05	3.83
	1.5	13	4	8.67	2.67	-	-
20 miles S.E. of Laingsburg R	2.2	16	8	7.36	3.64	6.54	3.96
	2.1	12	9	5.71	4.29	-	-
	2.0	12	8	6.00	4.00	5.75	4.00
	2.0	11	8	5.50	4.00	-	-
	2.1	12	8	5.71	3.90	5.67	3.35
	2.0	11	6	5.50	3.00	-	-
	1.9	11	6	5.79	3.16	-	-
	2.2	13	8	5.91	3.64	5.65	3.62
	2.0	13	9	6.50	4.50	-	-
	2.2	10	6	4.55	2.73	-	-
	2.1	11	6	5.24	2.86	5.62	3.43
	2.0	12	8	6.00	4.00	-	-
nr. Whitehill O	1.8	17	7	9.33	3.76	9.14	3.63
	1.8	15	6	8.33	3.33	-	-
	1.9	17	7	8.95	3.68	-	-
	1.8	17	7	9.33	3.76	-	-
	1.6	13	11	8.13	6.88	7.89	6.67

Appendix Table 5 contd. NUMBERS OF VASCULAR BUNDLES WITH BUNDLE CAPS IN THE A. FOLIOLOSA COMPLEX Contd.

Locality.	Leaf width.	No. vasc. bundles seen in T.S. Ventral	Dorsal	No. of bundles per cm.(B) Ventral	Dorsal	Mean of B. for each plant. Ventral	Dorsal
	cm.						
		Subsp. ROBUSTA. (Contd)					
nr. Whitehill O (Contd.)	1.7	13	11	7.65	6.47	-	-
	1.8	13	7	7.22	3.76	6.25	3.44
	1.8	10	6	5.56	3.33	-	-
	1.8	11	6	6.11	3.33	-	-
	1.8	11	6	6.11	3.33	-	-
Prince Albert R64	1.9	20	8	10.53	4.21	10.72	4.71
	1.9	20	9	10.53	4.74	-	-
	1.8	20	10	11.09	5.55	-	-
	2.0	19	7	9.50	3.50	9.77	3.55
	1.8	18	6	10.00	3.33	-	-
	1.9	19	6	10.00	3.16	-	-
	1.9	18	8	9.47	4.21	-	-
	2.0	20	9	10.00	4.50	9.67	4.50
	2.0	17	9	8.50	4.50	-	-
	2.0	21	9	10.50	4.50	-	-
	2.2	21	13	9.33	5.91	9.66	5.23
	2.2	22	10	10.00	4.55	-	-
	2.2	19	10	8.64	4.55	8.76	5.44
	2.2	18	11	8.18	5.00	-	-
	2.1	16	12	7.62	5.71	-	-
	2.0	21	13	10.50	6.50	-	-
	2.7	23	12	8.52	4.44	8.40	4.62
	2.6	22	12	8.46	4.62	-	-
	2.5	21	12	8.20	4.80	-	-
	1.9	13	9	7.00	4.74	8.36	4.43
	2.1	18	9	8.57	4.29	-	-
	2.1	20	9	9.52	4.29	-	-
	1.8	13	8	7.22	4.44	7.43	4.73
	1.9	15	9	7. 57	4.74	-	-
	1.6	12	8	7.50	5.00	-	-
Nr. Miller R8	2.2	22	11	10.00	5.00	8.86	4.77
	2.2	19	10	7.73	4.55	-	-
	2.0	18	6	9.00	3.00	8.39	2.94
	2.2	18	7	8.18	3.19	-	-
	2.0	16	4	8.00	2.00	-	-
	1.8	16	6	8.89	3.3	-	-
	1.9	15	6	7.89	3.16	-	-
	1.6	11	6	6.88	3.75	8.11	3.64
	1.5	14	7	9.33	4.67	-	-
	1.6	13	4	8.13	2.50	-	-
Klaarstroom R27	2.5	23	15	9.41	6.00	9.90	6.46
	2.5	27	18	10.39	6.92	-	-
	2.5	21	14	8.40	5.60	8.43	5.11
	2.6	22	12	8.46	4.62	-	-
Steytlerville R15	1.6	20	6	12.50	3.75	11.75	3.35
	1.7	17	5	10.00	2.94	-	-

Appendix Table 5 Contd. NUMBERS OF VASCULAR BUNDLES WITH BUNDLE CAPS IN THE A. FOLIOLOSA COMPLEX (Contd.)

