Inflorescence hydrocarbons of some species of Solanum L., section Tuberarium (Dunal) Bitt., and their taxonomic significance
by Helen Cameron Mecklenburg

A thesis submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree of DOCTOR OF PHILOSOPHY in Genetics
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Abstract:
A study of the hydrocarbon content of flowers of 35 tuberbearing Solanum species has yielded results applicable to the taxonomy of this group. These alkanes, which occur as a portion of the waxy coating on the surface of the plant parts, were purified and the relative amounts of the various components determined using gas-liquid chromatography* All species examined were found to contain both branched (C25-C32} and normal (C25-C31) components.

In general, the results of this work tended to confirm relationships among species postulated on the basis of morphological, cytologi-cal, and immunological studies. The types of patterns obtained did not seem to reflect ecological adaptations of the species involved. For example, the South American species S. acaule showed considerable interspecific variability, but in no. sample tested did it resemble S. demissum, its Mexican high-altitude counterpart.

On the other hand, similar patterns were often obtained for species considered morphologically similar but how isolated geographically or by differences in ploidy. level. Evidence was thus obtained applicable to determining relationships of South American to Mexican species, and of diploids to polyploids.

It appears that this type of approach will prove to be of value in the study of this complex group of species, in that it provides another tool for elucidating relationships irrespective of complexities associated with differences in ploidy level.

INFLORESCENCE HYDROCARBONS OF SOME SPECIES OF SOLANUM L., SECTION TUBERARIUM (DUNAL) BITT., AND THEIR POSSIBLE TAXONOMIC SIGNIFICANCE

by

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ABSTRACT

A study of the hydrocarbon content of flowers of 35 tuber-bearing Solanum species has yielded results applicable to the taxonomy of this group. These alkanes, which occur as a portion of the waxy coating on the surface of the plant parts, were purified and the relative amounts of the various components determined using gas-liquid chromatography. All species examined were found to contain both branched (C_{25}-C_{32}) and normal (C_{25}-C_{31}) components.

In general, the results of this work tended to confirm relationships among species postulated on the basis of morphological, cytological, and immunological studies. The types of patterns obtained did not seem to reflect ecological adaptations of the species involved. For example, the South American species S. acaule showed considerable interspecific variability, but in no sample tested did it resemble S. demissum, its Mexican high-altitude counterpart.

On the other hand, similar patterns were often obtained for species considered morphologically similar but now isolated geographically or by differences in ploidy level. Evidence was thus obtained applicable to determining relationships of South American to Mexican species, and of diploids to polyploids.

It appears that this type of approach will prove to be of value in the study of this complex group of species, in that it provides another tool for elucidating relationships irrespective of complexities associated with differences in ploidy level.

CHAPTER I

INTRODUCTION

A. Taxonomy

The family Solanaceae is a large and varied one, consisting of about 90 genera and 2000 species (Correll, 1962). The genus Solanum L., embracing more than two thirds of the species in the family, includes the species S. tuberosum, the common potato. Solanum is distinguished from other Solanaceae genera by its 2-locular ovary, distinctly curved embryo, five fertile stamens of equal or nearly equal length, fruit a berry, and either free anthers splitting through an opening in the apex, or anthers connected in a tube (Wettstein, 1897).

Since Dunal's work (1852) no one person has attempted to consider the genus Solanum as a whole (Correll, 1962). Very little work was done on the genus, including the recognition of newly found species, from Dunal's time until Bitter's invaluable contributions (1911-1914). Bitter developed broadly the concept of sections proposed by Dunal (Correll, 1962). He raised Dunal's subsection Tuberarium to section status; divided section Tuberarium into two subsections, Basarthrum and Hyperbasarthrum; and described more than 50 new species and varieties in section Tuberarium alone.

Section Tuberarium, distinguished by its short stamens and articulated pedicel, is further subdivided into Basarthrum, if the

articulation is at the base, or Hyperbasarthrum if the articulation is somewhat above the base. All the tuberous species fall into the subsection Hyperbasarthrum. With the exception of four species, three of which are of other genera, examined for comparative purposes, this work deals only with tuberous species included in subsection Hyperbasarthrum.

Beginning with Bitter, all systematists working with this subsection have found it necessary to divide it into a number of series, due to the large number of entities involved (Bitter, 1912; Rydberg, 1924; Juzepczuk and Bukasov, 1929; Juzepczuk, 1937; Bukasov, 1937, 1939; Hawkes, 1944, 1954, 1958; Cardenas and Hawkes, 1946; Correll, 1952, 1962). Since Bitter's time, the recognition of many new species has resulted in the expansion and reorganization of his original series assignments. Hawkes (1958) recognized 17 series containing 114 species, 108 wild and 6 cultivated. This was a welcome reduction from the 225 species he had formerly recognized. Correll (1962) divides the subsection into 26 series with 157 species.

Differences between Hawkes' and Correll's treatments are not as pronounced as the above figures might indicate. Hawkes tends to group more divergent entities into fewer species and series than does Correll, but their opinions as to the affinities of the various groups are not too divergent. For example, Hawkes (1958) assigned S. clarum to series Bulbocastana on the basis of its simple leaves; originally, Correll did the same. In 1962, however, Correll elected to place it in a separate series, Clara.

Correll (1962) points out that it may be essentially hopeless to construct a serial arrangement along natural lines. His series are distinguished by geographical distribution as well as by morphological characteristics. In order to identify a plant as to series and species by his key, a knowledge of its geographical origin is essential. This arrangement tends to mask similarities of entities which are now geographically isolated. Series assignments, as given by Hawkes (1958) and Correll (1962) are given in Table 1.

Of Correll's 26 series, two contain species which are not tuber-bearing. Of the remaining 24, 14 will be considered here. The following discussion has been summarized in Table 2.

Series Bulbocastana, Cardiophylla, Clara, Pinnatisecta, and Trifida contain species which are Mexican self-incompatible diploids with white stellata corollas. Occasional triploid clones have also been identified. Pandey (1960) has suggested these diploids share a two-locus system of incompatability, in contrast to the one-locus system of the South American diploids. Hawkes (1958) assigns S. trifidum, the only species in series Trifida, to series Pinnatisecta; and, as mentioned, S. clarum to series Bulbocastana.

Series Cardiophylla contains two species, one of which, S. ehrenbergii, might well be assigned to series Pinnatisecta. S. sambucinum, placed in series Pinnatisecta by Correll, is included in series Cardiophylla by Hawkes.

Series Polyadenia also contains a single Mexican diploid species,

Table 1. Serial assignments as given by Correll (1962) and Hawkes (1958).

Correll	Species studied	Hawkes
7. Juglandifolia	none	I. Juglandifolia
8. Etuberosa	none	II. Etuberosa
9. Ingaefolia	none	(Piurana)
10. Piurana	none	X. Piurana
11. Conicibaccata	S. oxycarpum	IX. Conicibaccata
12. Minutifoliola	none	- - -
13. Yungasensa	none	(Commersoniana)
14. Vaviloviana	none	(Tuberosa)
15. Tarijensa	S. berthaultii	(Tuberosa)
	S. tarijense	(Commersoniana)
16. Polyadenia	S. polyadenium	XIV. Polyadenia
17. Morelliformia	none	III. Morelliformia
18. Clara	S. clarum	(Bulbocastana)
19. Circaeifolia	S. capsicibaccatum	VIII. Circaeifolia
20. Trifida	S. trifidum	(Pinnatisecta)
21. Bulbocastana	none	IV. Bulbocastana
22. Cardiophylla	S. ehrenbergii	V. Cardiophylla
23. Pinnatisecta	S. jamesii	VI. Pinnatisecta
	S. pinnatisectum	Pinnatisecta
	S. sambucinum	(Cardiophylla)
24. Commersoniana	S. chacoense	VII. Commersoniana
	S. commersonii	

Table 1 (Continued).

Correll	Species studied	Hawkes
25. Megistacroloba	none	XVI. Megistacroloba
26. Cuneoalata	none	XV. Cuneoalata
27. Acaulia	S. acaule	XI. Acaulia
28. Demissa	S. brachycarpum	XII. Demissa
	S. demissum	
	S. guerreroense	
	S. hougasii	
	S. verrucosum	
29. Longipedicellata	S. stoloniferum	XIII. Longipedicellata
	S. polytrichon	
	S. fendleri	
30. Borealia	none	- - -
31. Transaequatorialia	S. brevicaule	XVII. Tuberosa Wild species
	S. canasense	
	S. candolleanum	
	S. kurtzianum	
	S. lignicaule	
	S. simplicifolium	
	S. soukupii	
	S. sparsipilum	
	S. velascanum	
	S. vernei	

Table 1 (Continued).

Correll	Species studied	Hawkes
32. Tuberosa	S. tuberosum	Cultivated species
	Cultivated groups	
	S. x curtilobum	

Table 2. Summary of discussion of series.

Series	Leaf Shape	Comments
Mexican self-incompatible diploids with white stellate corollas		
Bulbocastana, Clara	simple	
Pinnatisecta, Cardiophylla, Trifida	odd-pinnate	
Mexican self-fertile diploid with sub-stellate corolla		
Polyadenia	odd-pinnate	Plant with objectionable odor
Mexican tetraploids with rotate-stellate corollas		
Longipedicellata	odd-pinnate	
Mexican hexaploids, one diploid included		
Demissa	odd-pinnate	Heterogeneous group, might well be divided; usually found at high altitudes
Distribution from Mexico to Bolivia; corolla rotate-pentagonal; diploids, tetraploids, at least one hexaploid		
Conicibaccata	odd-pinnate	
South American incompatible diploids, corollas mostly white, stellate		
Commersoniana	odd-pinnate	Very similar to Pinnatisecta
South American self-incompatible diploids, corollas sub-stellate		
Tarijensa	odd-pinnate	Plants with objectionable odor

Table 2 (Continued).

Series	Leaf Shape	Comments
South American high-altitude tetraploid of rosette habit, corolla rotate		
Acaulia	odd-pinnate	One highly polymorphic species
South American diploids, great range of variability; corolla rotate to stellate		
Transaequatorialia	simple or odd-pinnate	
South American polyploid series; one species now under cultivation is widely distributed in temperate regions; corollas usually rotate		
Tuberosa	odd-pinnate	

S. polyadenium. These plants are distinguished by their covering of glandular hair and objectionable odor. They have sub-stellate corollas and are self-fertile. They are difficult to hybridize with other species.

Six Mexican tetraploids, including the highly polymorphic S. stoloniferum, are included in the series Longipedicellata. These species are distinguished from the other Mexican species by their rotate-stellate corollas and petiolulate leaflets. The supposed relationship of S. stoloniferum to the hexaploids in series Demissa will be considered in a later section.

Series Demissa is a heterogenous Mexican group containing four hexaploids, a self-compatible diploid, and a species whose chromosome count has not been determined. The species in this group are in general found at high altitudes. In contrast, the 20 species in series Conicibaccata, which resemble some of the members of series Demissa, occur usually at lower elevations in wet forests from Mexico to Bolivia. Diploids, tetraploids, and at least one hexaploid species are included here.

The two species in the South American series Tarijensa are characterized by their glandular pubescense. They are self-incompatible diploids with sub-stellate corollas. Hawkes assigns S. tarijense to series Commersoniana; S. berthaultii to series Tuberosa.

Series Commersoniana contains three self-incompatible diploid species, two of which, S. chacoense and S. commersonii, are extremely

wide-spread in central South America. They resemble the members of the Mexican series Pinnatisecta so closely that the two series are maintained separately on a geographic basis alone.

The single species, S. acaule, in series Acaulia, is a frost-resistant, small plant of rosette habit in its native environment high in the Andes. It is a highly fertile tetraploid species with a considerable range of variability.

The South American series Transaequatorialia contains more than forty species found at high or low altitudes, among natural vegetation and as weeds. There is a great deal of variability both within and between them. All species so far examined are self-incompatible diploids which often hybridize readily in areas where their ranges overlap. Series Tuberosa contains three wild species and all the cultivated entities, grouped by Dodds (1962) into one species, S. tuberosum, and two hybrids, a triploid, S. x juzepczukii, and a pentaploid, S. x curtilobum. Hawkes grouped these two series into one, Tuberosa, which was further divided into wild and cultivated species. He considered several of the cultivated taxa as separate species.

B. Distribution and Variability

The distribution and variability of tuber-bearing Solanums were little known before 1920 (Hawkes, 1958). In 1925 the first major potato-collecting expedition was sent out by the Russian government. Instigated by Vavilov and under the direction of Bukasov, this expedi-

tion made detailed collections of living material in Mexico, Guatemala and Colombia (Correll, 1962). In the years following, the Russians sent out further expeditions to South and Central America; realizing the practical value of these collections, the governments of Sweden, Great Britain, Germany and the United States soon sent out their expeditions (Hawkes, 1958). The collections made by the U. S. expeditions, in part headed by Correll, laid the foundation for the potato collection now maintained at the Inter-Regional Potato Introduction Station, Sturgeon Bay, Wisconsin.

Correll (1962) has pointed out the morphological variability of several species (i.e., S. demissum, S. stoloniferum, S. verrucosum, S. acaule) under different ecological conditions. Studies on a commercial variety (Triumph) of S. tuberosum have shown that varying photo-periods alone may cause differences in the size of the plant, number and size of stolons, leaf-to-stem ratios, tuber-to-topgrowth ratios, tuber shape and yields, as well as time from planting to tuber-initiation and maturity (Werner, 1940). It is not surprising that so many new species were described in the years following as much of the material in the form of tubers, which was collected by these expeditions, was carried home to high latitudes and grown under ecological conditions quite different from the native environment. The trend today is to reduce many of these entities to synonomy with previously described species.

The range of wild potato species known today extends from

southwestern U. S. as far north as Nebraska, south through the mountains of Mexico, Central America, and northern and western South America into Chile; species in series Commersoniana and Yungasensa also are found in lowland areas of northern Argentina, Uruguay, Paraguay and southern Brazil. Some species are found in desert areas; others occur in the high rainfall forests of Central and South America; still others, especially S. acaule, are found at altitudes of over 4000 m, at the highest limit of plant growth. They are thus able to withstand a far wider range of ecological conditions than the potatoes of commerce.

C. Cytology

The existence of a polyploid series with a basic number of x = 12 was first shown for the wild potato species by Smith (1927) and by Vilmorin and Simonet (1927). Rybin (1930) established that the cultivated potatoes also formed a polyploid series; prior to this counts of 2n = 48 were made for them by Fukuda (1927) and Smith (1927). Species with 2n = 24, 48, and 72 are found in nature; the polyploids, with the exception of S. tuberosum, show quite regular meiosis and appear to be allopolyploids. Wild triploids and pentaploids have also been identified; they show highly irregular meiosis and appear to maintain themselves vegetatively (Longley and Clark, 1930; Oppenheimer, 1933; Rybin, 1930, 1933; Choudhuri, 1943, 1944; Lamm, 1943, 1945; Koopmans, 1951; Okuno, 1951; Prakken and Swaminathan, 1952; Swaminathan

and Howard, 1953; Swaminathan and Hougas, 1954; Swaminathan, 1954a; Marks, 1955a; Magoon, Hougas and Cooper, 1958).

Meiotic irregularities in the domestic potato have been noted by a large number of workers (Fukuda, 1927; Rybin, 1933; Muntzing, 1933; Ellison, 1936; Lamm, 1937, 1945; Arnason, 1941, 1943; Swaminathan, 1954a, b). Multivalent frequencies indicate it is an autotetraploid (Hawkes, 1958). Perhaps the best evidence supporting this view has come from the work of a group under the leadership of R. W. Hougas at the University of Wisconsin working with haploid plants derived from commercial varieties of S. tuberosum. Twenty-three of the 29 haploid plants described by them flowered; 22 of these proved to be female fertile and 2 were also male fertile (Hougas and Peloquin, 1957, 1958, 1960; Peloquin and Hougas, 1960; Hougas, Peloquin, and Ross, 1958a, b).

Study of the cytological data of numerous workers has led Hawkes (1958) to the conclusion that genome differentiation in the tuberous Solanums has not progressed very far. F_1 hybrids of the diploids have shown fairly regular meiotic pairing, even when the plants were weak and infertile due to wide species crossings (Rybin, 1933; Choudhuri, 1944; Lamm, 1945; Swaminathan, 1951; Magoon, Hougas and Cooper, 1958). Very little structural differentiation has been discernable by these methods. Cytological evidence on some of the polyploids, i.e., S. demissum (Swaminathan and Hougas, 1954; Marks, 1955b); S. polytrichon (Marks, 1955a); S. acaule (Howard and Swamina-

than, 1954a); and from S. stoloniferum (Wangenheim, 1954), indicates some genome differentiation has occurred in these species.

From this work, Hawkes has proposed the following tentative genome symbols for this group of species:

Genome	Taxonomic Group
A_1	Series Tuberosa, Commersoniana, S. verrucosum
A_2A_3	Series Acaulia
A_4B	Series Longipedicellata
$A_1A_4B_{(1-4)}$	Hexaploid Demissa species

He points out that the differences between the various A genomes are not complete; further, the B genome does not differ fundamentally from the A group.

However, Dodds (1965) has suggested that a similar phenomenon to that described by Riley (1960) in wheat (Triticum aestivum L.) may have occurred in the Solanum polyploids. Riley has demonstrated that diploidisation in wheat by means of genome differentiation may have occurred after the formation of the polyploids. He further suggests that the same mode of chromosome differentiation leading to regular meiosis may have occurred in other polyploids.

If indeed the partial genome differentiation noted in the Solanum polyploids occurred after they arose, studies on genome similarities or differences would be expected to shed little light on the

degree of affinity of the polyploids to their putative diploid ancestors, or to each other.

D. Crossability

Crossability data of the various tuberous Solanum species considered here is summarized in Table 3. As indicated on the table, several diploid species are self-incompatible (Stout and Clark, 1924; Clark, 1927; Pushkarnath, 1942a, b, 1945, 1953; Pal and Pushkarnath, 1942; Carson and Howard, 1942; Choudhuri, 1944; Pandey, 1960, 1962; Grun and Radlow, 1961; Dionne, 1961). On the other hand, three diploids have been reported as self-compatible. These are S. polyadenium (Clark, 1927; Choudhuri, 1944; Pal and Pushkarnath, 1951), S. verrucosum (Lamm, 1945; Swaminathan and Hougas, 1954; Hawkes, 1956b), and S. morelliforme (Hawkes, 1958).

Pandey (1962) has reported on a diallel cross involving eleven self-incompatible and three self-compatible diploid Solanum species. In several cases, crosses between a self-incompatible female and self-compatible male were incompatible, while the reciprocals were compatible. However, in one cross, female S. vernei x male S. verrucosum, a self-compatible species was successful as a male parent on a self-incompatible species.

Crosses within and between other ploidy levels are also often possible. Such crosses are thought to have given rise to the naturally-occurring triploids and pentaploids, and, followed by chromosome doubling,

Table 3. Crossability chart

♀ \ ♂	demissum	verrucosum	trifidum	clarum	fendleri	polytrichon	stoloniferum	jamesii	sambucinum	ehrenbergii	pinnatisectum	polyadenium	oxycarpum	hougasii	guerreroense	brachycarpum	berthaultii	tarijense	chacoense	commersonii	canasense	kurtzianum	maglia	simplicifolium	soukupii	vernei	sucrense	phureja	curtilobum	sparsipilum	tuberosum	acaule
dem.	+	x			+		x	–		–	–			x		x		x	x					x	x	x	+	x	x	+	x	x
ver.	–	+					–	–		–	–	–		x					+	+		+	+	+		+	–	+		+	–	
tri.																																
cla.																																
fend.					+	+	+												x												–	
polyt.	x				+	+	x																									
stol.	x						+												x								–	x				x
jam.	–	–					–	o			+	+								+												
sam.										–																						
ehr.		–							–	o	–	–							–			–	–	–	–	–		–		–		
pin.		–						+	+	x	o	x							–			–		–	–	–		–		–		
polya.		–						x	–		x	+							–			–	–	–	–	–		–		–		
oxy.													+																			
houg.	x	–					–							+		x														–		
guer.	x													x	+	x																
brach.														x		+																
bert.																																
tar.																		o	x									+				
cha.		+			+		–										+	+	o	+				+			–	+		+	x	
com.		x																	x	+								x				
can.																																
kurt.		–								–	–	–						+	x			o		+	–	+		x		–		
mag.																						+										
simp.		–								–	–	–							+			+		o	+	+		+		–		
sou.		–								–	–	–							+			+	–	+	o	–		–		–		
vernei		+								–	–	–							+			–		+	+	o		+		+	x	
suc.																															+	
phu.	x	–					x	x	–		–	x						x	+			–		+	+	–	+	o		–	+	
curt.																												+	x		+	
spar.		–							–	–	–						+		+			x		+	+	–		+		o	+	
tub.	x	x					x					x																+	+		+	+
aca.	+						x												x					x				x		x	x	+

KEY: + — cross successful, F_1 reasonably fertile
x — cross successful, but difficult or reduced fertility in the F_1
o — self-incompatible
– — cross impossible

Ref.: Hawkes, 1958; Magoon and Cooper, 1959; Gell, Hawkes and Wright, 1960; Pandey, 1962.

to the hexaploids (Marks, 1955b).

These results indicate that genetic isolation of many of these species is not complete. Considerable introgression would be expected to occur in areas where the ranges of the species overlap, and has indeed been observed.

E. Immunological Methods Applied to Solanum Taxonomy

The application of immunological methods to the taxonomy of Solanum species was reported by Gell, Hawkes and Wright (1960). Their results indicate relationships which on the whole correlate quite well with those proposed on the basis of morphological and cytogenetical studies. They point out that discrepencies between their results and those obtained by either or both of the other disciplines are of value in calling attention to points which need reexamination.

Tuber extracts from various species of Solanum were tested side by side against S. tuberosum antiserum (developed in rabbits). The South American species tested were indistinguishable from S. tuberosum itself. The Mexican species, however, fell into three categories, viz., those giving one, two and four precipitin lines, grouped by the authors as follows:

4 lines	2 lines	1 line
S. bulbocastanum	S. cardiophyllum	S. morelliforme
S. verrucosum	S. sambucinum	
S. semidemissum	S. ehrenbergii	

S. demissum
S. guerreroense
S. spectabile
S. polytrichon
S. stoloniferum
S. polyadenium
S. tuberosum
S. jamesii
S. pinnatisectum

To cross-check these results, antiserum was produced against S. ehrenbergii. To simplify the analysis, the resulting antiserum was absorbed out with S. tuberosum extract.

Of the group giving four lines against S. tuberosum antiserum, only three, S. tuberosum, S. verrucosum and S. semidemissum, could be grouped together on the basis of their reaction with the absorbed S. ehrenbergii antiserum. The others showed a range of patterns and possessed considerable differences within species.

S. jamesii and S. pinnatisectum, which grouped with S. cardiophyllum, S. sambucinum, and S. ehrenbergii when tested against S. tuberosum antiserum, showed similarity to S. bulbocastanum, S. stoloniferum, and S. polytrichon when tested against the absorbed S. ehrenbergii antiserum. The authors suggested that S. jamesii and S. pinnatisectum may constitute a linking group between the other two groups. S. morelliforme they considered to be only distantly related to all the other species tested.

The results are discussed in some detail here because they indicate the value of methods for elucidating relationships between species irrespective of complexities associated with polyploidy, one-way incompatibility, or ecologically-triggered variability.

CHAPTER II

INVESTIGATION

A. Statement of Problem

Some of the difficulties involved in determining affinities of various tuberous Solanums have been brought out in the preceding discussion. The large number of entities involved, incomplete speciation complicated by one-way incompatibility, variability within a species or even within a single clone under varying ecological conditions, and incomplete genome differentiation all contribute to the problems faced by the systematist studying this group.

It was suggested by Metcalf (unpublished) that the application of chemotaxonomic techniques, used in conjunction with cytogenetic information, would prove to be of material assistance in the study of relationships among this highly complex and variable group of species.

The history of chemotaxonomy has recently been discussed by Gibbs (1963) and by Alston and Turner (1963) and will not be repeated here.

As pointed out by J. Heslop-Harrison (1963), two methods are available for systematically evaluating chemical data obtained from living organisms. One alternative would be to fit them in with morphological and cytogenetic data with the purpose of refining the natural system of classification; the other would involve establishing an artificial classification based on chemical criteria alone. The same genetic system which controls the morphological development of an

organism also controls the chemical constituents of that organism; indeed, it is through the biochemical synthesis of these compounds that the morphology is determined. Chemical data should then be usable as another, not essentially different, type of evidence to be incorporated into a natural system of classification. This approach was adopted for the present study.

There may come a day when comparisons of basic enzyme systems, or even of the DNA configurations controlling these enzyme systems, will be the best tool available for determining affinities of different taxa. At present, the analytical techniques necessary for making this sort of comparison are not available. For this type of study, we are compelled to use so-called "secondary" plant products; those which are not involved in primary metabolic pathways, but rather are stable by-products in their biological environment. They should be neither ubiquitous to all living organisms nor characteristic of one individual alone (Erdtman, 1956).

Hudgins and Schueuer (1964) note that chemotaxonomic studies have often been hampered by the laborious and often difficult chemical separations necessary before correlations between chemical data and other taxonomic criteria can be determined. If a large number of samples is to be examined, the methods of extraction and determination should be quite simple; the chemical data obtained should not be affected by the stage of development of the plants, within certain limits, or minor or unavoidable modifications of the environment under which they are grown.

The compounds in question should be reasonably stable during storage and extraction.

In order to be of taxonomic value on a species level, these compounds should show similar patterns for different clones of the same species if that species appears to be rather well-defined by other criteria; conversely, they should show dissimilarities for species considered to be unrelated by other criteria. Further, grouping of several related species would be of value, provided this grouping could be supported by morphological similarities.

The problem, then, was to find a group of compounds meeting these requirements.

Two of the preliminary tests made of compounds not satisfactory for this purpose might be mentioned. Polyphenols were extracted from the tubers and separated using paper chromatography according to the method of Swain (1953). The relative amounts of these compounds showed considerable variation within the same clone when extracted from tubers held in storage for different lengths of time.

The possible chemotaxonomic value of hydrocarbons has been suggested by Eglinton and coworkers (Eglinton, Gonzalez, Hamilton and Raphael, 1962; Eglinton, Hamilton and Martin-Smith, 1962; Eglinton and Hamilton, 1963). These hydrocarbons occur as part of the waxy coating on the surface of plant parts. One function of these coatings appears to be control of the water balance of the plant; in addition, they may play a part in protection from insects, bacteria, and fungi. The

advantages of these coatings for taxonomic purposes include their universal occurrence, species variation in composition, extracellular occurence, and ease of sampling.

The foregoing approach was initially tested by comparing gas chromatograms of hydrocarbons extracted from the tubers of various species. In contrast to the polyphenols, the analyses showed the same relative proportions of constituents whether extracted from newly-dug and immature tubers or from tubers that had been in storage for a year. Unfortunately for these purposes, the same similarity of pattern was observed in all chromatograms, even those obtained from samples of tubers of plants considered quite unrelated by other taxonomic criteria.

One possible successful approach to this problem became apparent with the discovery that differences did exist in the chromatograms of hydrocarbons extracted from the flowers (rather than the tubers) of various species. This paper deals with the application of chromatographic analysis of the hydrocarbon content of their flowers to the taxonomy of tuberous species of the genus Solanum.

B. Experimental Procedure

1. Plant Materials.

Tubers of 42 Solanum species were obtained from the Inter-Regional Potato Introduction Station at Sturgeon Bay, Wisconsin, and planted in a greenhouse in the summer of 1962. Notes made on the resulting plants may be found in Appendix 3. These include observa-

tions of the growth habit, leaf type, pubescence, size and shape of leaf including interstitial leaflets, and flower characteristics. Flowers were collected, no special care being exercised as to the stage of development when picked, other than that they were beyond the closed bud stage, from about 80% of the plants. The flowers were dried at 110° C. overnight prior to storage.

Most of the tubers harvested from these plants were grown in the field in the summer of 1963 (some were used in chemical tests, as mentioned previously). Due to an exceptionally late first freeze (October 24), several of the resulting plants produced tubers despite our long-day conditions. Notes were made on these plants, but no flowers collected.

Tubers harvested in 1963 were again planted in the field in 1964. Flowers were obtained from a few of these plants; most, however, were badly damaged by hail on July 30 before they flowered.

A second shipment was received from Sturgeon Bay in 1964, including both tubers and seeds. These were grown in a greenhouse in the spring. Flowers were collected and treated as before. A list of the specimens examined is given in Table 6.

A complete list of the plants received, with planting record, is given in Appendix 2.

2. Chemical Procedure.

The procedure for extracting the hydrocarbon constituents was

developed with the following considerations in mind:

(1) to determine relative, rather than absolute amounts of these compounds,

(2) to minimize the contamination, and

(3) to reduce the time needed for each determination, so that a large number of samples could be run in a reasonable length of time.

The procedure developed, in detail, is as follows: 100 ml. of chloroform was added to each dried flower sample (0.1 to 1.0 g.) in a 500-ml. Erlenmeyer flask and the mixture was agitated with a magnetic stirrer for one hour. Solids were removed by filtration and the solvent completely removed by vacuum rotary evaporation at about 50° C. The residue was dissolved in 1-2 ml. of hexane and transferred to a 10 mm. x 11 cm. column for separation of the hydrocarbons from the more polar components of the mixture. The column was prepared from a slurry of 4.5 gm. of Unicil (activated silicic acid) in hexane, and washed with 50 ml. of hexane before the sample was added. The hydrocarbon fraction was eluted with 100 ml. of hexane. The resulting solution was concentrated to 2 ml. by vacuum rotary evaporation at about 50° C. The remaining solution was transferred to a weighed vial, and evaporation was completed by passing a stream of nitrogen over the vial while it was suspended in a warm water bath. The sample weight was then determined. Sample weights ranged from 0.1% to 0.01% of the dry weights of the flowers.

Checks of the procedure were made periodically by thin-layer

chromatography. These checks showed the presence in the samples of saturated hydrocarbons only.

The samples were next dissolved in sufficient hexane to give a concentration of 100 µg. per µl. Two µl. of each sample was gas-chromatographed using an F and M Model 400 gas chromatogram fitted with a 4 foot column containing 3.8% SE30 on Gas Chrom Q, 80-100 mesh. The column temperature was 230° C.; flow rate of the carrier (Helium) was 60 cm./min. The detector was hydrogen flame.

Note: Care must be exercised to avoid contamination from extraneous hydrocarbons. All solvents were redistilled and checked periodically for hydrocarbons in the C_{25} to C_{35} range. The column material was thoroughly washed to remove adsorbed contaminants. The solvents were not allowed to come into contact with plastic (other than Teflon), grease, paraffin or paper. The caps of the sample vials were metal-lined; no stop-cock grease was used on the rotary evaporator joints; filtering was done through glass or porcelain filters without filter paper.

The chromatograms produced show two series of peaks. Comparison with a paraffin standard run under the same conditions indicates one of these series represents straight-chain saturated hydrocarbons, the odd-numbered predominating. The second series represents branched-chain hydrocarbons. These may be iso (2-methyl) or anteiso (3-methyl) homologs, or a mixture of both, as reported for tobacco by Mold et al (1963).

To simplify the following discussion, I shall refer to a particular normal (unbranched) saturated hydrocarbon as n-C_n, or n-odd or n-even of a particular set; to a particular branched component as br-C_n.

C. Results

Four representative chromatograms are shown in Figure 1. Figure 1a depicts the hydrocarbon content of the flowers of S. polyadenium, P.I. 275,237, grown from seed under glass in 1964. Figure 1b is of the same species, but a different clone (P.I. 275,238). In contrast, the differences observed in the pattern of peaks obtained from S. fendleri, P.I. 275,158, and S. hougasii, P.I. 239,423, Figures 1c and 1d, may be noted.

Due to the very small amounts of n-even components, the peaks seem to be arranged in 4 sets of 3 peaks each. The center peak in each set is an n-odd species; the peak immediately preceding it is a branched hydrocarbon of the same C number; that following is a branched component of the next higher C number. The n-even component, if it is apparent at all, appears as a "shoulder" on the branched components of the same C number. These sets, which I shall refer to be the number of the n-component, run from C_{25} to C_{31}.

The incomplete resolution of the normal and branched compounds of the same C number should be noted. This incomplete resolution makes determination of the area under each curve subject to some error.

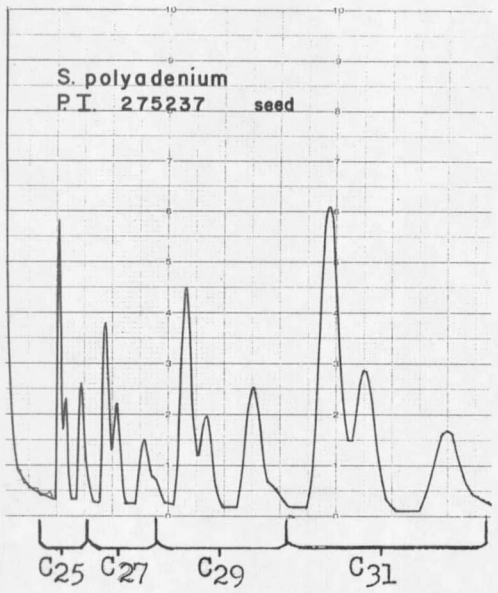


Fig. 1a

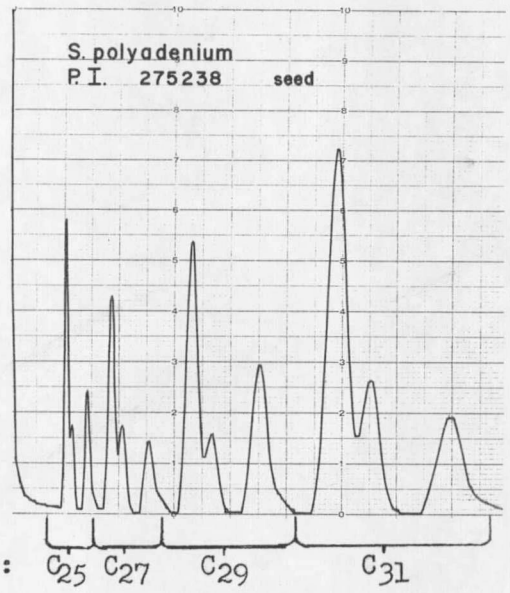


Fig. 1b

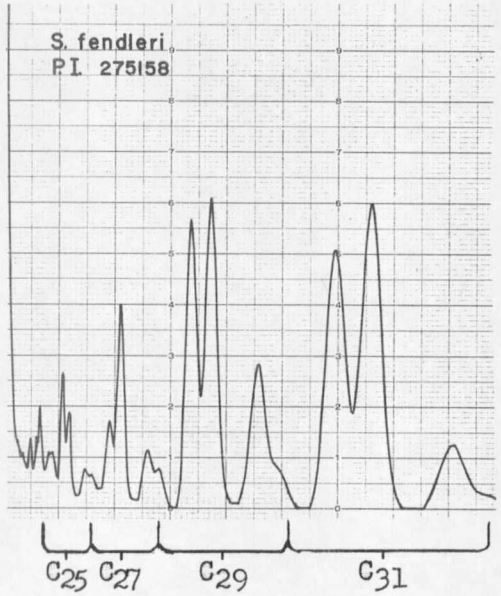


Fig. 1c

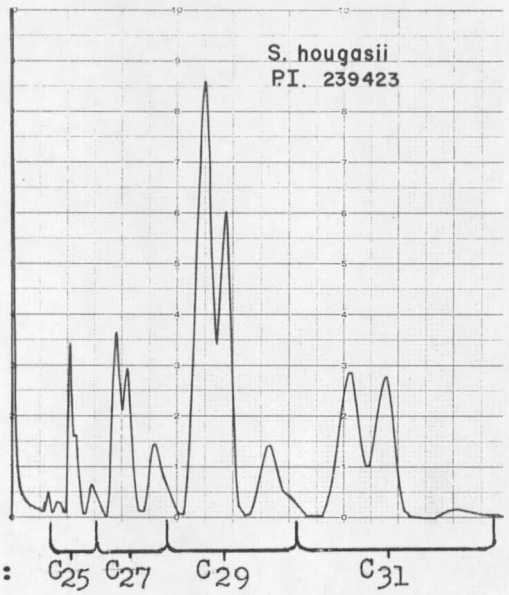


Fig. 1d

Figure 1. Four representative chromatograms

Chromatograms of the hydrocarbon content of the flowers from 94 samples of 35 tuber-bearing Solanum species were obtained. For comparative purposes, one sample each of Solanum quitoense, P.I. 263,169, pepper, tomato and tobacco of the family Solanaceae were also obtained. A list of the specimens examined, with graph numbers, is given in Table 6, immediately preceeding the graphs.

The area under each curve, which is proportionate to the amount of material, was determined from integrator pen tracings and calculated as a percentage of the total of the four sets. Bar graphs depicting these percentages are given in Graphs 1 to 98. The data from which these graphs were prepared are given in Appendix 4.

To check the reproducibility of this method, S. kurtzianum, P.I. 175,434 and 175,435, which flowered very well, was used. Information depicting five separate extractions of this species is shown in Graphs 62 to 66. The source of flowers for each sample, as noted on the graphs, are: 62 and 63--plants from tubers in 1962, flowers collected at different times; 64--plants grown from tubers in 1964; 65--plants grown from seed in 1964; 66--plants grown from tubers P.I. 175,435 (C-1), which are colchicine-induced tetraploids.

Although the graphs are not identical, certain similarities are apparent. The most abundant component in each case is br-C_{31}, comprising 22% or more of the total. The n-C_{31} peak is equal to or greater than br-C_{30} and br-C_{29}, both of which are in greater amount than n-C_{29}. On the other hand, the n-C_{27} peak, though smaller than the

six previously mentioned, is equal to or larger than the branched peak on either side of it. The C_{26} and C_{25} components, branched and normal, are present in very small amounts, no one being greater than 3% of the total except in the P.I. 175,434 sample.

Similarity or dissimilarity of other chromatograms was determined by a number of qualitative comparisons as in the preceeding example.

Before proceeding to the discussion of the separate Solanum species examined, a summary of the procedure might be made as follows:

(1) We are considering relative, rather than absolute amounts of each hydrocarbon component in the C_{25} to C_{31} range, within which over 99% of the hydrocarbons in these species was found to occur.

(2) These relative amounts appear to be essentially independent of minor environmental fluctuations under which the plants are grown, the stage of development of the flower, or the length of time in storage.

Study of the graphs has resulted in the following conclusions:

(1) Species belonging to the series Acaulia, Graphs 52-54, Transaequatorialia, Graphs 55-77, and Tuberosa, Graphs 78-94, do not in general show consistent patterns. Separate extractions of the same clone, as mentioned previously in regard to S. kurtzianum, give patterns which are reasonably alike. However, there is often as much variation between different clones of the same species as between

different species.

This diversity of pattern may be the result of several factors. The most important may well be the considerable interfertility among the various species, both within and between the series (see Crossability Chart, Table 3).

Series Acaulia, distinguished by its rosette-type of habit, varies considerably in regard to other features, such as presence or absence of interstitial leaflets, amount of pubescence and color of flower. Because of the interfertility of the various strains, both Correll and Hawkes consider all of these small South American herbs to be a single species, S. acaule. The hydrocarbon patterns are similar in the C_{29} and C_{25} sets, with br-C_{29} the most abundant component. Variation is shown in the C_{27} and C_{31} sets. The observed diversity of this species' hydrocarbon content is probably just another reflection of its general genetic diversity. The patterns shown do not resemble S. demissum, its Mexican high-altitude counterpart.

The cultivated entities may have yet another reason for their inconsistency of pattern. Generations of vegetative reproduction would tend to preserve any variation originally present when man first began to grow them from tubers, or any mutation which may have arisen in the meantime; occasional outcrossing with various wild species would tend to increase this variability.

It might well be possible, if enough samples of the various species were available, to find statistical correlations within

species. Perhaps a gradual change from one type of pattern to another might also be discernable in plants from areas where considerable introgression is thought to have occurred. A great many samples would be needed, along with a knowledge of which part of the range of the species each sample came from, for this to be feasible.

The two clones of S. kurtzianum examined show similarity of pattern to a group, to be discussed later, which includes S. chacoense. S. kurtzianum differs morphologically from this latter species in its rotate corolla, shape and attachment of leaflets, etc.; it is interfertile with it, however. Considering the diversity of the other members of this series, one hesitates to assign one species to any particular group on the basis of two clones.

The commercial cultivars show considerable diversity of pattern, but do have certain similarities. Only one, Russet Burbank, has a peak exceeding 20% of the total ($n\text{-}C_{31}$). The others have a high proportionate amount of branched components, particularly of the shorter chain lengths, and virtual absence of n-even constituents. With the exception of Russet Burbank, the $br\text{-}C_{25}$ peak in each case exceeded 10% of the total.

(2) The results obtained for the South American species, S. capsicibiccatum, series Circaeifolia, are somewhat anomalous (Graphs 49-51). These small plants, with stellate corolla, leaves usually odd-pinnate, and ellipsoid berries, are found in Bolivia. The chromatograms obtained from them showed considerable variability, but

did suggest a pattern. These plants morphologically resemble S. trifidum, found in Mexico. Their chromatograms, though somewhat resembling those obtained from S. trifidum, appear to correlate much better with the S. demissum type.

(3) The results from the other species examined do for the most part show reproducible patterns. Further, these patterns fall into three major groups, groups which correlate reasonably well with series assignments based on other criteria. The following key (Table 4) has been constructed as a guide to these groupings. The graphs for these species are found in the order in which they appear in this key, Graphs 1-48. The series assignments are taken from Correll (1962).

The general morphological characteristics of these groups are given in Table 5 following the key (Table 4). Series which are now maintained separately on the basis of geographical isolation alone are indicated by brackets.

A map depicting the distribution of these groups is shown on the following page. It appears that these hydrocarbon distributions do not appear to be a function of the ecological conditions of the areas where these plants are now found, but are widely distributed.

Group I

Included in Group I are S. demissum, S. verrucosum, and S. stoloniferum, v. malinchense.

The S. demissum samples, although they show considerable

Figure 2.

GROUPS OF

SOLANUM SPECIES INVESTIGATED

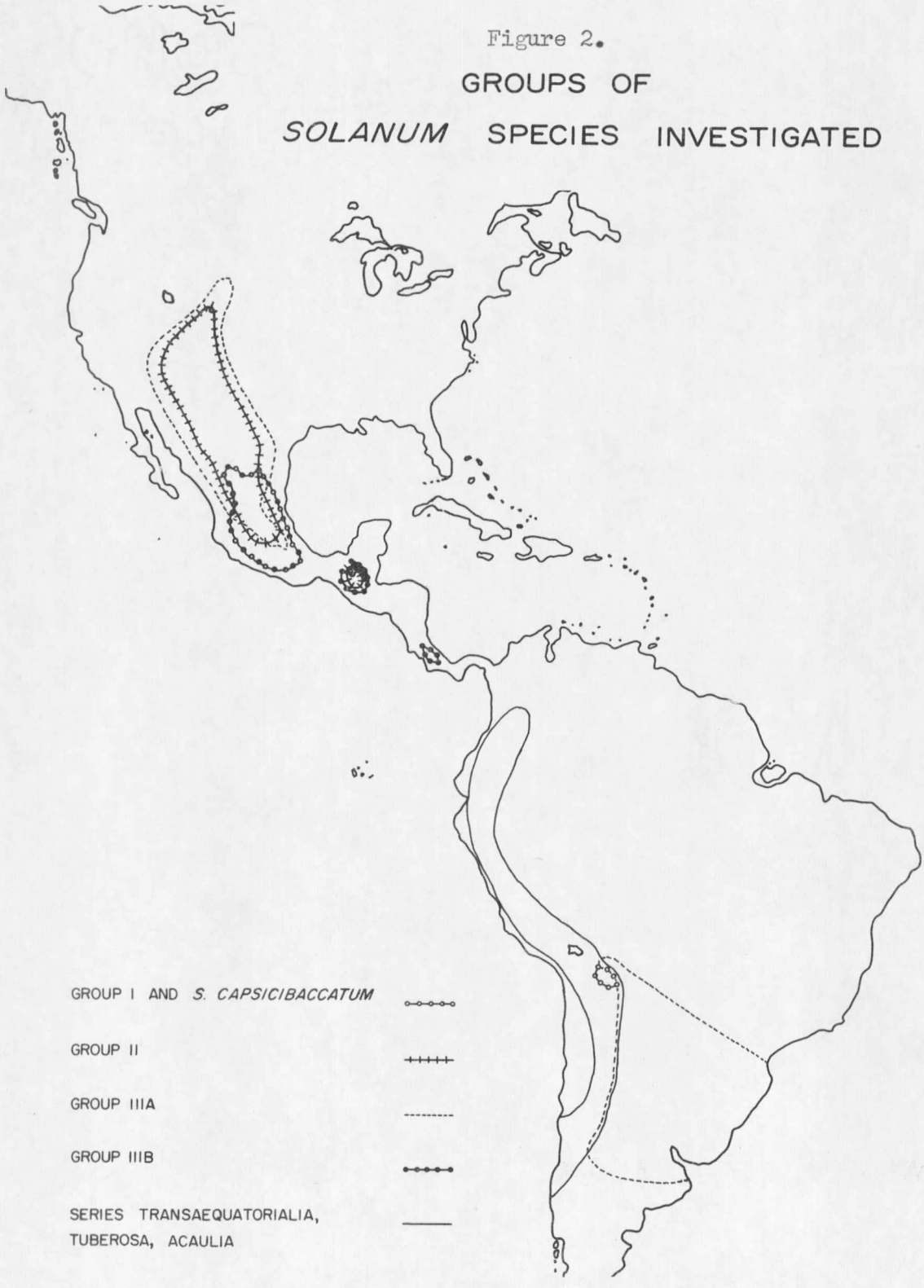


Table 4. Key based on hydrocarbon content.

1. n-odd peak ≥ to branched components of the same set	Group I (Graphs 1-6)	
2. All n-odd peaks distinctly larger than adjoining br's	1. *S. demissum* 6x 2. *S. stoloniferum* v. *malinchense* 4x	
2. $n\text{-}C_{27}$ only distinctly larger; others about equal to br's.	3. *S. verrucosum* 2x	
1. At least one n-odd smaller than adjoining branched		
3. Major peak $n\text{-}C_{31}$ ($br\text{-}C_{29}$ usually larger than $n\text{-}C_{29}$). .	Group II (Graphs 7-20)	
	4. *S. trifidum* 2x 5. *S. clarum* 2x 6. *S. fendleri* 4x 7. *S. polytrichon* 4x (8. *S. stoloniferum*) 4x	
3. Major $br\text{-}C_{29}$ or $br\text{-}C_{31}$.	Group III	
4. $br\text{-}C_{31}$ usually largest; usually no peak in C_{27} or C_{25} sets over 5%.	Group IIIA (Gr. 21-37)	
5. $n\text{-}C_{29} < br\text{-}C_{30}$.	9. *S. jamesii* 2x 10. *S. sambucinum* 2x 11. *S. berthaultii* 2x 12. *S. tarijensa* 2x 13. *S. ehrenbergii* 2x	
5. $n\text{-}C_{29} > br\text{-}C_{30}$		
6. $n\text{-}C_{25}$ and $n\text{-}C_{27}$ largest in set.	14. *S. pinnatisectum* 2x 15. *S. chacoense* 2x 16. *S. commersonii* 2x	
6. $br\text{-}C_{27}$, C_{28}, C_{29} and $C_{30} > n$ in same set. . . .	17. *S. polyadenium* 2x	
4. $br\text{-}C_{29}$ or C_{31} largest; usually at least one peak in sets C_{25} or C_{27} over 5%.	Group IIIB (Gr. 38-48)	

Table 4 (Continued).

7. br-C_{29} usually larger . .	18. S. oxycarpum 4x	
	19. S. hougasii 6x	
7. br-C_{31} usually larger . .	20. S. guerreroense 6x	
	21. S. brachycarpum 6x	

Table 5. Morphological comparison of species in key.