Locality.	Leaf width.	No. vasc. bundles seen in T.S. Ventral	Dorsal	No. of bundles per cm.(B) Ventral	Dorsal	Mean of B. for each plant. Ventral	Dorsal
	cm.						
		Subsp. ROBUSTA (Contd.)					
Steytlerville R15 (Contd.)	2.0	22	11	11.00	5.5	10.77	5.32
	1.9	20	10	10.53	5.14	-	-
	1.8	19	9	10.57	5.00	10.55	4.32
	1.8	20	8	11.09	4.44	-	-
	1.7	17	6	10.00	3.53	-	-
	1.8	20	6	11.09	3.33	10.36	2.96
	1.8	18	5	10.00	27 8	-	-
	1.8	18	5	10.00	2.78	-	-
	1.8	17	6	9.33	3.33	9.94	3.54
	1.8	19	7	10.56	3.76	-	-
		Subsp. FOLIOLOSA.					
Miscellaneous Localities	1.4	12	-	8.57	-	-	-
	1.4	13	8	9.29	5.71	-	-
	1.3	9	5	6.92	3.85	-	-
	1.3	19	10	14.62	7.69	-	-
	1.2	16	10	13.33	8.33	-	-
	1.1	12	8	10.91	7.27	-	-
	1.1	11	9	10.00	8.18	-	-
	1.1	15	9	13.64	8.18	-	-
	1.0	13	8	13.00	8.00	-	-

Appendix Table 5 Contd. NUMBERS OF VASCULAR BUNDLES WITH BUNDLE CAPS IN THE A. FOLIOLOSA COMPLEX (Cont.)

Locality.	% Lignification.		Area largest bundle cap (1 unit = 130μ)		Thickness of sclereid wall bundle cap (1 unit = 35μ)	
	%	Mean %	sq.unit	Mean sq.unit.	unit	Mean unit
			Subsp. ROBUSTA.			
Molteno Pass Hall 2284	-	93	-	2.0	-	.45
	-	88	-	1.6	-	.40
	-	88	-	1.8	-	.35
	-	83	-	0.9	-	.40
	-	76	-	1.6	-	.35
Whitehill R57	-	90	-	7.0	-	.20
	-	77	-	3.2	-	.40
20 Miles S.E. of Laingsburg R65	86	-	2.4	-	.45	-
	72	79	3.4	2.9	.60	.53
	83	-	2.2	-	.50	-
	73	78	2.1	2.2	.45	.48
	80	-	2.4	-	.60	-
	57	69	2.6	2.5	.55	.68
	-	100	-	5.7	-	.55
	100	-	5.0	-	.55	-
	94	97	5.0	5.0	.50	.53
	100	-	1.8	-	.45	-
	90	95	1.6	1.7	.35	.40
	95	-	4.1	-	.45	-
	95	95	5.3	4.7	.50	.48
	95	-	6.8	-	.60	-
	92	94	4.8	5.8	.65	.63
	95	-	6.4	-	.65	-
	90	93	7.0	6.7	.55	.60
	88	-	9.0	-	6.5	-
	87	88	6.3	7.7	.60	.63
	91	-	3.8	-	.50	-
	83	87	3.7	3.8	.45	.48
Klaarstroom R27	-	86	-	7.2	-	.65
	-	78	-	6.4	-	.60
Miller R8	-	100	-	3.0	-	.40
	89	-	7.3	-	.55	-
	84	-	8.1	-	.60	-
	95	89	7.8	7.8	.55	.57
	-	88	-	8.6	-	.65
	-	84	-	7.3	-	.65
	73	-	3.6	-	.65	-
	90	82	4.6	4.1	.55	.60
Steytlerville R15	-	94	-	4.4	-	.50
	-	81	-	5.3	-	.75
	-	69	-	2.6	-	.50
	-	63	-	2.7	-	.50
	-	49	-	3.4	-	.45
	-	19	-	2.8	-	.40
	-	4	-	6.0	-	.30
			Subsp. CONGESTA.			
Cradock R32	-	97	-	1.3	-	.30
	-	91	-	1.7	-	.30
	-	90	-	1.9	-	.35
	-	88	-	1.3	-	.35
	-	86	-	1.3	-	.35
	-	77	-	1.8	-	.35
	-	66	-	1.7	-	.25
	-	60	-	1.3	-	.25

Appendix Table 6 SIZE AND LIGNIFICATION OF LARGEST BUNDLE CAPS FROM VENTRAL SIDE OF LEAF IN A. FOLIOLOSA COMPLEX.

Locality.	% Lignification.		Area Largest bundle cap (1 unit = 130 μ)		Thickness of sclereid wall bundle cap (1 unit = 35 μ)	
	%	Mean %	sq.unit	Mean sq.unit	unit	Mean unit
		Subsp. CONGESTA. (Contd.)				
Cradock R32 (Contd.)	-	40	-	1.0	-	.25
	82	-	1.0	-	.25	-
	42	62	1.0	1.0	.25	.25
	66	-	1.2	-	.20	-
	2	34	1.4	1.3	.10	.15
	-	6	-	1.4	-	.15
Adelaide R38,39	-	77	-	1.0	-	.20
	-	64	-	1.1	-	.15
	-	52	-	0.9	-	.25
	-	51	-	1.0	-	.15
	-	23	-	1.2	-	.15
	-	1	-	1.3	-	.10
	-	1	-	1.1	-	.10
Helspoort R41	-	88	-	1.2	-	.35
	-	82	-	1.2	-	.30
	-	77	-	2.4	-	.30
	-	77	-	1.5	-	.25
Alice Dale Commins	-	90	-	1.0	-	.30
	-	50	-	1.0	-	.25
	-	14	-	1.8	-	.20
Dikkop Vlakte R40	-	94	-	1.8	-	.35
	-	35	-	1.8	-	.20
	-	0	-	2.3	-	0
		Subsp. FOLIOLOSA.				
Miscellaneous Localities	-	75	-	0.9	-	.25
	-	75	-	0.6	-	.30
	-	50	-	0.8	-	.25
	-	25	-	1.0	-	.35
	-	25	-	0.6	-	.15
	-	13	-	0.7	-	.20
	-	13	-	1.1	-	.20
	-	0	-	1.0	-	-
	-	0	-	0.8	-	-
	-	0	-	0.7	-	-

Appendix Table 6 SIZE AND LIGNIFICATION OF LARGEST BUNDLE CAP FROM VENTRAL SIDE OF LEAF IN A. FOLIOLOSA COMPLEX. Cont.

Subspecies.	Leaf length.	Diam. ped. base.	Leaf length.	Diam. ped. base.
FOLIOLOSA.	cm.	cm.	cm.	cm.
Graaff Reinet R29	3.0	.28	2.1	.28
	2.3	.32	1.9	.36
	2.2	.32	2.0	.38
	2.2	.36	1.9	.38
	2.4	.35	2.3	.25
	2.3	.34	2.0	.23
Lake Mentz R36,37	1.6	.24	1.5	.30
	1.4	.27	2.1	.36
	1.5	.34	1.4	.35
	1.4	.35	1.6	.33
	2.1	.31	1.7	.33
	1.9	.39	1.4	.33
	1.4	.25		
nr. Waterford R10	1.7	.35	1.5	.35
	1.5	.70	1.8	.36
Wolwefontein R11	1.9	.41	2.1	.31
	1.8	.30	1.7	.35
	2.0	.45	2.2	.38
	1.7	.34	1.9	.37
	1.7	.31	2.1	.50
Baroe R12	2.2	.35		
Mount Stewart R13	1.7	.38	2.5	.29
	2.1	.42	1.9	.37
	1.8	.34		
Steytlerville R14	2.3	.31	2.3	.27
	2.5	.45	2.1	.37
	1.7	.38	1.9	.29
	1.8	.30	1.8	.25
	2.3	.25	1.9	.29
	1.7	.29	1.8	.28
	2.2	.32	2.2	.43
	2.1	.38	2.4	.31
	1.7	.25	1.8	.43
	1.9	.35	2.1	.39
	1.7	.32	1.8	.28
	2.0	.39	1.8	.37
	2.3	.32	1.7	.25
	1.8	.38	1.8	.37
CONGESTA.				
19 Miles N. of Cradock R31	2.8	.25	2.7	.44
	2.9	.55	2.6	.44
Cradock R32	3.6	.42	3.3	.47
	3.3	.44	2.7	.46
	2.9	.40	3.8	.40
	3.2	.32	4.0	.48
	2.7	.34	3.3	.45
	2.8	.47	3.5	.48
Rayners Kop R33	2.9	.50	3.4	.37
	3.5	.44	3.5	.42
	4.0	.40	4.6	.55
	3.4	.49	4.5	.39