Group	Species: Mexican	Species: South American	Series*	Corolla	Fruit
I	S. demissum		Dem.	rotate	globose
	S. stoloniferum v. malinchense		Long.	rotate-stellate	globose
	S. verrucosum		Dem.	rotate	globose to ovoid
II	S. trifidum		Tri.	stellate	ovoid-conical
	S. clarum		Cla.	stellate	globose
	S. fendleri		Long.	rotate-stellate	globose
	S. polytrichon		Long.	rotate-stellate	globose
	S. stoloniferum		Long.	rotate-stellate	globose
III A.	S. jamesii		Pinn.	stellate	globose
	S. sambucinum		Pinn.	stellate	globose
		S. berthaultii	Tar.	sub-stellate	globose to ovoid
		S. tarijense	Tar.	sub-stellate	globose to ovoid
	S. ehrenbergii		Card.	stellate	globose
	S. pinnatisectum		Pin.	stellate	globose
		S. chacoense	Com.	stellate	globose to ovoid
		S. commersonii	Com.	stellate	globose to ovoid

Table 5 (Continued).

Group	Species: Mexican	Species: South American	Series*	Corolla	Fruit
	S. polyadenium		Poly.	sub-stellate	ovoid
B.	S. oxycarpum		Conic.	rotate ± stellate	long-conical
	S. hougasii		Dem.	rotate	ovoid
	S. guerreroense		Dem.	rotate	ovoid
	S. brachycarpum		Dem.	rotate	ovoid

*Cornell (1962)

diversity of hydrocarbon patterns, do have one property in common. In each set of compounds, the odd-n is the constituent present in the largest amount. This property is shared by only one other North American sample tested, namely S. stoloniferum v. malinchense, a tetraploid.

S. verrucosum, a diploid, showing nearly equal amounts of n-odd and branched components, has also been placed in this group. This noticable lack of a dominant peak easily distinguishes it from the other North American diploids examined.

S. demissum is characterized in its native habitat, high in the mountains of Mexico, by its rosette or semi-rosette habit, rotate corolla, and globose berries. This last feature distinguishes it from the other hexaploid species now included in series Demissa, which are ovoid- to ellipsoid-fruited. It is resistant to late blight and frost, characteristics which make it of considerable value to potato breeders interested in introducing these characteristics into the common potato. S. verrucosum, usually found at somewhat lower elevations than S. demissum, is morphologically very similar to it. The diploid usually has a more caulescent habit, though S. demissum, when grown at lower elevations, often assumes a more upright habit. These two species are combined with the other Mexican hexaploids into series Demissa by Correll (1962), an arrangement first suggested by Bukasov and later maintained by Hawkes. Correll expresses doubt that this is the best arrangement for these species, suggesting that a more natural inter-

pretation would be to separate S. verrucosum and S. demissum from the other hexaploids and assign them to two new series.

S. stoloniferum is described by Correll (p. 374) as a "highly variable complex species." The rotate corolla may be white, or vary in color to dark purple. The globose berries may vary in color also. Usually the plant is erect and slender, but bushy forms also occur.

The genetic origin of the Mexican hexaploids has long been of interest to a number of plant geneticists. These hexaploids show interfertility with several South American species (see Crossability Chart, Table 3), but very little with most of the North American diploids, with the exception of S. verrucosum. S. verrucosum shares this interfertility with the South American species, and morphologically is quite similar to them (e.g., S. andreanum, Hawkes, 1960, a species which unfortunately I did not examine). It is believed to be a quite recent introduction to Mexico from South America.

Marks (1955), on the basis of meiotic behavior of artificially produced hybrids of the various hexaploid species, has proposed a common diploid ancestor for all of them. He suggests they arose quite recently from a cross between this diploid and various unrelated tetraploid species, followed by chromosome doubling. He further suggests that the diploid parent may have been S. verrucosum.

The hydrocarbon pattern found for S. verrucosum appears to confirm its relationship with the South American diploids of section Transaequatorialia. Its essentially "neutral" pattern, in contrast to

the other North American diploids, would indirectly support its supposed role as diploid ancestor of the hexaploids.

Hawkes (1958) suggests that the tetraploid ancestors may have been Mexican tetraploid species in the series Longipedicellata. Serological evidence (Gell, Hawkes and Wright, 1960) supports the idea that two of the three hexaploids they examined, S. guerreroense and S. spectabile, are in fact related to the Longipedicellate tetraploids; S. demissum however showed no such relationship.

The sample of S. stoloniferum, P.I. 195,167, whose chromatographic pattern resembles that of S. demissum, is called S. stoloniferum v. malinchense in the Sturgeon Bay index. Under the synonyms for S. stoloniferum as listed by Correll (1962) is the name S. malinchense, Hawkes (1944). I am assuming that the plant received from Sturgeon Bay and identified as v. malinchense is essentially similar to the taxon once designated as a separate species by Hawkes. It is possible that this particular variety of this highly heterogeneous species was not included in the S. stoloniferum samples tested immunologically by Gell, Hawkes and Wright. I have thus decided, on the basis of admittedly slim evidence, to include this variety in the same group with S. demissum and S. verrucosum and to suggest that the tetraploid ancestor of S. demissum may have been similar to it.

Two additional characteristics support the proposed arrangement. One involves the extreme morphological variability of these species when grown under different environmental conditions as discussed by

Correll. He mentions that plants grown from tubers collected from a single plant of S. demissum collected in Mexico and grown under three different environments were dissimilar enough to be classed as three separate species if one did not know they were of the same clone (p. 27). This same variability was observed in S. verrucosum (p. 362). A similar observation was made for one of Correll's Mexican collections of S. stoloniferum, a plant which he points out was a good match for the plant labeled S. malinchense by Hawkes.

Secondly, certain R genes controlling a hyper-sensitive reaction to Phytophthora infestans are common to S. stoloniferum and S. demissum (McKee, 1962). This led Dodds (1965) to the conclusion that it is highly probable that doubling of triploid hybrids of S. verrucosum, S. stoloniferum, and their near allies has resulted in the evolution of the Demissa hexaploids.

Group II

Group II is distinguished by its predominant n-C_{31} peak. It differs from Group I in that at least one branched peak, usually C_{29}, exceeds the normal of the same set. Included are S. trifidum, the only species in series Trifida; S. clarum, the only species in series Clara; and two species found in series Longipedicellata, S. fendleri and S. polytrichon. The patterns found in this group, with the exception of one change in the relative amounts in the C_{29} set of one sample of S. fendleri, are quite similar in the C_{29} and C_{31} sets. One sample

of S. stoloniferum v. longipedicellatum would key here; the other two would appear in the next group. This highly variable species, discussed previously in Group I, may be a linking complex between other better-defined and more uniform species.

S. trifidum has a stellate corolla, ovoid-conical fruits, and a leaf which is often 3-foliate, with winged, elongate petioles. It is erect in habit, with many branches, and grows up to 4 dm. tall (Correll, p. 250). It is found in the mountains of west-central Mexico. It was assigned by Hawkes (1956) to series Pinnatisecta. Correll states that it is more nearly akin to series Conicibaccata. The hydrocarbon pattern is not similar to that of either the species of Pinnatisecta examined nor to S. ehrenbergii, of series Conicibaccata.

S. clarum, in series Clara, is a small plant with stellate corolla and globular fruits. It has simple leaves, distinguishing it from any other species examined. It is found at high elevations in southern Mexico and Guatemala. It was formerly placed in series Bulbocastana on the basis of its simple leaves.

The series Longipedicellata is characterized by a corolla described as rotate-stellate and by globose berries. This distinctive corolla, along with its petiolulate leaflets, distinguishes it from other North American series. Its range extends from central United States to central Mexico. The three species examined may be erect or bushy and spreading in habit.

The results seem to correlate well with the morphological

similarities noted in series Longipedicellata. On the other hand, the similarity of pattern for the series Longipedicellata and the otherwise rather dissimilar S. trifidum and S. clarum was an unexpected result. Perhaps these results do point to a phylogenetic relationship despite the other differences noted.

Group III

The members of this group, in contrast to Groups I and II, show a preponderance of branched components over normals. In some instances the br-C_{31} peak is much larger than any other, exceeding 30% of the total.

The group easily divides into two subgroups on the basis of hydrocarbon patterns, ploidy level, or corolla shape. As noted in the key, species in the same sub-group are often distinguishable from one another.

Group IIIA, whose patterns show no peak in the C_{25} or C_{27} sets exceeding 5%, are all diploids with stellate or sub-stellate corollas. Group IIIB, with more material in the C_{25} and C_{27} sets, are polyploids with rotate corollas.

Four South American species with similar patterns have also been included here, plus S. oxycarpum of series Conicibaccata, a series which ranges from southern Mexico to Bolivia.

Series Pinnatisecta is characterized by its stellate corollas, globose fruits and narrow leaflets. Correll suggests that series

Cardiophylla, with the possible exception of S. cardiophyllum (not examined), might well be combined with Pinnatisecta (p. 261). He also points out the close affinity of the South American series Commersoniana with Pinnatisecta, maintaining them as separate series because of the wide geographical separation of the two. Series Pinnatisecta ranges from central United States to central Mexico; series Commersoniana occurs in central South America (southern Brazil and Bolivia; northern Argentina).

S. chacoense, a widespread species of series Commersoniana, is interfertile with several other species (see Crossability Chart, Table 3), including S. verrucosum, S. berthaultii, and S. tarijense. These last two species are assigned to series Tarijensa by Correll on the basis of their glandular, aromatic characteristic.

This glandular characteristic is shared by S. polyadenium, the sole member of series Polyadenia, which also shares the sub-stellate corolla. S. polyadenium has a hydrocarbon pattern distinctive from the other members of this group in that the br-evens are larger than the normals of the same set in sets C_{27} and C_{29}. This pattern is directly opposite to that which characterizes S. demissum. As noted on the Crossability Chart, S. polyadenium can be crossed with S. jamesii and S. pinnatisectum. The cross is difficult, but the F_1 is fertile (Gell, Hawkes, and Wright, 1960).

These results, then, correlate quite well with morphological and crossability data.

Group IIIB

Group IIIB is distinguished from IIIA by a larger proportion of material in the C_{25} and C_{27} sets. Either br-C_{29} or br-C_{31} still remains the largest peak, but the proportionate amounts of material indicated by these peaks are less than in IIIA. It can be seen that it appears possible to further divide this sub-group on the basis of the relative size of br-C_{29} and br-C_{31}. In S. oxycarpum and S. hougasii, (referred to as S. spectabile by the British authors) br-C_{29} appears to be in greater amount; in S. guerreroense and S. brachycarpum the larger peak is br-C_{31}.

These species are morphologically quite similar. The corolla of series Demissa is described as rotate to rotate-stellate, appearing to be 10-15 lobulate. The corolla of series Conicibaccata is described as rotate-stellate, appearing to be 10-lobulate. The fruits of these species (in contrast to S. demissum itself) are ovoid to ellipsoid. Correll (1960) and Hawkes (1956) point out that these series are maintained separately on a geographic basis (ecological); the species in Conicibaccata are found in moist, warm areas, while those of series Demissa occur in high, cool mountains of Mexico and Guatemala.

The hexaploids included here are thought to have shared with S. demissum the same common diploid ancestor, S. verrucosum, as mentioned previously. It is tempting to look for possible tetraploid ancestors of these hexaploids in this group. S. oxycarpum suggests itself for this role in the production of S. hougasii. As to the

Longipedicellata tetraploids having served in this capacity as suggested by Hawkes (1956), the highly variable S. stoloniferum remains a possibility; S. polytrichon and S. fendleri do not appear likely from these data. This would agree with the immunological findings of Gell, Hawkes and Wright (1960). (Of these four tetraploids, samples of only two were examined by these authors, namely S. stoloniferum and S. polytrichon.)

Other Species

Chromatographic patterns of S. quitoense, tomato (Lycoperisicon), pepper (Capsicum), and tobacco (Nicotiana) are shown in Graphs 95-98. It should be noted that these species, with the exception of tobacco, have appreciable amounts of material in the C_{33} set. None showed measurable amounts in the C_{25} set. In comparing these graphs to those of the tuber-bearing Solanums, therefore, it should be kept in mind that they are "set over" 2 carbon units.

Each of these is clearly distinct from any other and from the tuber-bearing Solanums examined. Of them, the tomato is closest to Group III. Most distinct from the type of pattern in the tuber-bearing Solanums is the non-tuber bearing member of this genus, Solanum quitoense. The simplicity of this pattern is striking, with its large br-C_{33} peak and virtual absence (less than 1%) of either branched or normal even compounds.

D. Summary and Conclusions

A chemotaxonomic method applicable to the genus Solanum, section Tuberarium, subsection Hyperbasarthrum, has here been proposed. Hydrocarbons extracted from the flowers of various Solanum species were gas-chromatogrammed, graphs made of the relative amounts of the compounds found, and the graphs compared. Groupings were made of species whose graphs showed similar patterns, in the hope that such groupings might reflect phylogenetic relationships among these species.

The proposed biosynthetic pathways leading to these long-chain alkanes have been summarized by Eglinton and Hamilton (1963). In general, it is felt that these compounds are synthesized by decarboxylation of long-chain fatty acids. Corresponding long-chain acids of the size of the average alkane, C_{29}, have rarely been found, however; where found, the alkane fraction was not examined. Labelling experiments designed to substantiate the proposed biosynthetic pathways have not yet been reported.

From these results, several general and highly tentative proposals might be made. The synthesis of these compounds appears to be under the control of a relatively stable genetic system. The results indicate that genetic control of normal components may be different from that of branched components; further, that the production of even-branched components may be controlled by a different enzyme system than that which catalyzes the synthesis of the branched odd components.

Species showing one very large peak are in general those considered

by Hawkes (1958) as the more primitive (i.e., S. pinnatisectum, S. jamesii). The general effect of polyploidy and evolutionary advancement (i.e., series Demissa) seems to be a "leveling" of relative amounts of material. Species which are morphologically similar but widely separated geographically usually show similarity of hydrocarbon pattern (i.e., series Pinnatisecta and series Commersoniania). Similarly, series ecologically separated but morphologically similar also show similarity of pattern, i.e., series Demissa and series Conicibacatta.

It appears, therefore, that this approach toward the understanding of phylogenetic relationships, not only in this genus but in other taxa as well, may prove of value in the future.

Table 6. List of specimens examined.

Series (Correll)	Species	Ploidy	P.I. Number	Graph No.
Conicibaccata Bitt., 1912	S. oxycarpum Schiede, 1841	2n=48	230,479 seed	38
Tarijensa (Tub.)* Correll, 1962	S. berthaultii Hawkes, 1944	2n=24	218,215.2	24
(Com.)*	S. tarijense Hawkes, 1944	2n=24	195,206	25
Polyadenia Buk., 1939	S. polyadenium Greenm., 1903	2n=24	275,237 seed	35
			275,238 seed	36
			275,238.5	37
Clara Graham & Dionne, 1961 (Bulbocastana)*	S. clarum Corr., 1952	2n=24	243,355.1	9
			275,202.2	10
			275,205.4	11
Circaeifolia Hawkes, 1954	S. capsicibaccatum Card., 1944	2n=24	205,460.1	49
			205,560.2	50
			210,036.2	51
Trifida Corr., 1950 (Pinnatisecta)*	S. trifidum Corr., 1950	2n=24	255,538 seed	7
			255,538.4	8
Cardiophylla Buk., 1939	S. ehrenbergii (Bitt.) Rydb., 1924	2n=24	251,725	27
			255,519.1	28
Pinnatisecta Rydb., 1924	S. jamesii Torr., 1828	2n=24	195,190.1	21
			275,171	22
	S. pinnatisectum Dun., 1852	2n=24	184,764.3	29
			184,764 C-3	30

Table 6 (Continued)

Series (Correll)	Species	Ploidy	P.I. Number	Graph No.
	S. sambucinum Rydb., 1924	2n=24	275,243.3	23
Commersoniana	S. chacoense Bitt., 1912	2n=24	133,664	31
		2n=48	189,217 C-19	32
		2n=24	189,220.9	33
	S. commersonii Dun., 1814	2n=24	243,503 seed	34
Acaulia Juz., 1937	S. acaule Bitt., 1913	2n=48	195,160.4	52
			205,507.1	53
			210,033.1	54
Demissa Buk. ex Buk. & Kameraz, 1938, 1959	S. brachycarpum Corr., 1952	2n=72	230,459.1	45
			243,344.4	46
			275,183 seed	47
			275,183.5	48
	S. demissum Lindl., 1848	2n=72	160,227.4	1,2
			161,153.5	3
			175,411.1	4
	S. guerreroense Corr., 1952	2n=72	161,727.1	43
			161,730.13	44
	S. hougasii Corr., 1958	2n=72	161,174.5	39
	(S. spectabile)*	2n=72	161,174 seed	40
			239,423	41
			283,107.1	42

Table 6 (Continued)

Series (Correll)	Species	Ploidy	P.I. Number	Graph No.
	S. verrucosum Schlechtd., 1839	2n=24	160,228.1	6
Longipedicellata Buk. ex Buk. & Kameraz, 1938, 1959	S. stoloniferum Schlechtd., 1833	2n=48	195,167.10	5
			195,195.1	18
			205,522 seed	19
			205,522.3	20
	E. polytrichon Rydb., 1924	2n=48	186,545.11	14
			184,772	15
			184,773.1	16
			184,773 seed	17
	S. fendleri A. Gray, 1856	2n=48	275,158.1	12
Transaequatorialia Buk. ex Buk. & Kameraz, 1959, (Tuberosa)*	S. brevicaule Bitt., 1912		233,961.4	55
	S. canasense Hawkes, 1944	2n=24	265,864.1	56
			265,864 seed	57
			210,035.4	58
			210,035.2	59
	v. neohawskii (Ochoa) Corr., 1961 (neohawskii)*		230,506.1	60
	S. candolleanum Berth., 1911	2n=24	243,502	61
	S. kurtzianum Bitt. & Wittm., 1914	2n=48	175,434	62
			175,435.1	63,64

Table 6 (Continued)

Series (Correll)	Species	Ploidy	P.I. Number	Graph No.
			175,435 seed	65
			175,435 C-1	66
	S. lignicaule Vargas, 1943	2n=24	230,504.2	67
	S. simplicifolium Bitt., 1912	2n=24	208,866.1	68
			218,222.1	69
	S. soukupii Hawkes, 1944	2n=24	230,511.4	70,71
	S. sparsipilum (Bitt.) Juz. & Buk., 1937	2n=24	230,502.2	72
			233,693	73
	v. llallaguanianum (Card. & Hawkes) Corr. 1962 (sucrense)*		230,465.2	74
	S. velascanum Bitt. & Wittm., 1914 (famatinae)*		275,143.1	75
			275,144.1	76
	S. vernei Bitt. & Wittm., 1914		230,562.2	77
Tuberosa Rydb. 1924 Cultivated**	S. tuberosum L. 1753 Group stenotomum	2n=48	195,204 C-13	78
	(stenotomum)*	2n=24	230,512	79
	Subgroup goniocalyx	2n=24	195,188	80
	(goniocalyx)*		195,214	81
	Group phureja (phureja)*	2n=24	195,198	82
	Group tuberosum S. tuberosum	2n=48	195,162.1	83

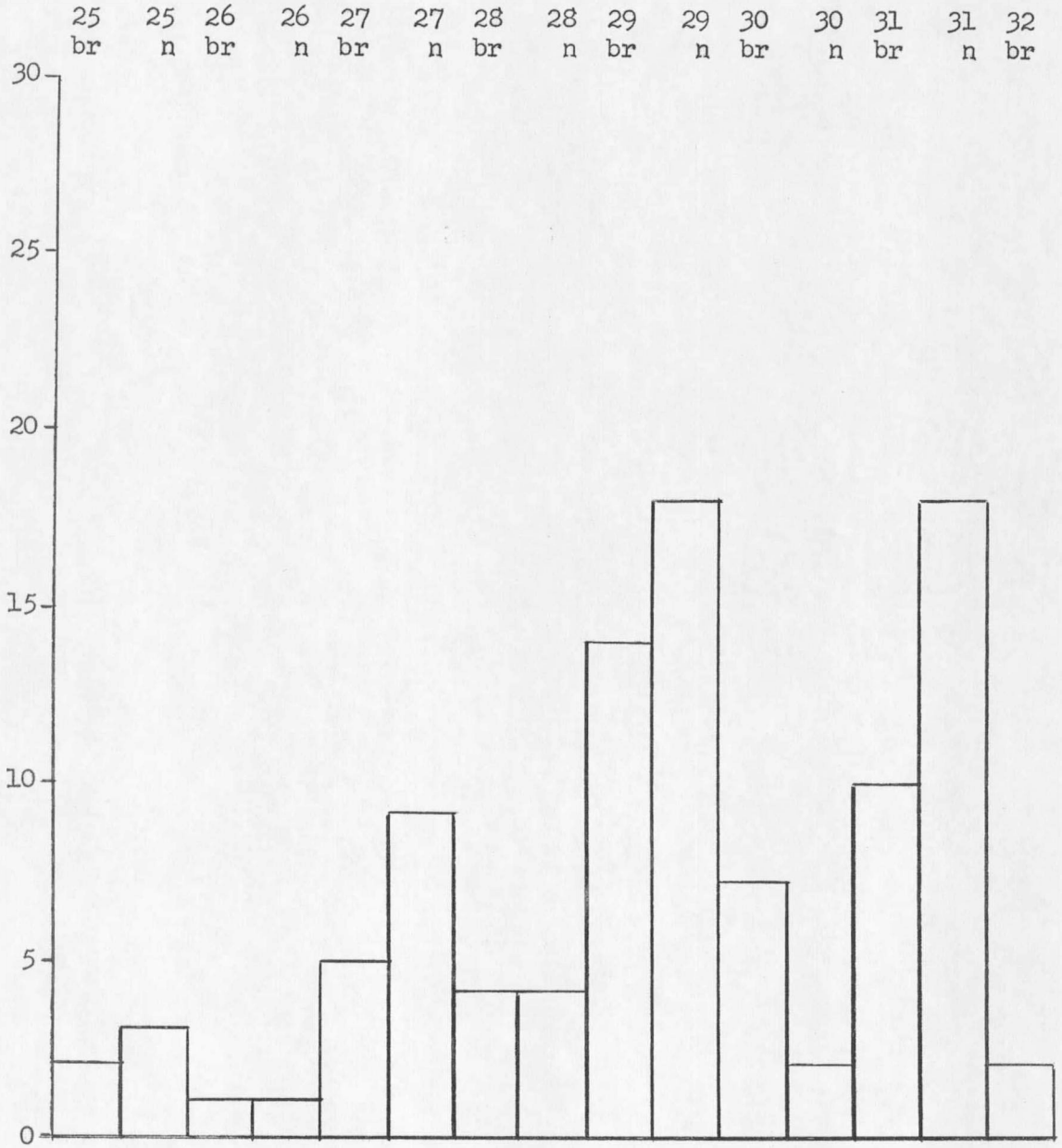
Table 6 (Continued)

Series (Correll)	Species	Ploidy	P.I. Number	Graph No.
	Commercial cultivars***			
	Russet Burbank			84
	Norland			85
	Dazoc			86
	Fruhperle			87
	Bliss Triumph			88
	Blanca			89
	Bounty			90
	60131			91
	S. x curtilobum Juz. & Buk., 1929	2n=60	195,181	92
			195,181***	93
			225,651	94
	Other Species Examined			
Solanum quitoense			263,169	95
Nicotiana tabacum				96
Lycopersicon sp.				97
Capsicum sp.				98

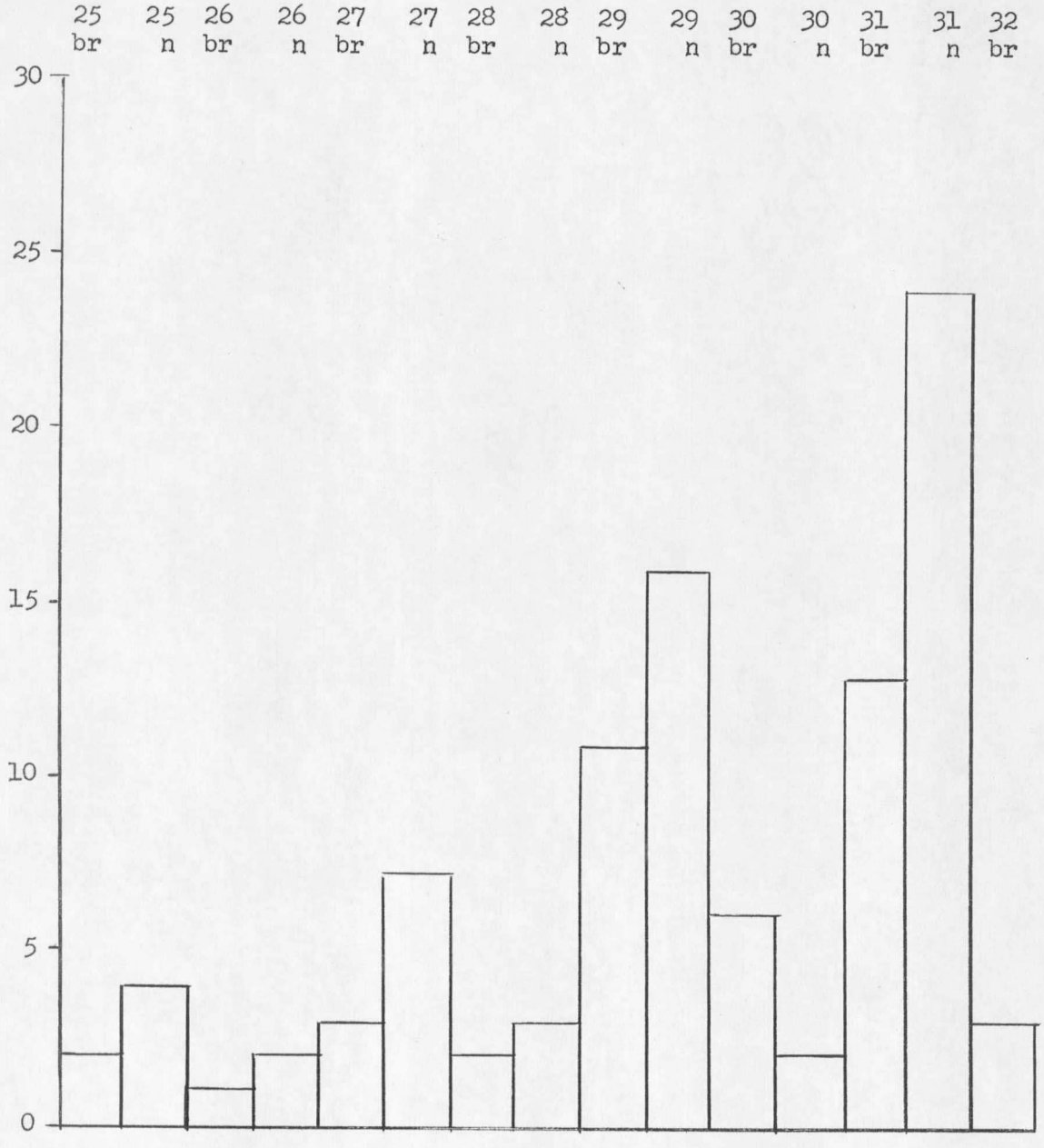
*Indicates Hawkes' assignments
**Dodds' arrangement, in Correll, 1962
***Field-grown
Plants grown from tubers unless "seed" specified
"C" after P.I. number indicates a colchicine-induced tetraploid

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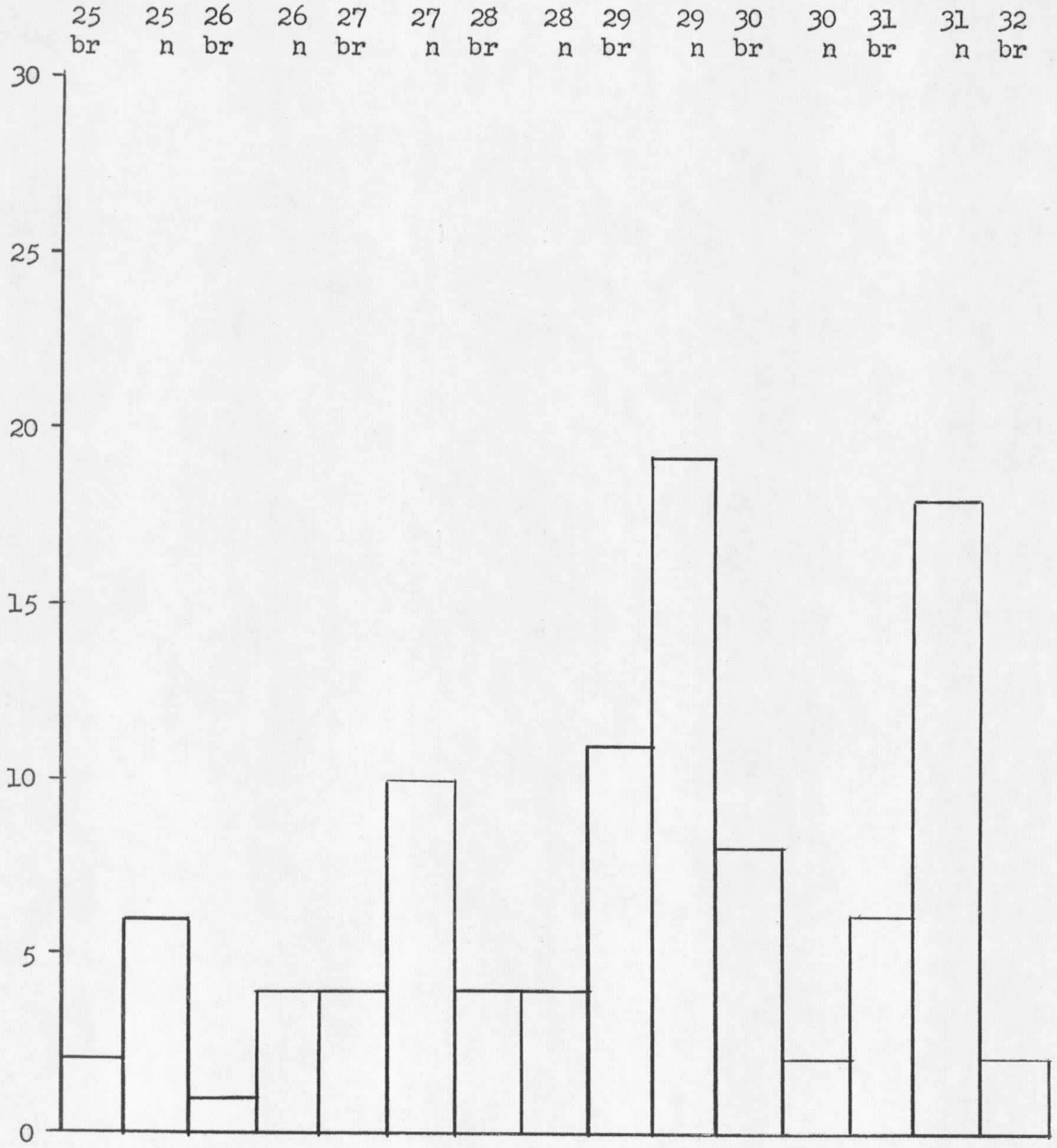
Graph 1. S. demissum P.I. 160,227.4 (73-62)
Demissa



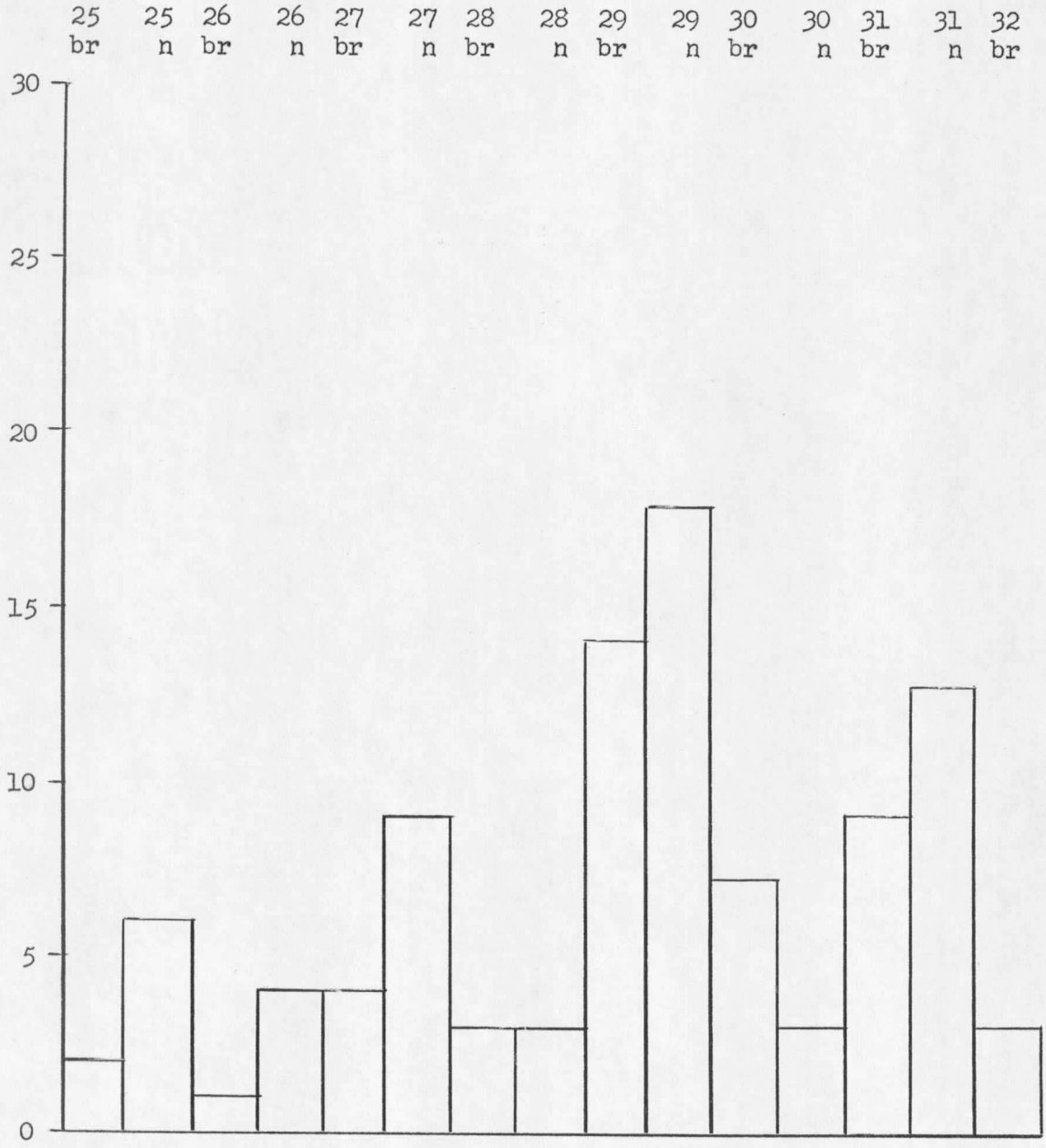
Graph 2. S. demissum P.I. 160,227.4 ('64)
Demissa



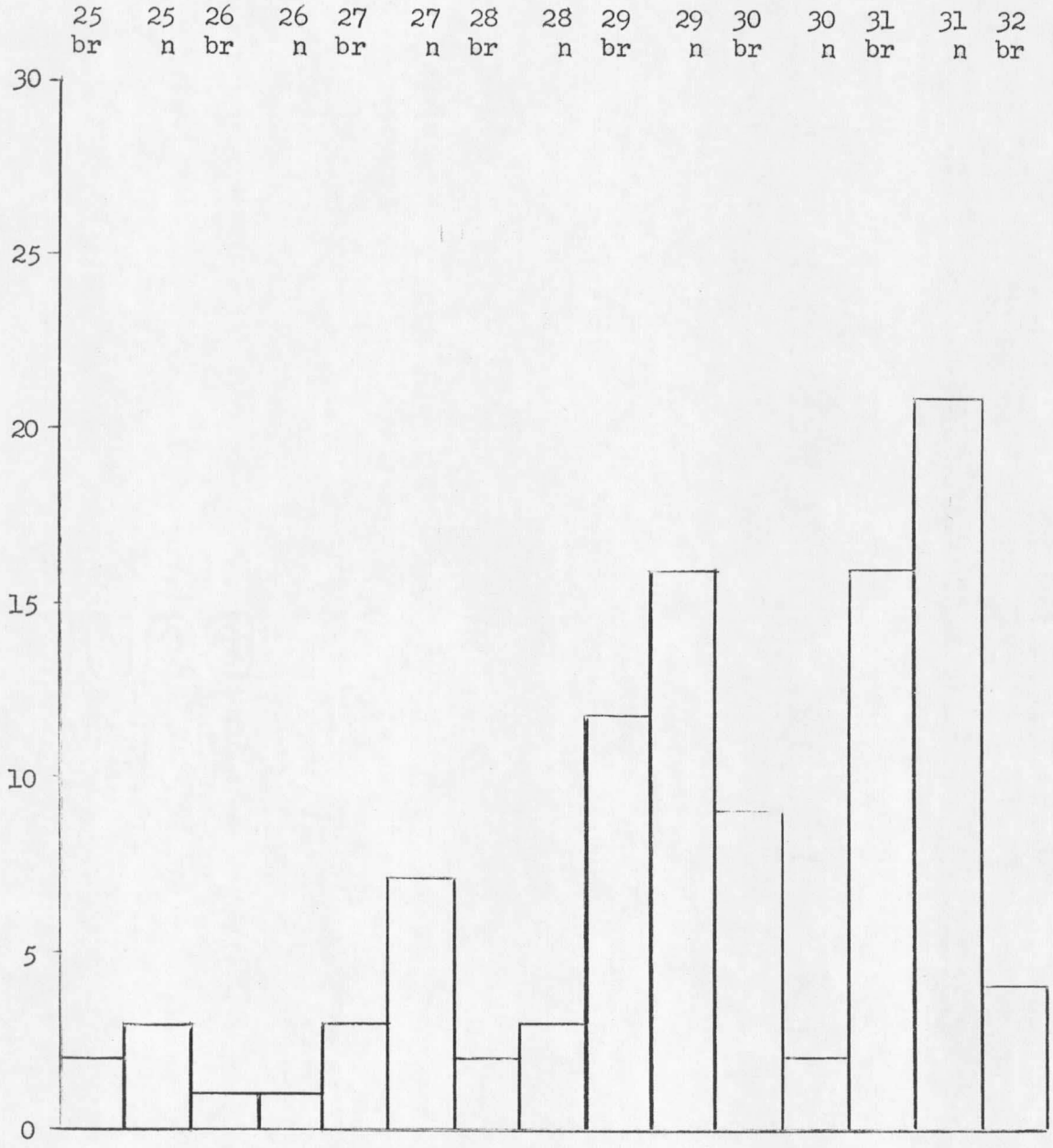
Graph 3. S. demissum P.I. 161,153.5 (44-62)
Demissa



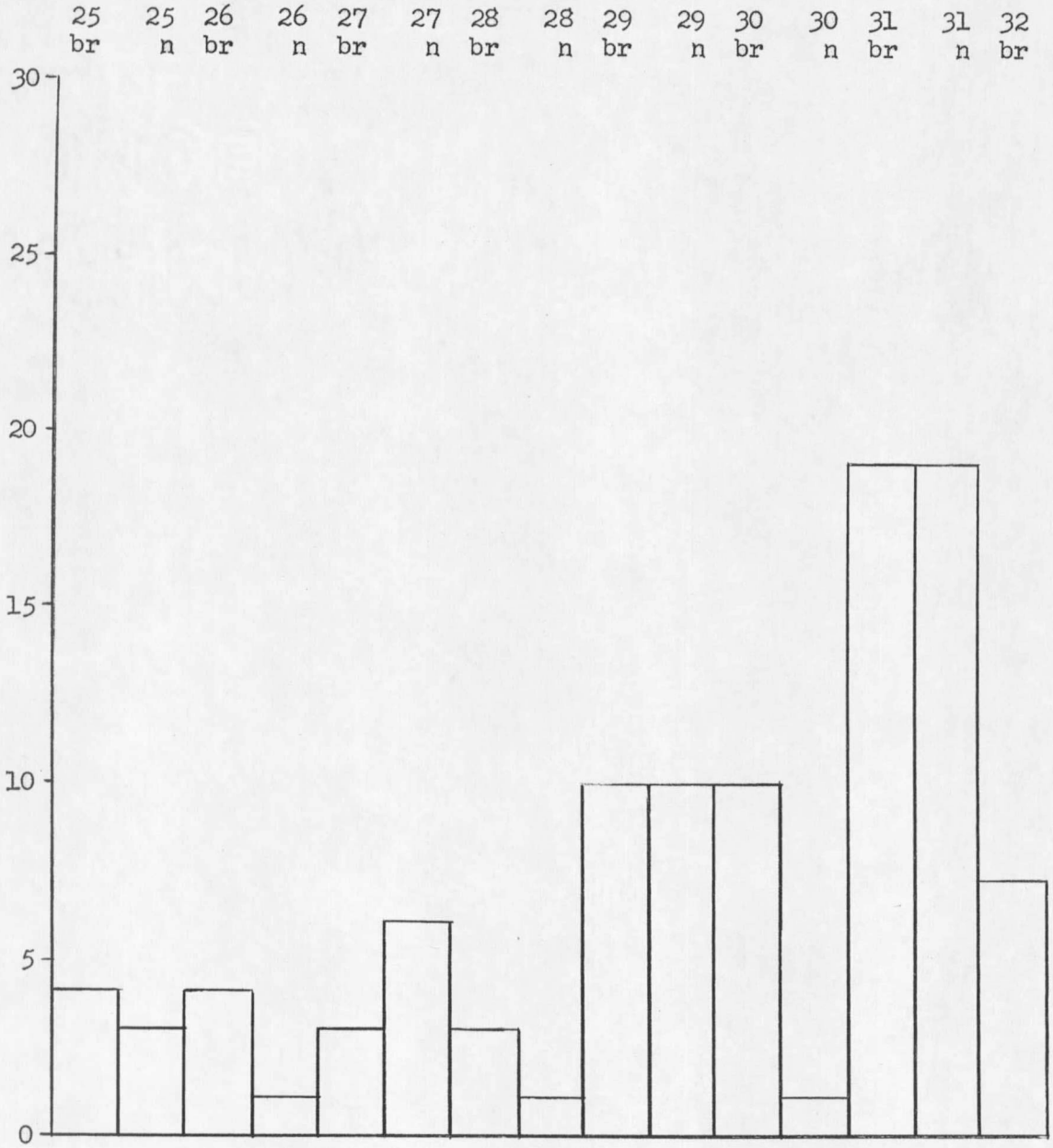
Graph 4. S. demissum P.I. 175,411.1 (34-62)
Demissa



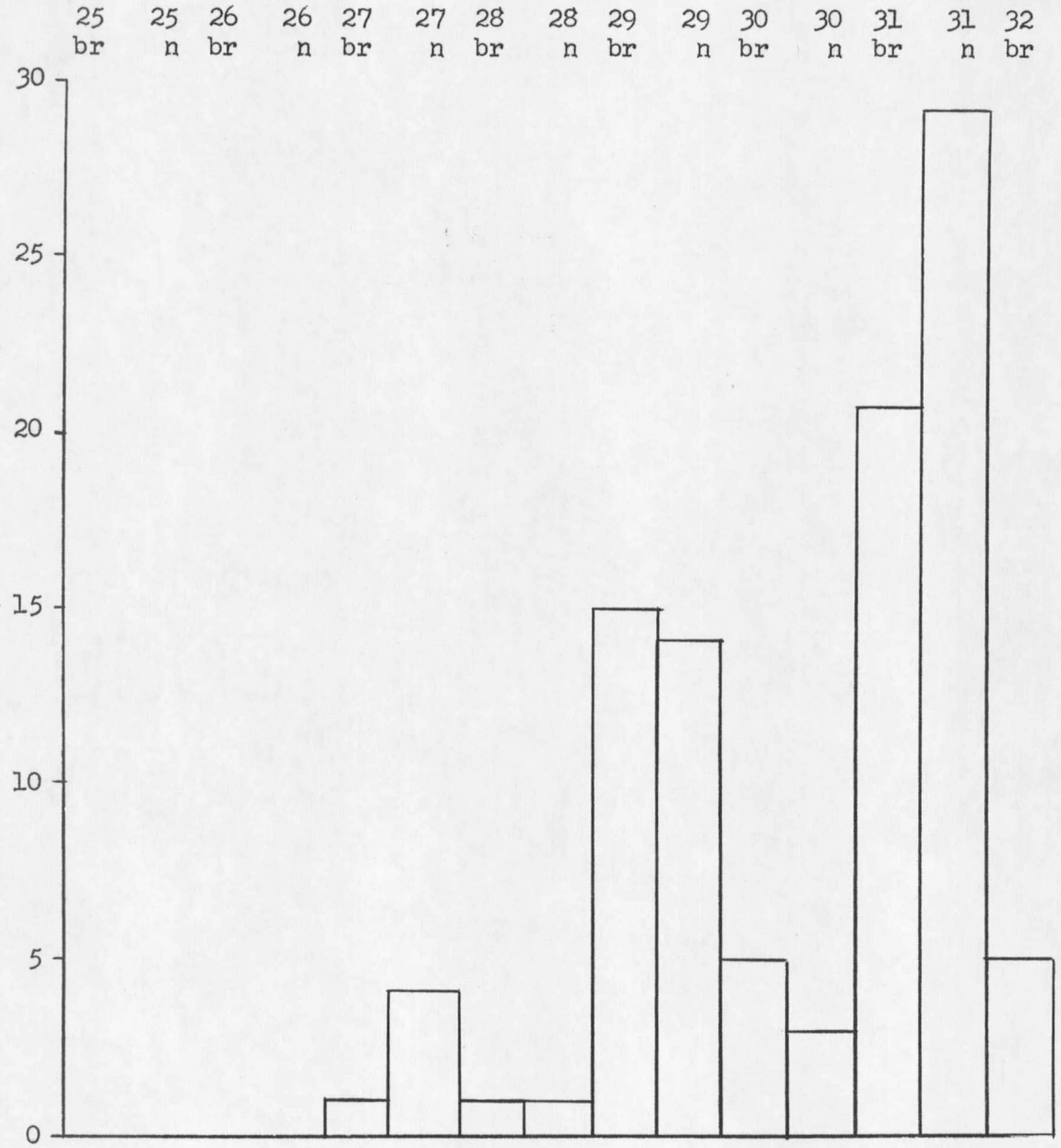
Graph 5. S. stoloniferum v. malinchense P.I. 195,167.10 (12-62)
Longipedicellata



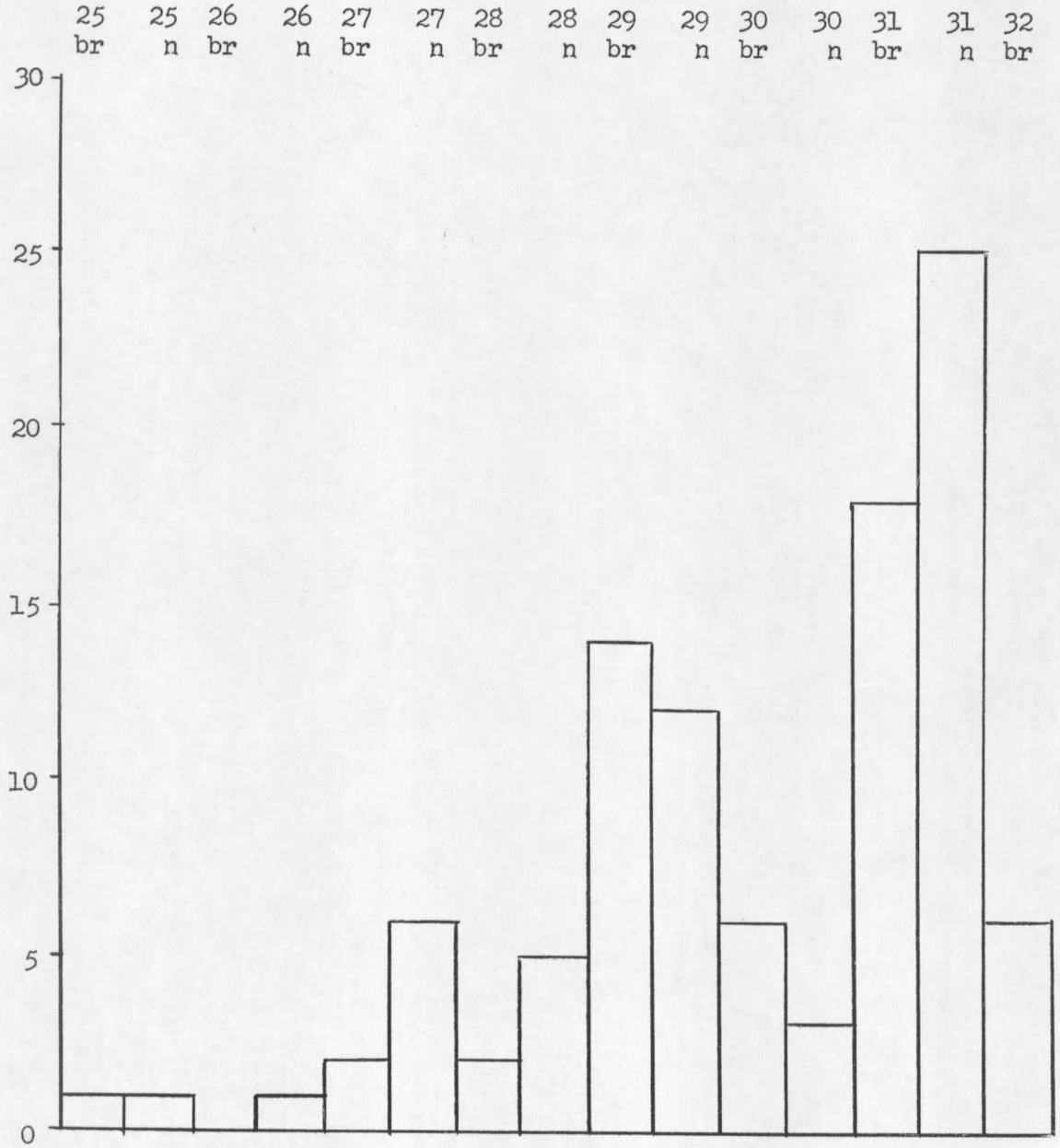
Graph 6. S. verrucosum P.I. 160,228.1 ('64)
Demissa



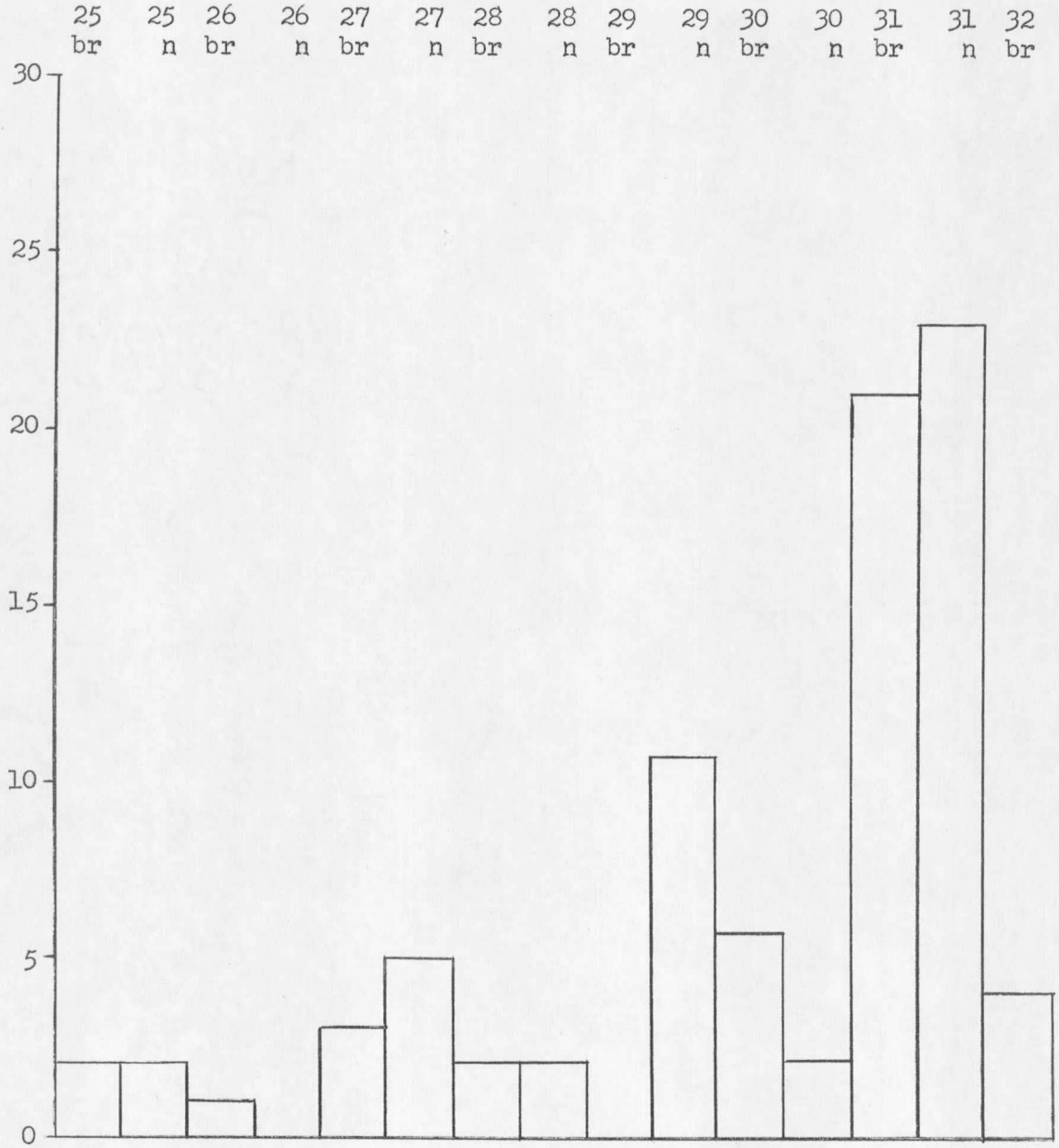
Graph 7. S. trifidum P.I. 255,538 (seed) ('64)
Trifida



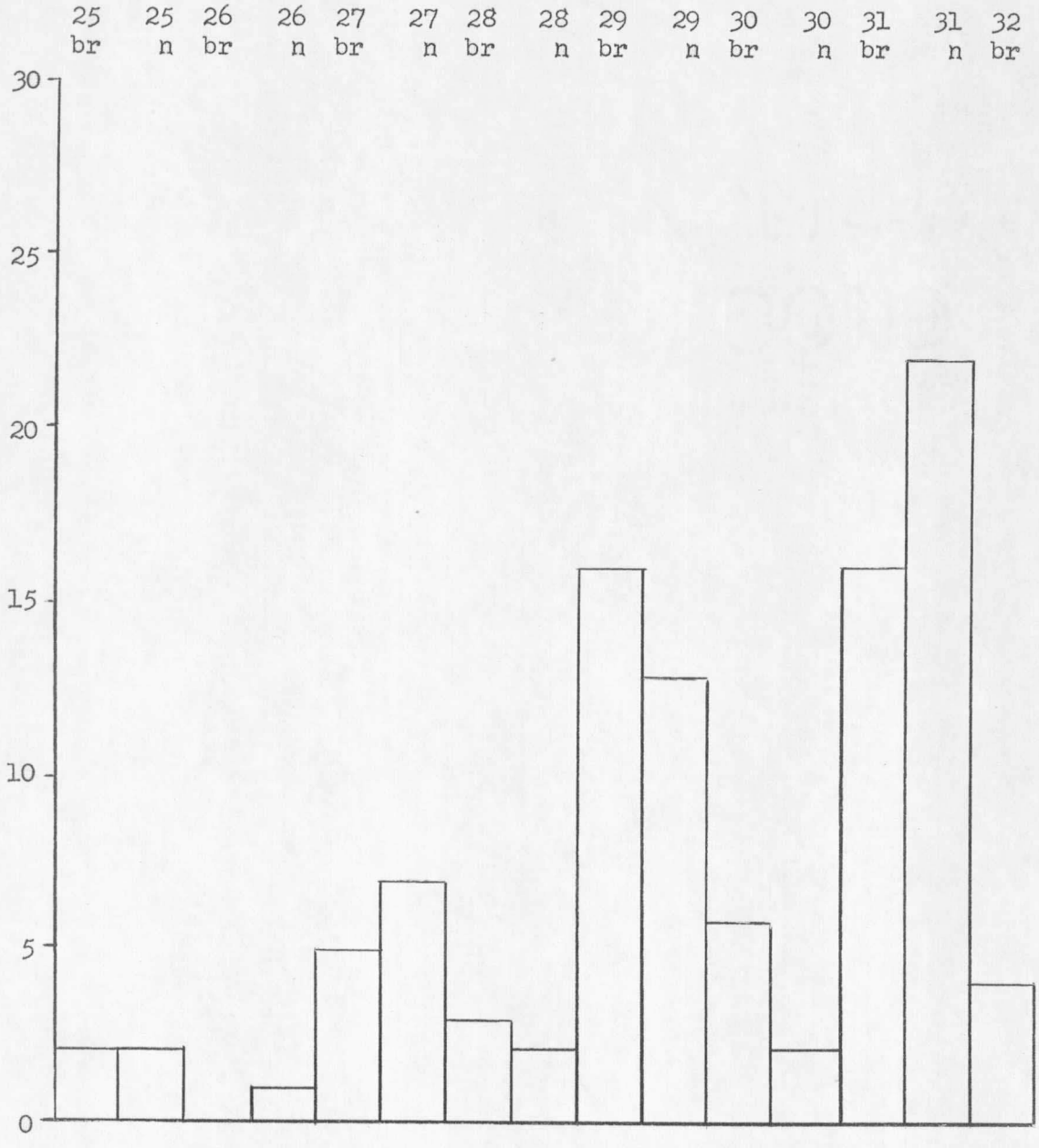
Graph 8. S. trifidum P.I. 255,538.4 ('64)
Trifida



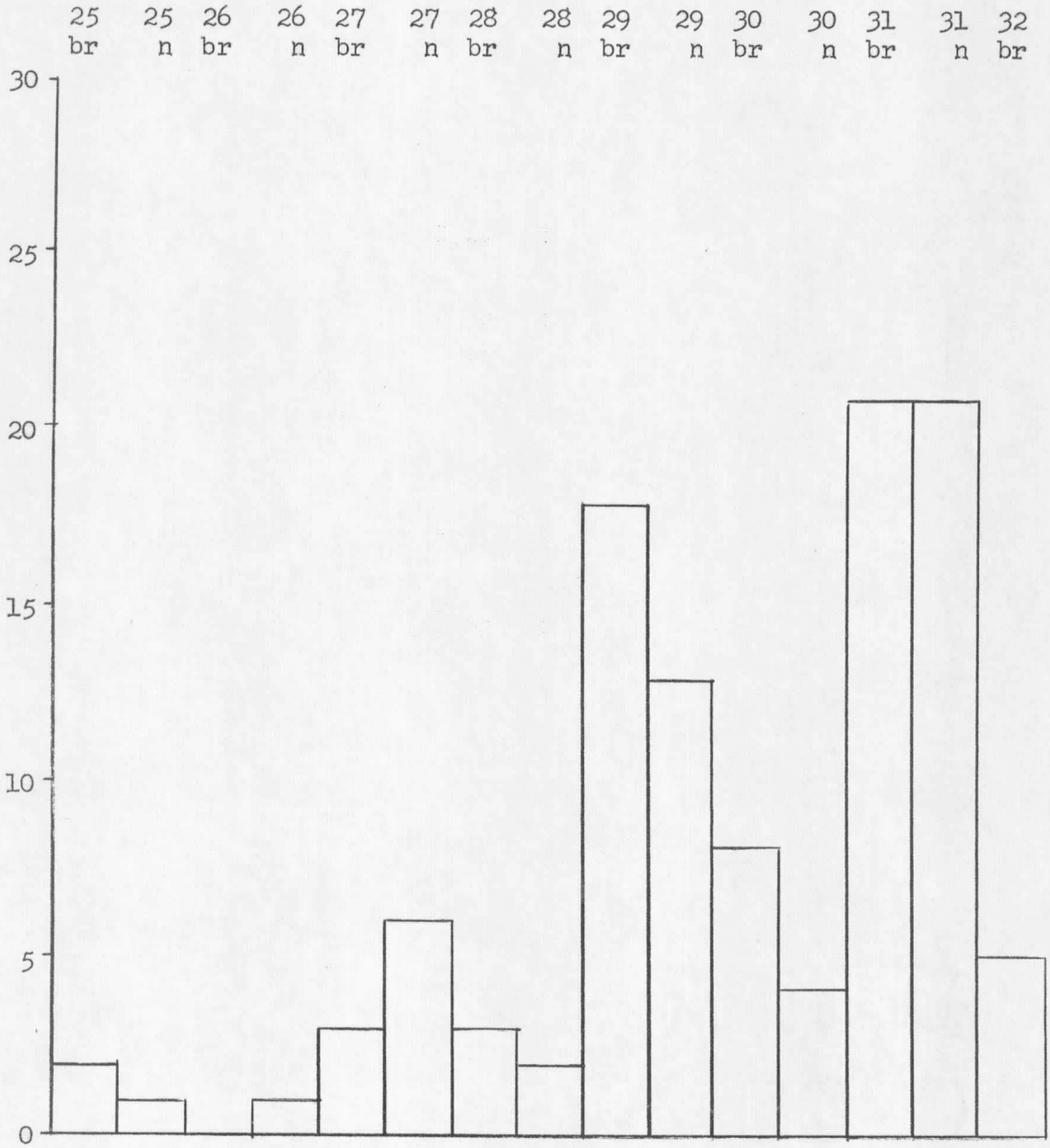
Graph 9. S. clarum P.I. 243,355.1 (18-62)
Clara



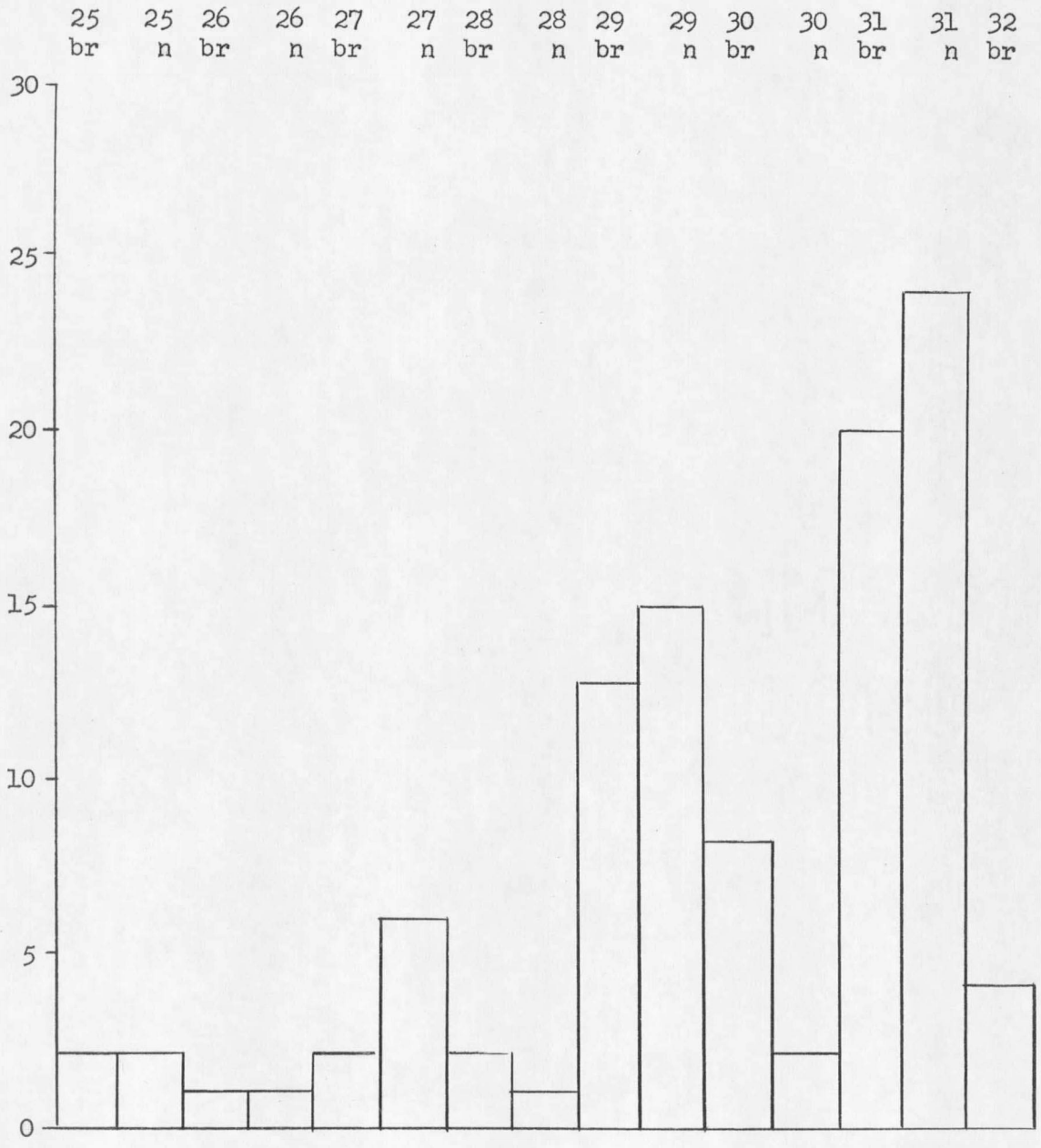
Graph 10. S. clarum P.I. 275,202.2 (4-62)
Clara



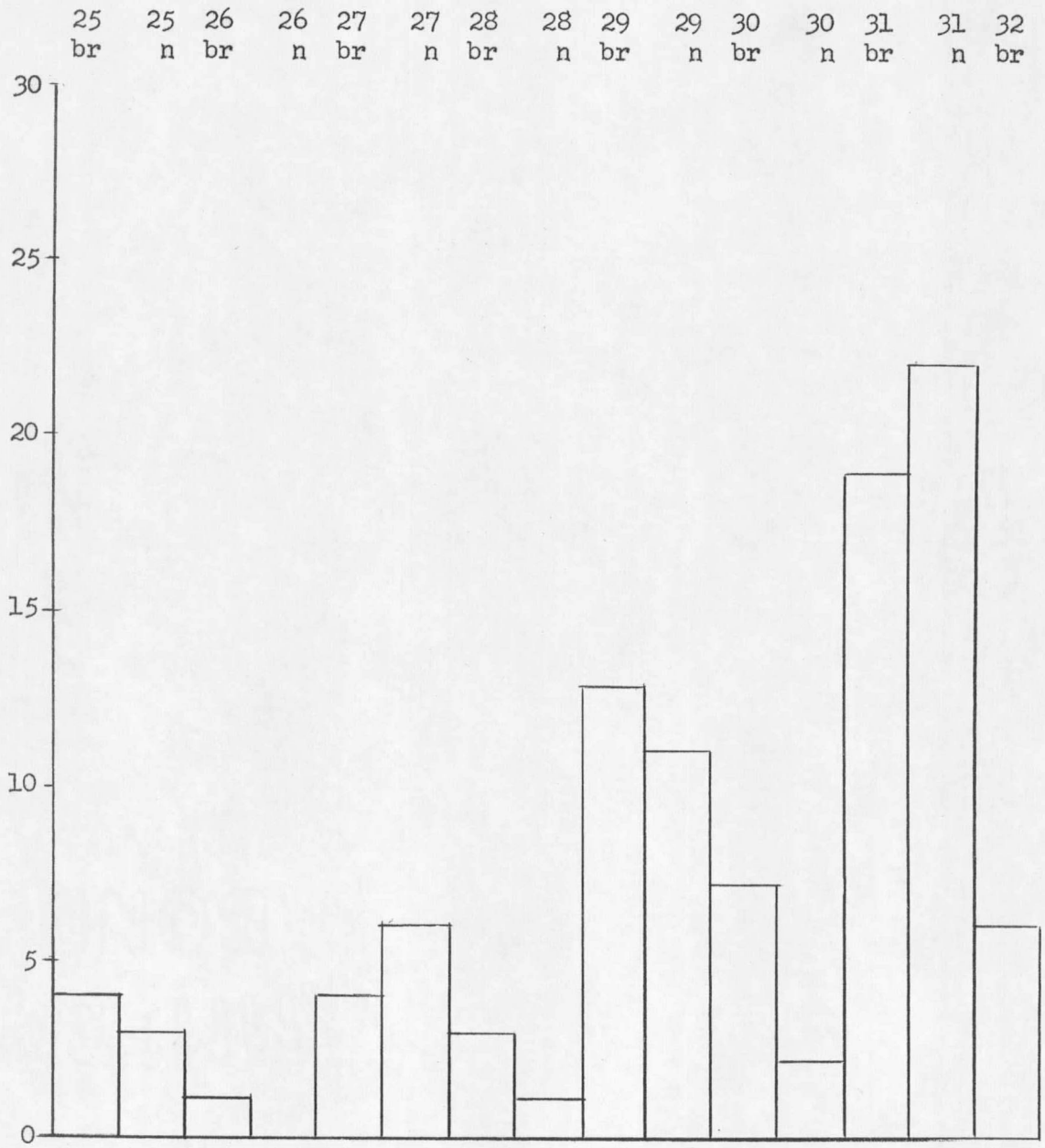
Graph 11. S. clarum P.I. 275,205.4 (16-62)
Clara



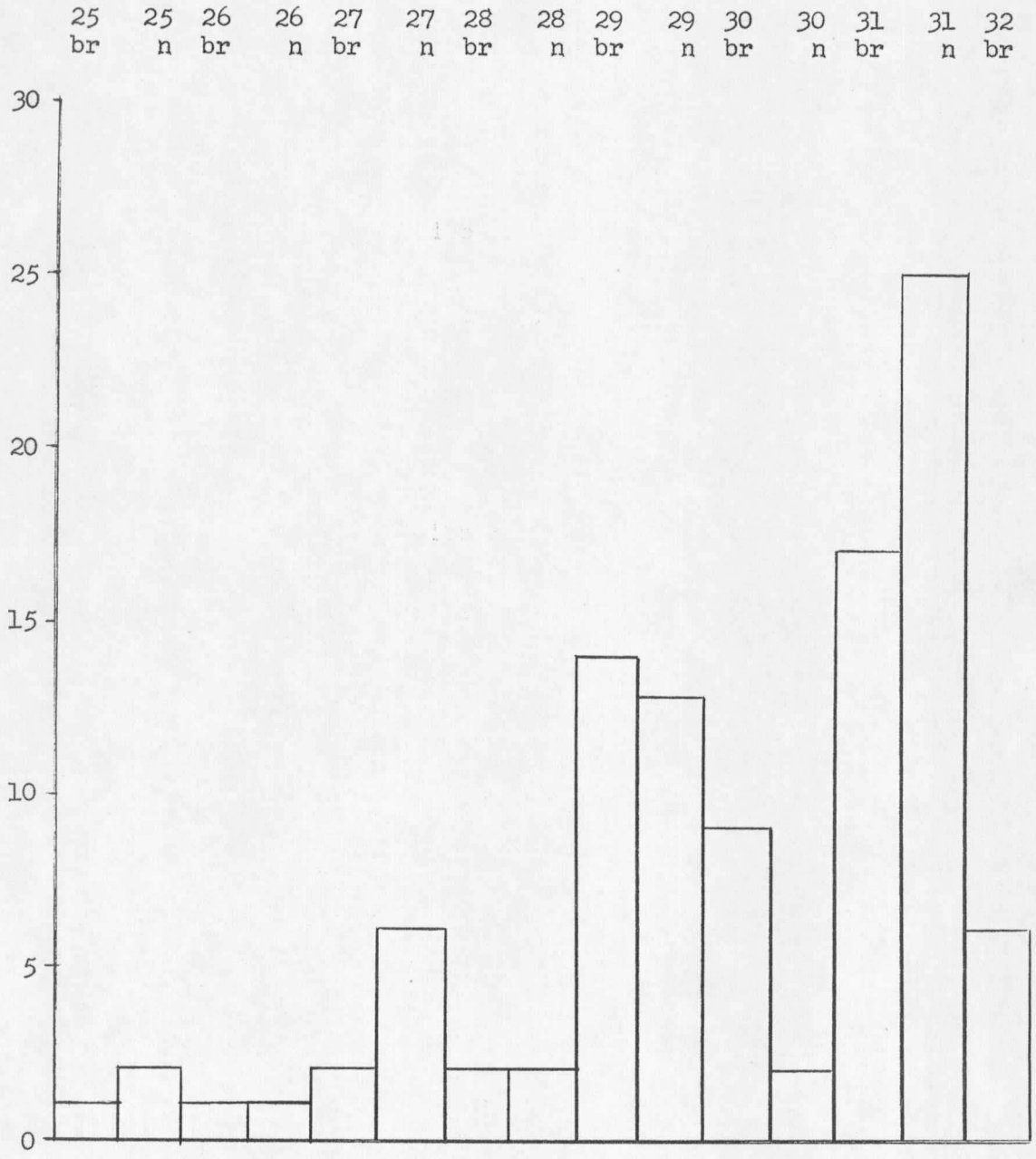
Graph 12. S. fendleri P.I. 275,158.1 (43-62)
Longipedicellata



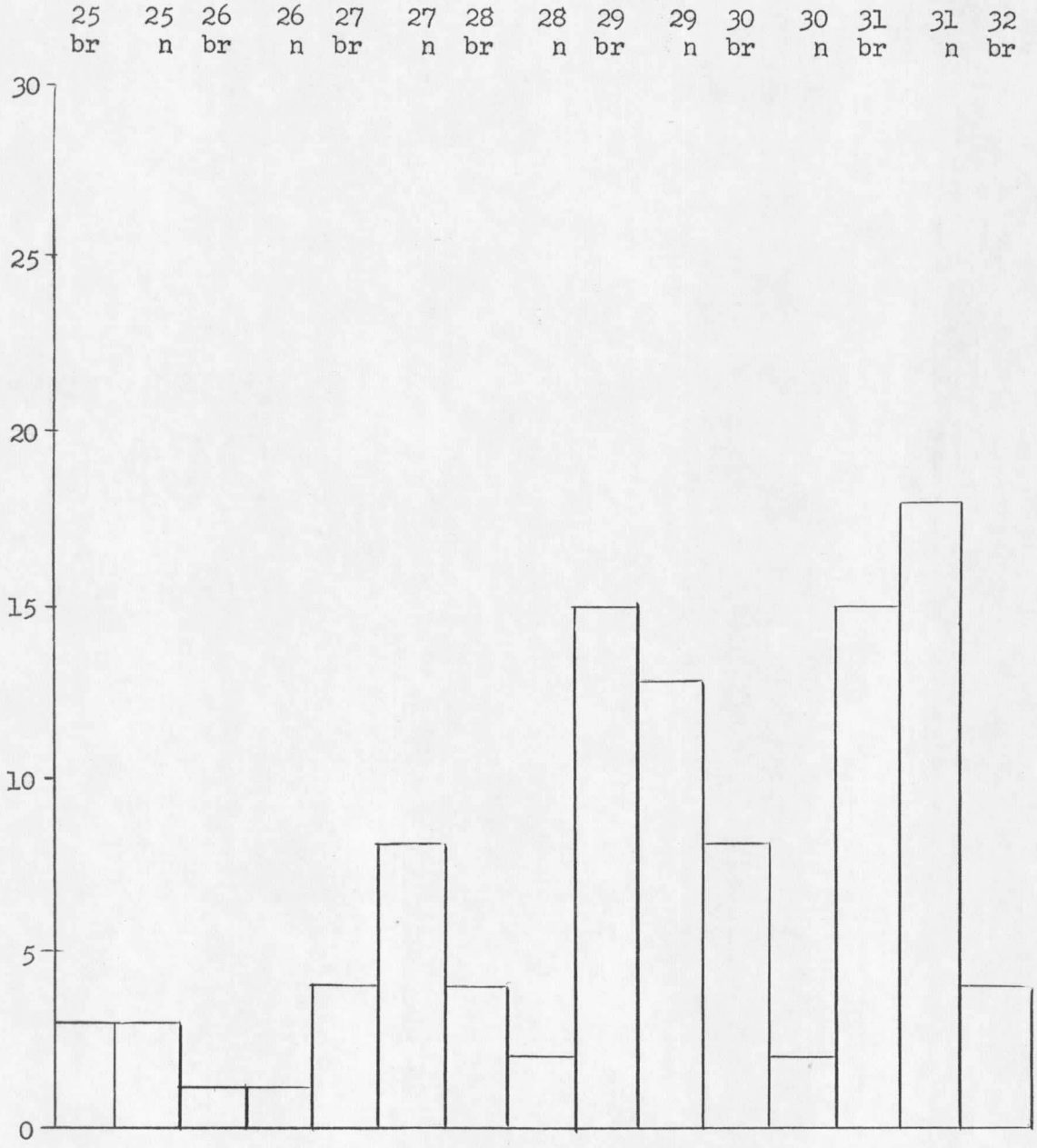
Graph 13. S. fendleri P.I. 251,062 (27-62)
Longipedicellata



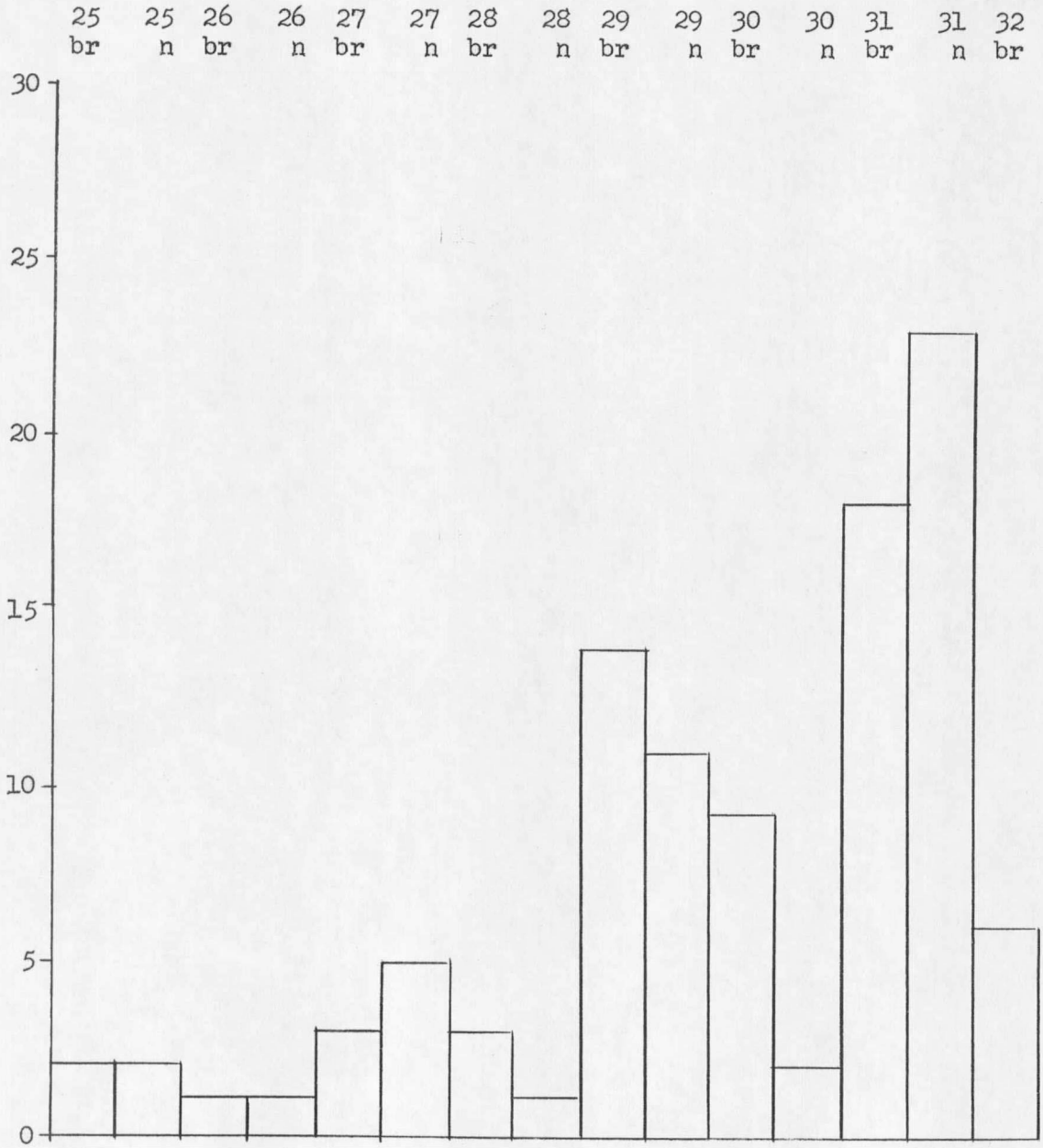
Graph 14. S. polytrichon P.I. 186,545.11 (30-62)
Longipedicellata



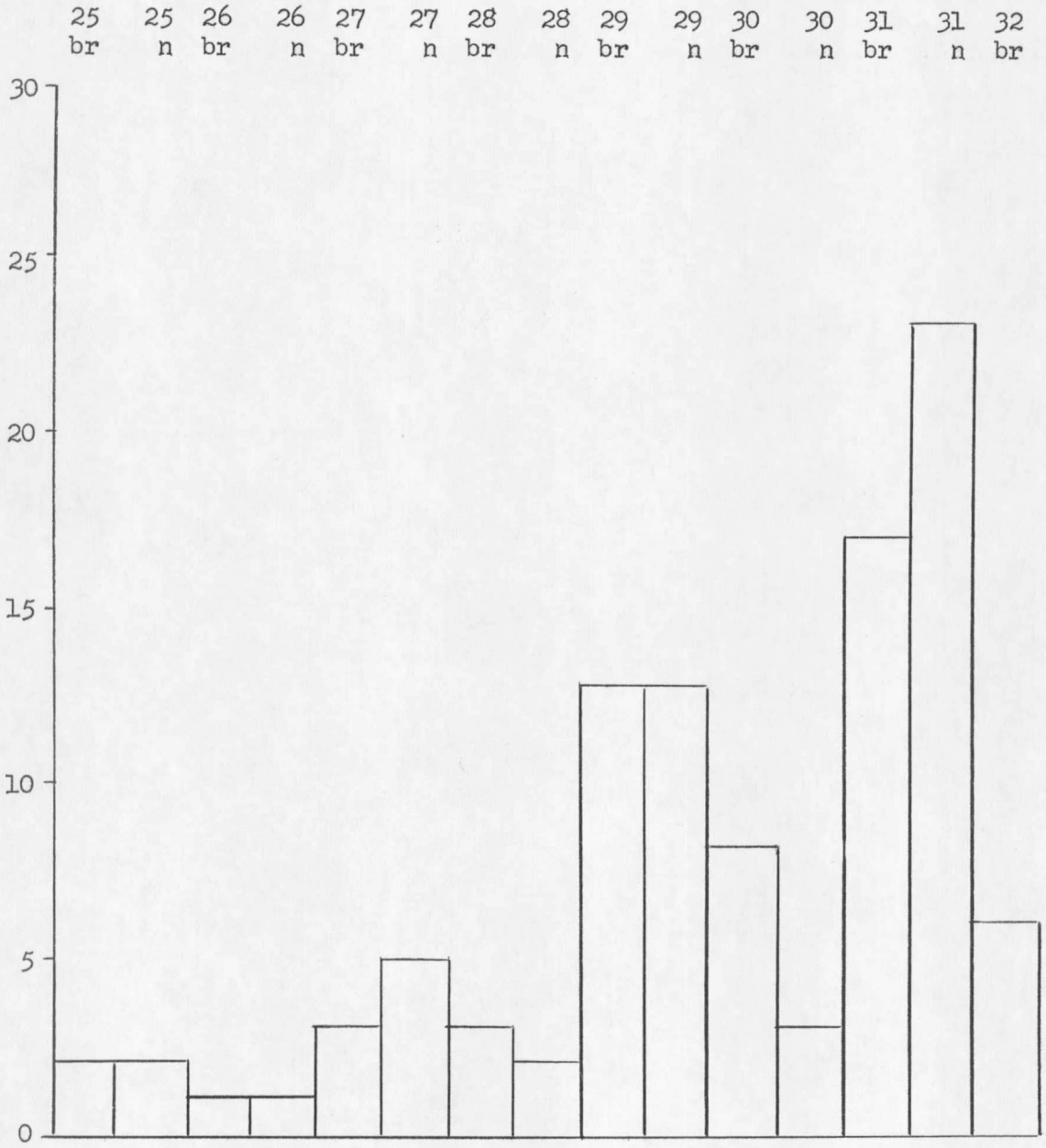
Graph 15. S. polytrichon P.I. 184,772 (32-62)
Longipedicellata



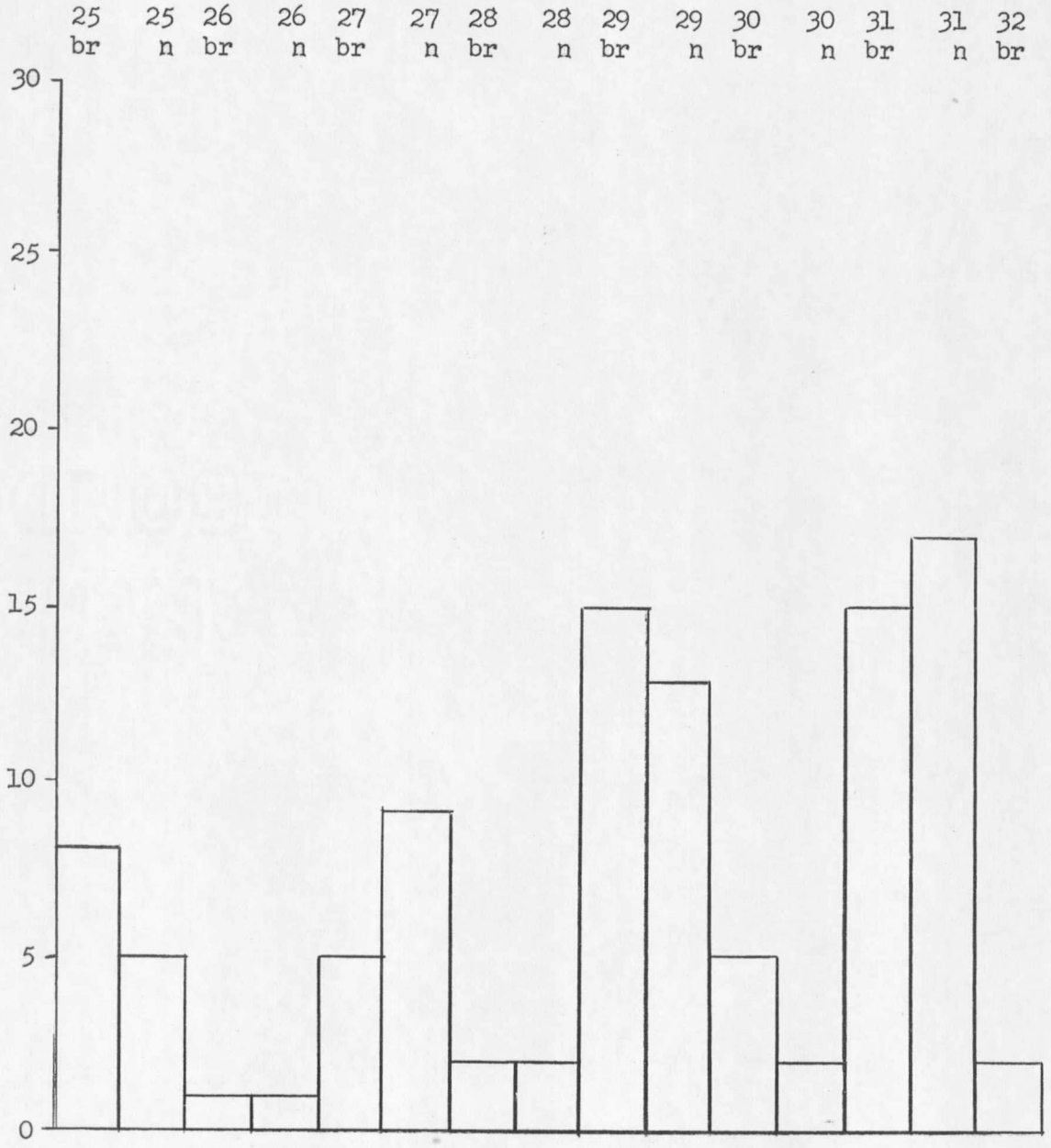
Graph 16. S. polytrichon P.I. 184,773.1 ('64)
Longipedicellata



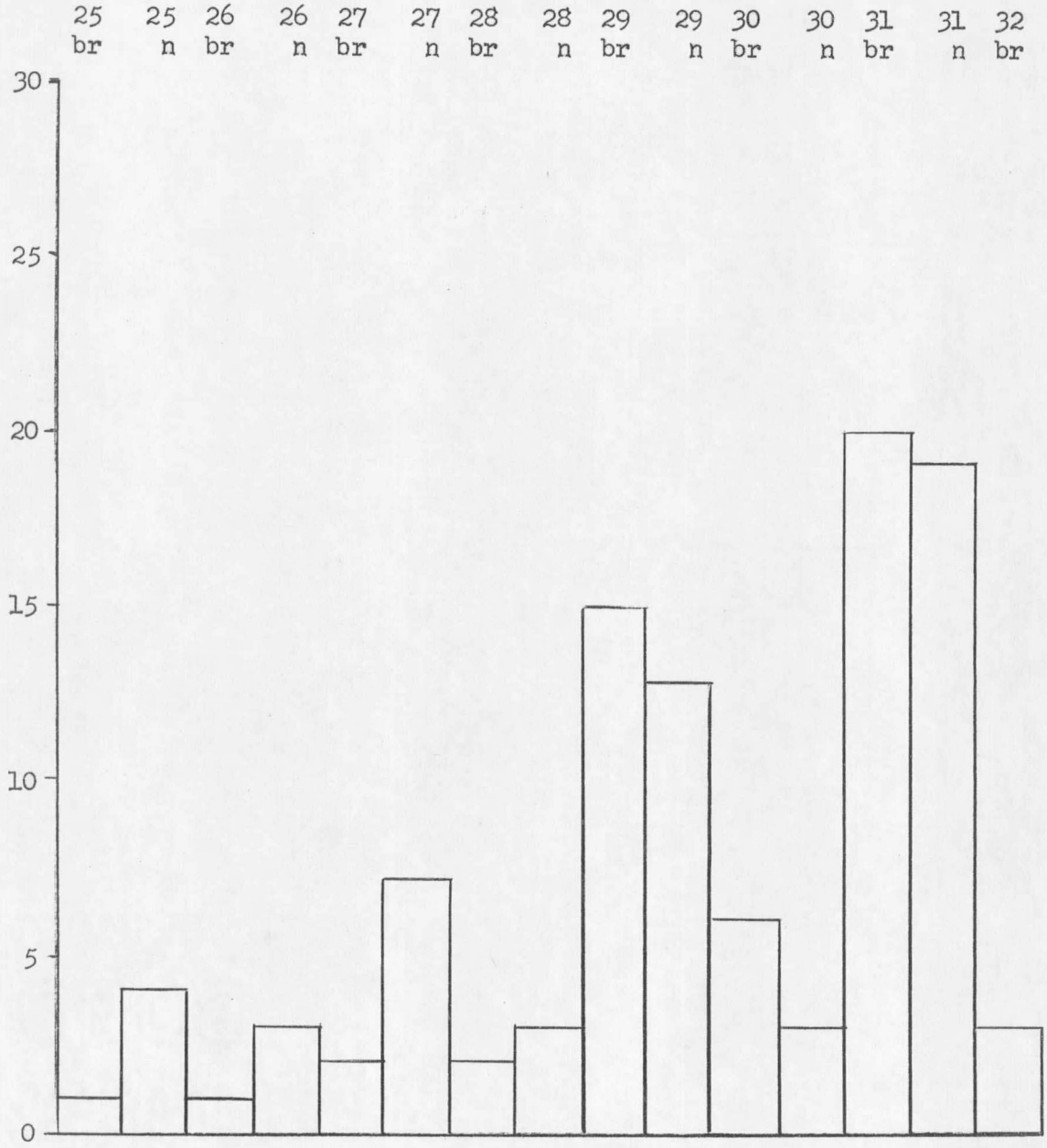
Graph 17. S. polytrichon P.I. 184,773 (seed) ('64)
Longipedicellata



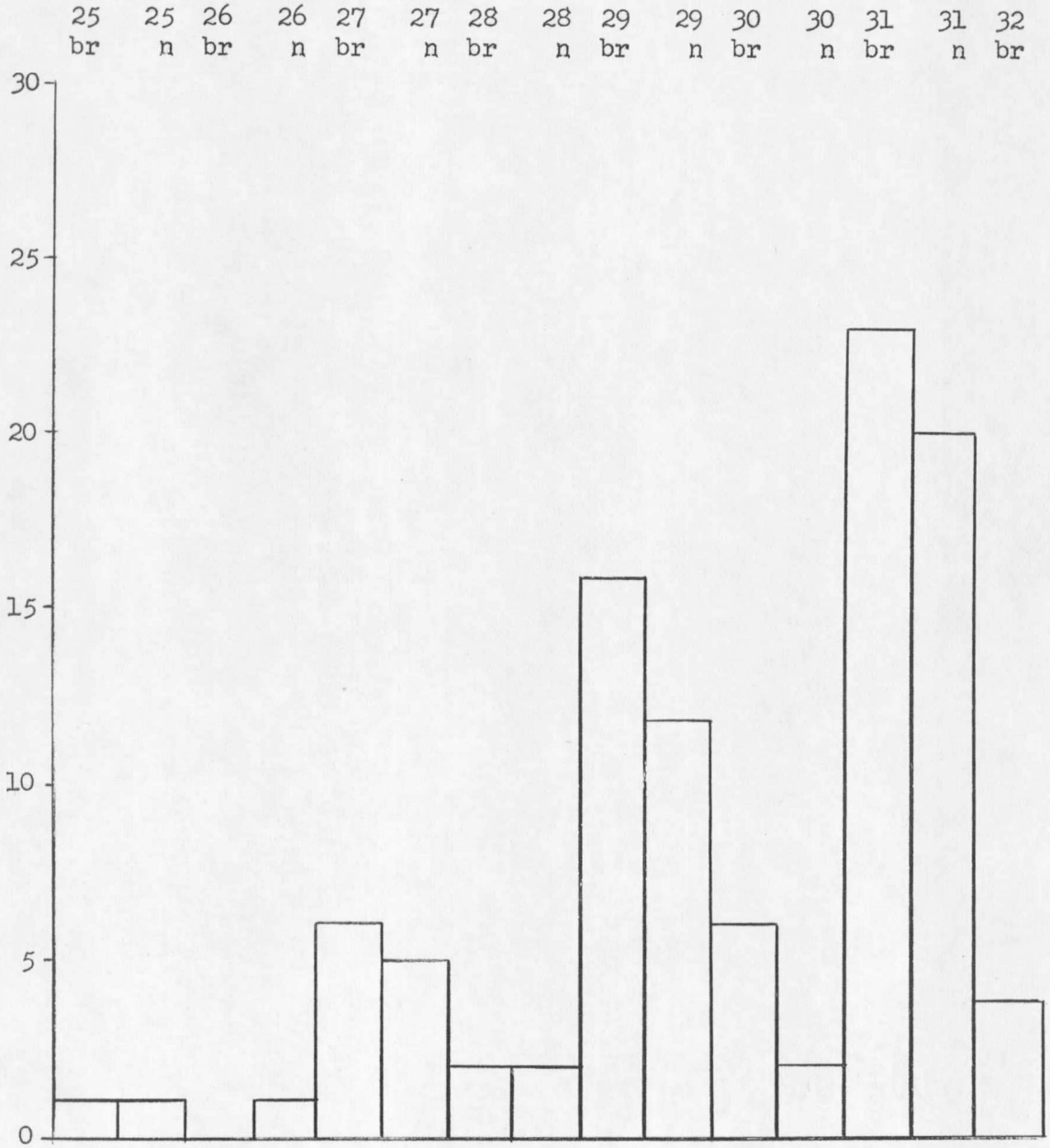
Graph 18. S. stoloniferum P.I. 195,195.1 (1-62)
Longipedicellata