Appendix Table 7 LENGTH OF LEAF AND BASAL DIAMETER OF OLD PEDUNCLE BASES IN FIELD POPULATION SAMPLES OF A. FOLIOLOSA COMPLEX.

Species	Area of largest bundle cap from ventral side of leaf in sq.units	Vertical distance from lower epidermis of same bundle cap in units
A. HERREI		
Uniondale R16	19.0	1.0
	11.4	0.8
	9.2	0.7
	8.7	1.0
	7.5	1.5
	6.3	0.7
	4.4	0.7
	2.4	0.7
Prince Albert R46	5.6	1.0
	5.2	1.1
	5.1	1.0
	4.8	1.1
	4.0	0.8
	3.8	1.2
	3.7	0.9
A. SPIRALIS		
Oudtshoorn R7	2.9	4.0
	2.3	3.5
	2.3	3.2
	1.0	3.6
Calitzdorp R47	3.6	3.0
	3.4	3.2
	3.2	3.8
	3.1	3.2
	2.6	2.7
	2.2	3.2
	1.4	3.5
Ladismith-Barrydale R6	0.8	4.5
	0.6	3.0
A. SMUTSIANA		
Ladismith-Barrydale R3, R5	4.5	2.8
	4.5	2.7
	3.9	2.8
	3.0	3.0
	2.9	2.5
	2.6	1.5
	2.3	2.5
	1.8	2.0

Appendix Table 8. VERTICAL DISTANCE FROM LOWER EPIDERMIS OF LARGEST BUNDLE CAP AND APPROXIMATE AREA OF SAME BUNDLE CAP, AS SEEN IN TRANSVERSE SECTION HALF-WAY ALONG LEAF (1 Unit = 130μ)

Locality	Height of plant	Spiral Angle	Angle of leaf with stem	Curvature of leaf apices
	cm.	o	o	
		HAWORTHIA MARGARITIFERA		
Rietvlei R50B	11	30	20	u
	6	33	20	u
	13	40	30	u
		×ASTROWORTHIA BICARINATA		
Miscell. garden plants:-				
Ex B. Carp	10	13	25	o
Ex. Malherbe	6	Irreg.	40	f
Ex H. Herre (3 Vaalkoppens?)	18	Irreg.	40	f
	14	5	30-50	o
Ex Karroo Gdns.	9	8	35-40	u

Appendix Table 9A. LEAF ARRANGEMENT IN SPECIMENS OF HAWORTHIA MARGARITIFERA AND ×ASTROWORTHIA BICARINATA.

(See Appendix Table 1).

Locality.	Length	Width widest part	Width leaf base	Distance of widest part from base	Side on which Keel situated	Keel length	Mucro length	Length breadth ratio
	cm.	cm.	cm.	cm.		cm.	cm.	
				×ASTROWORTHIA BICARINATA.				
Baden Baden R58	4.4 3.9	1.7 1.7	1.1 1.0	1.4 1.3	R R	1.9 1.0	0.10 0.10	2.59 2.29
Rietvlei R50	4.6 3.5	2.0 2.0	1.2 1.4	1.7 1.5	R R	1.7 1.3	0.08 0.09	2.28 1.75
Misc. Garden Plants - No. 7262 K'bosch	4.5 3.7	2.3 2.2	1.2 1.5	1.8 1.4	Sl. double "	1.9,2.3 1.8,2.0	0.08 0.12	1.96 1.68
Ex. B. Carp	3.3	2.1	1.2	1.6	L	0.7	0.03	1.56
Ex. Karoo Gardens	5.1	2.8	1.5	1.9	L	1.6	0.09	1.82
Ex. J. Malherbe	3.4	1.8	1.1	1.6	L	1.2	0.07	1.89
Ex. H. Herre (3 Vaal Koppen ?)	4.6 3.9	2.1 2.0	1.3 1.4	1.6 1.5	R L	2.4 1.5	0.10 0.08	2.24 1.95
				HAWORTHIA MARGARITIFERA.				
Rietvlei R50B	9.0 6.8 5.3	2.3 2.5 1.6	1.5 2.2 1.3	2.0 1.8 1.5	L L L	3.2 2.9 1.8	0.13 0.12 0.10	3.96 2.70 3.28

Appendix Table 9B DIMENSIONS OF LEAVES IN ×ASTROWORTHIA BICARINATA AND HAWORTHIA MARGARITIFERA.

Locality.	Lowest Fertile Bract length	middle -width.	basal -width.	Lowest Sterile Bract length	middle -width.	basal -width.	Pedicel Length Flowering basal	-middle	Fruiting basal	No. of sterile bracts.	Peduncle Width at base	below raceme.	Length Peduncle	-Raceme	No. of side branches.
	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.		cm.	cm.	cm.	cm.	
							X ASTROWORTHIA BICARINATA. (Contd.)								
Herbarium Specimens.															
	=	=	=	=	=	=	0.47	0.42	0.56	2	-	0.17	-	35.0	1a
	0.55	0.07	0.26	0.80	0.08	0.40	-	-	0.54	2	0.38	0.18	27.0	26.0	0
	0.55	0.08	0.30	-	-	-	0.47	0.46	-	5	-	0.20	-	37.0	5b
	0.60	0.05	0.23	1.25	0.07	0.40	0.47	0.32	-	3	0.47	0.20	28.0	13.0	3b
	-	-	-	-	-	-	0.50	0.56	-	2	0.60	0.31	28.0	15.0	2b
							HAWORTHIA MARGARITIFERA.								
Rawsonville	0.34	-	0.45	0.90	-	0.70	0.59	0.50	-	5	0.95	0.38	29.0	18.0	5b
	0.50	-	0.30	0.70	-	0.43	0.60	0.55	-	3	0.78	0.35	41.0	38.0	2b
	0.50	0.05	0.28	0.70	0.08	0.40	0.32	-	-	4	0.45	0.27	41.0	-	2alb
	0.60	0.07	0.32	0.85	0.07	0.55	-	-	0.61	5	0.72	0.30	39.0	14.0	4b
Herbarium Specimens.															
	0.60	0.10	0.30	1.50	0.13	0.40	0.34	-	-	5	0.54	0.47	30.0	10.0	5b
	-	-	-	-	-	-	0.39	-	-	5	0.67	-	31.0	13.0	5b

Appendix Table 9C DIMENSIONS OF INFLORESCENCES IN X ASTROWORTHIA BICARINATA & HAWORTHIA MARGARITIFERA.