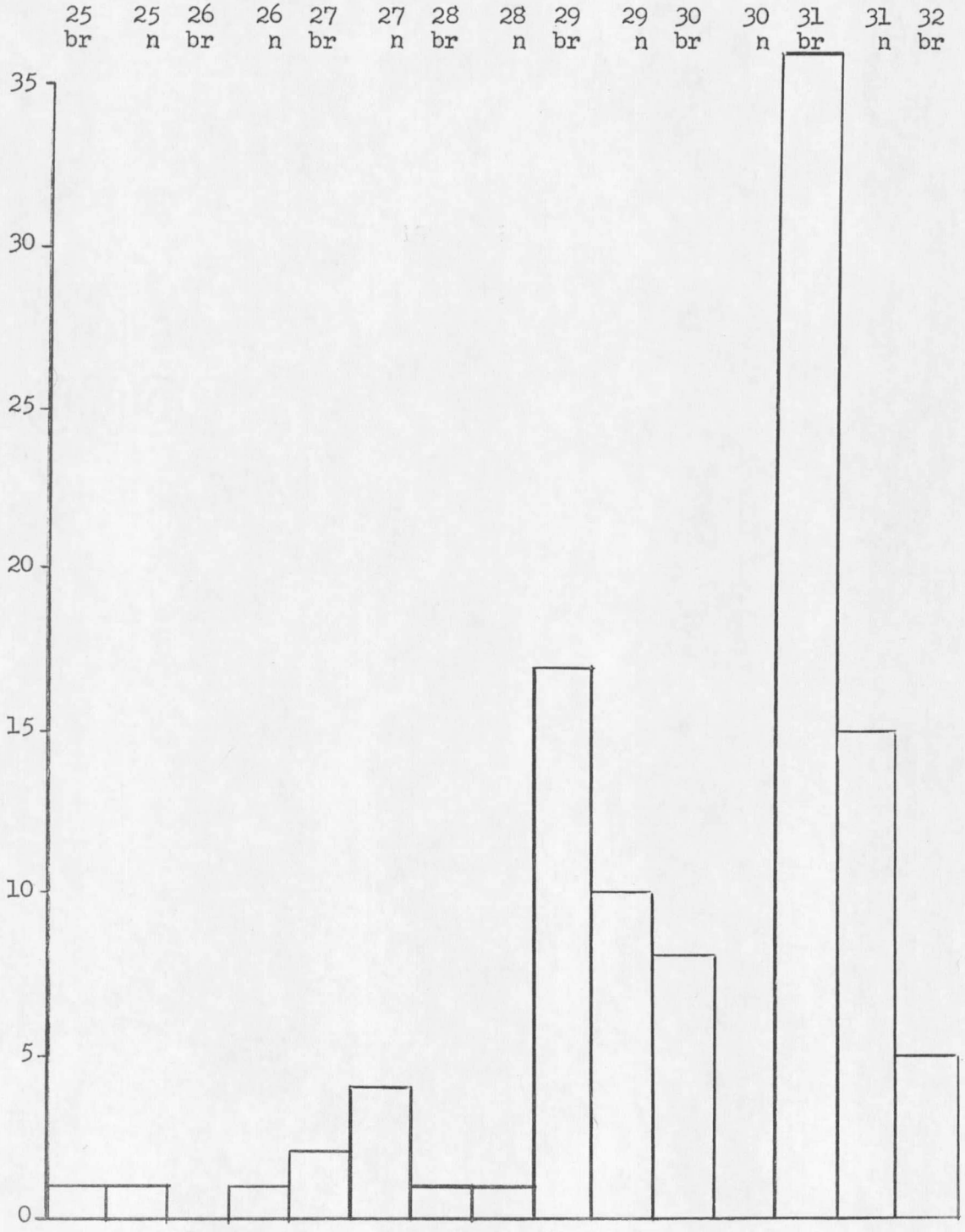
Graph 19. S. stoloniferum P.I. 205,522 (seed) ('64)
Longipedicellata



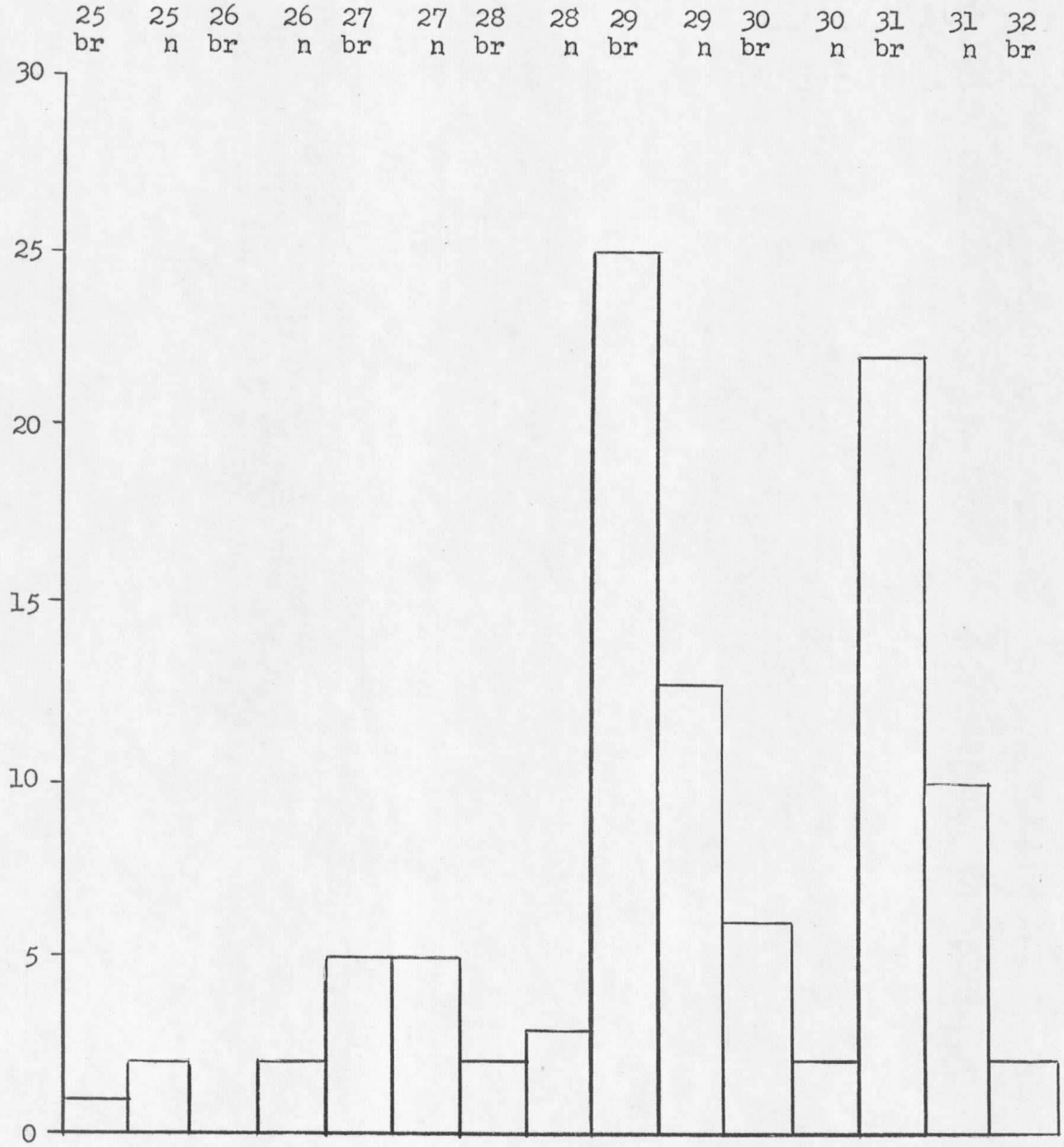
Graph 20. S. stoloniferum P.I. 205,522.3 ('64)
Longipedicellata



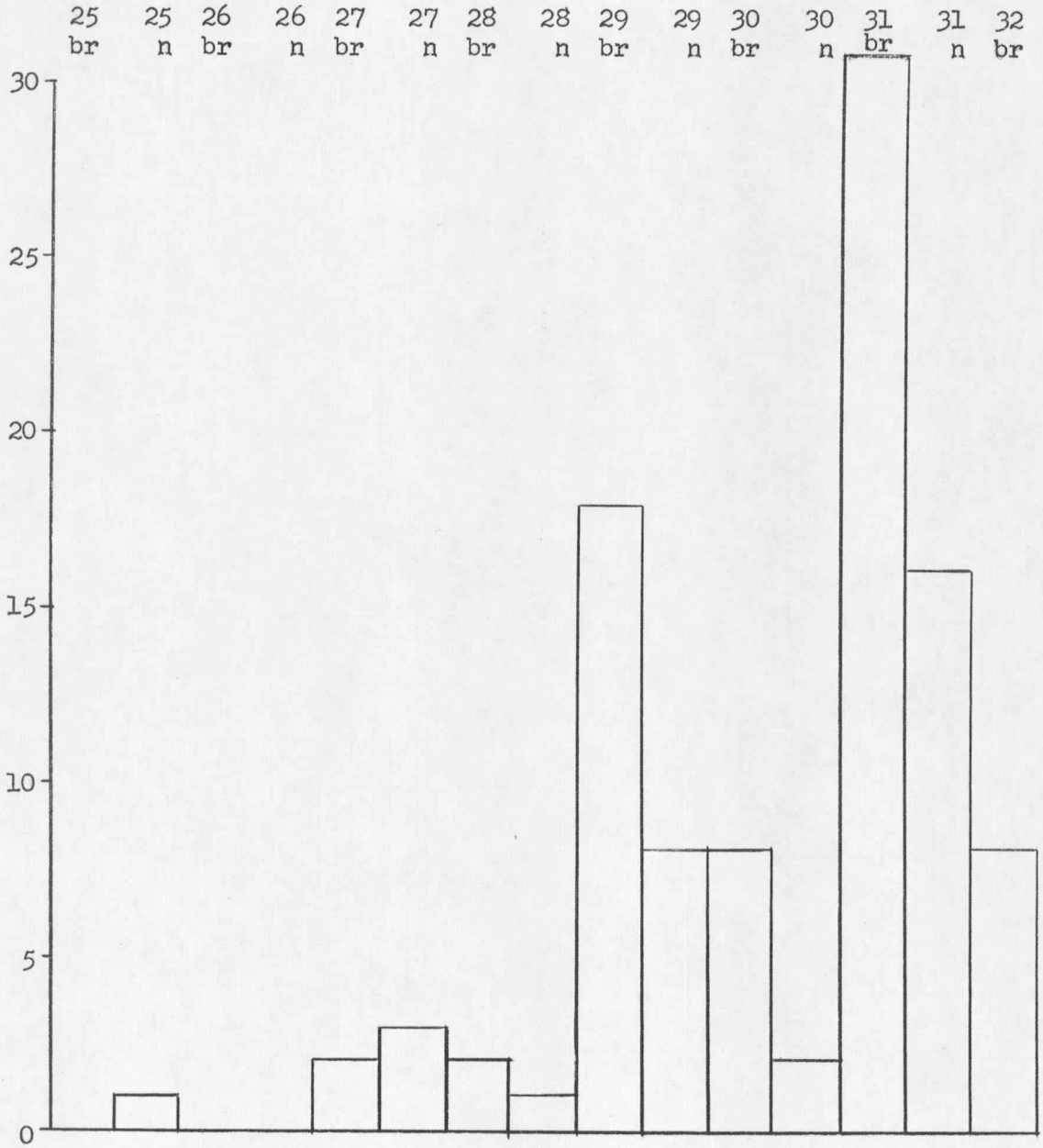
Graph 21. S. jamesii P.I. 195,190.1 (89-62)
Pinnatisecta



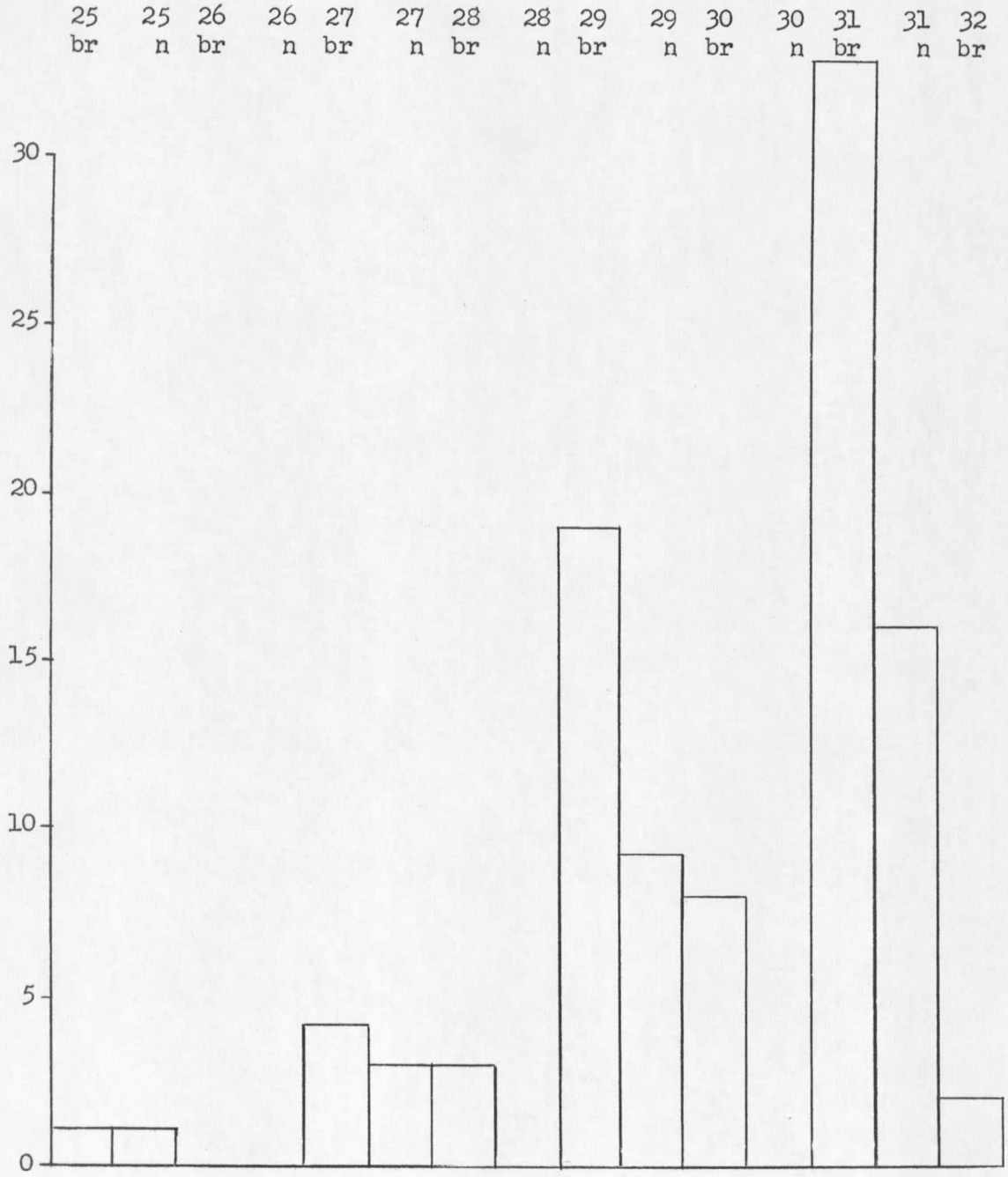
Graph 22. S. jamesii P.I. 275,171 (42-62)
Pinnatisecta



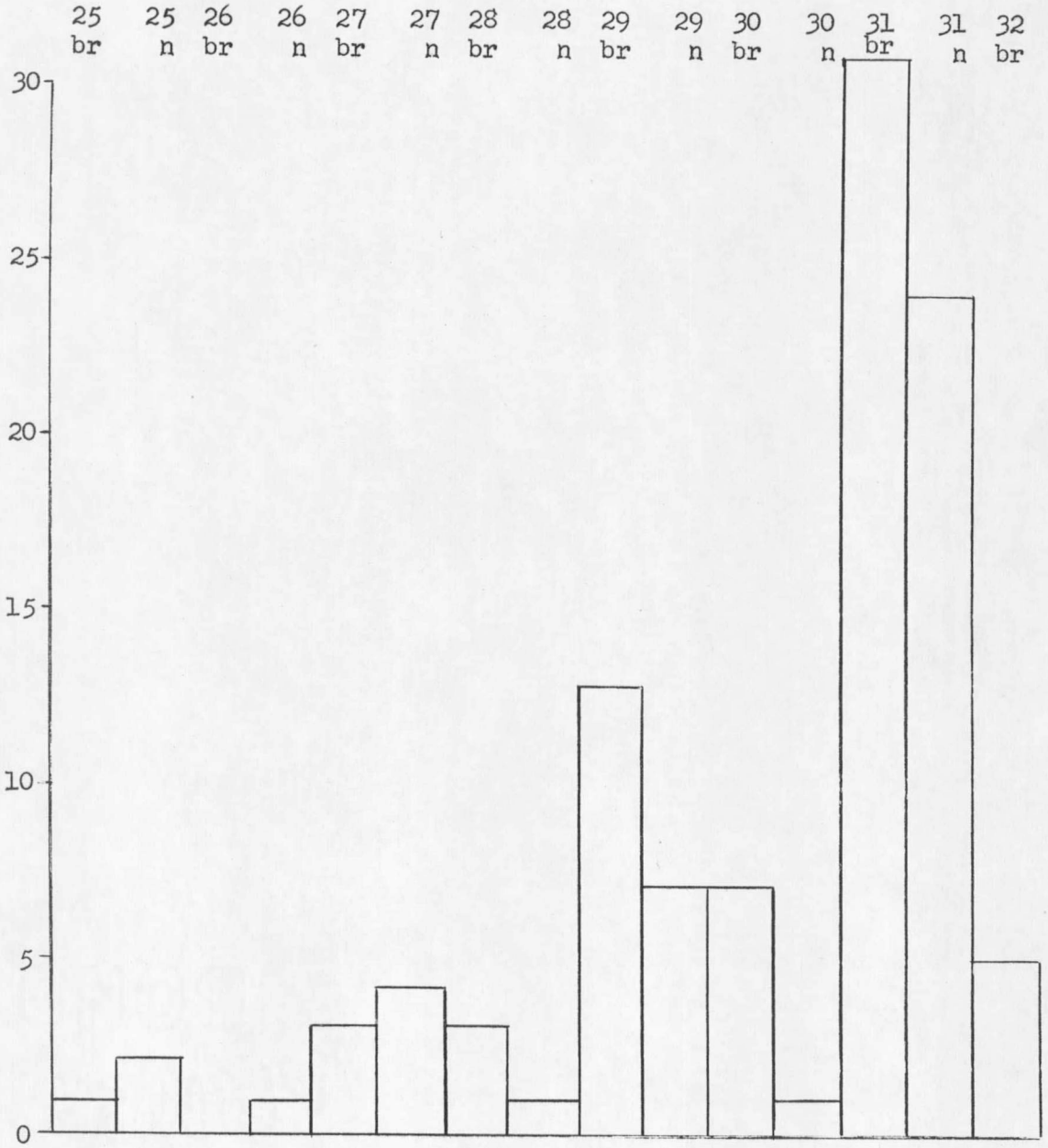
Graph 23. S. sambucinum P.I. 275,243.3 ('64)
Pinnatisecta



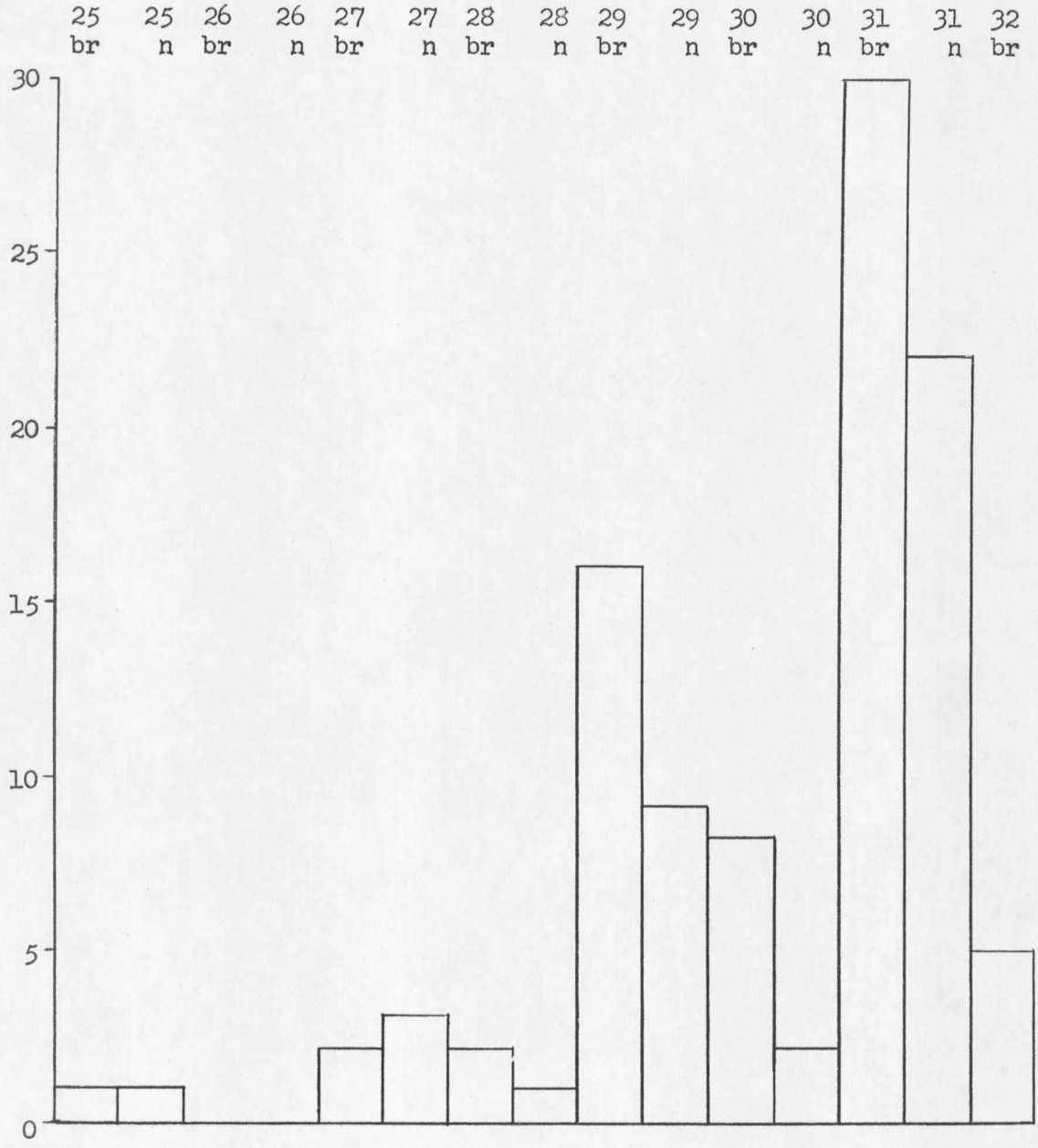
Graph 24. S. berthaultii P.I. 218,215.2 (17-62)
Tarijensa



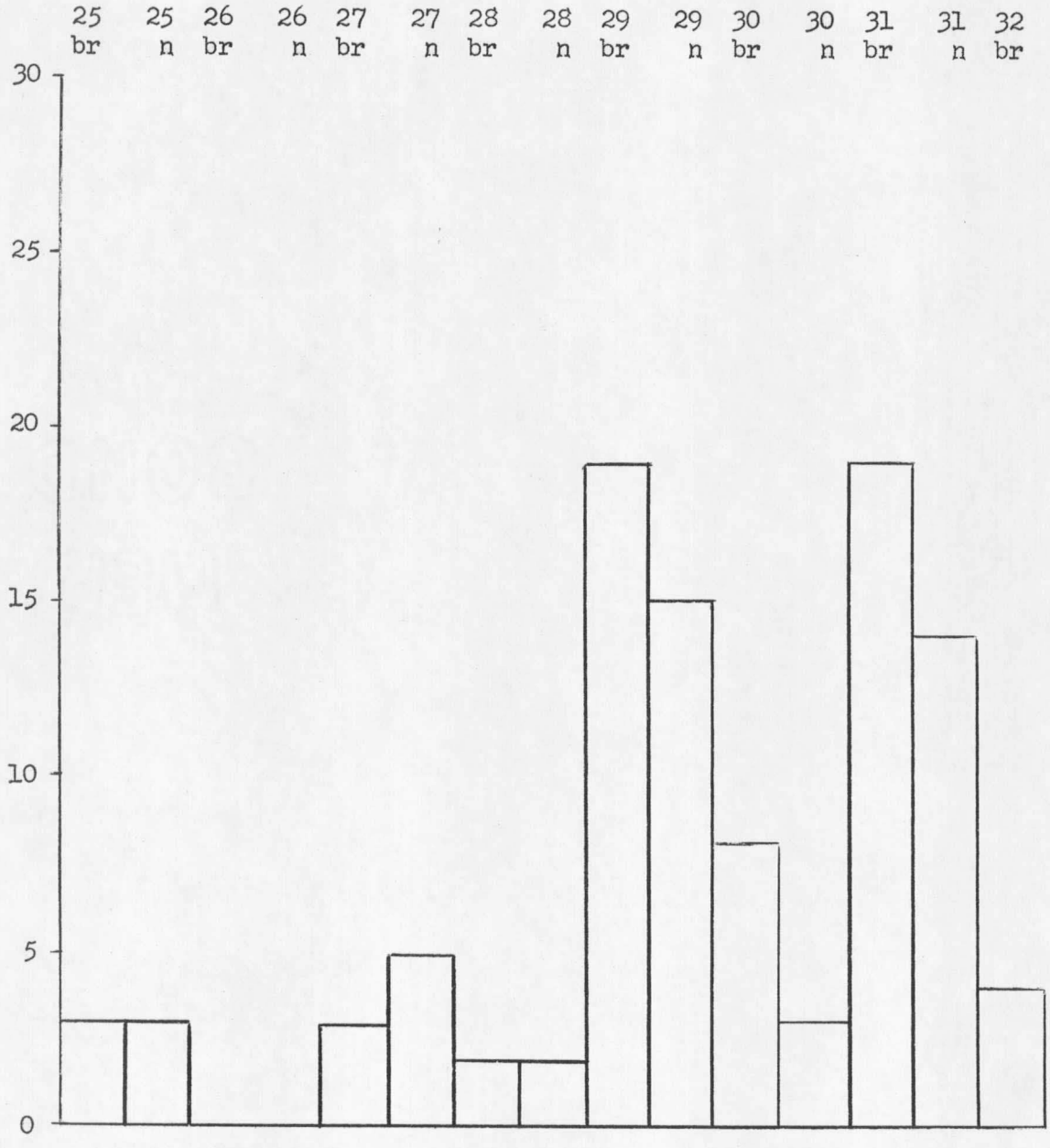
Graph 25. S. tarijense P.I. 195,206 ('64)
Tarijensa



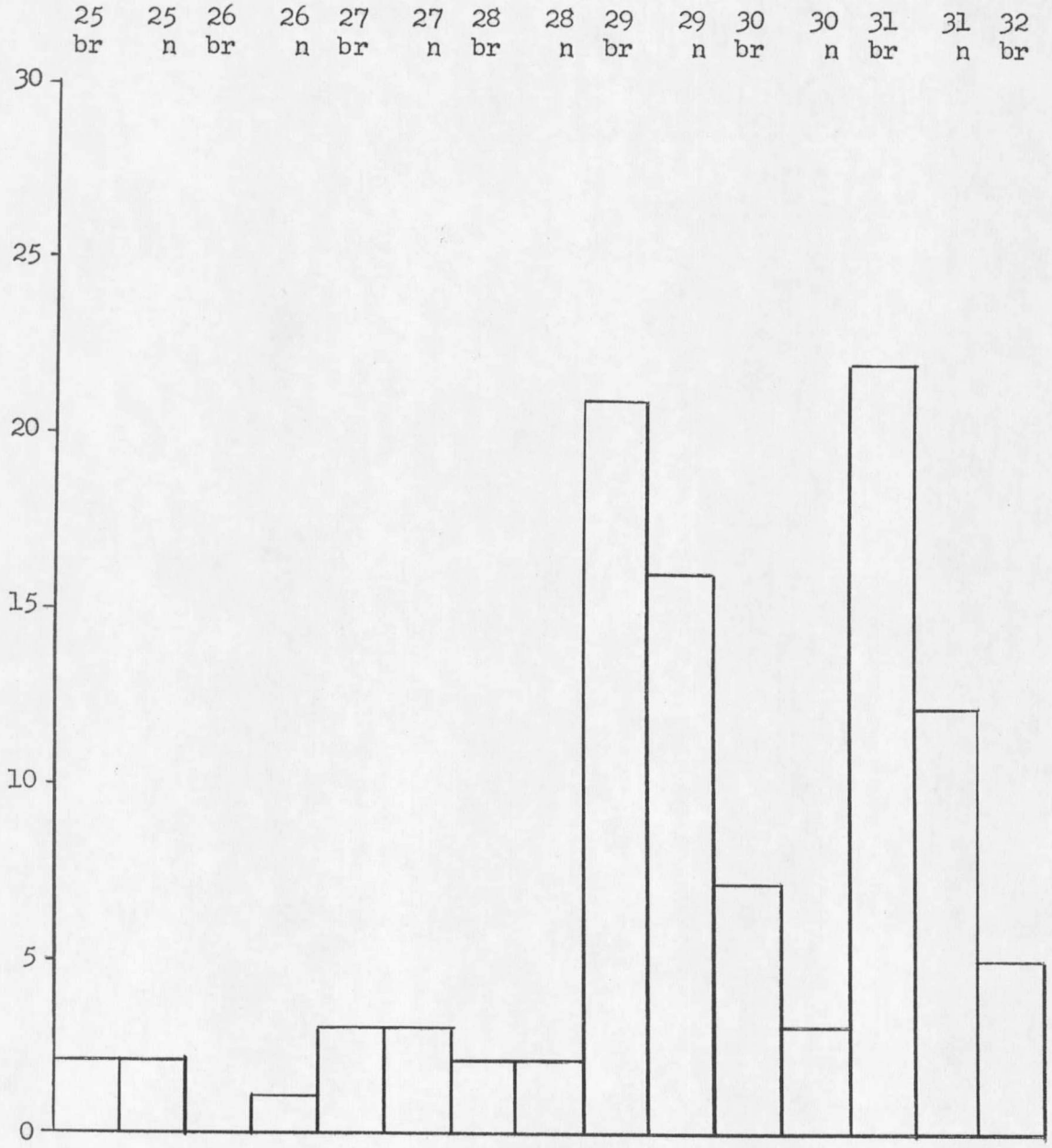
Graph 26. S. tarijense P.I. 230,466.3 ('64)
Tarijensa



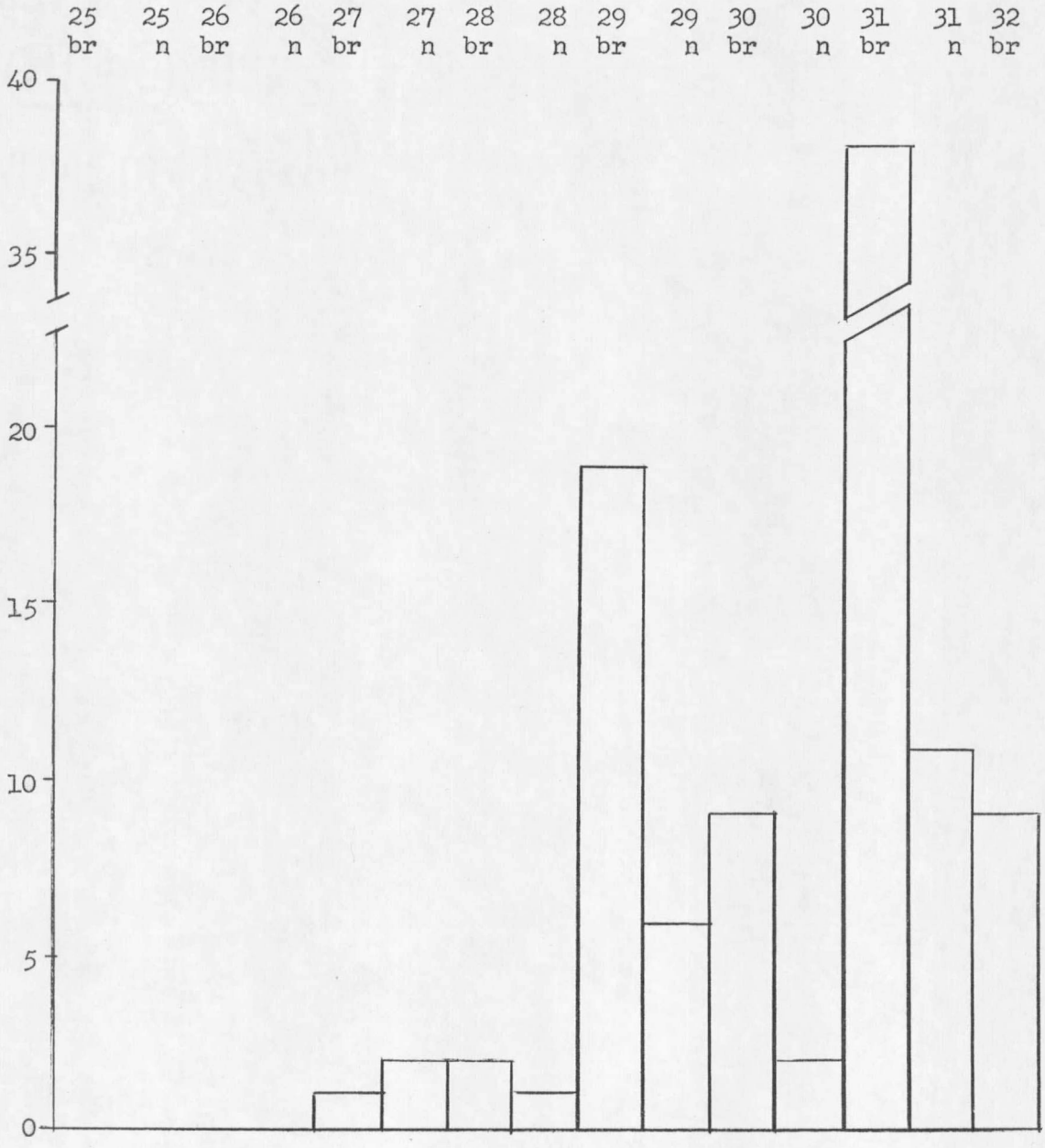
Graph 27. S. ehrenbergii P.I. 251,725 (67-62)
Cardiophylla



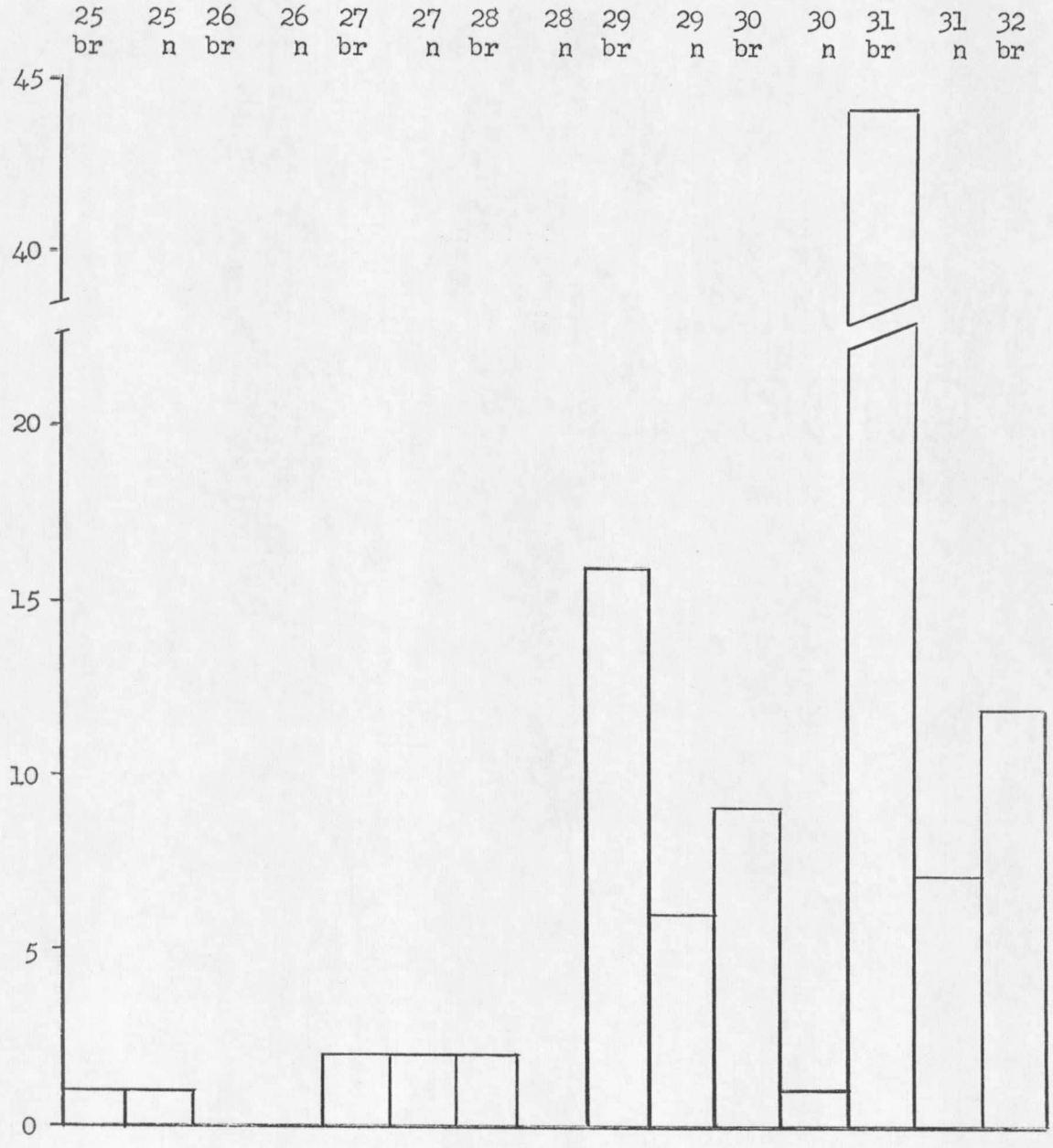
Graph 28. S. ehrenbergii P.I. 255,519.1 (15-62)
Cardiophylla



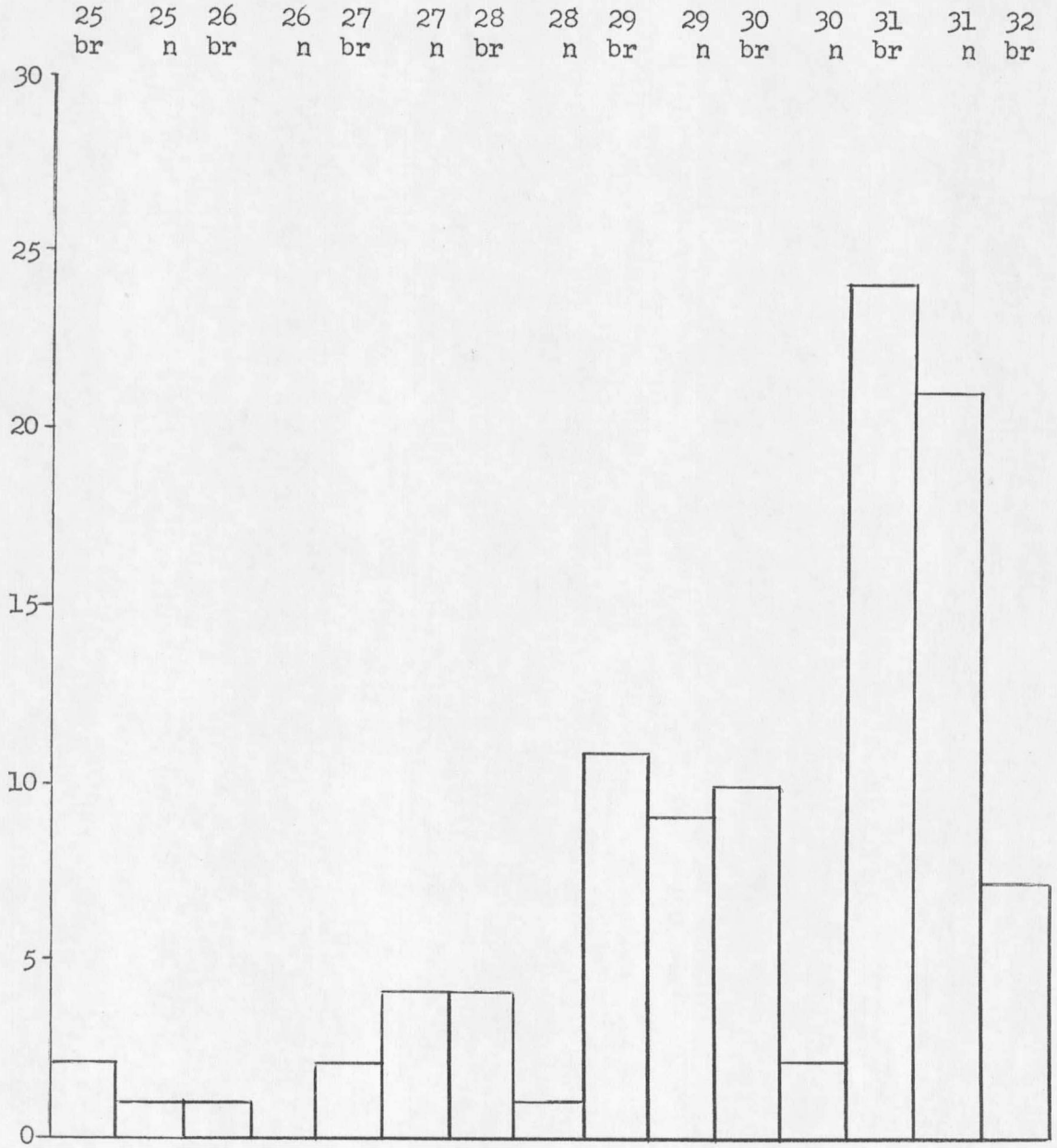
Graph 29. S. pinnatisectum P.I. 184,764.3 (14-62)
Pinnatisecta



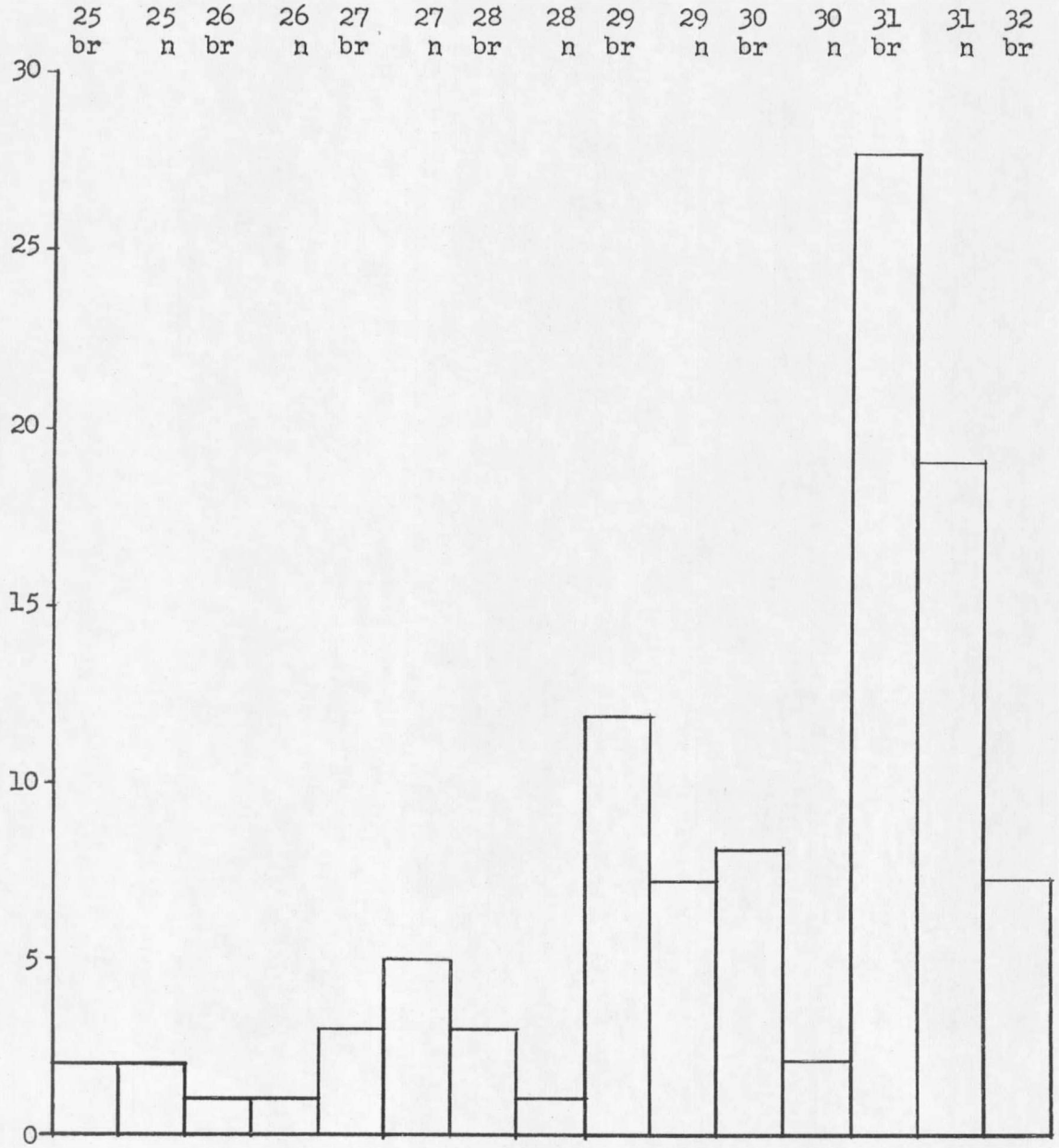
Graph 30. S. pinnatisectum P.I. 184,764 C-3 ('64)
Pinnatisecta



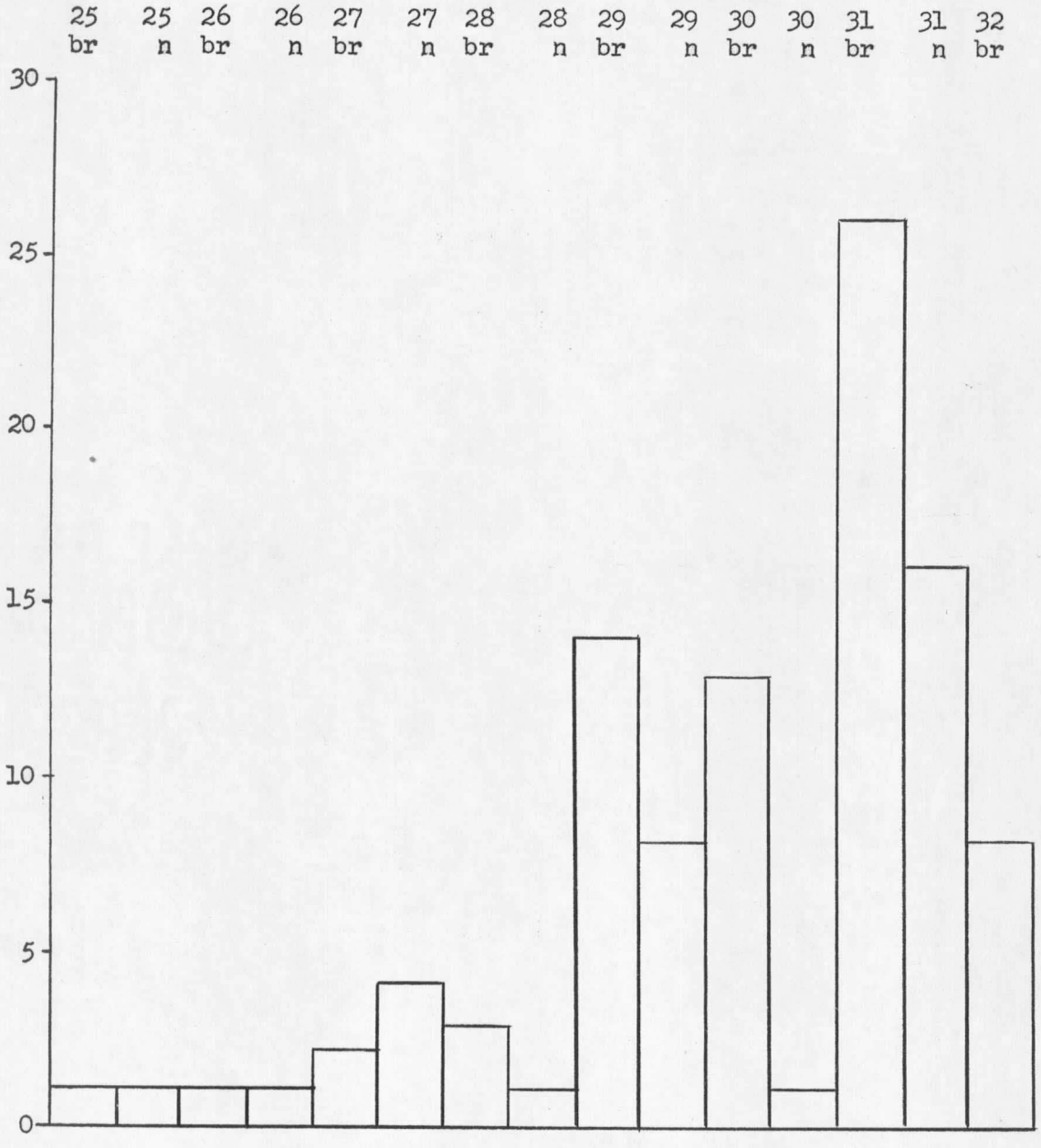
Graph 31. S. chacoense P.I. 133,664 ('64)
Commersoniana