Locality.	Lowest Fertile Bract length	Lowest Fertile Bract middle width	Lowest Fertile Bract basal width	Lowest Sterile Bract length	Lowest Sterile Bract middle width	Lowest Sterile Bract basal width	Pedicel Length Flowering basal	Pedicel Length Flowering middle	Pedicel Length Fruiting basal	No. of sterile bracts.	Peduncle Width at base	Peduncle Width below raceme.	Length Peduncle	Length Raceme	No. of side branches.
	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.		cm.	cm.	cm.	cm.	
							×ASTROWORTHIA BICARINATA.								
Baden-Baden R58	0.36	0.17	0.30	0.75	0.18	0.40	-	-	0.42	3	-	0.16	-	18.0	2b
	0.40	0.15	0.28	-	-	-	0.57	-	-	-	-	0.19	-	21.0	-
	0.42	0.18	0.28	0.75	0.20	0.38	0.48	-	-	3	0.55	0.19	13.0	23.0	1b
	0.45	0.20	0.29	0.60	0.18	0.28	-	-	0.62	3	0.52	0.20	18.0	18.0	0
	0.45	-	0.30	0.70	-	0.43	0.95	0.57	-	5	0.57	0.22	18.0	17.0	1b3a
	0.47	-	0.30	0.70	-	0.60	0.60	0.43	-	4	0.73	0.24	27.0	-	3b
Rietvlei R50	0.43	-	0.30	0.40	-	0.35	-	0.32	-	3	0.36	0.22	14.0	14.0	2a
	0.45	-	0.43	0.60	-	0.38	0.64	0.45	-	3	0.45	0.24	15.0	13.0	2a
	0.45	0.10	0.30	0.60	0.13	0.38	0.48	0.46	-	4	0.36	0.23	21.0	26.0	1b
	0.49	0.18	0.40	0.83	0.07	0.63	0.67	0.57	-	4	0.47	0.26	27.0	18.0	2b
Misc. Garden Plants - No. 7262 K'bosch	0.70	0.23	0.50	0.85	0.20	0.65	0.40	0.32	-	3	0.60	0.32	25.0	16.0	0
	0.70	0.21	0.60	0.90	0.20	0.65	0.32	0.26	-	4	0.64	0.37	27.0	20.0	0
	0.72	-	0.47	0.90	-	0.46	0.38	0.29	-	3	0.47	0.34	19.0	20.0	1a
	0.73	0.20	0.43	1.00	0.23	0.70	-	-	-	-	0.55	0.25	25.0	-	1b
	0.75	0.15	0.45	0.80	0.20	0.50	0.30	0.30	-	3	0.51	0.30	21.0	21.0	3a
	0.81	0.15	0.44	1.05	0.16	0.59	0.31	0.27	-	4	0.50	0.35	20.0	18.0	0
	-	-	-	0.85	0.20	0.60	-	-	-	3	0.57	0.25	-	-	3b
	-	-	-	-	-	-	0.32	-	-	3	-	-	36.0	17.0	3a
Ex. B. Carp	0.33	0.17	0.38	0.60	0.13	0.45	0.45	0.40	-	3	0.39	0.21	25.0	8.0	2a
	0.35	0.16	0.40	0.60	0.15	0.45	0.48	0.38		4	0.53	0.27	19.0	4.0	3a
Ex. Karoo Gardens	0.24	0.10	0.30	0.47	0.10	0.35	0.45	0.40	-	5	0.60	0.30	12.0	18.0	0
	-	-	-	-	-	-	0.55	0.48	-	3	0.48	0.25	24.0	33.0	2a
Ex. H. Herre (3 Vaal Koppens ?)	0.43	0.12	0.33	0.53	0.10	0.45	0.39	0.37	-	3	0.38	0.25	30.0	15.0	2b1a
	0.45	0.13	0.35	0.75	0.15	0.50	0.57	0.49	-	2	0.47	0.20	33.0	14.0	1b
	0.55	-	0.35	0.70	-	0.40	0.64	0.49	-	4	-	0.21	17.0	12.0	2a
	0.55	-	0.30	0.90	-	0.30	0.50	-	-	4	-	0.20	25.0	-	2a

Appendix Table 9C DIMENSIONS OF INFLORESCENCES IN ×ASTROWORTHIA BICARINATA & HAWORTHIA MARGARITIFERA (Contd.)