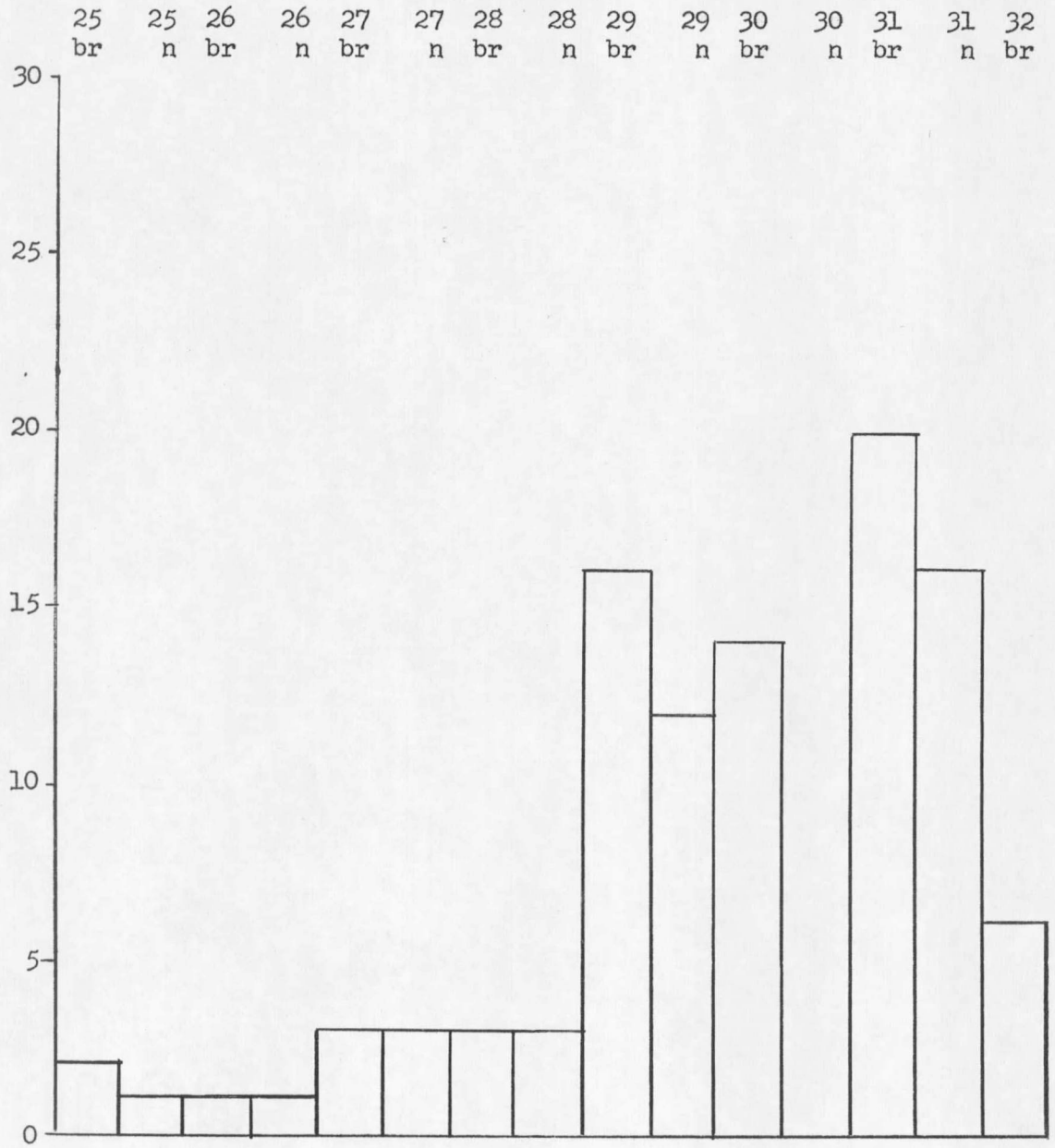
Graph 32. S. chacoense P.I. 189,217 C-19 (seed) ('64)
Commersoniana



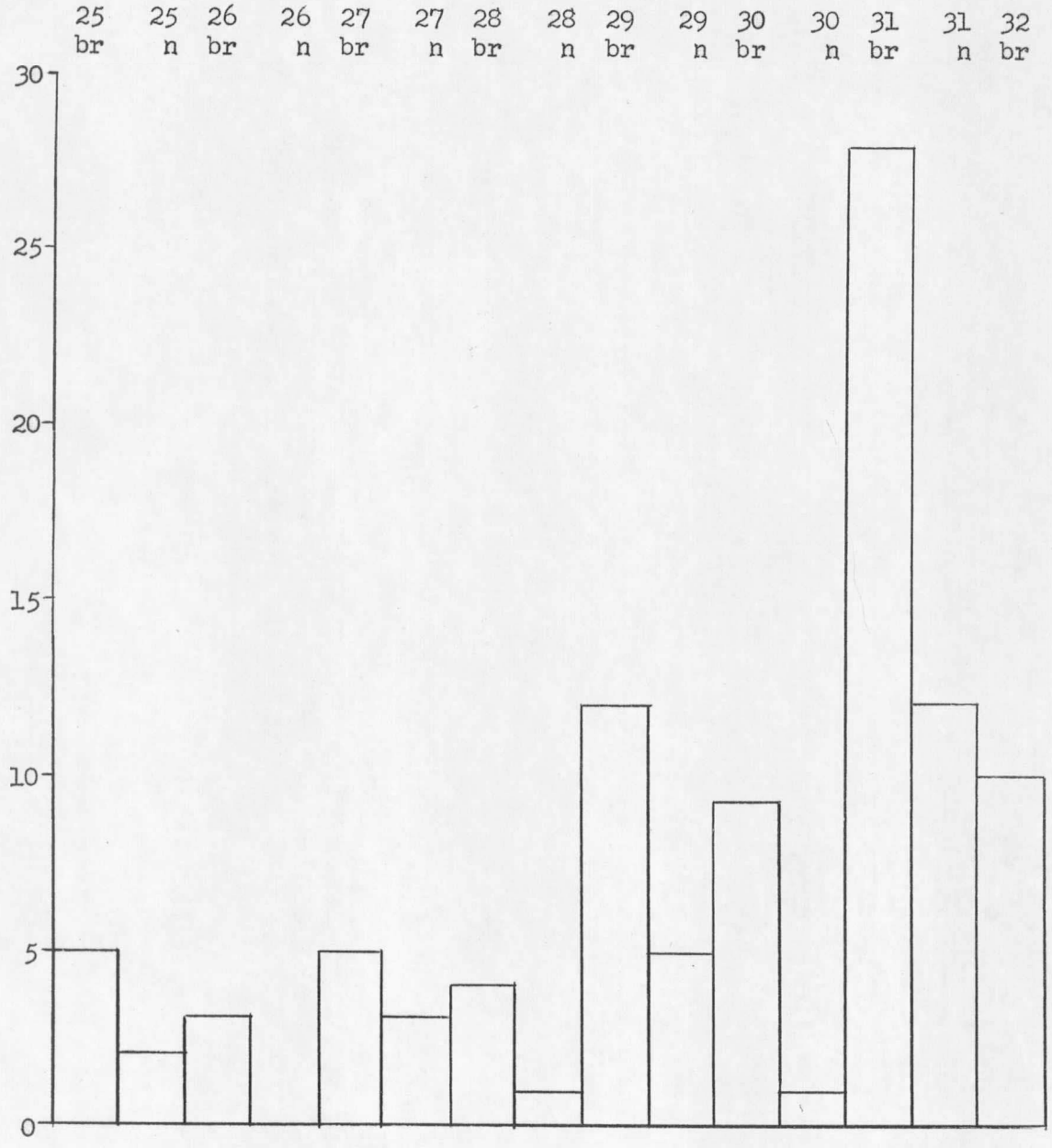
Graph 33. S. chacoense P.I. 189,220.9 ('64)
Commersoniana



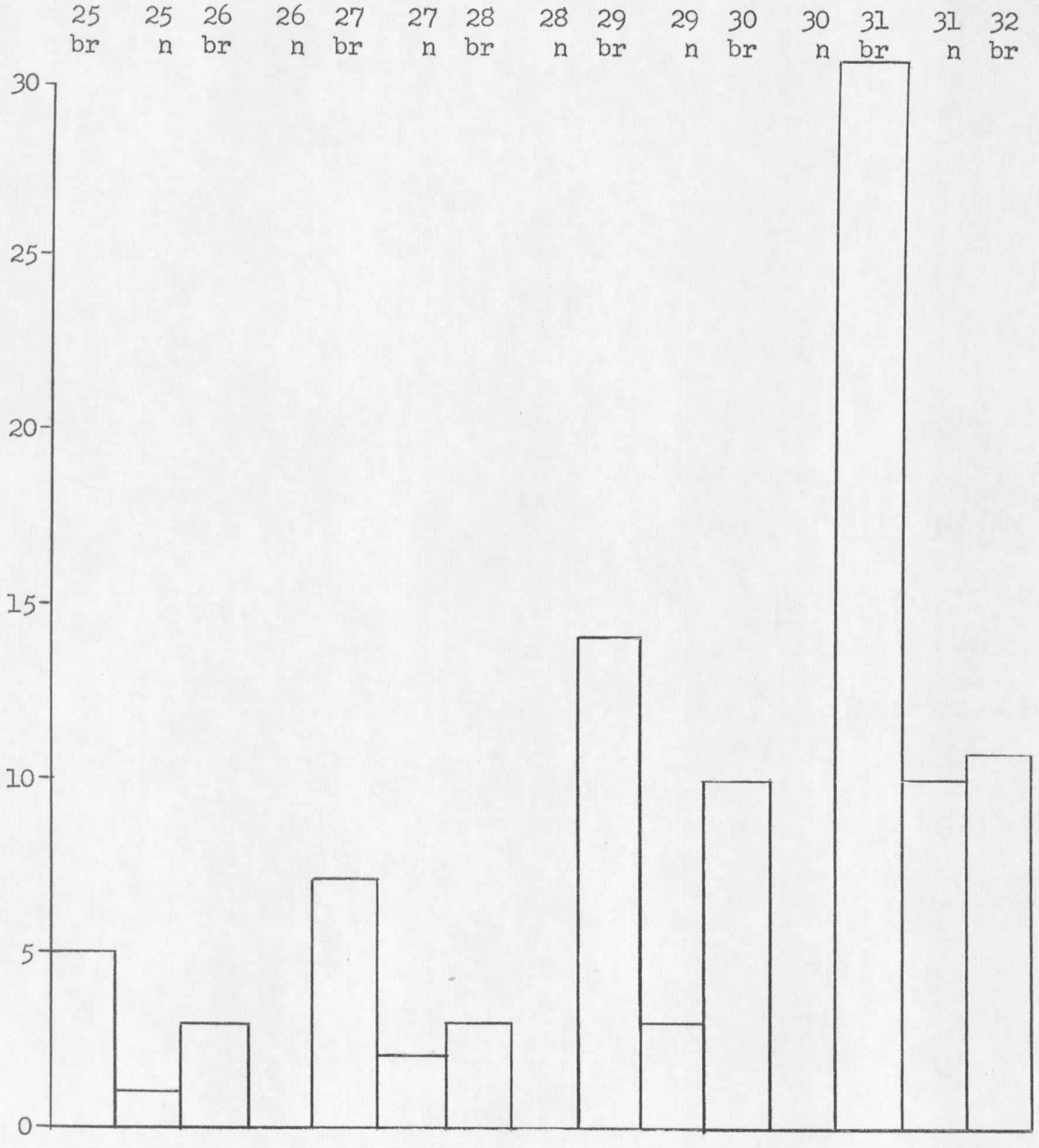
Graph 34. S. commersonii P.I. 243,503 (seed) ('64)
Commersoniana



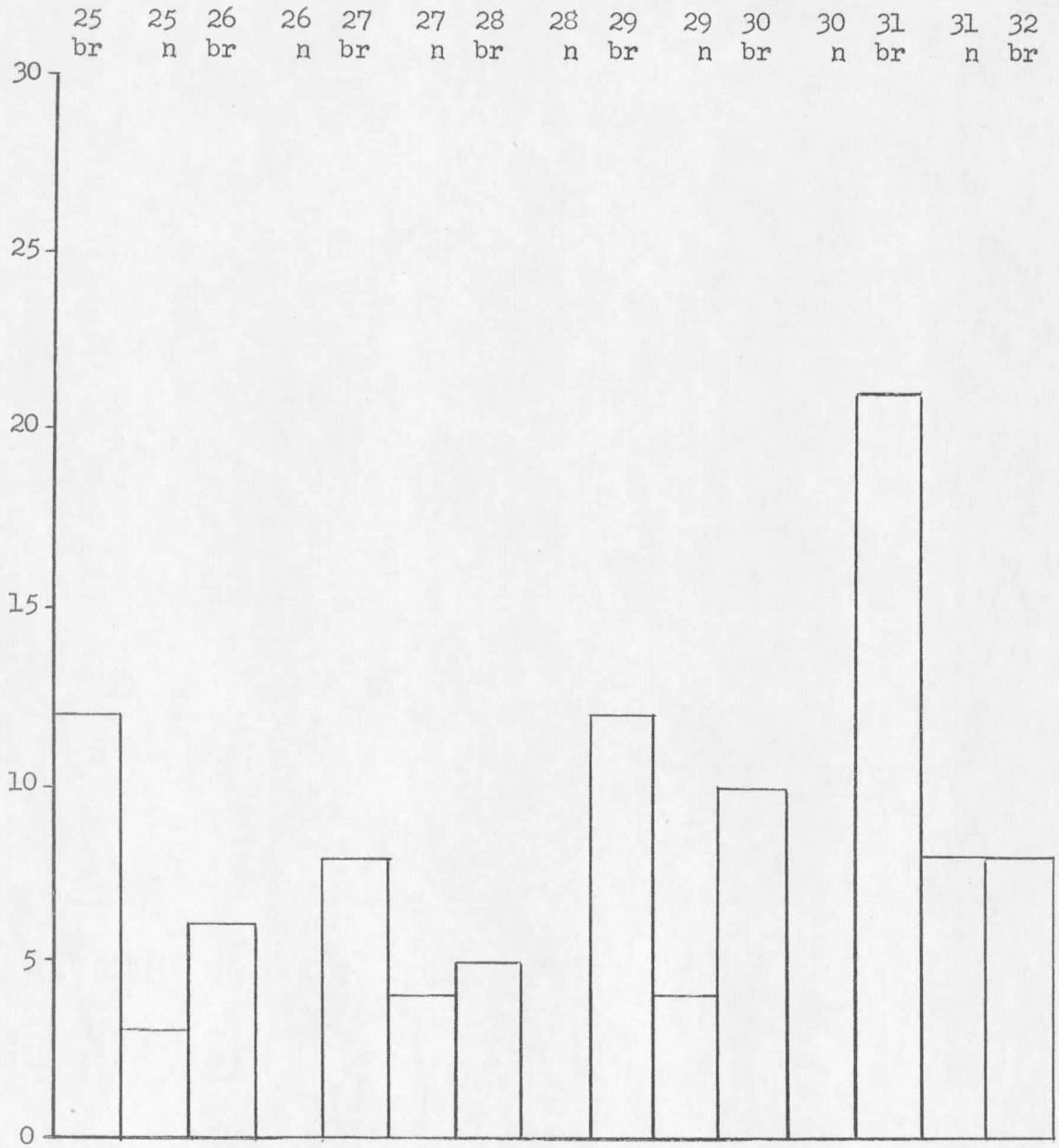
Graph 35. S. polydenium P.I. 275,237 (seed) ('64)
Polyadenia



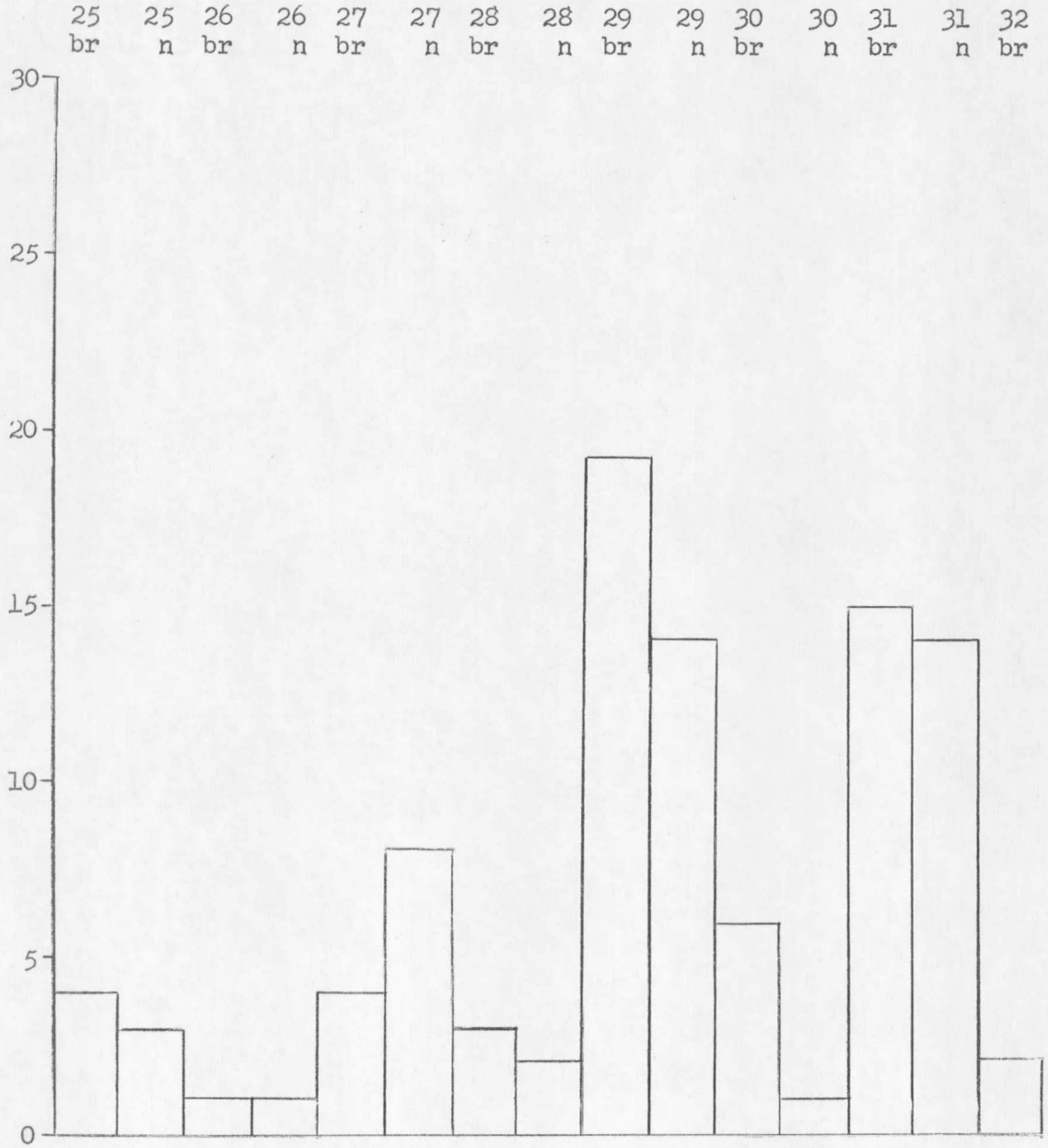
Graph 36. S. polydenium P.I. 275,238 (seed) ('64)
Polyadenia



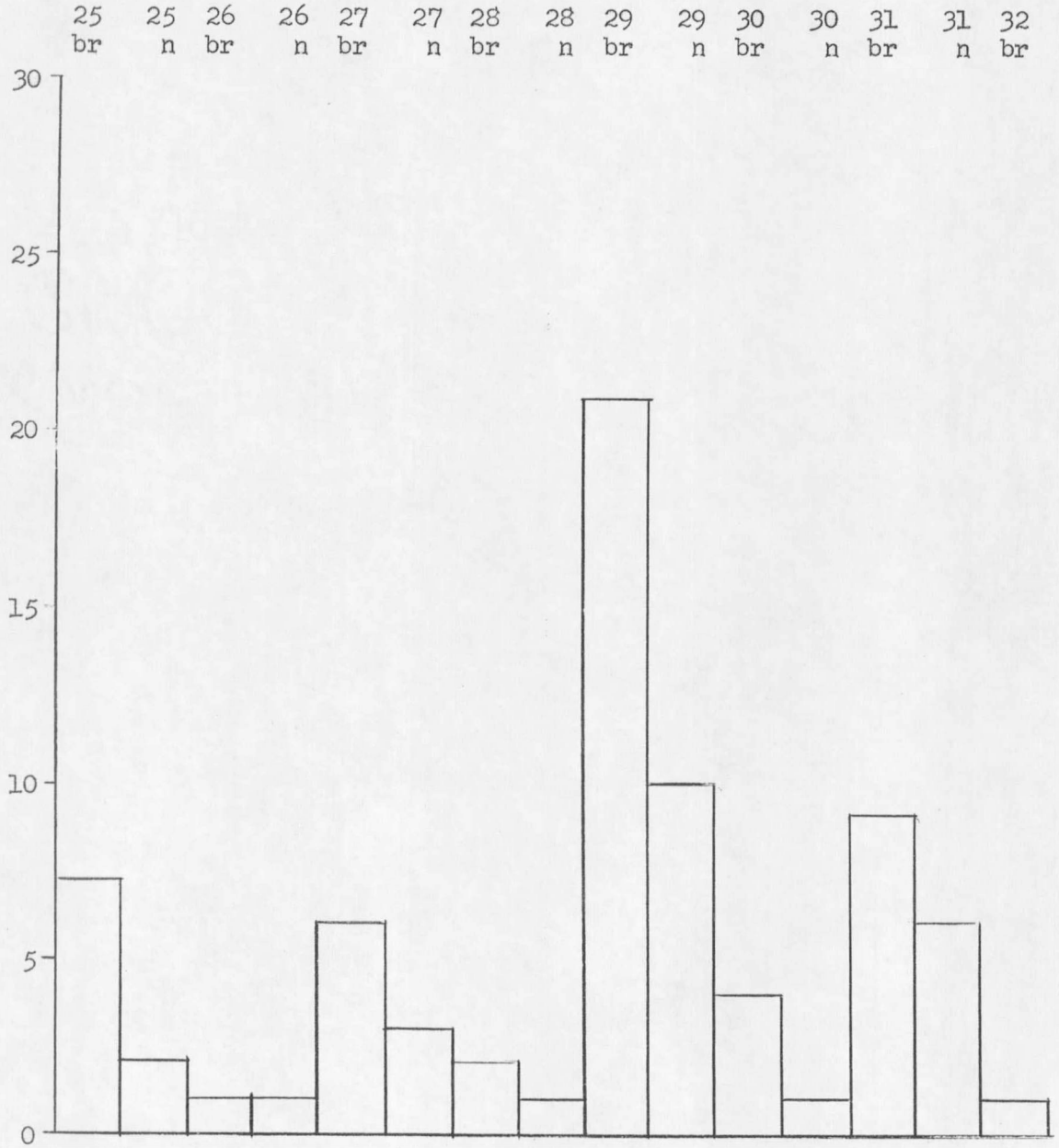
Graph 37. S. polydenium P.I. 275,238.5 (69-62)
Polyadenia



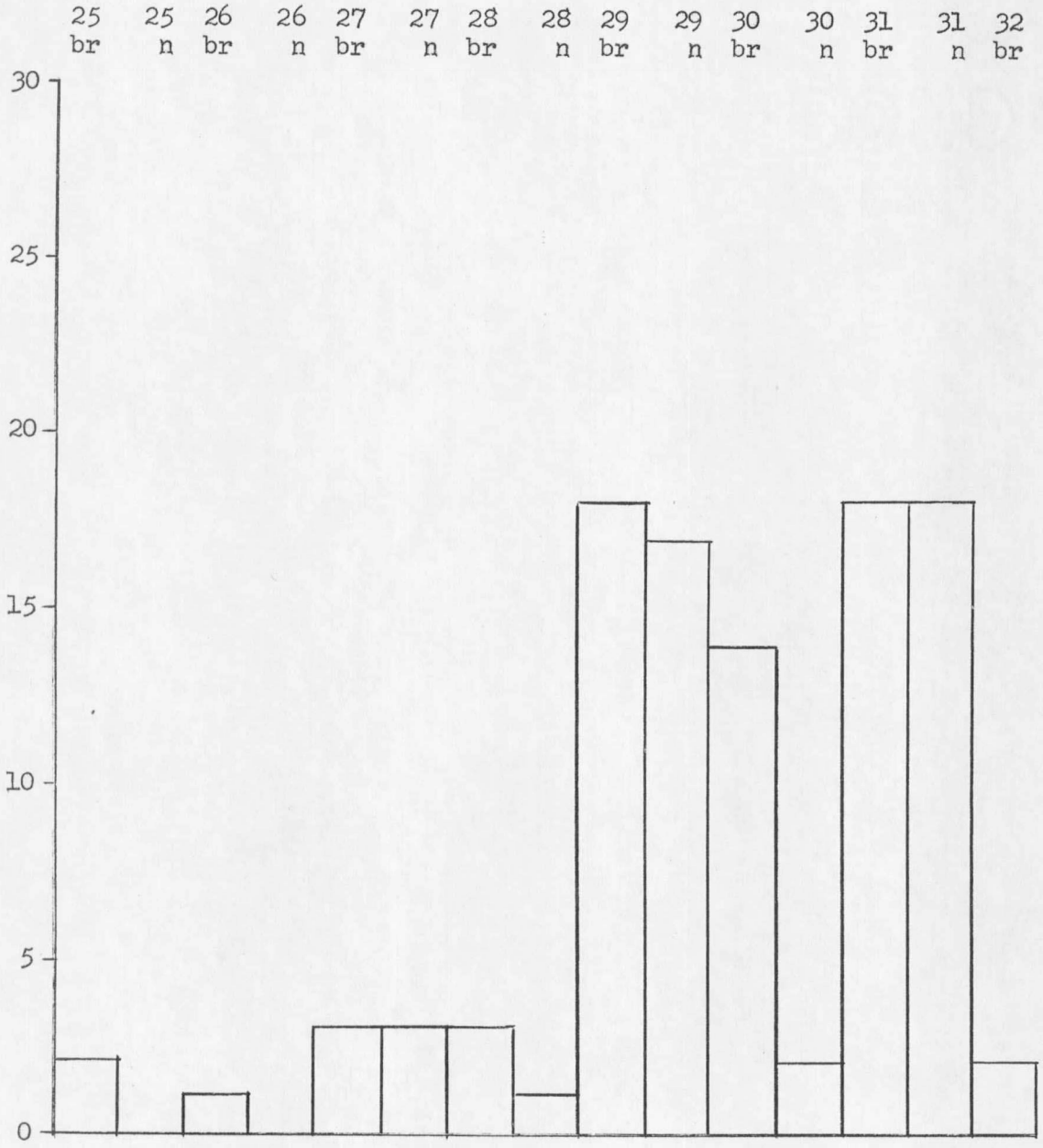
Graph 38. S. oxycarpum P.I. 230,479 (seed) ('64)
Conicibaccata



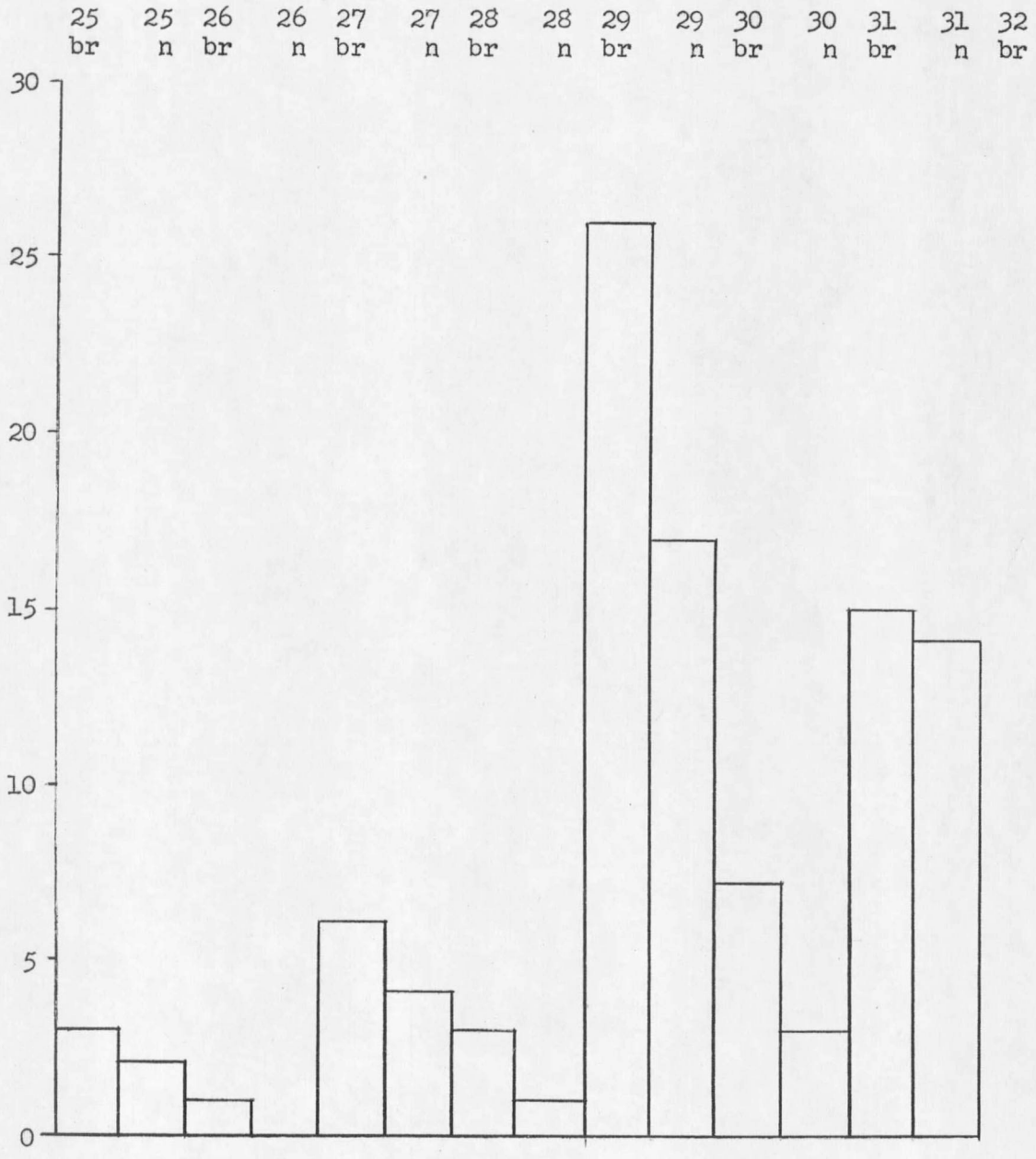
Graph 39. S. hougasii P.I. 161,174.5 (8-62)
Demissa



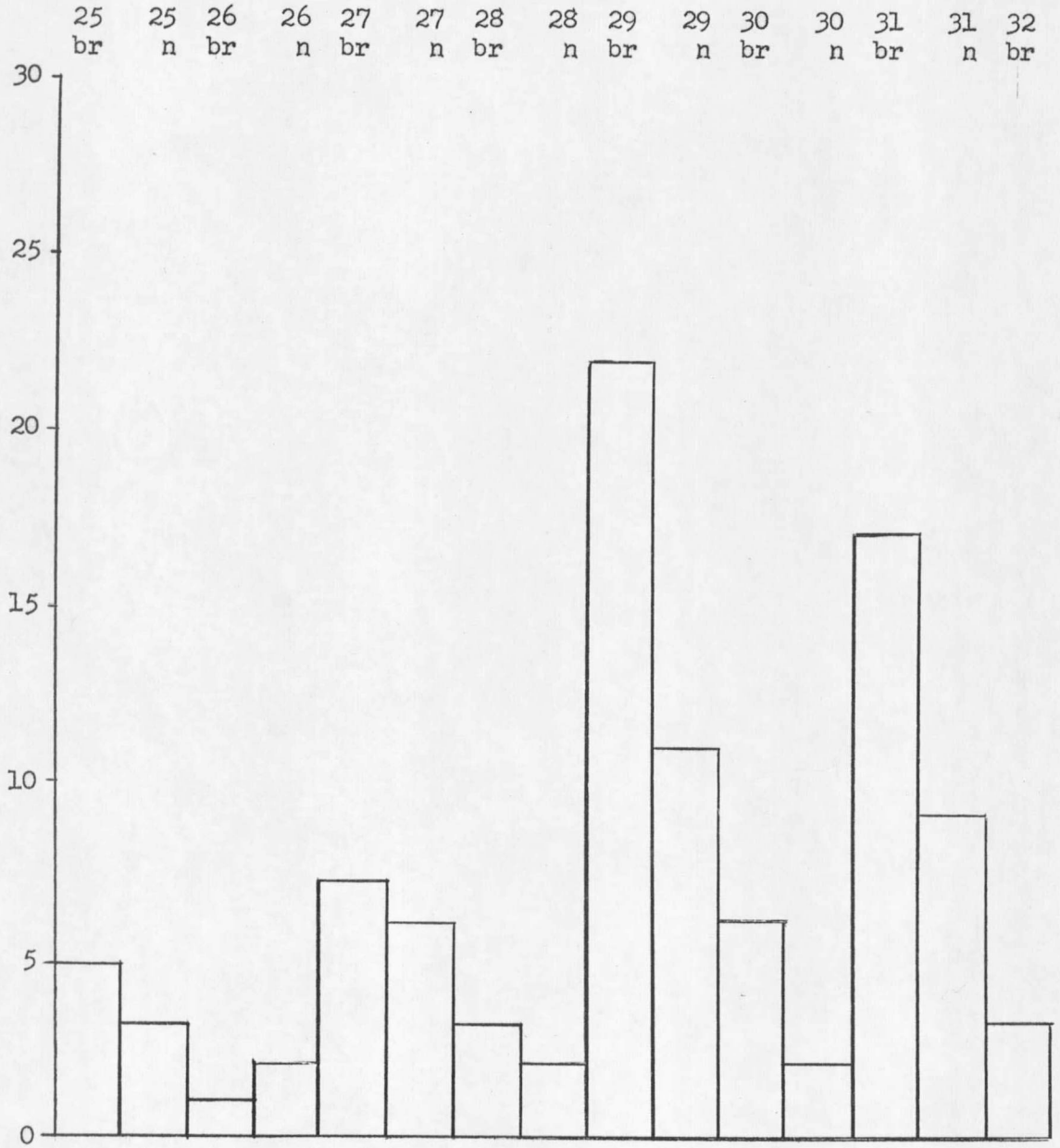
Graph 40. S. hougasii P.I. 161,174 (seed) ('64)
Demissa



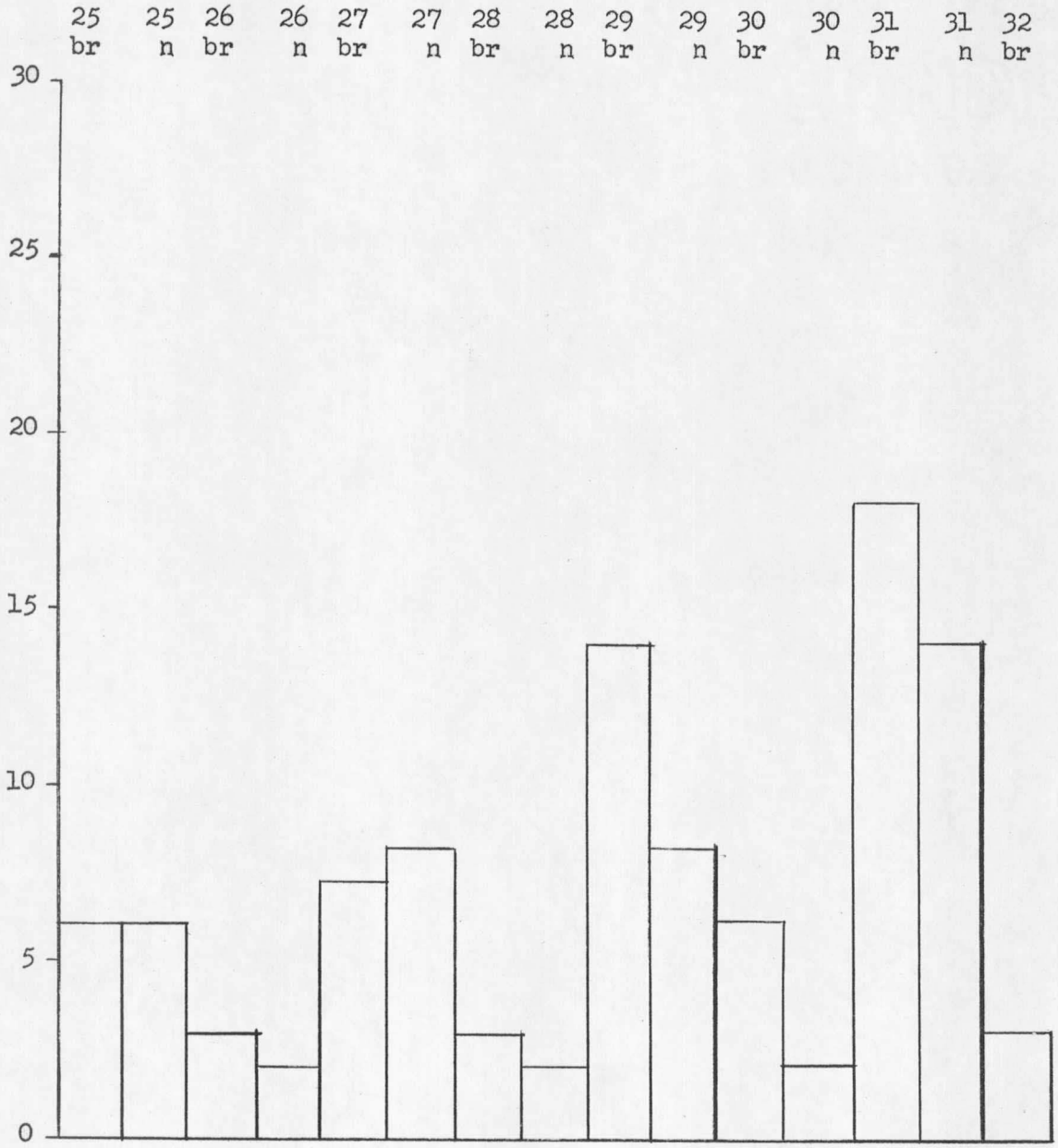
Graph 41. S. hougasii P.I. 239,423 ('64)
Demissa



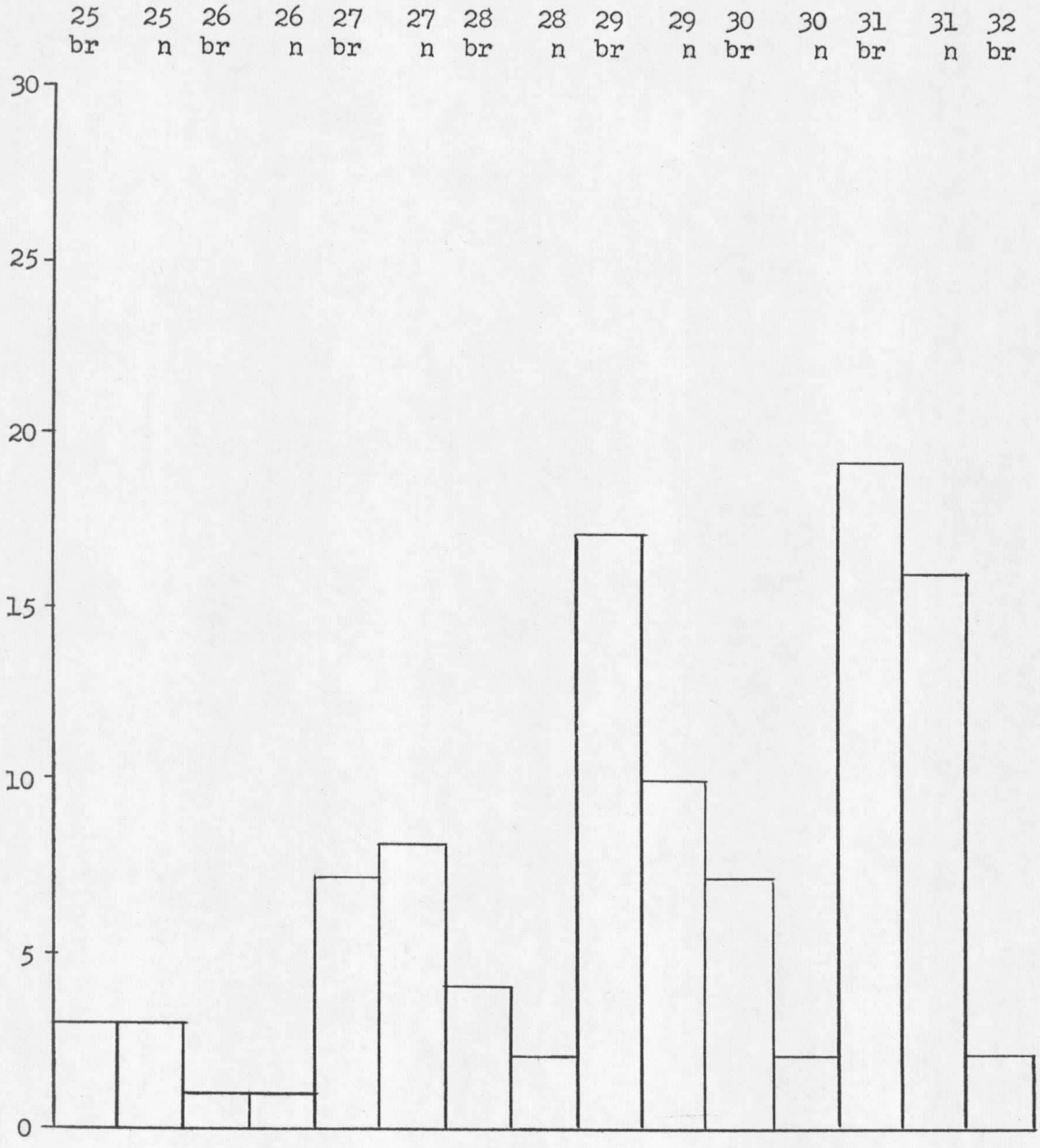
Graph 42. S. hougasii P.I. 283,107.1 ('64)
Demissa



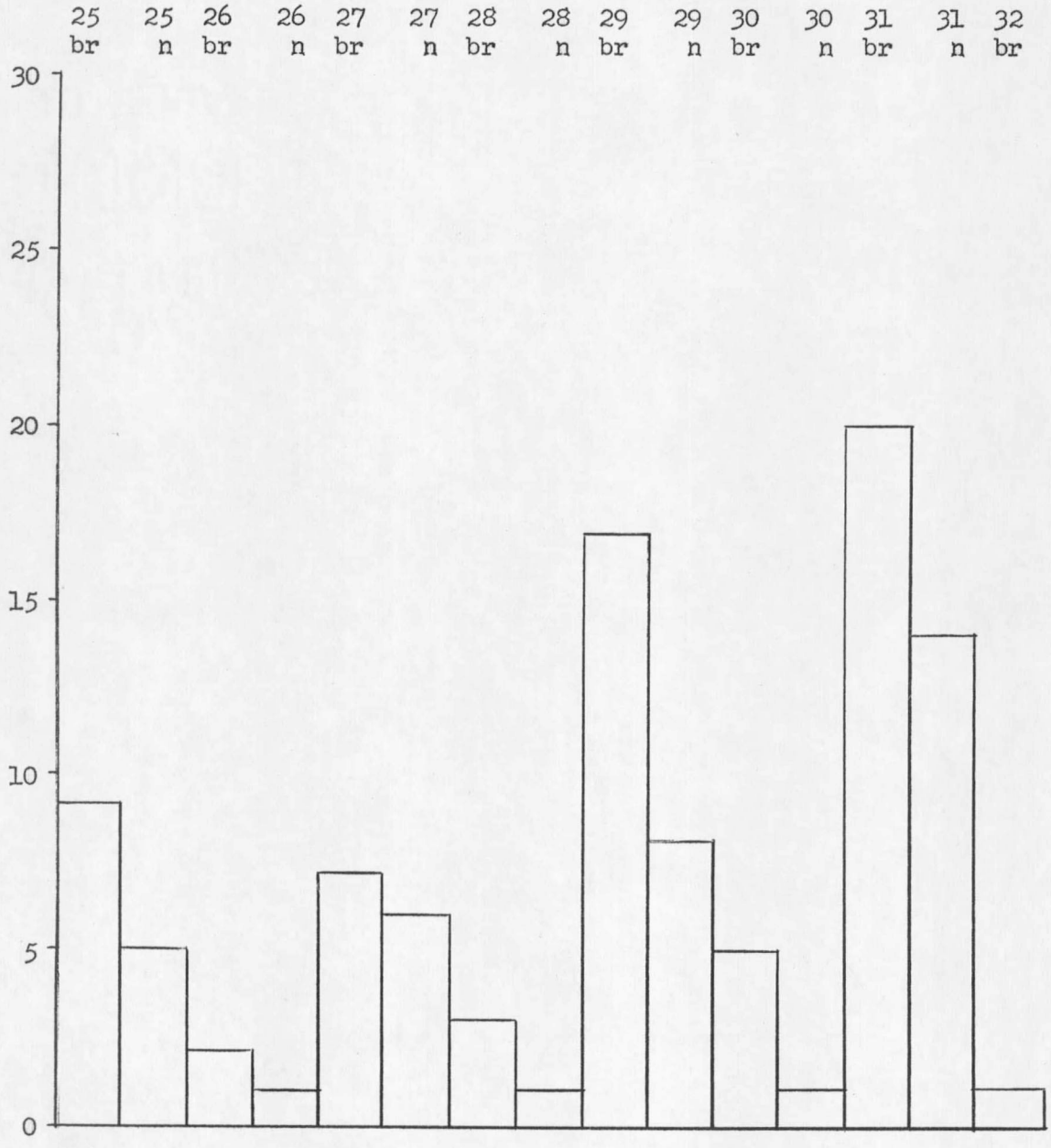
Graph 43. S. guerreroense P.I. 161,727.1 (3-62)
Demissa



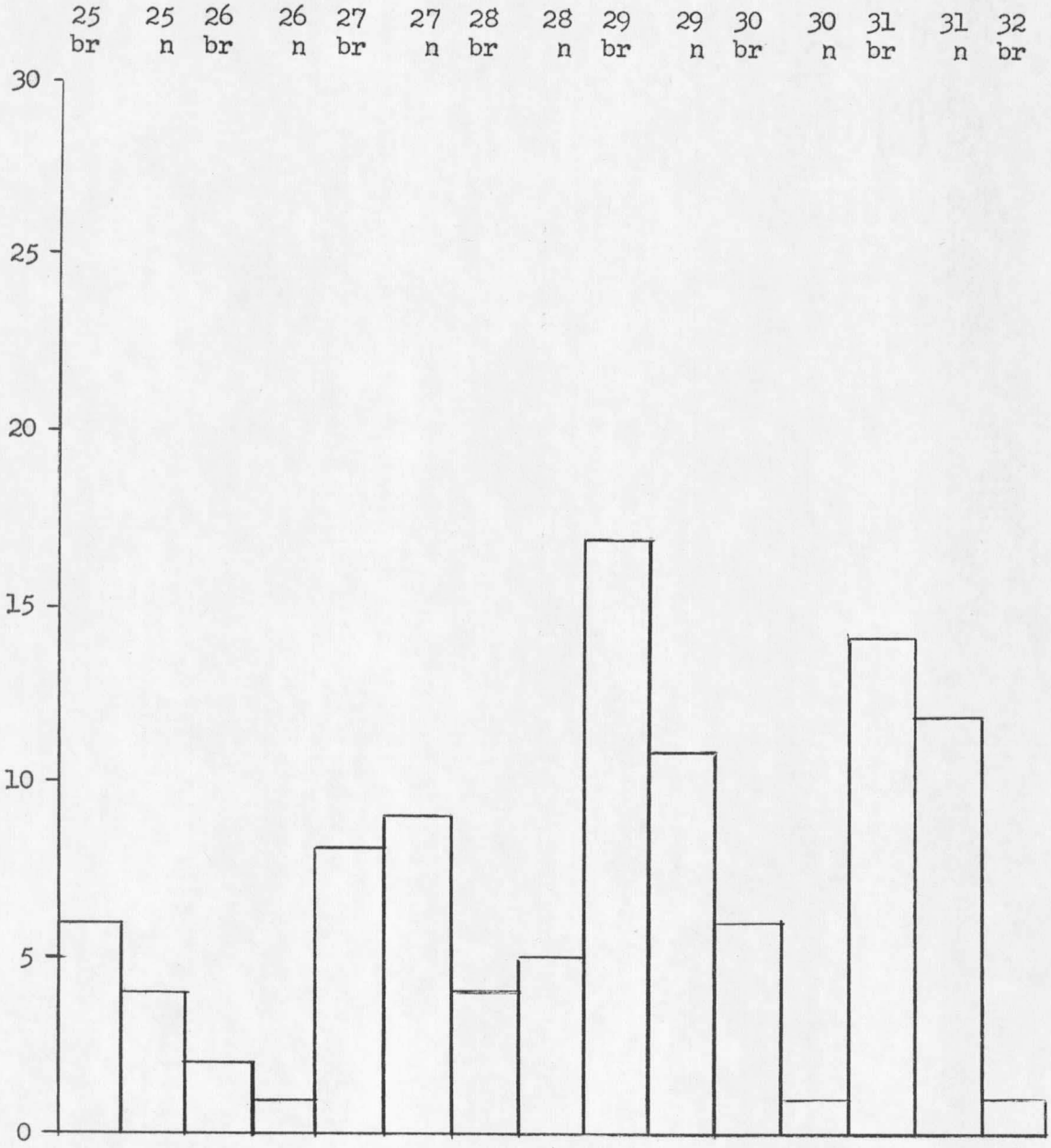
Graph 44. S. guerreroense P.I. 161,730.13 (21-62)
Demissa



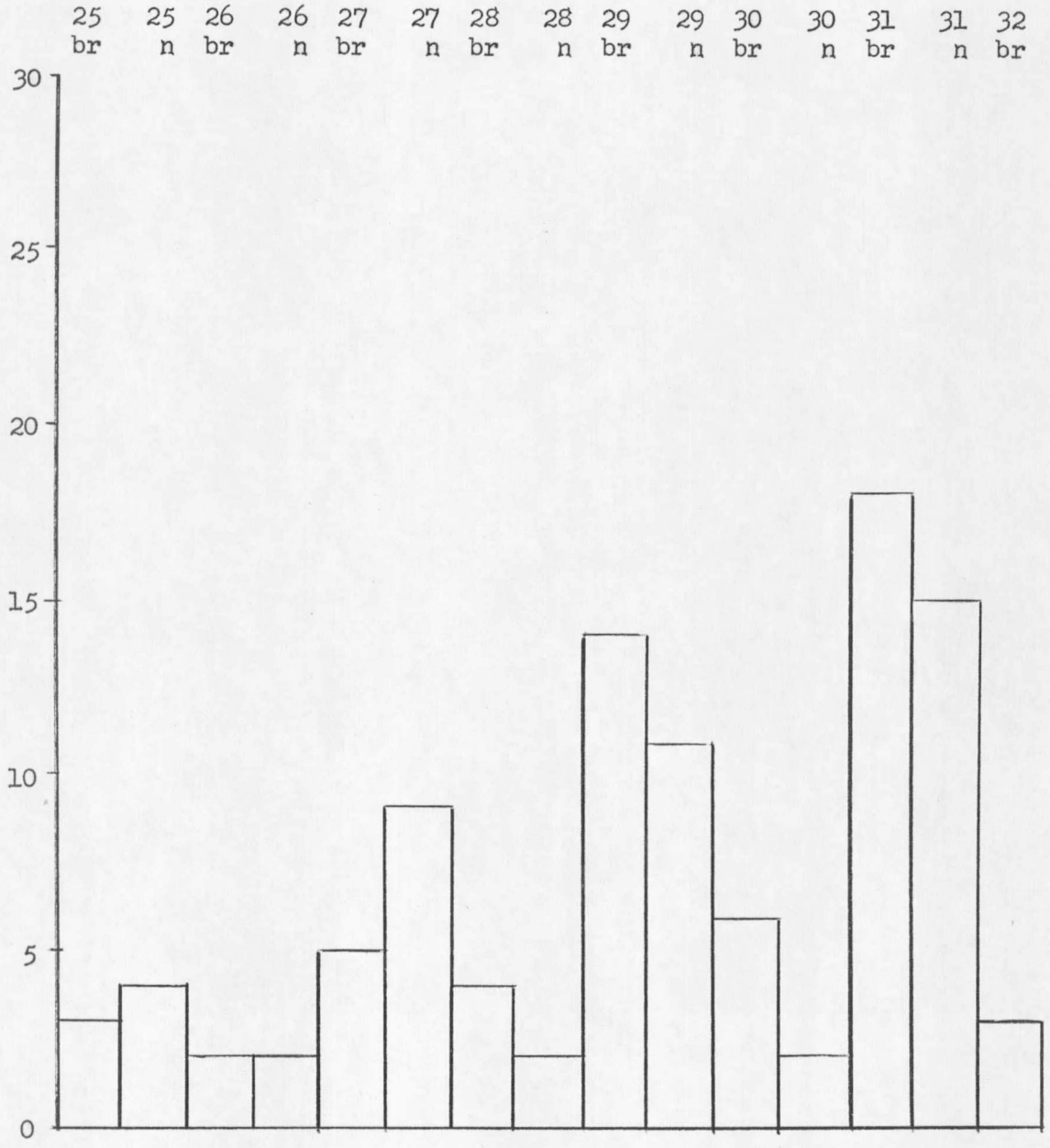
Graph 45. S. brachycarpum P.I. 230,459.1 (45-62)
Demissa



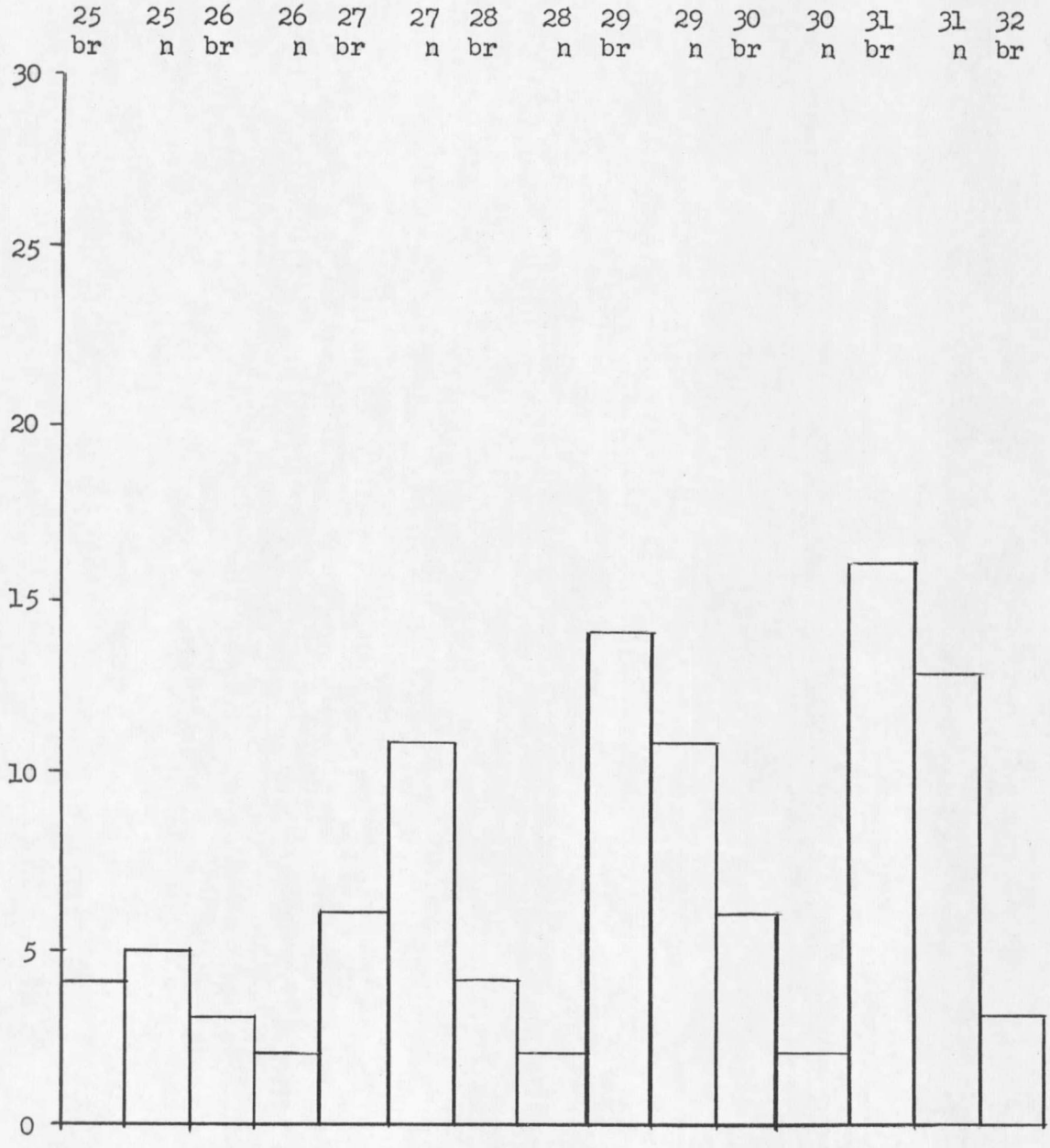
Graph 46. S. brachycarpum P.I. 243,344.4 (90-62)
Demissa



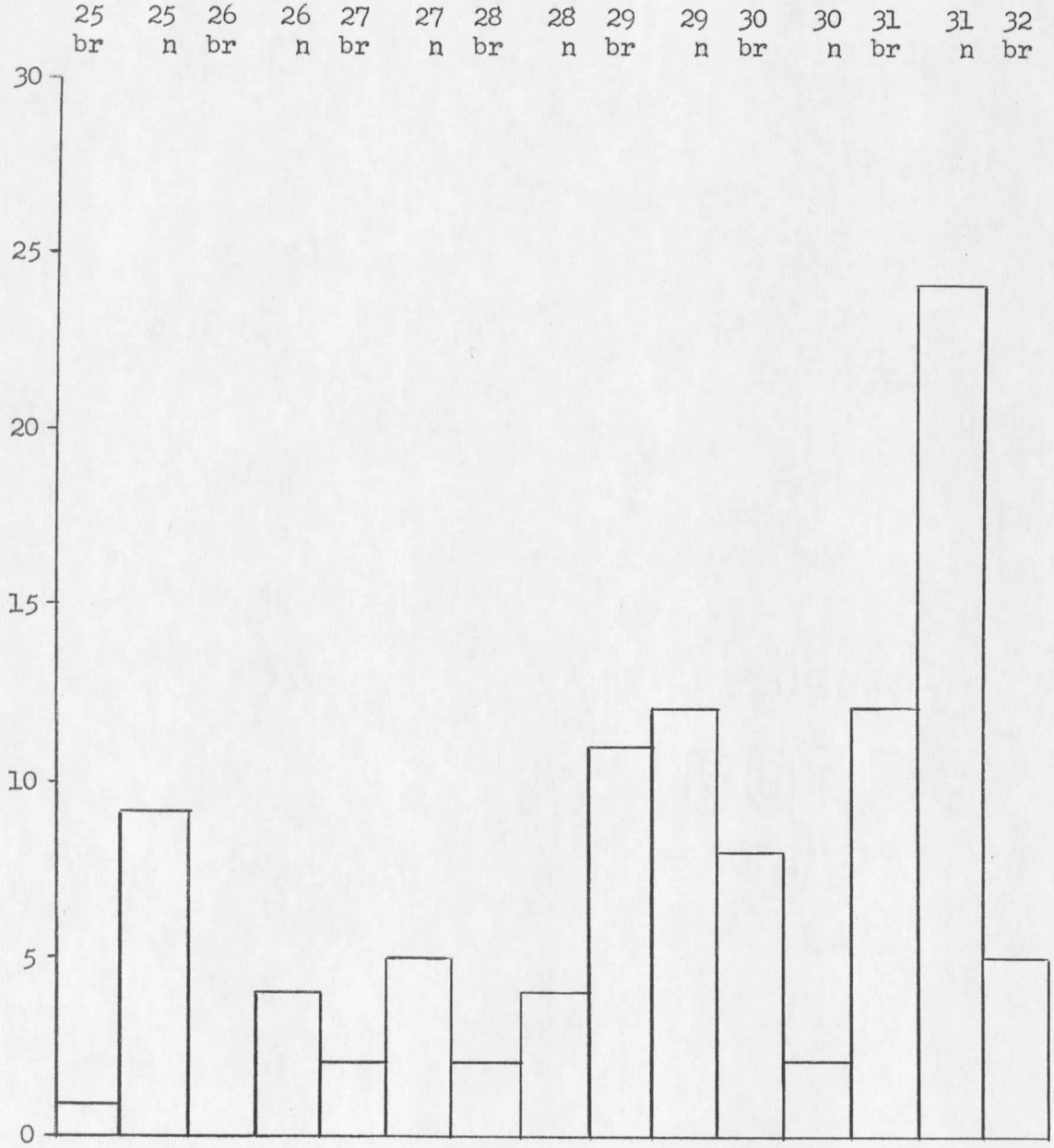
Graph 47. S. brachycarpum P.I. 275,183 (seed) ('64)
Demissa



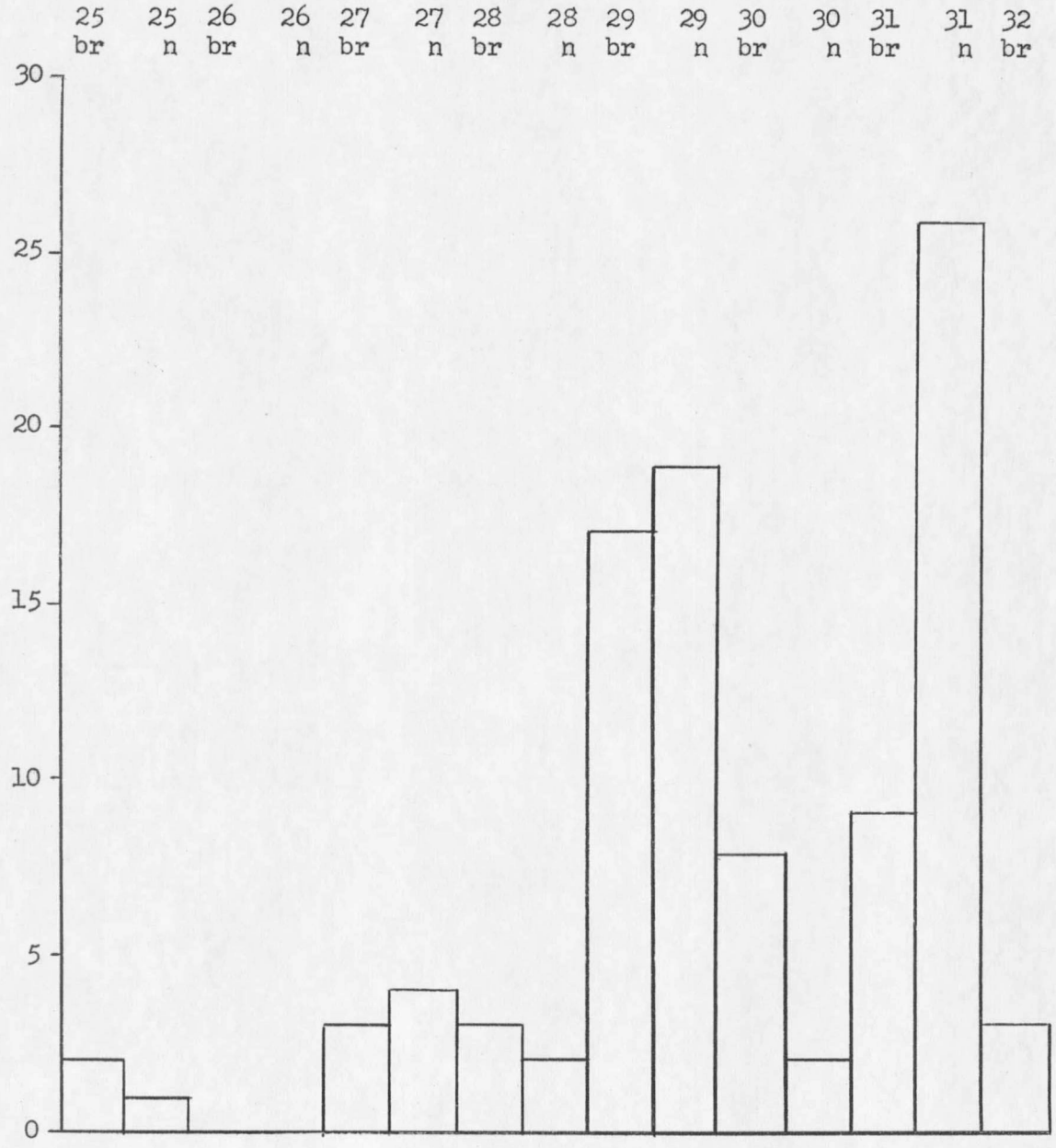
Graph 48. S. brachycarpum P.I. 275,183.5 ('64)
Demissa



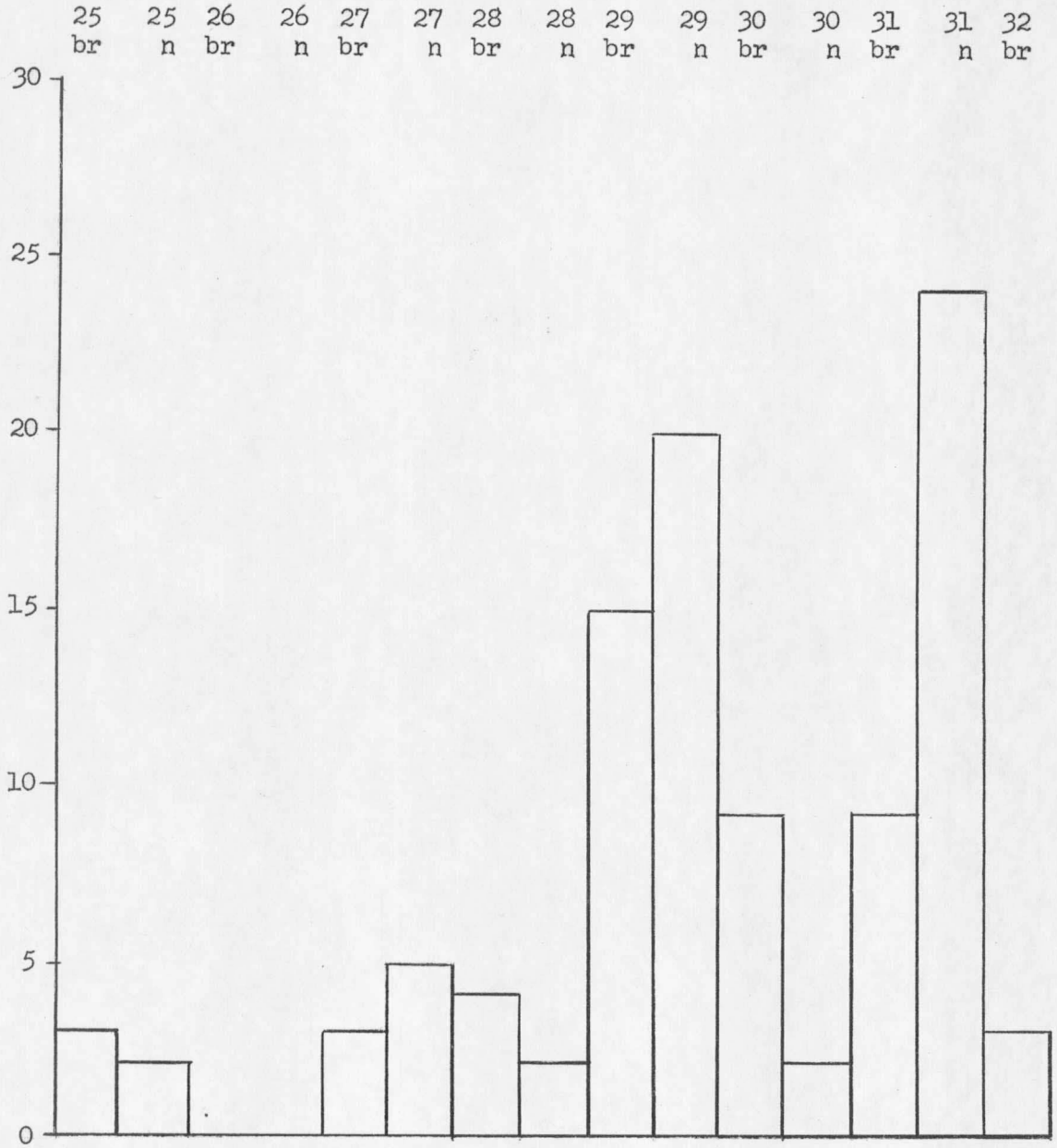
Graph 49. S. capsicibaccatum P.I. 205,560.1 ('64)
Circaeifolia



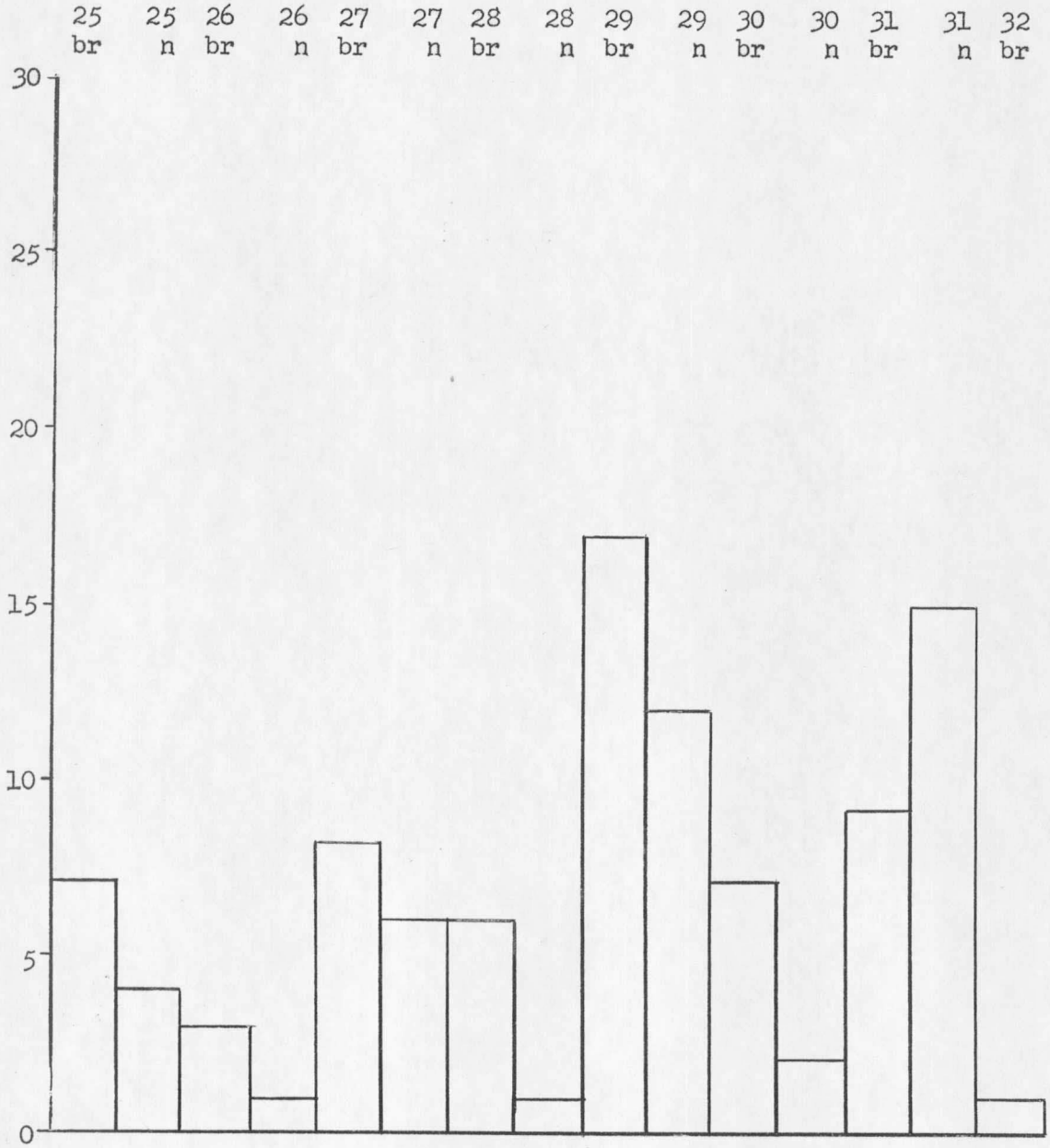
Graph 50. S. capsicibaccatum P.I. 205,560.2 (65-62)
Circaeifolia



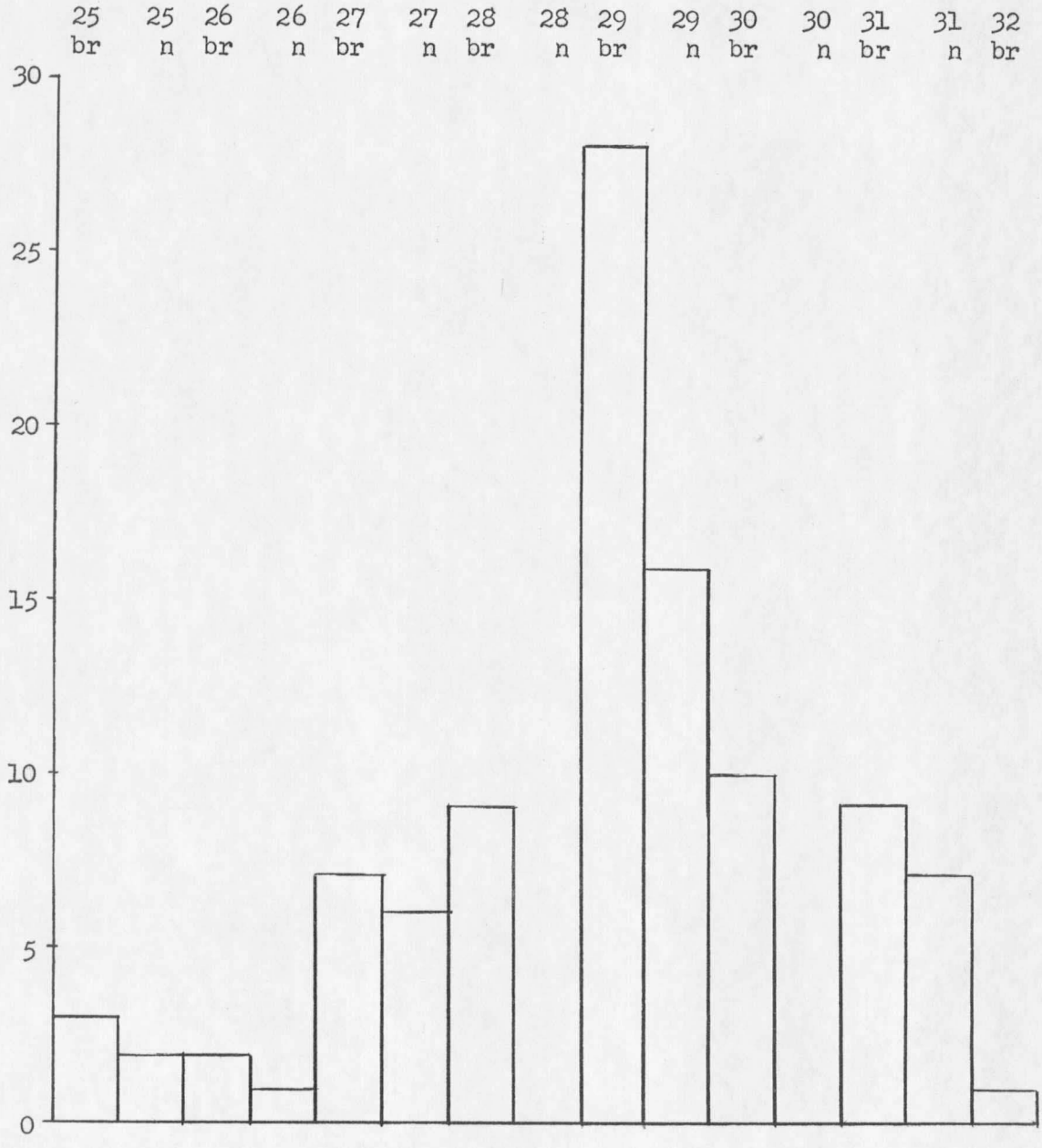
Graph 51. S. capsicibaccatum P.I. 210,036.2 (64-62)
Circaeifolia



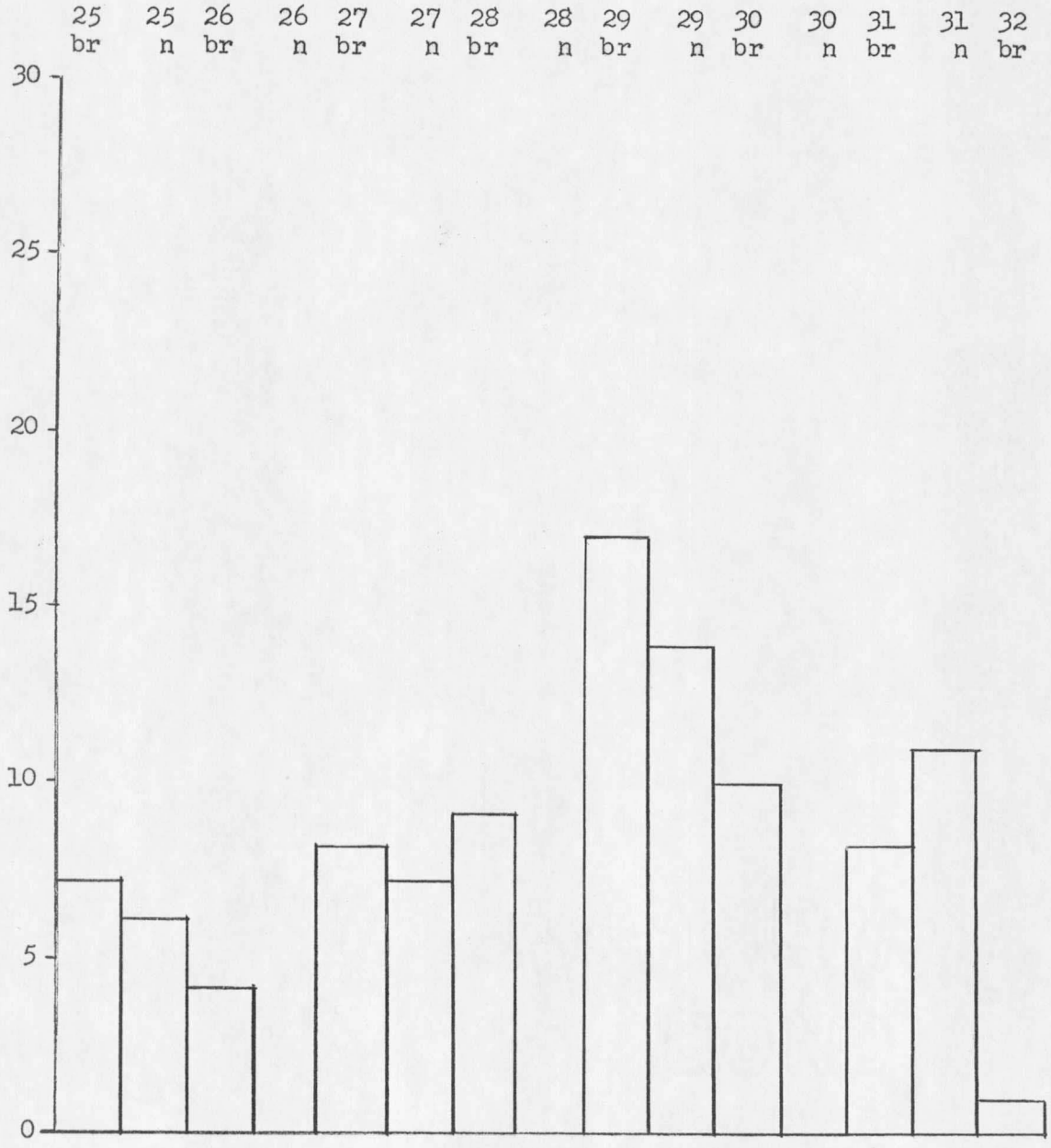
Graph 52. S. acaule P.I. 195,160.4 (48-62)
Acaulia



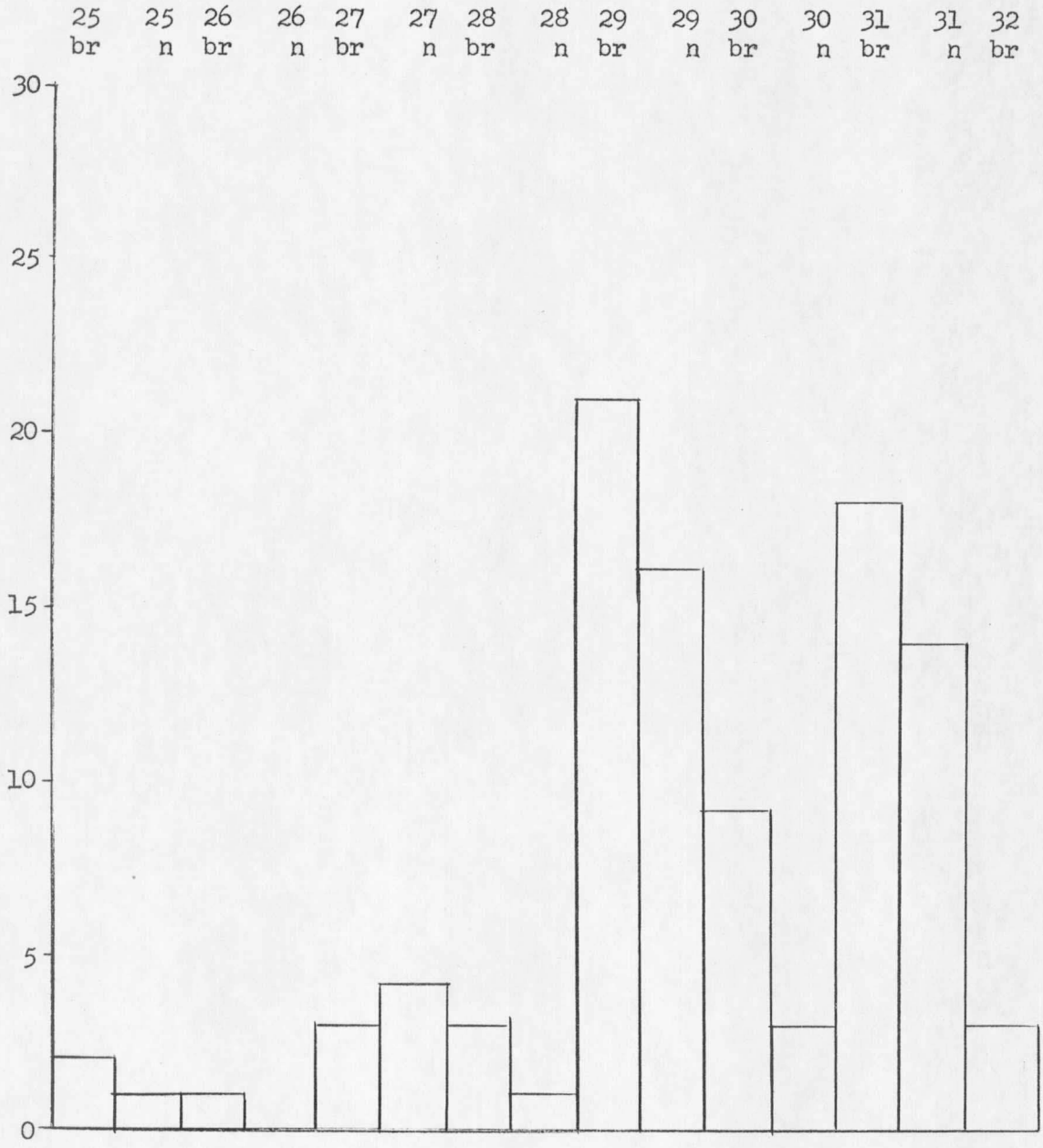
Graph 53. S. acaule P.I. 205,507.1 (61-62)
Acaulia



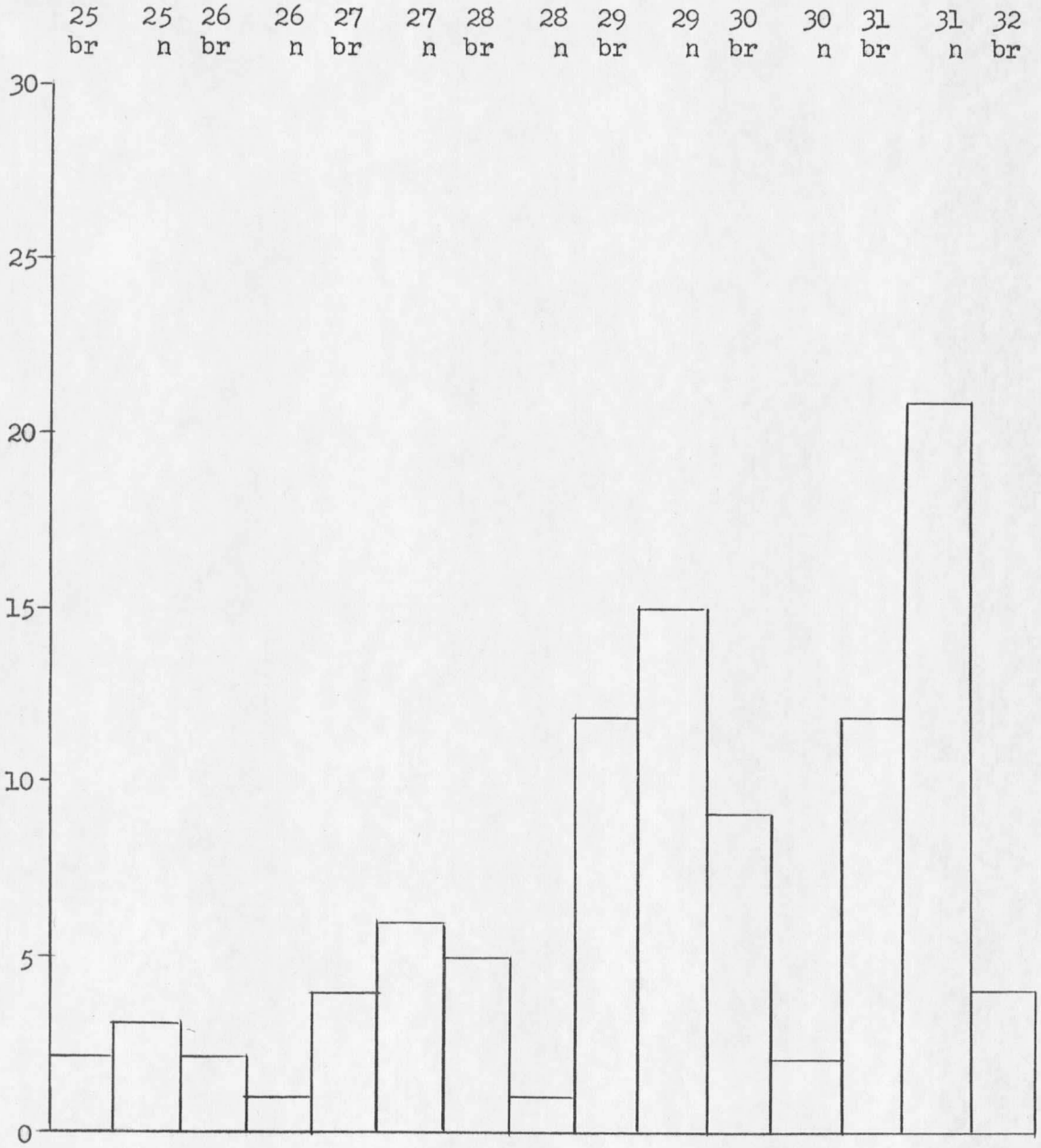
Graph 54. S. acaule P.I. 210,033.1 (40-62)
Acaulia



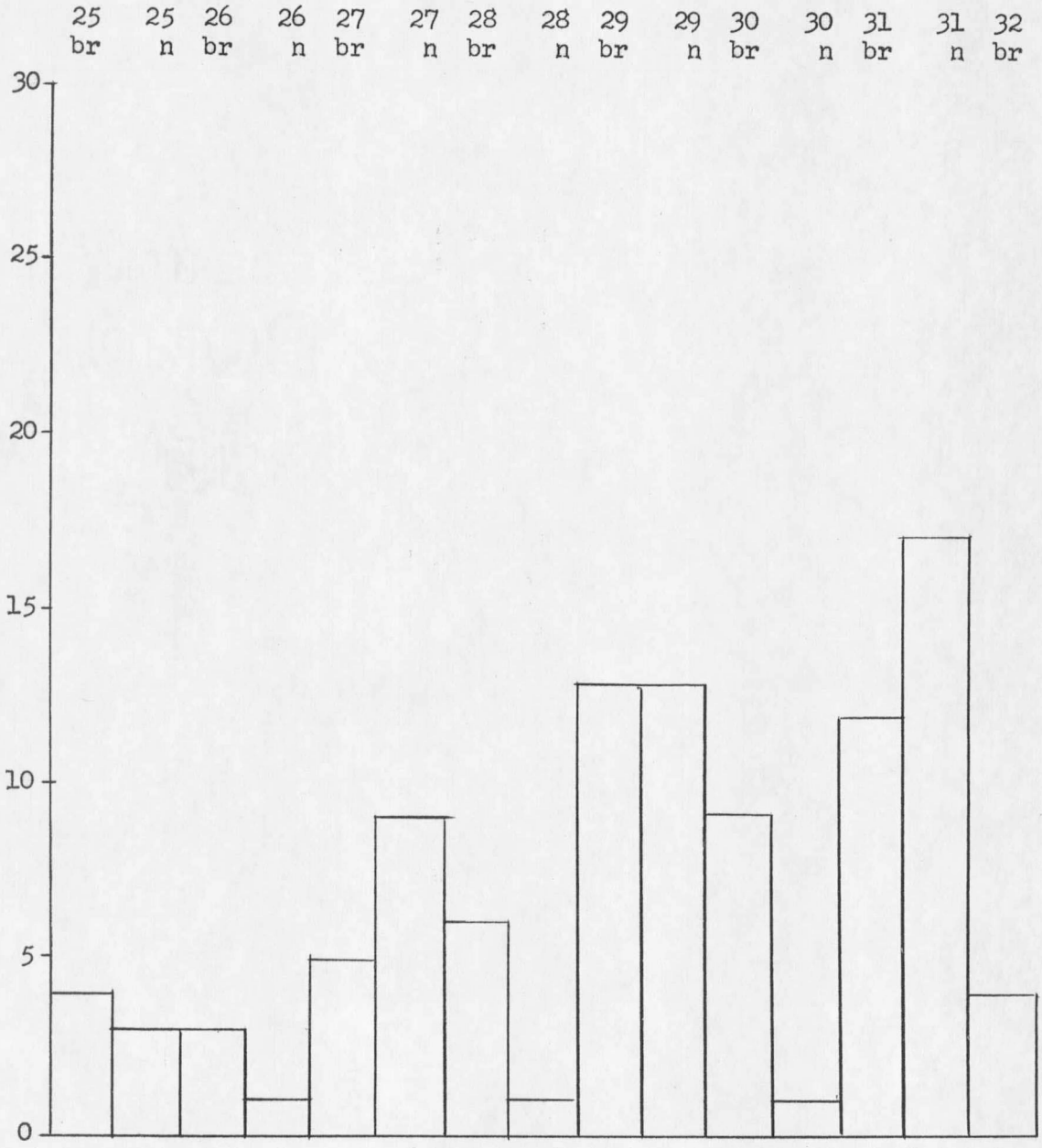
Graph 55. S. brevicaule P.I. 233,961.4 (57-62)
Transaequatorialia



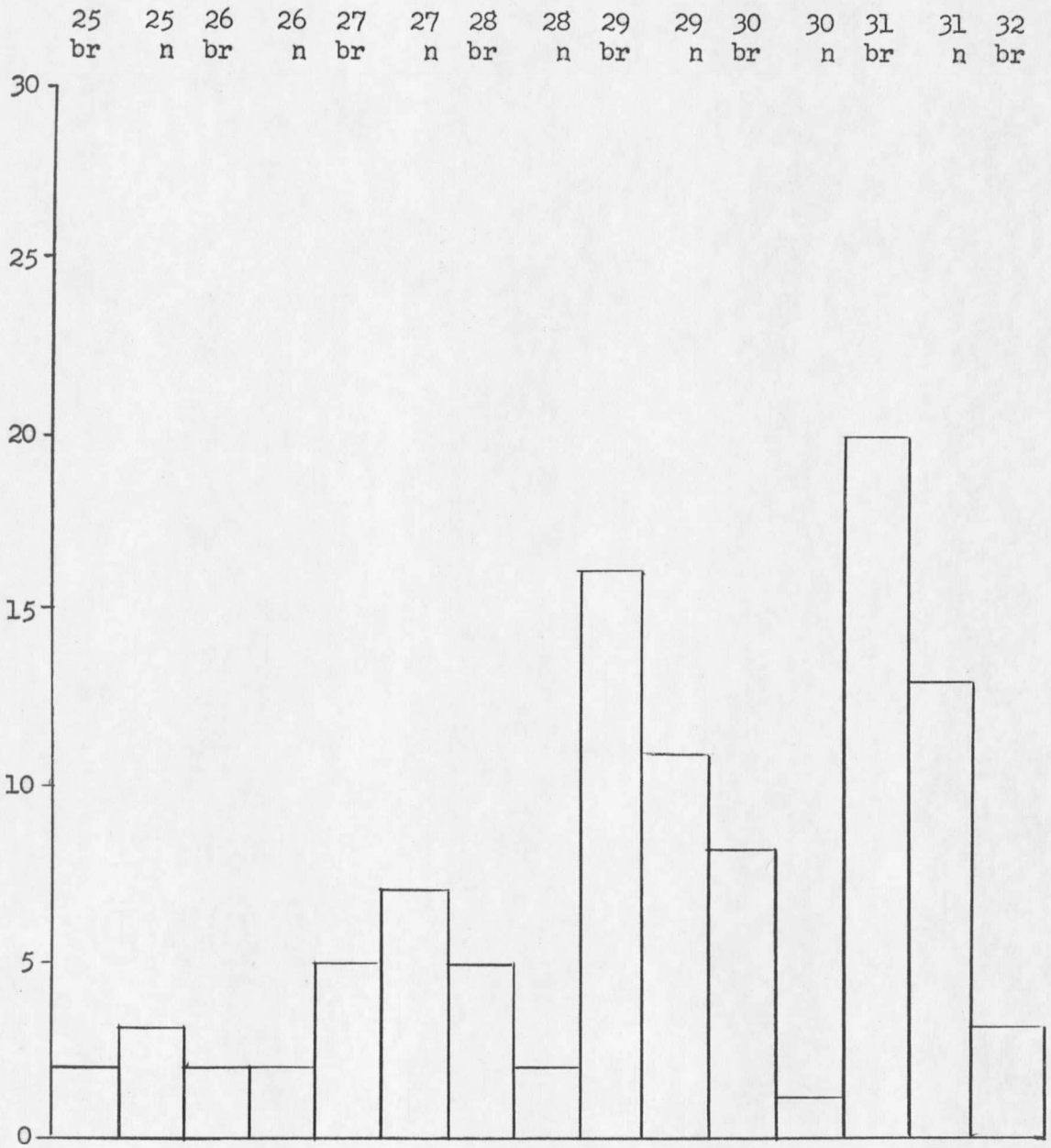
Graph 56. S. canasense P.I. 265,864.1 ('64)
Transaequatorialia