	PERIANTH TUBE Length to Neck	Neck	Diameter Middle	Base	LOBES Length Outer	Inner	Width Outer	Inner	GYNAECIUM Length Ovary	Style	DIFFERENCE BETWEEN DIAMETER OF middle and Neck	Base and Middle	ANGLE OF OPEN LOBES. Ant. Outer	Outer Lats.	Post. Inner	Inner Lats.
	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.				
					×ASTROWORTHIA BICARINATA.											
Baden-Baden	0.90	.20	.27	.37	.20	.20	.15	.20	-	-	.07	.10	-	-	-	-
R58	.95	.20	.28	.38	.19	.20	.16	.21	-	-	.08	.10	110°	70°	60°	40°
Rietvlei R50	1.13	.25	.29	.36	.20	.20	.14	.24	.29	.33	.04	.07	70°	50°	40°	50°
	.93	.26	.28	.33	.18	.19	.15	.21	.38	.41	.02	.05	90	40°	55°	30°
	.87	.20	.26	0.33	018	.20	.17	.22	-	-	.06	.07	-	-	-	-
	.85	.23	.28	.35	.20	.22	.16	.21	-	-	.05	.07	-	-	-	-
Misc. Garden Plants	.94	.23	.35	.39	.20	.28	.20	.30	-	-	.12	.04	-	-	-	-
No. 7262 K'bosch	.98	.24	.35	.40	.20	.25	.16	.30	-	-	.11	.05	-	-	-	-
	.91	.27	.32	.37	.23	.27	.15	.25	.37	.37	.05	.05	125	90	70	40
	.87	.25	.35	.35	.23	.25	.17	.31	.38	.32	.10	.00	90	70	60	60
	.86	.27	.34	.34	.23	.23	.16	.29	.36	.24	.07	.00	90	70	60	60
	.84	.24	.34	.38	.25	.25	.15	.31	.40	.30	.10	.04	180	100	70	70
	.82	.27	.30	.33	.20	.21	.17	.30	.37	.37	.03	.03	90	90	45	30
	.80	.27	.32	.33	.20	.21	.15	.25	.30	.26	.05	.01	90	80	30	20
	.79	.28	.30	.31	.16	.18	.15	.23	.37	.30	.02	.01	140	80	55	30
Ex. B. Carp.	.97	.26	.34	.36	.21	.25	.13	.18	.36	.33	.08	.02	100	40	50	30
	.72	.32	.36	.43	.22	.23	.17	.25	.49	.44	.04	.07	180	65	50	50
Ex. H. Herre	1.05	.26	.28	.33	.20	.20	.17	.22	.29	.34	.02	.05	90	60	65	50
(3 Vaal Koppen)	.94	.25	.29	.35	.18	.18	.15	.18	.37	.23	.04	.06	90	60	50	40
	1.03	.19	.26	.29	.20	.23	.18	.20			.07	.03	60	40	30	30
	.93	.20	.25	.30	.20	.20	.16	.20			.05	.05				
Ex. Karoo Gdn's	1.06	.24	.34	.38	.25	.25	.15	.19	.39	.37	.10	.04	85	60	50	40
	.90	.27	.32	.35	.20	.21	.14	.20	-	-	.05	.03	-	-	-	-

Appendix Table 9D DIMENSIONS OF PERIANTH IN ×ASTROWORTHIA BICARINATA

Appendix Table 9E. DIMENSIONS OF PERIANTH IN <u>HAWORTHIA MARGARITIFERA</u>.

	PERIANTH TUBE				LOBES				GYNAECIUM		DIFFERENCE BETWEEN DIAMETER OF		ANGLE OF OPEN LOBES.			
	Length to Neck-Neck		Diameter Middle-Base		Length Outer-Inner		Width Outer-Inner		Length Ovary-Style		Middle and Neck	Base and Middle	Ant.	Outer Outer-Lats.	Post.	Inner Inner-Lats.
	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.				
							HAWORTHIA MARGARITIFERA.									
nr. Montagu nr.	1.07	.20	.29	.43	.30	.31	.12	.17	-	-	.09	.14	180	70	60	60
Rawsonville	1.05	.29	.35	.46	.22	.29	.12	.20	.36	.32	.06	.11	185	70	60	90
	1.05	.30	.37	.47	.25	.27	.10	.20	.37	.29	.07	.10	180°	70	60	90
	1.03	.29	.34	.46	.21	.26	.10	.22	.38	.24	.05	.12	-	-	-	-