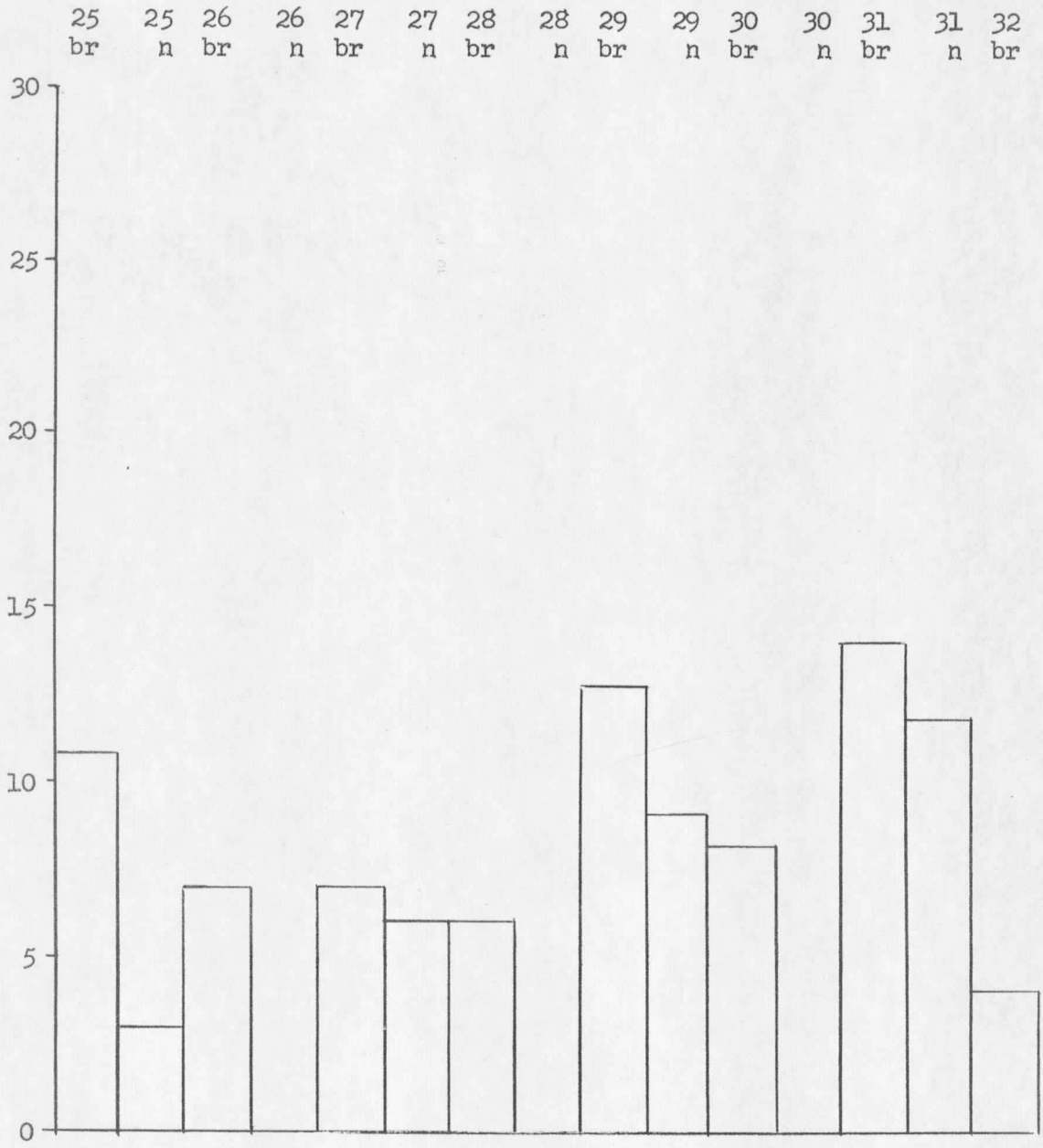
Graph 57. S. canasense P.I. 265,864 (seed) ('64)
Transaequatorialia



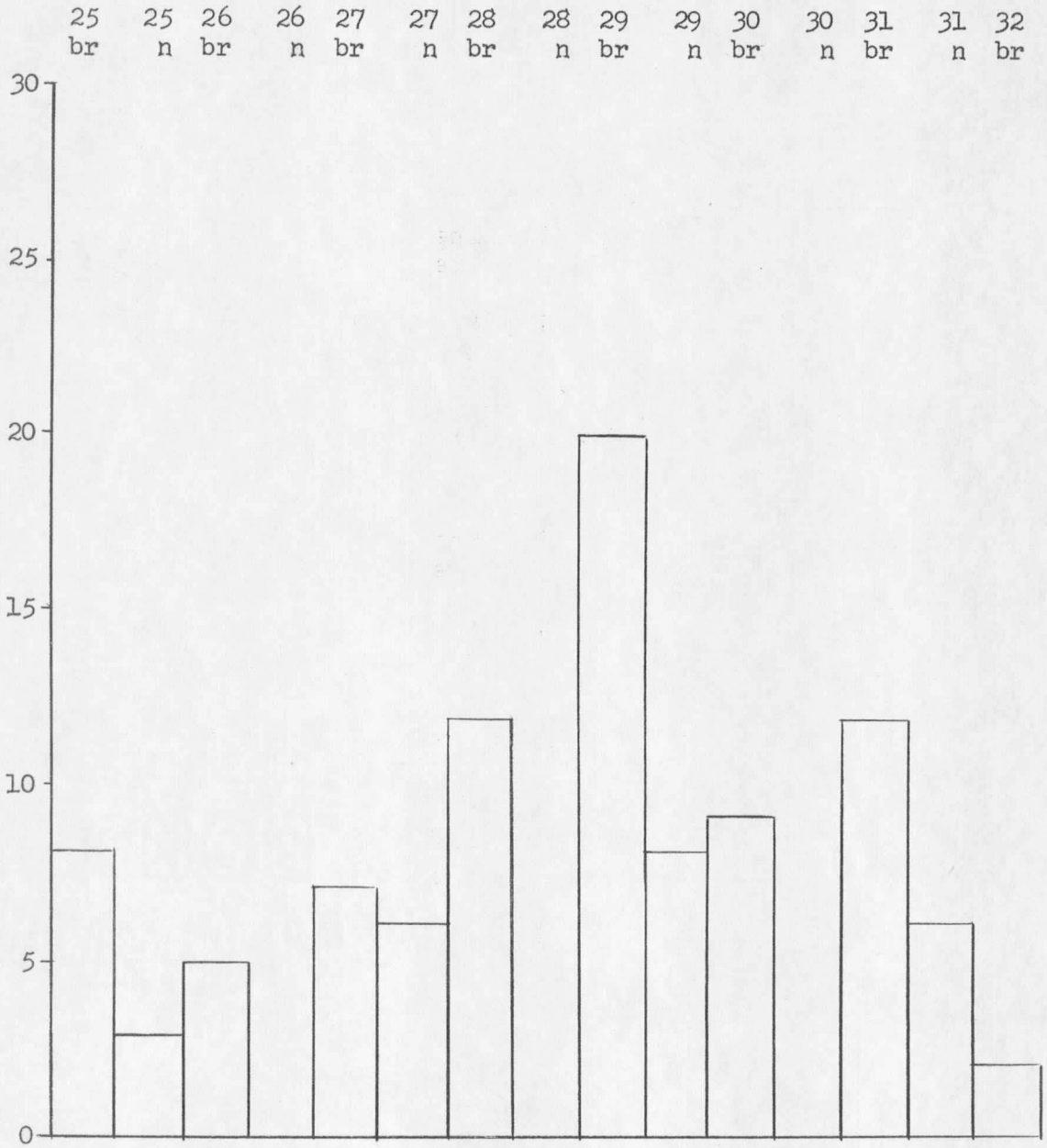
Graph 58. S. canasense P.I. 210,035.4 ('64)
Transaequatorialia



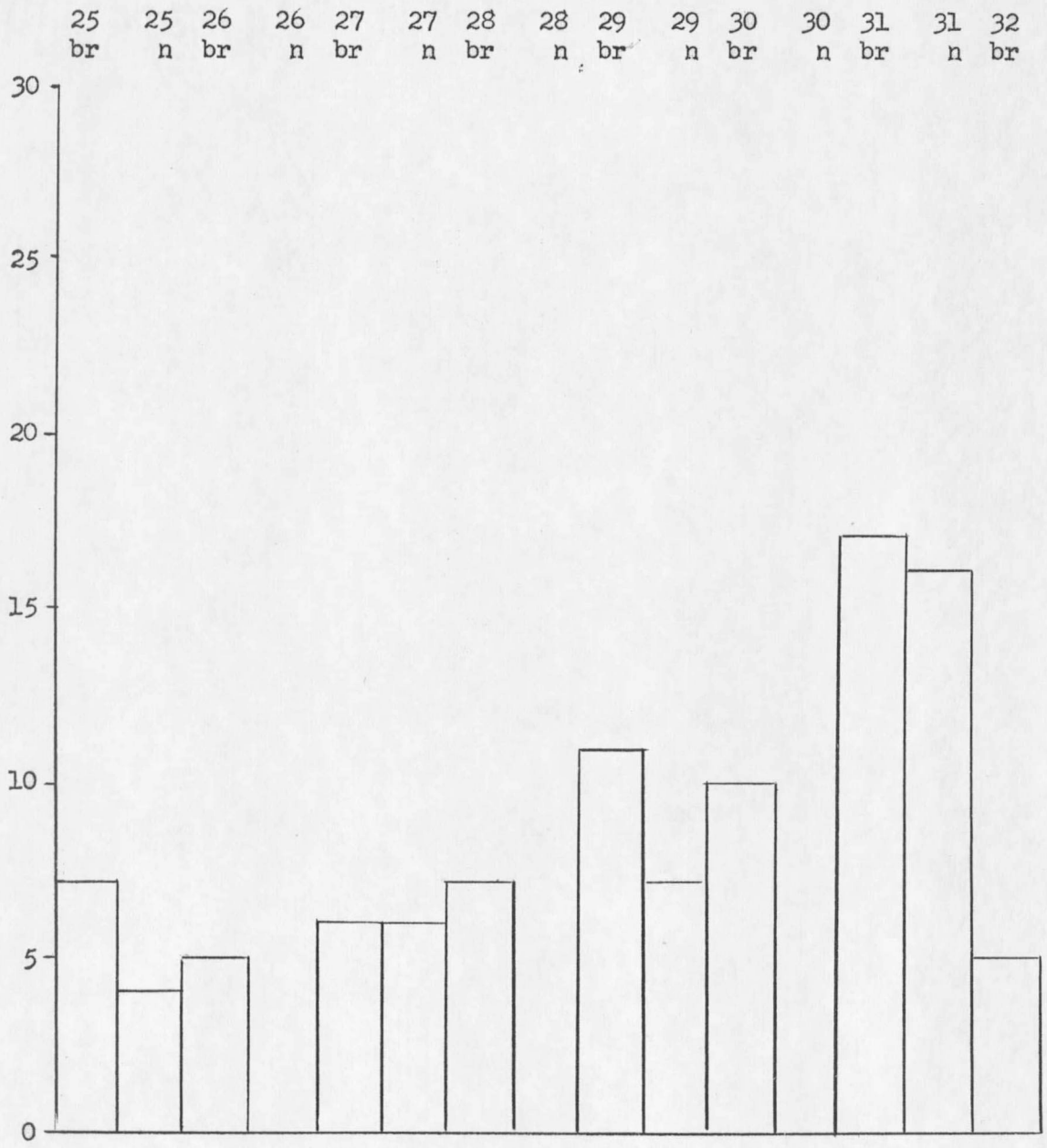
Graph 59. S. canasense P.I. 210,035.2 (37-62)
Transaequatorialia



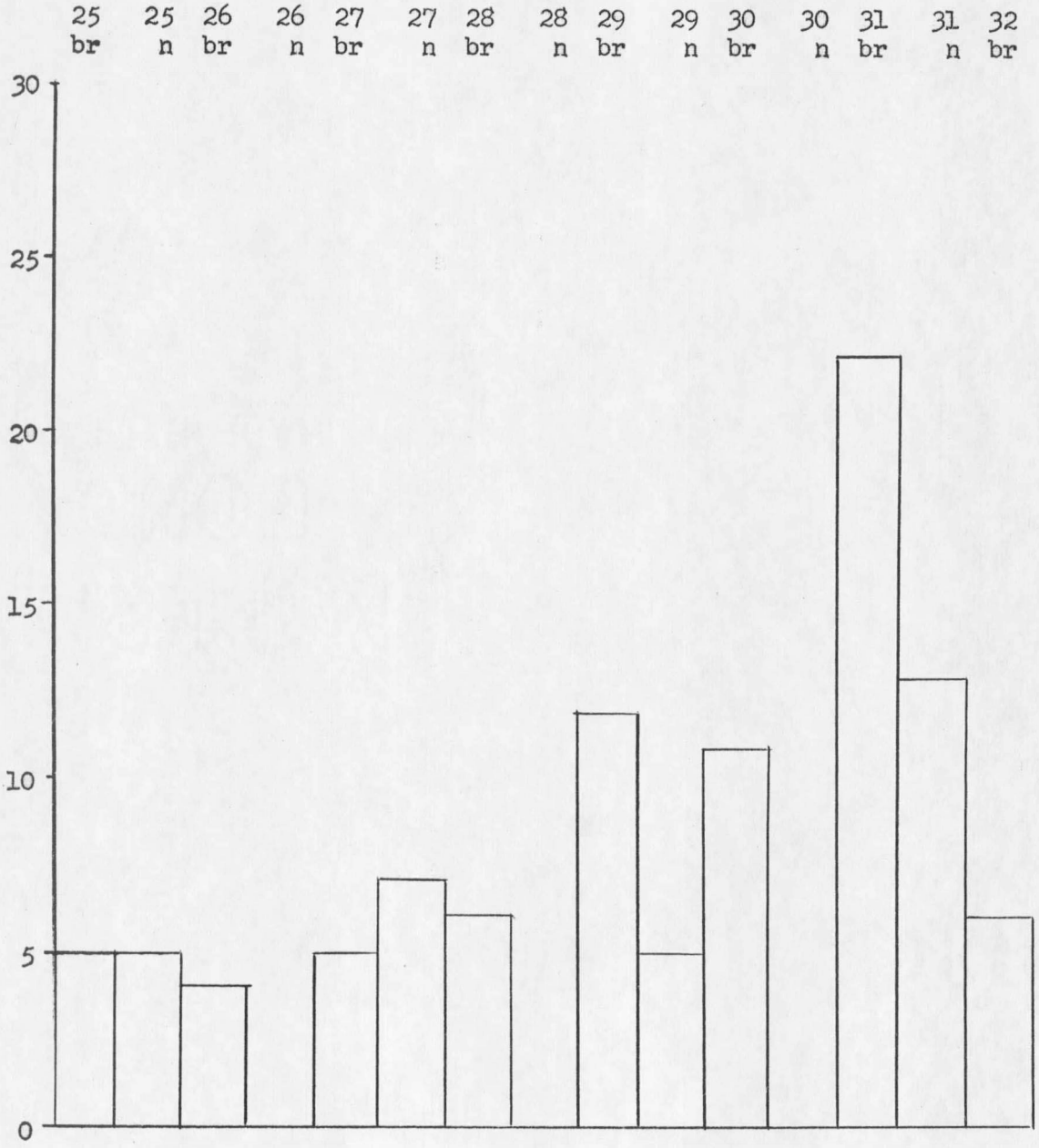
Graph 60. S. canasense v. neohawskii P.I. 230,506.1 (86-62)
Transaequatorialia



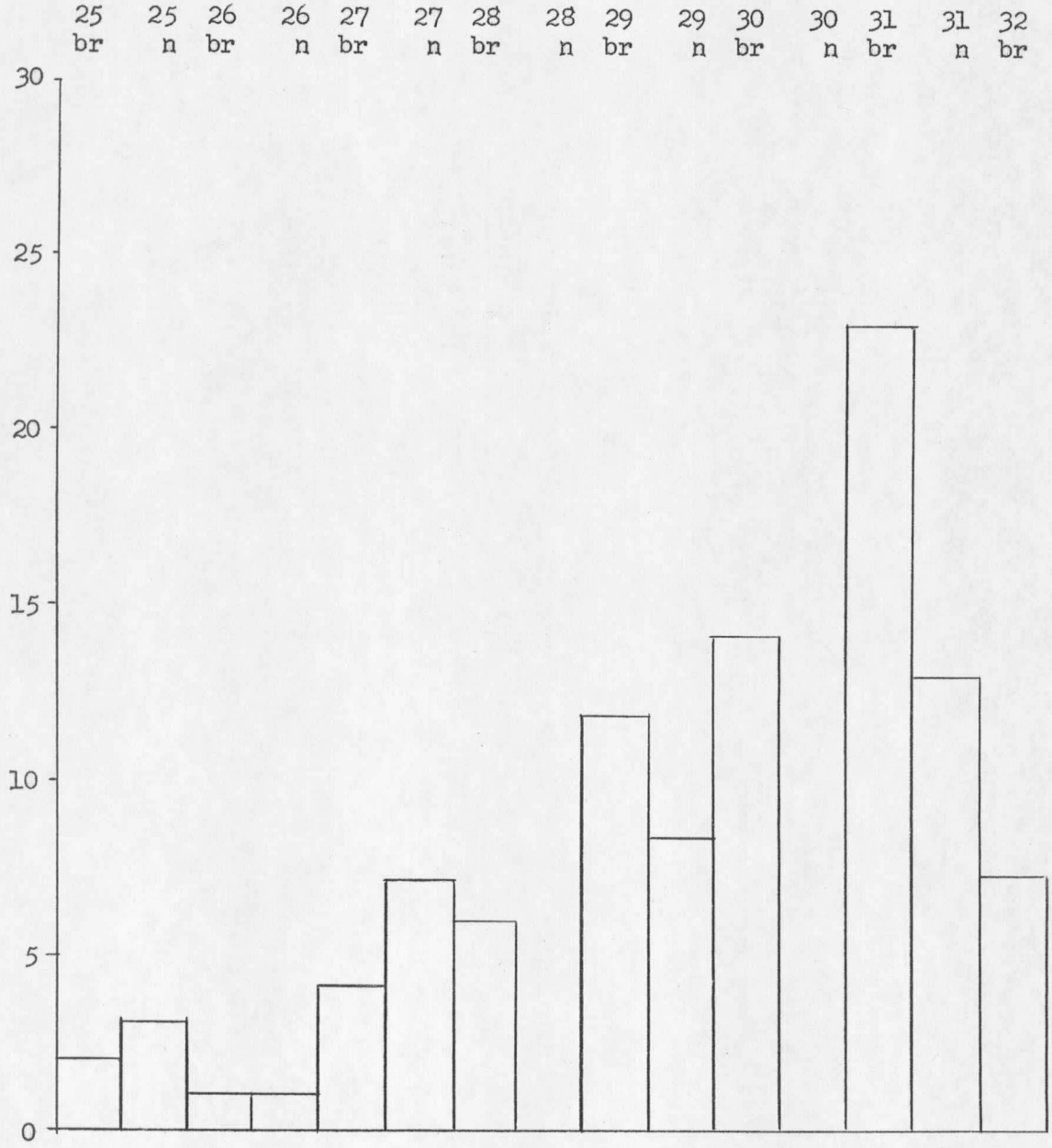
Graph 61. S. candolleanum P.I. 243,502 (55-62)
Transaequatorialia



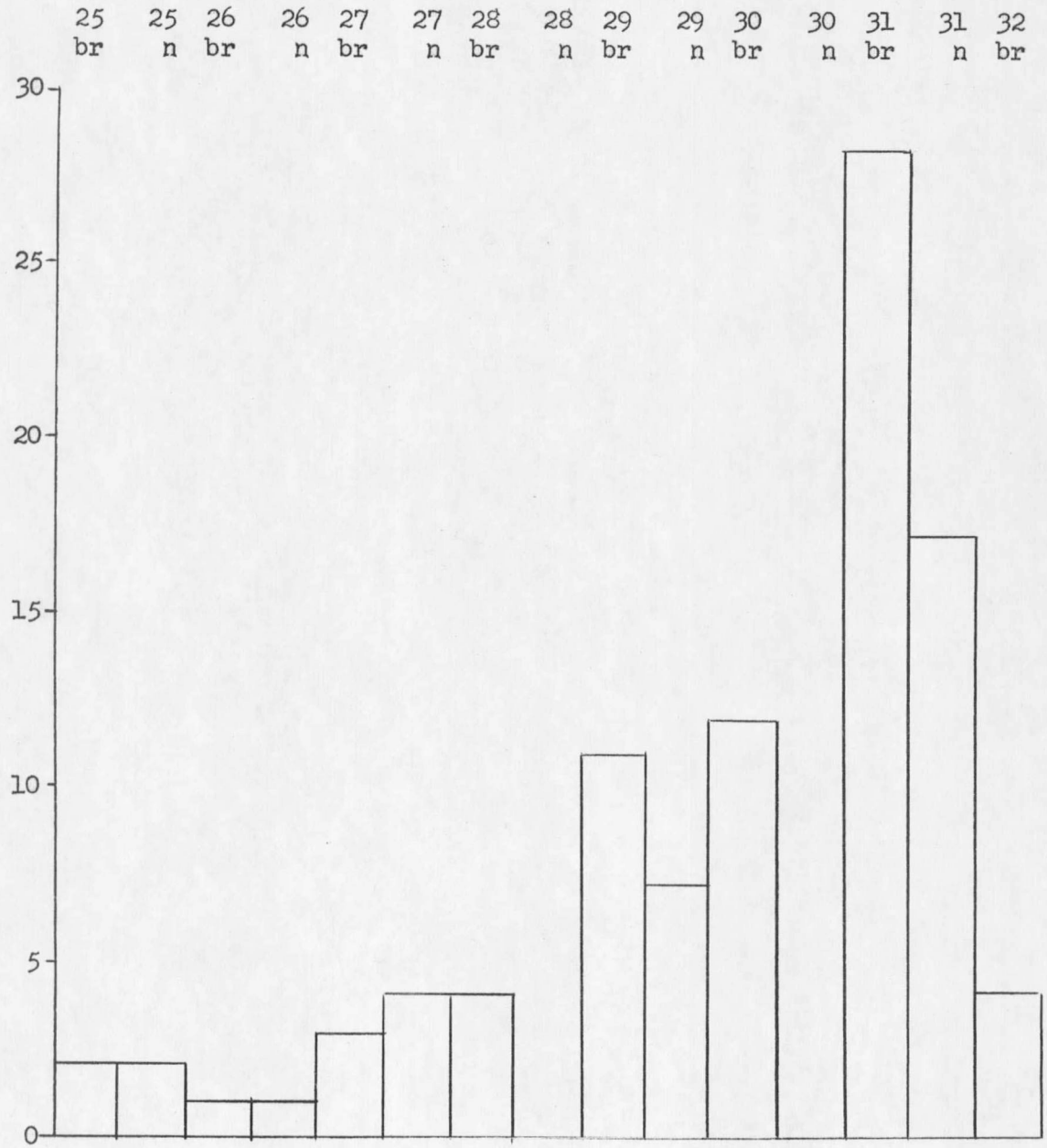
Graph 62. S. kurtzianum P.I. 175,434.1 (26-62)
Transaequatorialia



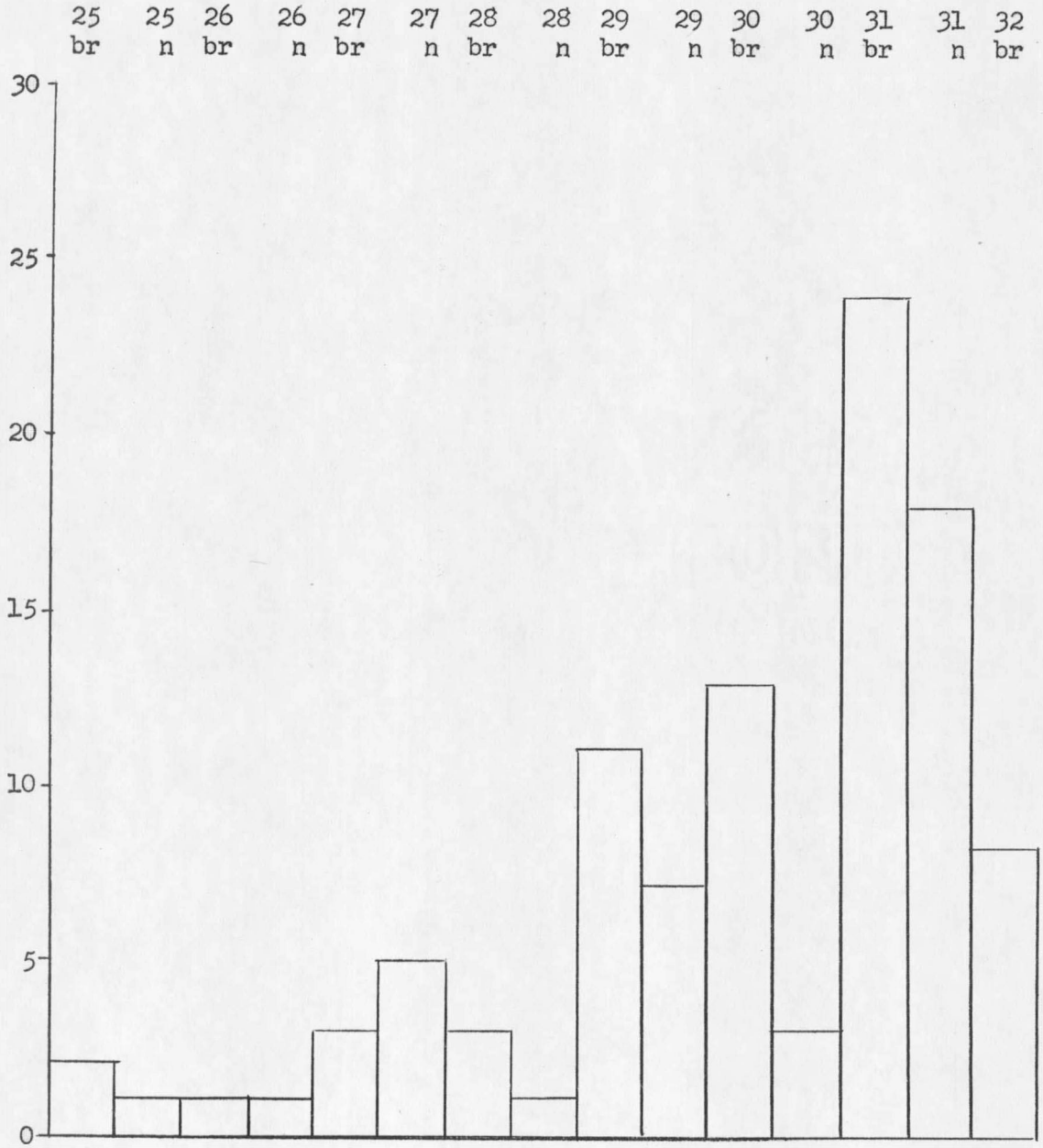
Graph 63. S. kurtzianum P.I. 175,435.1 (53-62)
Transaequatorialia



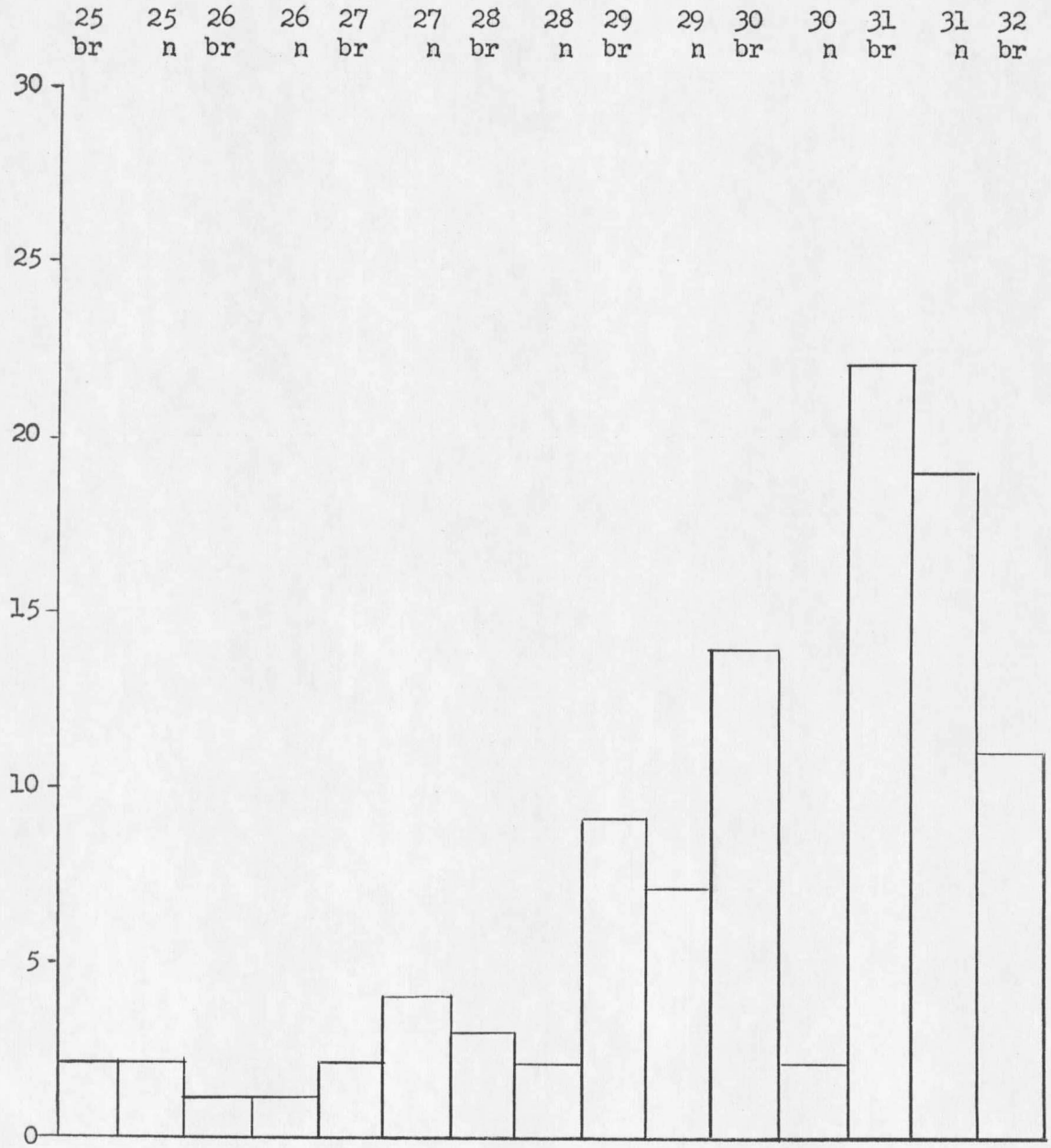
Graph 64. S. kurtzianum P.I. 175,435.1 ('64)
Transaequatorialia



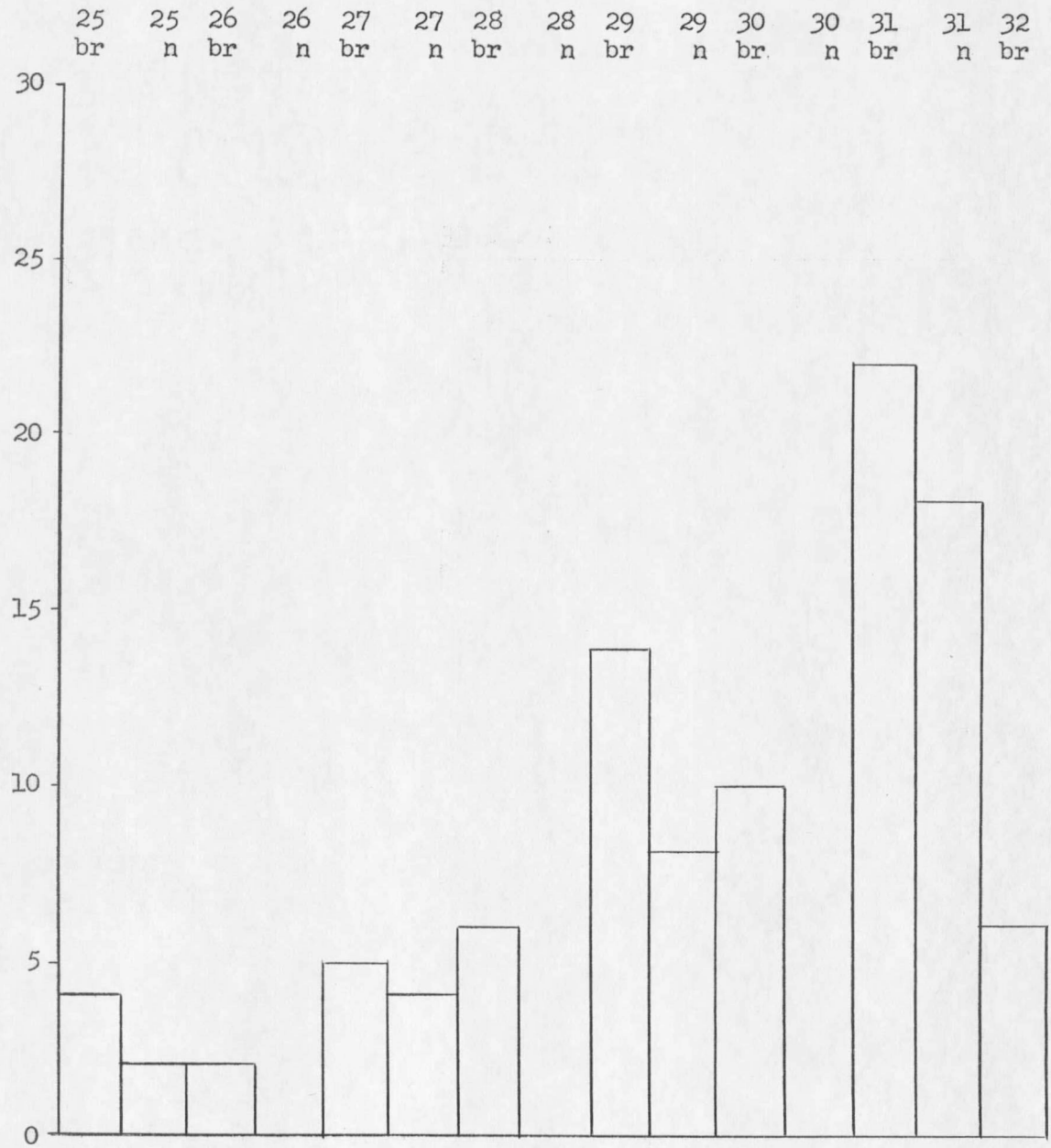
Graph 65. S. kurtzianum P.I. 175,435 (seed) ('64)
Transaequatorialia



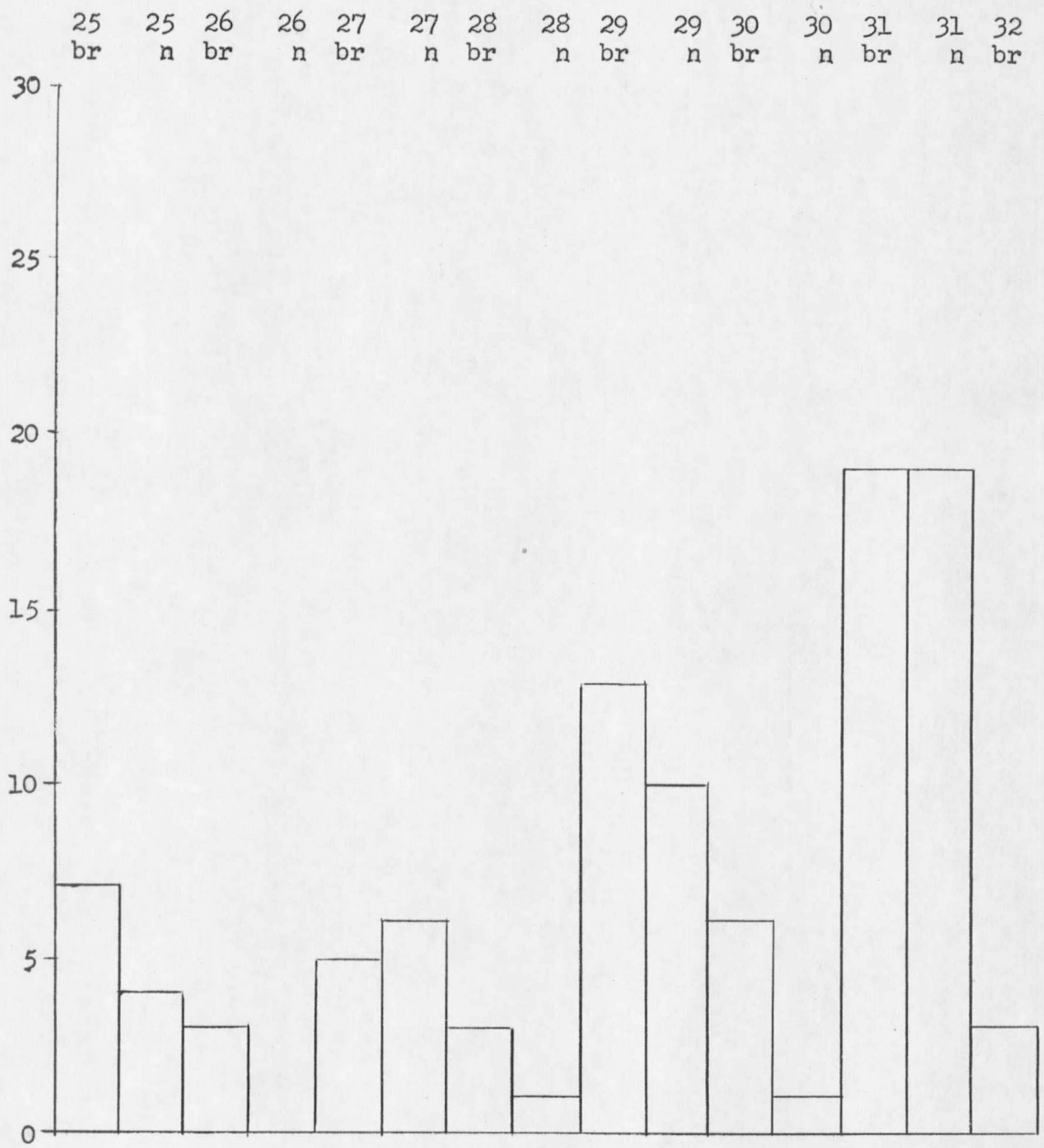
Graph 66. S. kurtzianum P.I. 175,435 C-1 ('64)
Transaequatorialia



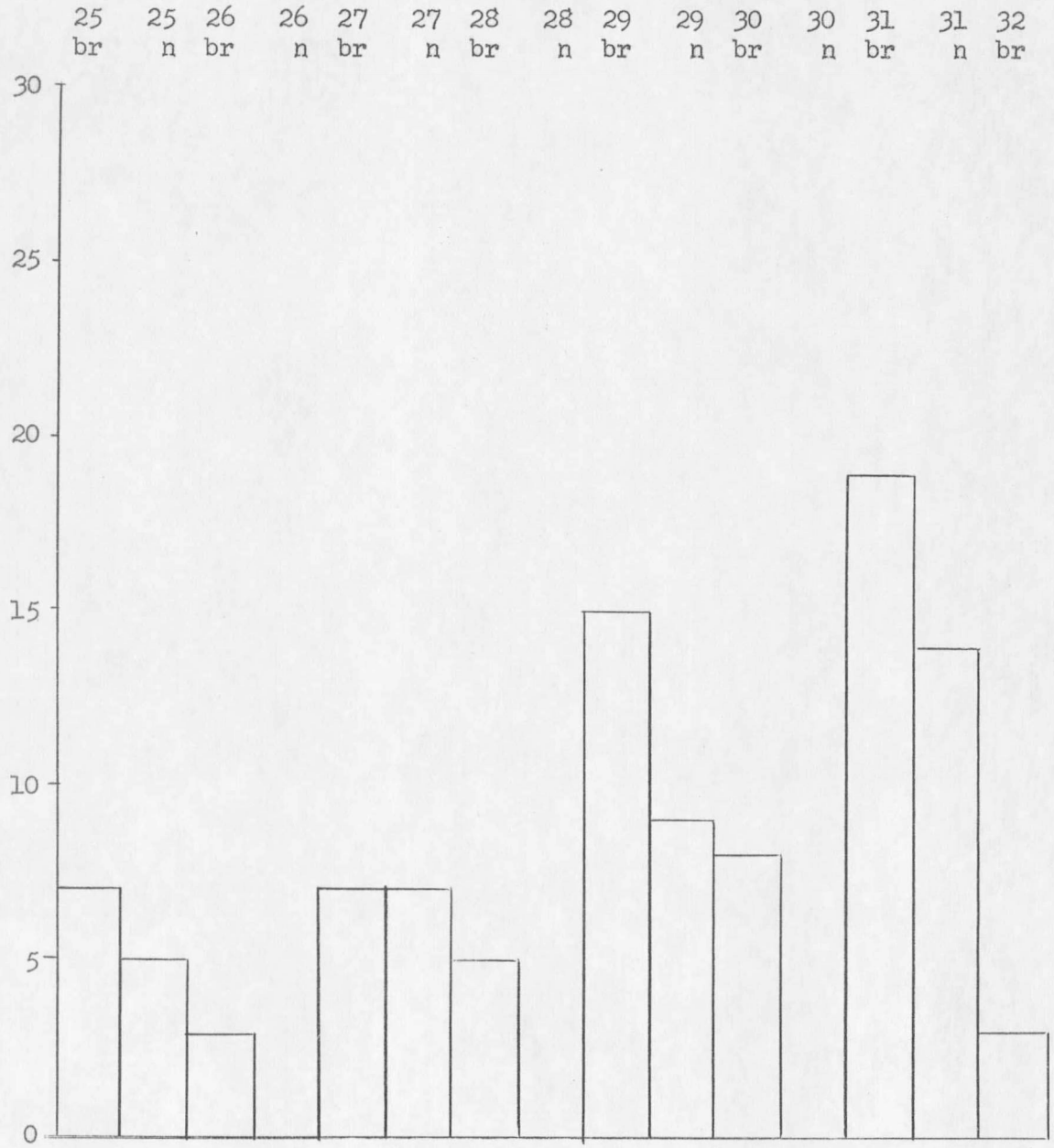
Graph 67. S. lignicaule P.I. 230,504.2 ('64)
Transaequatorialia



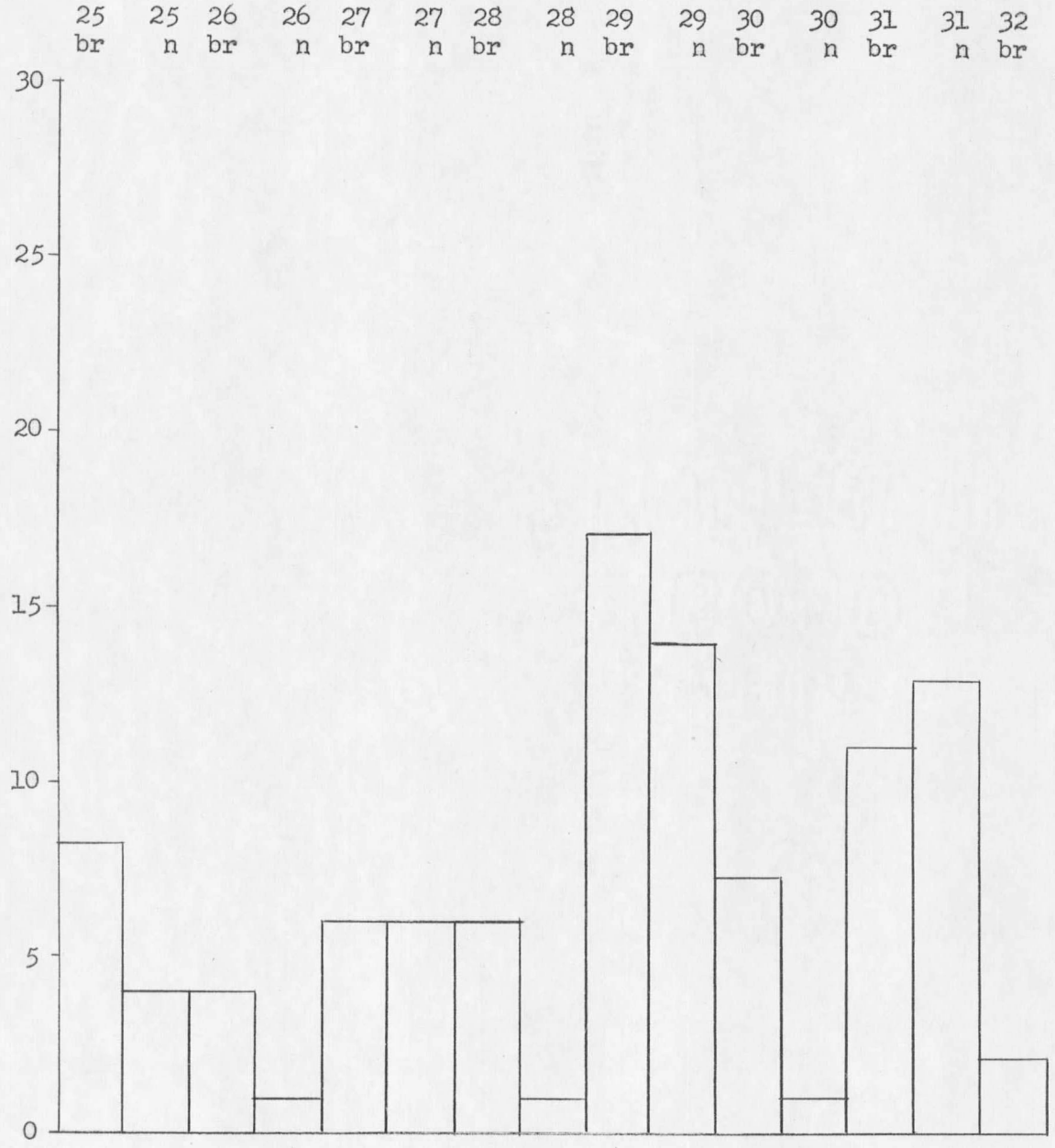
Graph 68. S. simplicifolium P.I. 208,866.1 (56-62)
Transaequatorialia



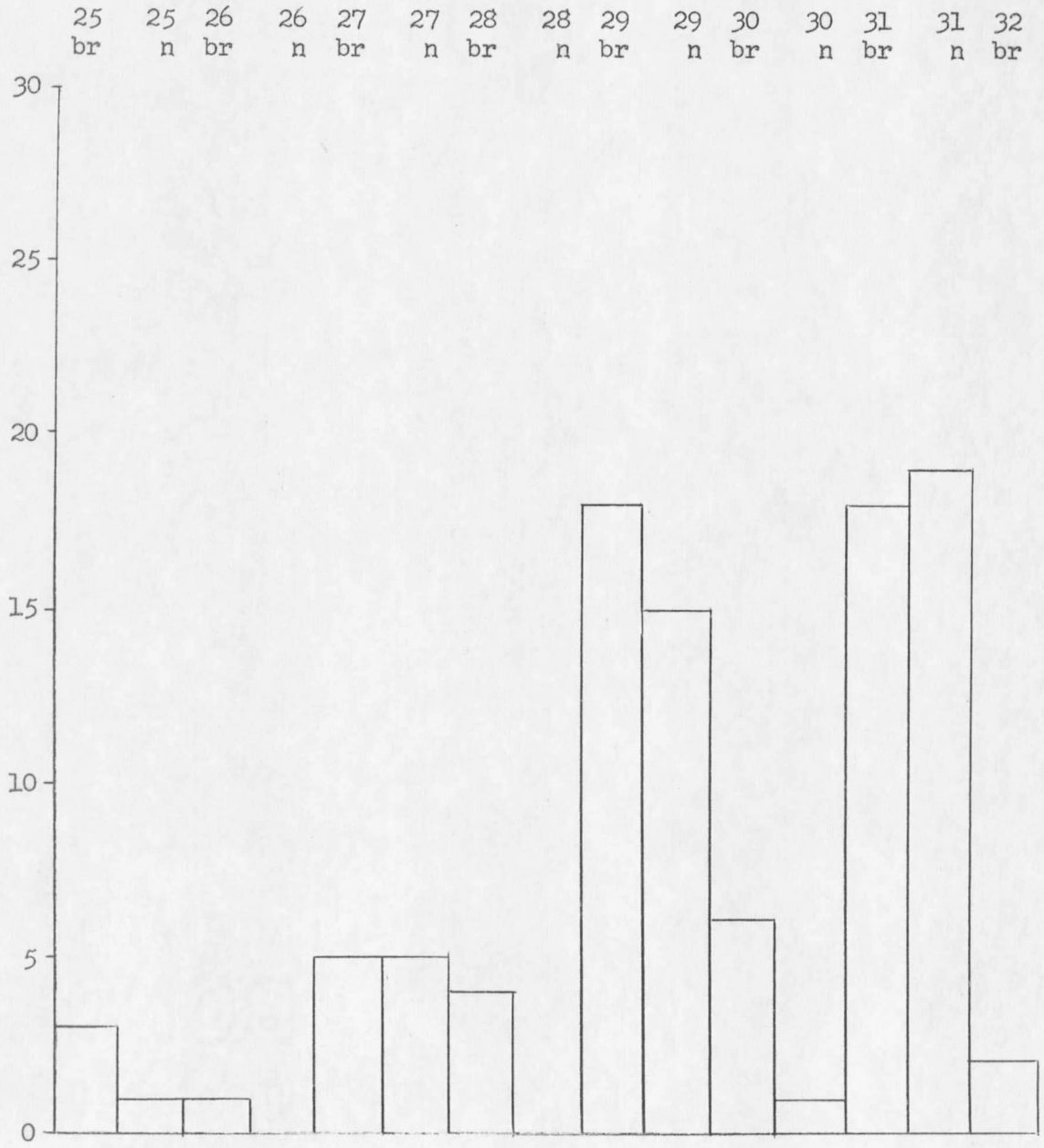
Graph 69. S. simplicifolium P.I. 218,222.1 (24-62)
Transaequatorialia



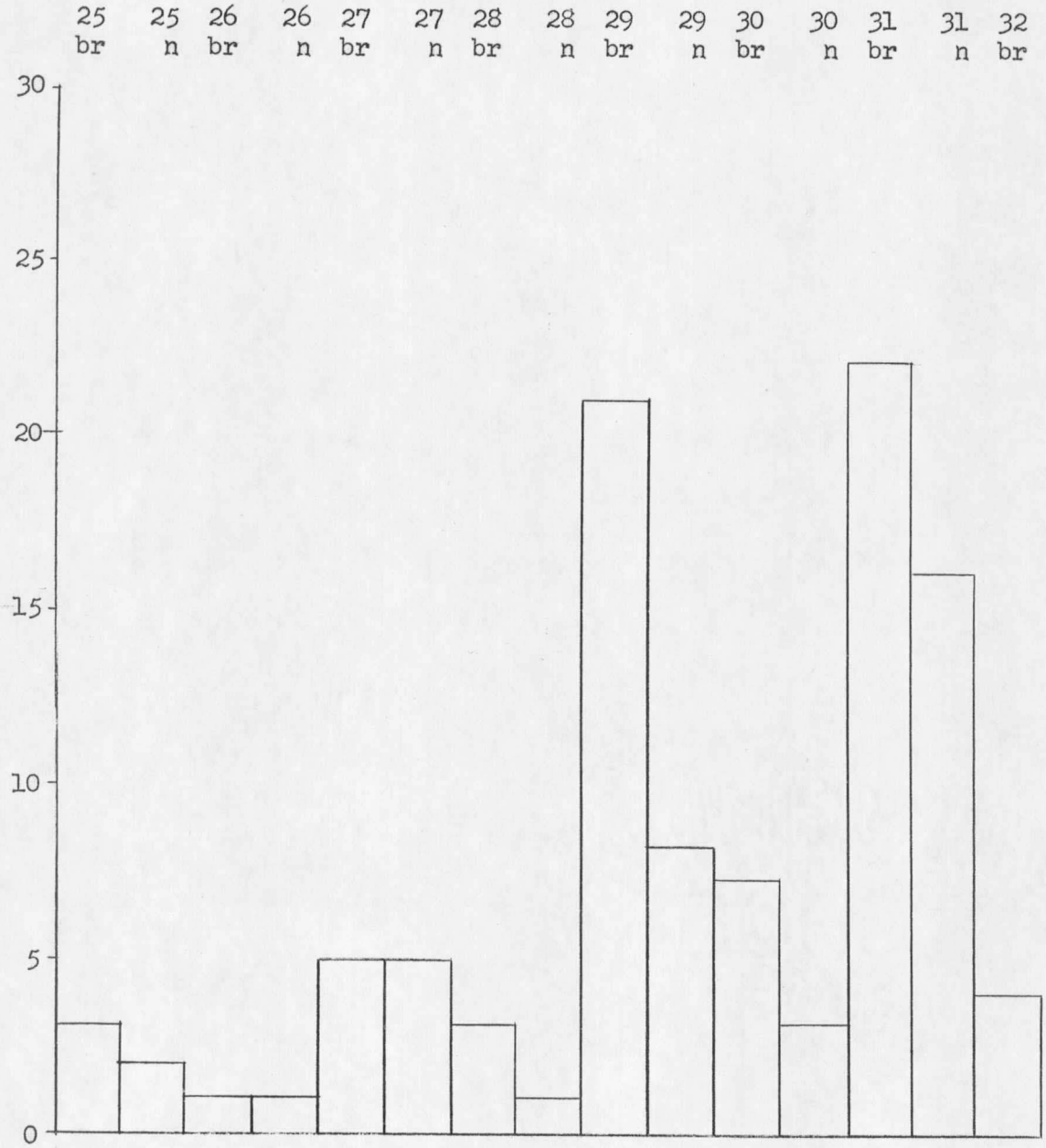
Graph 70. S. soukupii P.I. 230,511.4 (28-62)
Transaequatorialia



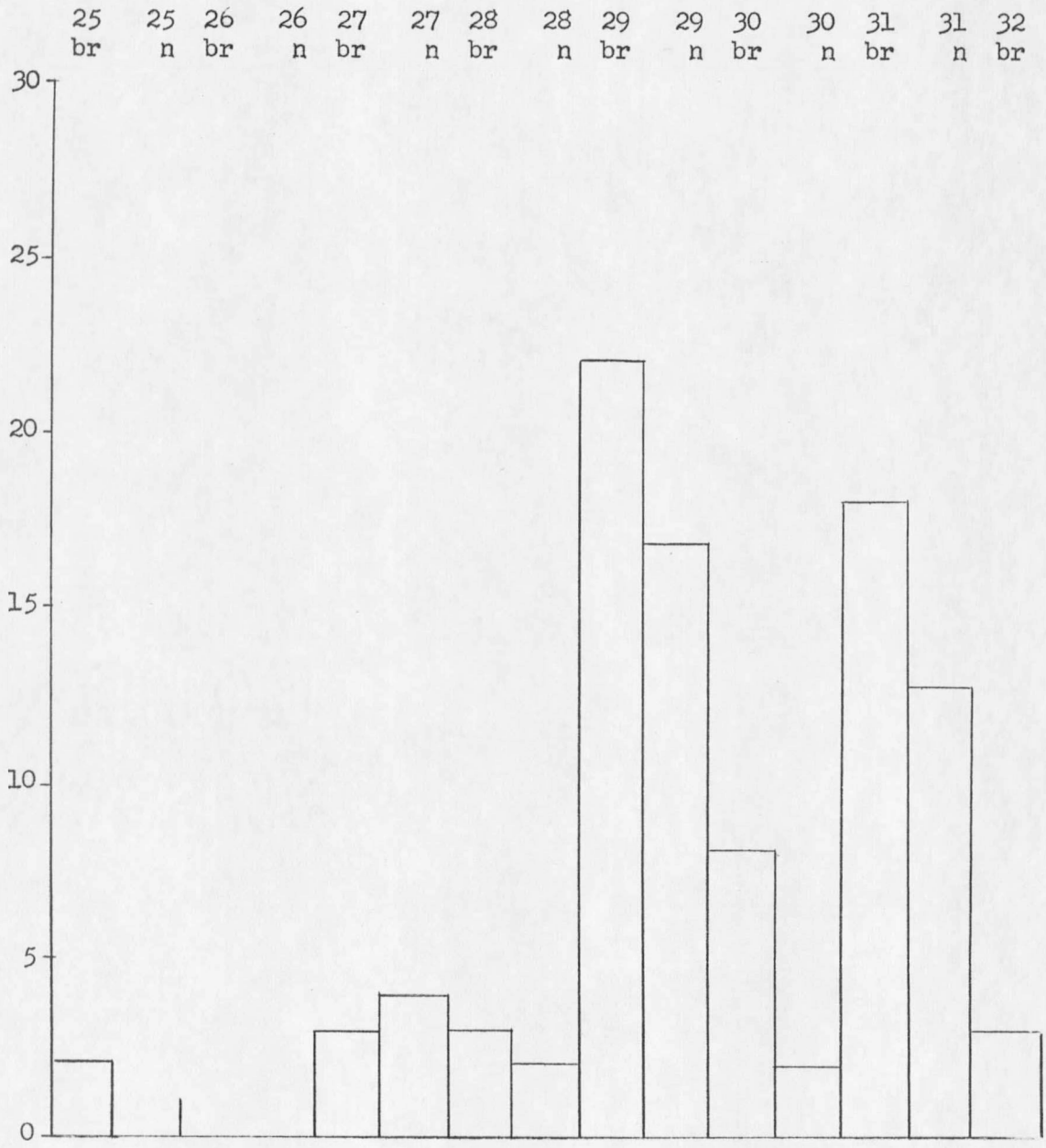
Graph 71. S. soukupii P.I. 230,511.4 ('64)
Transaequatorialia



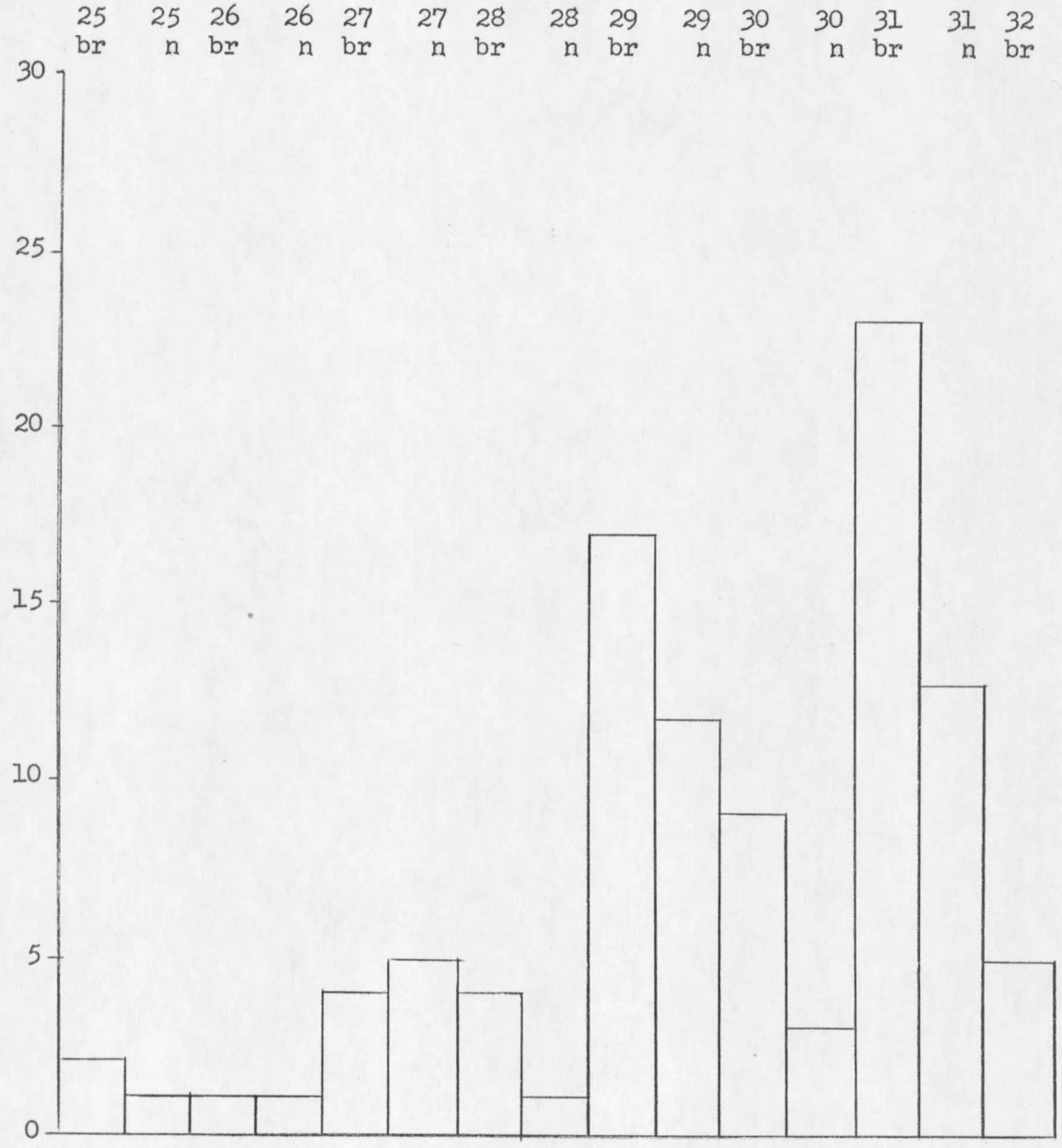
Graph 72. S. sparsipilum P.I. 230,502.2 (84-62)
Transaequatorialia



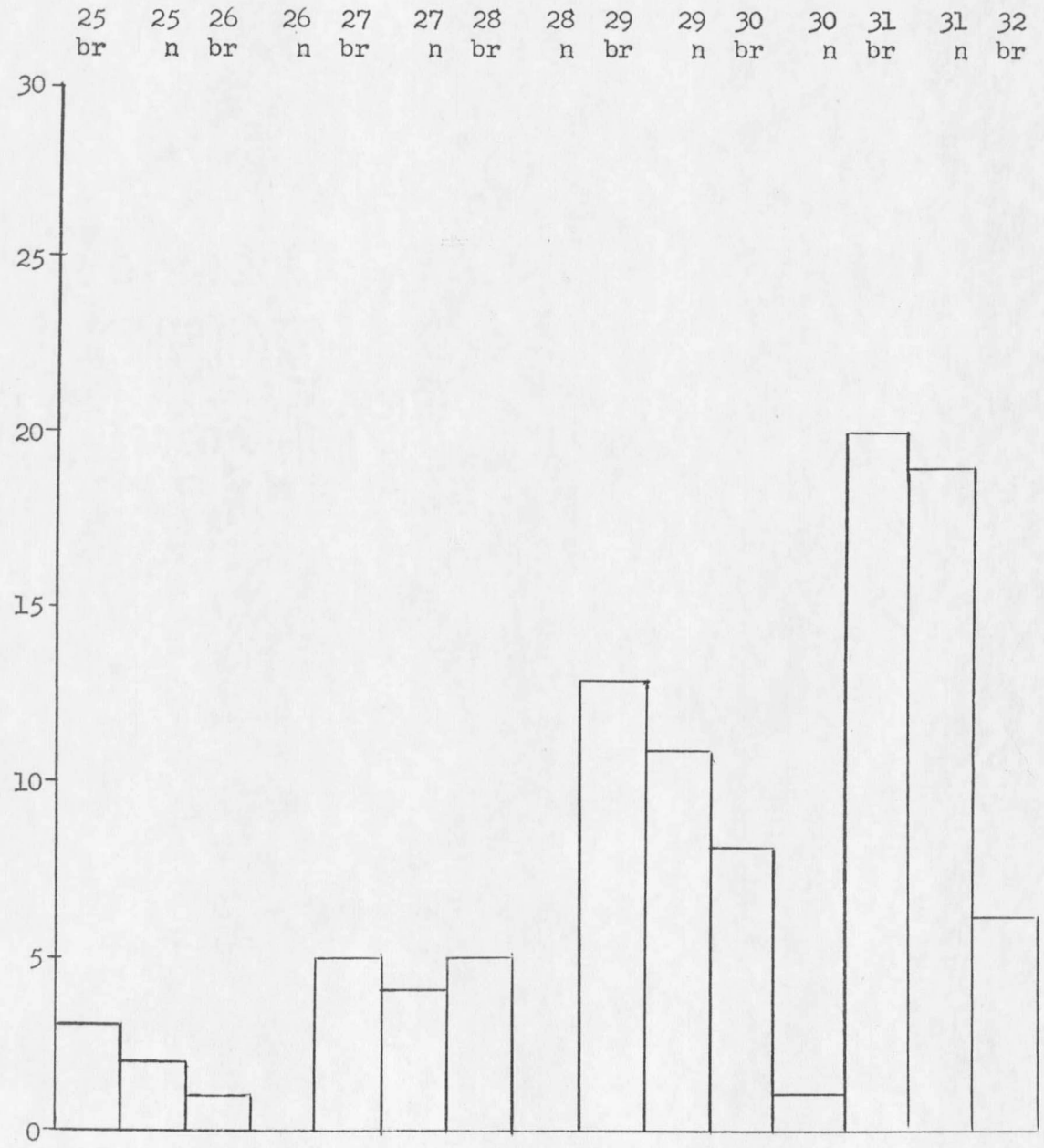
Graph 73. S. sparsipilum P.I. 233,693 (25-62)
Transaequatorialia



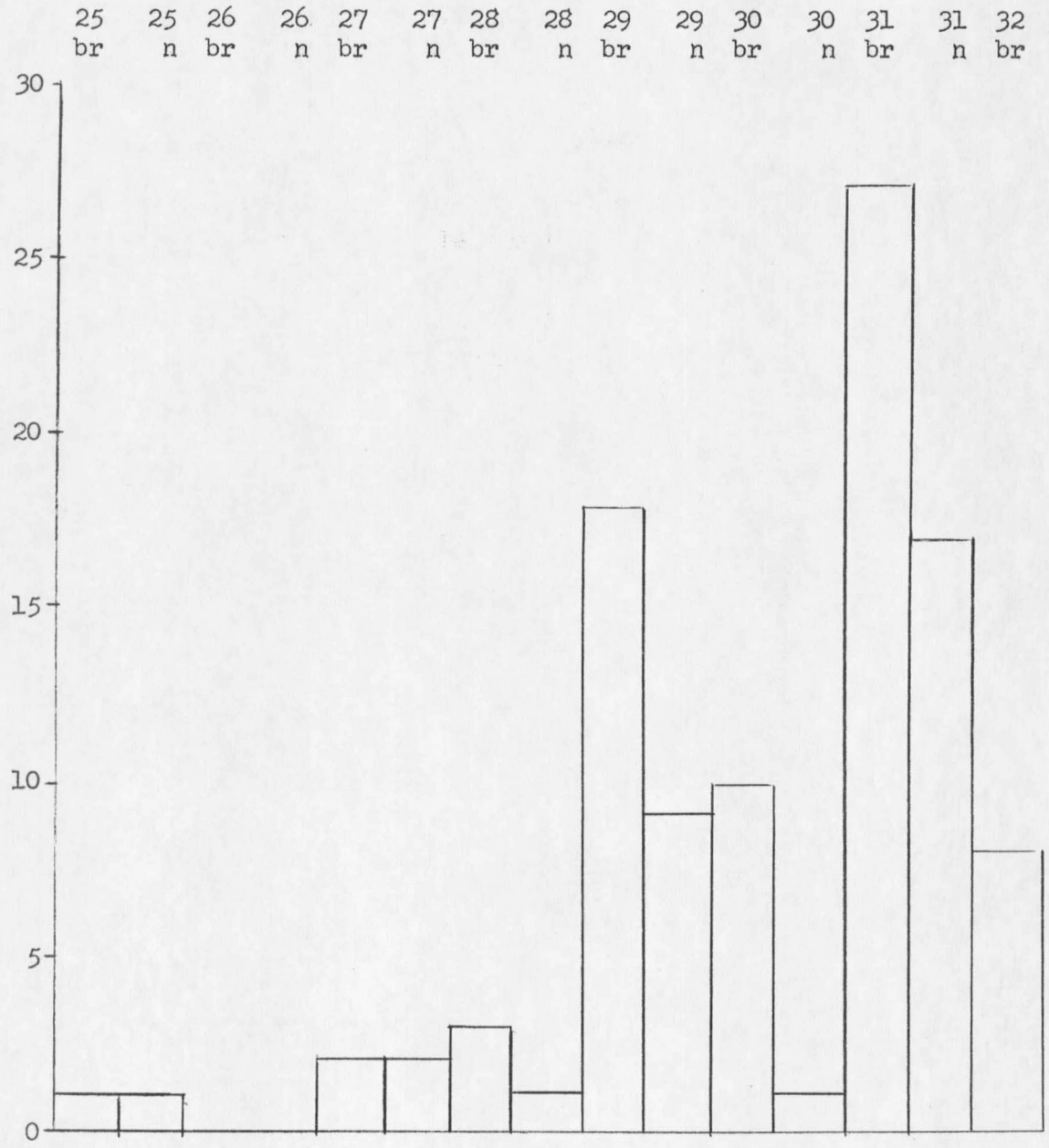
Graph 74. v. llallaguanianum (S. sucrense) P.I. 230,465.2 (19-62)
Transaequatorialia



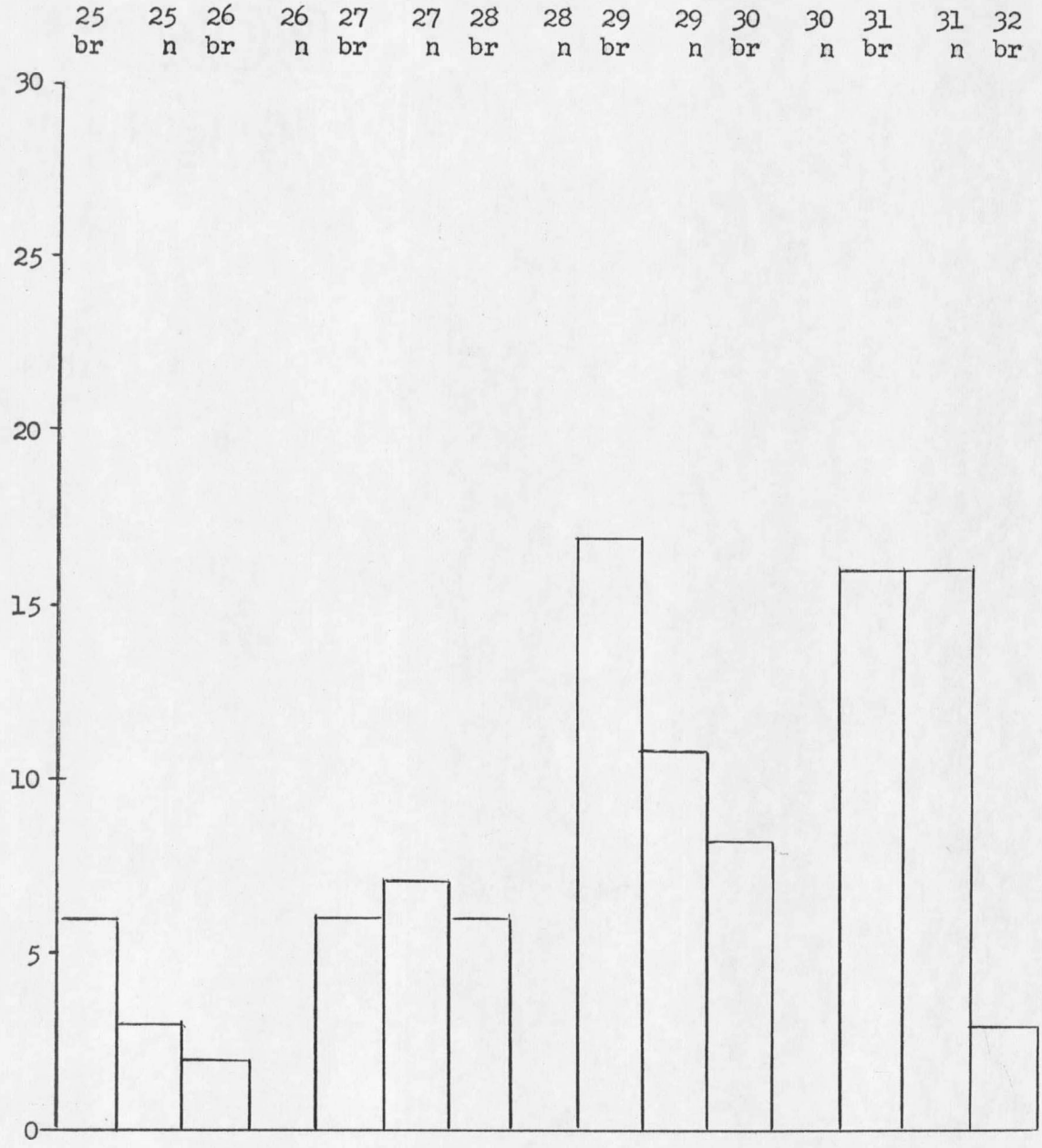
Graph 75. S. velascanum (S. famatinae) P.I. 275,143.1 (59-62)
Transaequatorialia



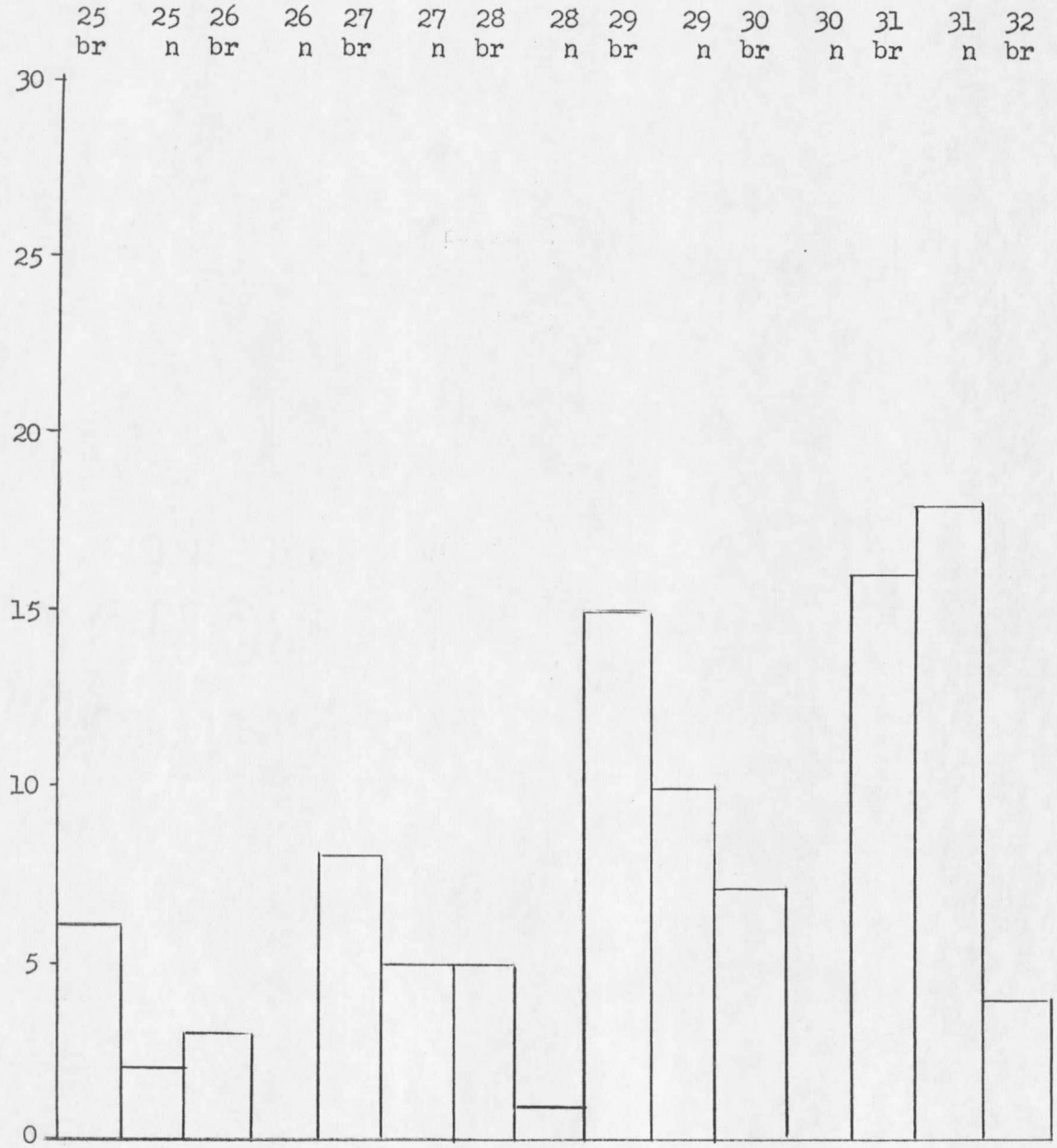
Graph 76. S. velascanum (S. famatinae) P.I. 275,144.1 (76-62)
Transaequatorialia



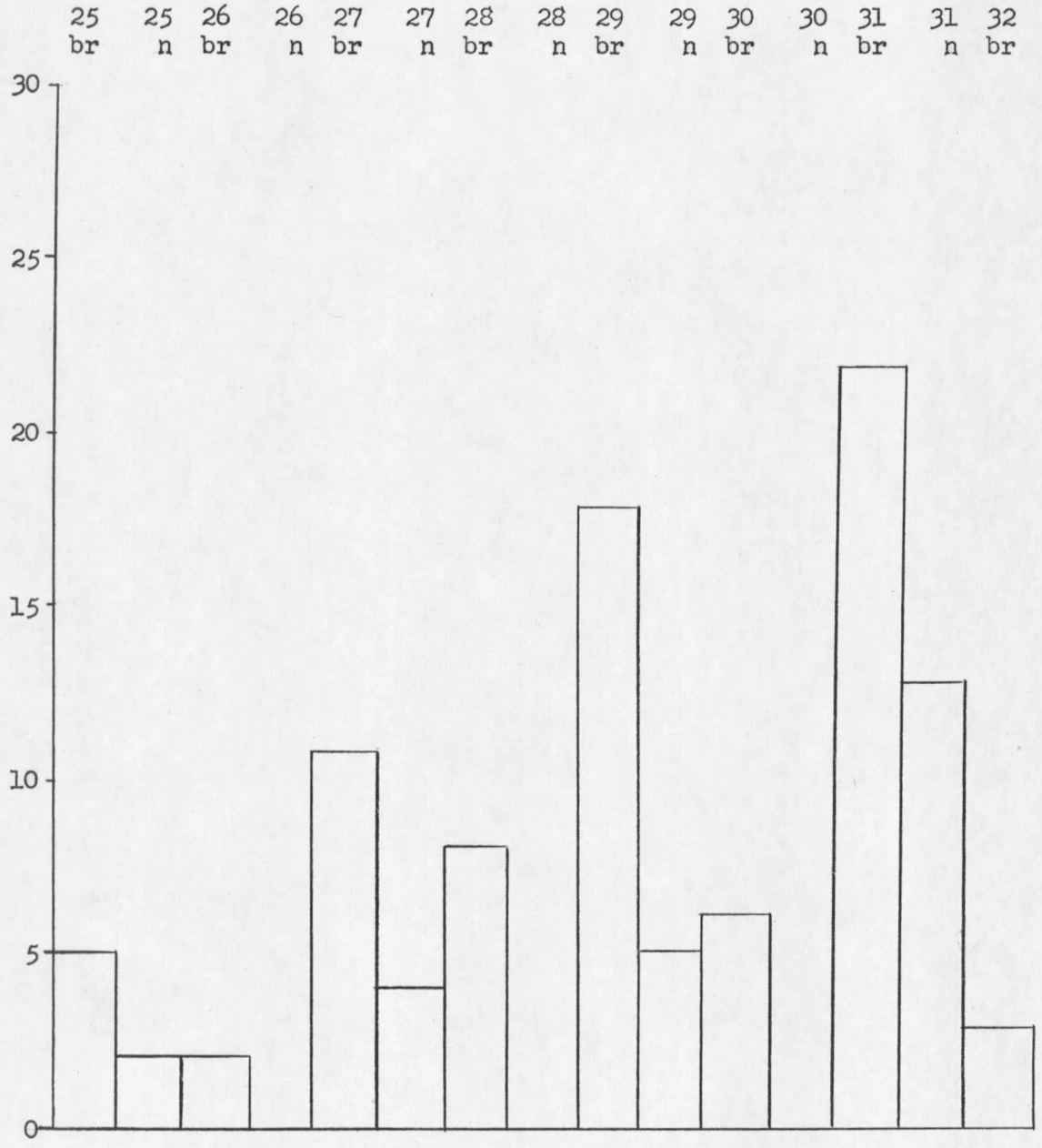
Graph 77. S. vernei P.I. 230,562.2 (82-62)
Transaequatorialia



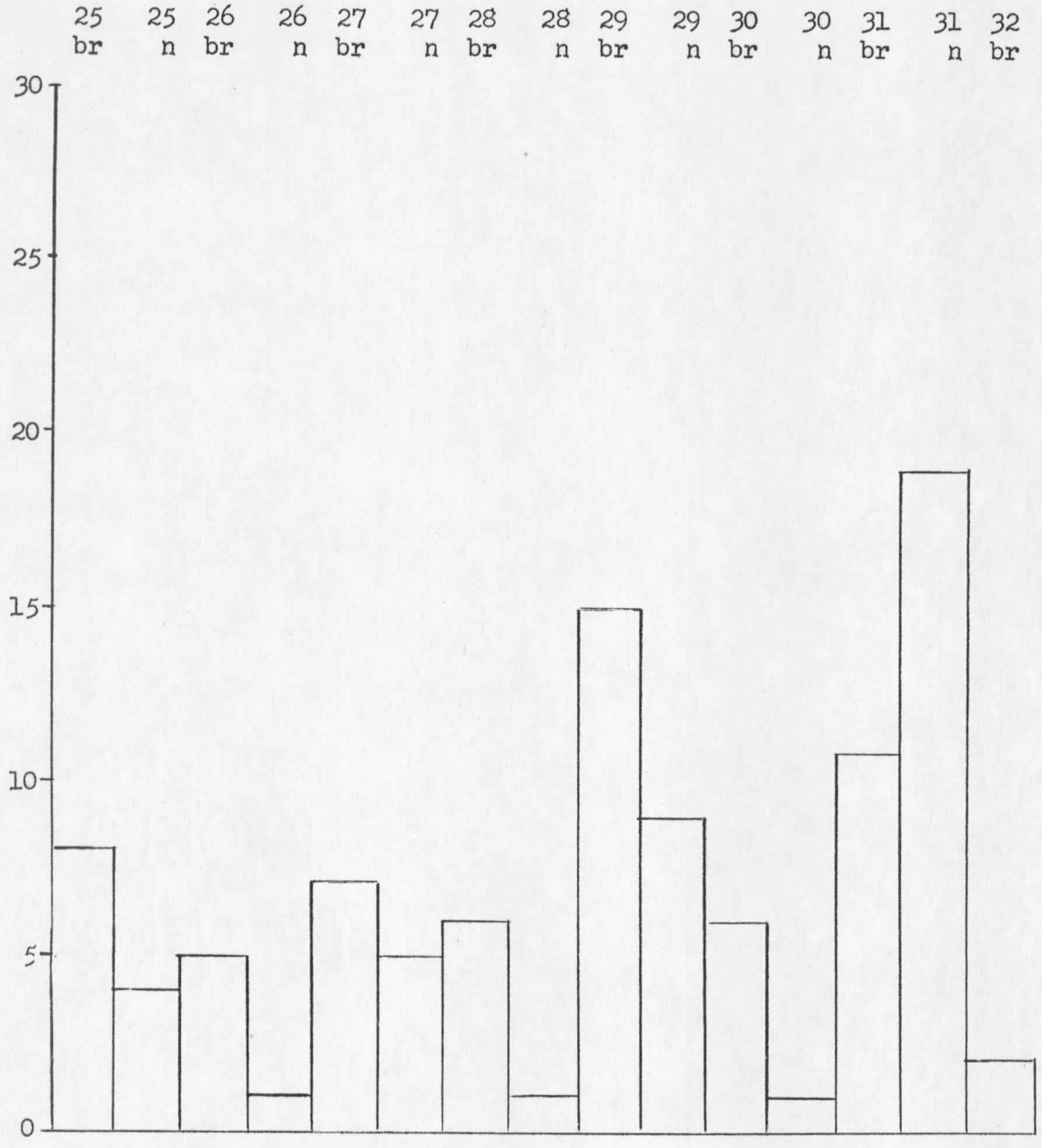
Graph 78. S. tuberosum (S. stenotomum) P.I. 230,512.3 (70-62)
Tuberosa



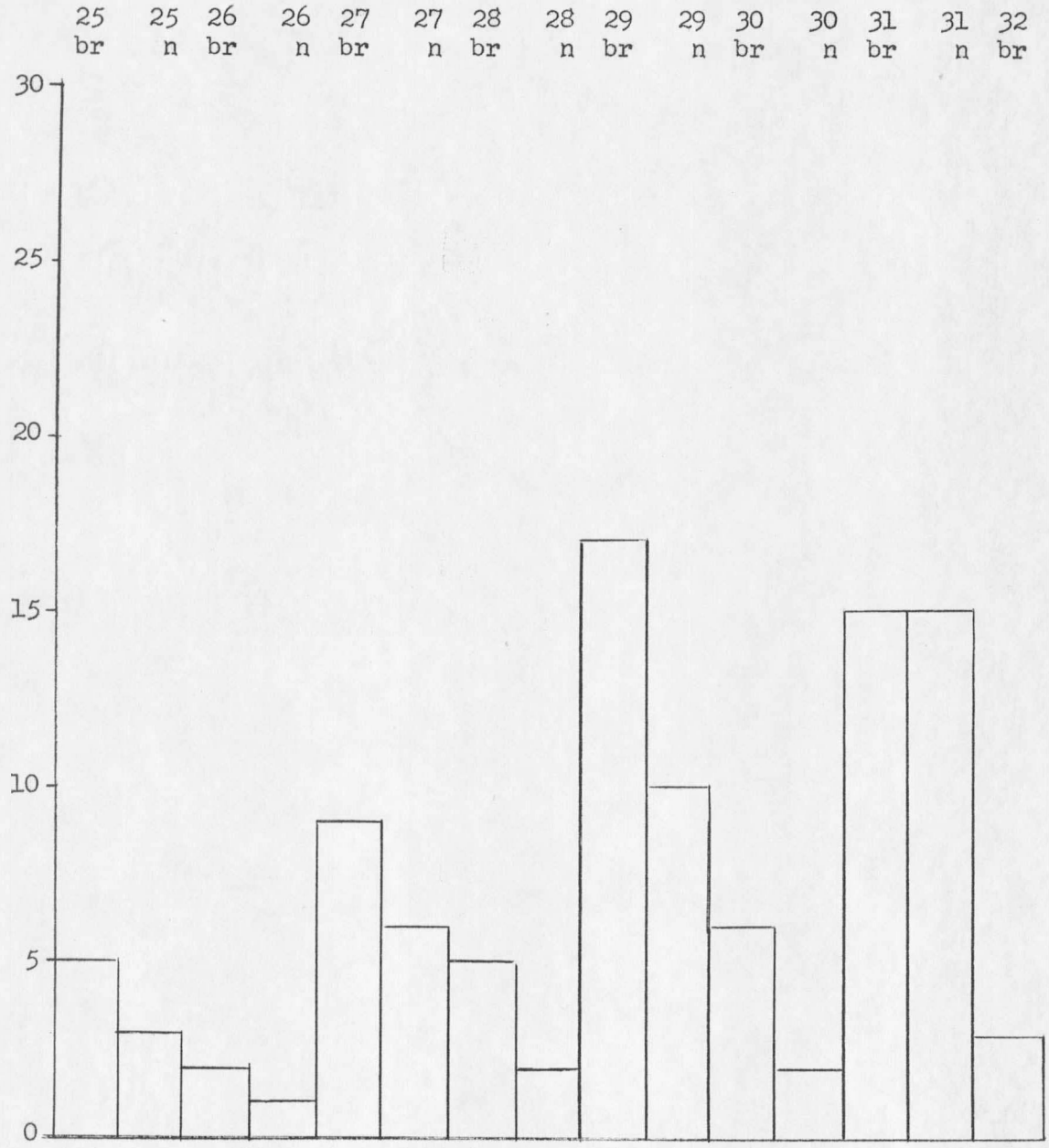
Graph 79. S. tuberosum (S. stenotomum) P.I. 195,204 (C-13) (11-62)
Tuberosa



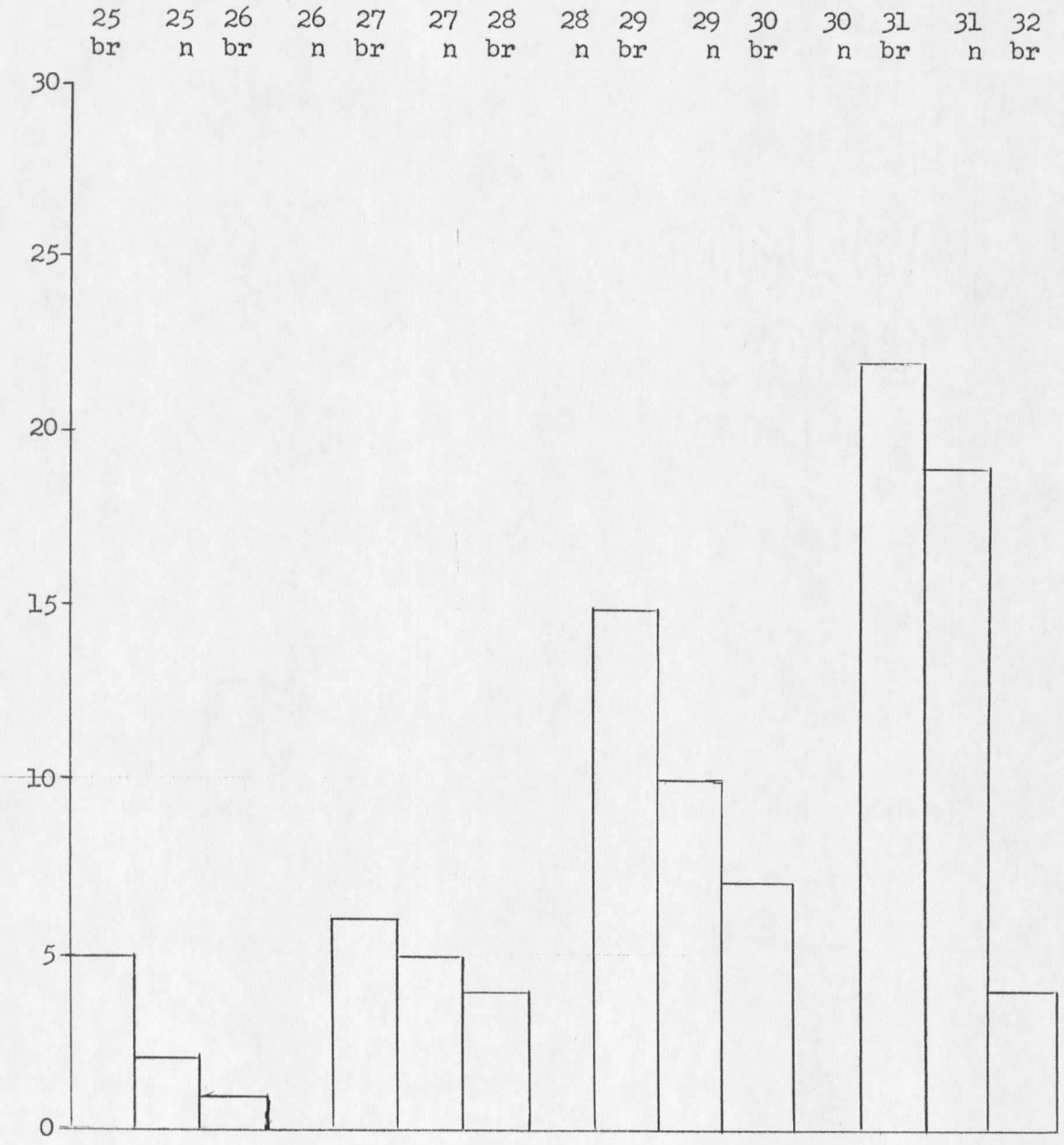
Graph 80. S. tuberosum (S. goniocalyx) P.I. 195,188 (39-62)
Tuberosa



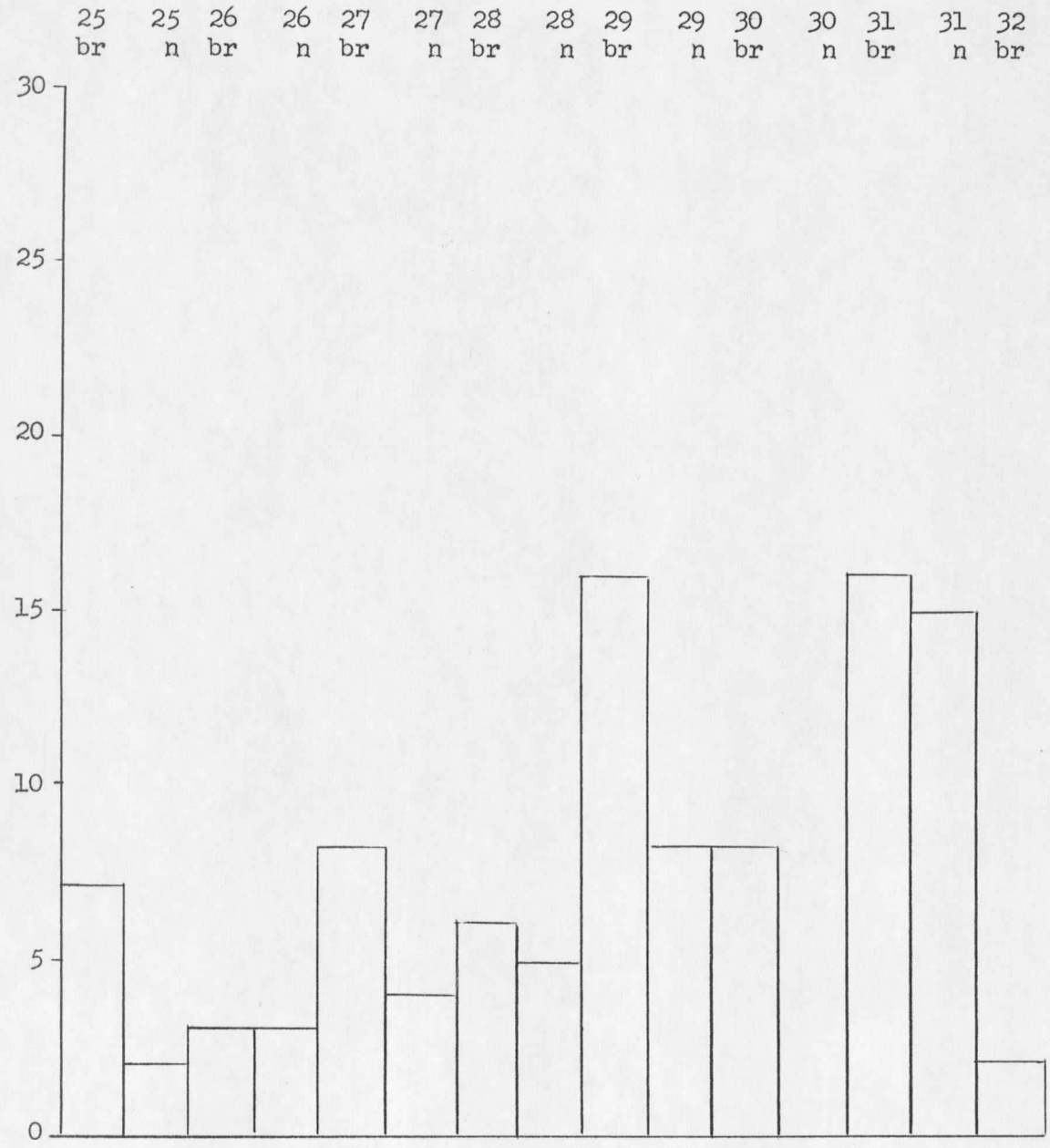
Graph 81. S. tuberosum (S. goniocalyx) P.I. 195,214 (31-62)
Tuberosa (Cultivated)



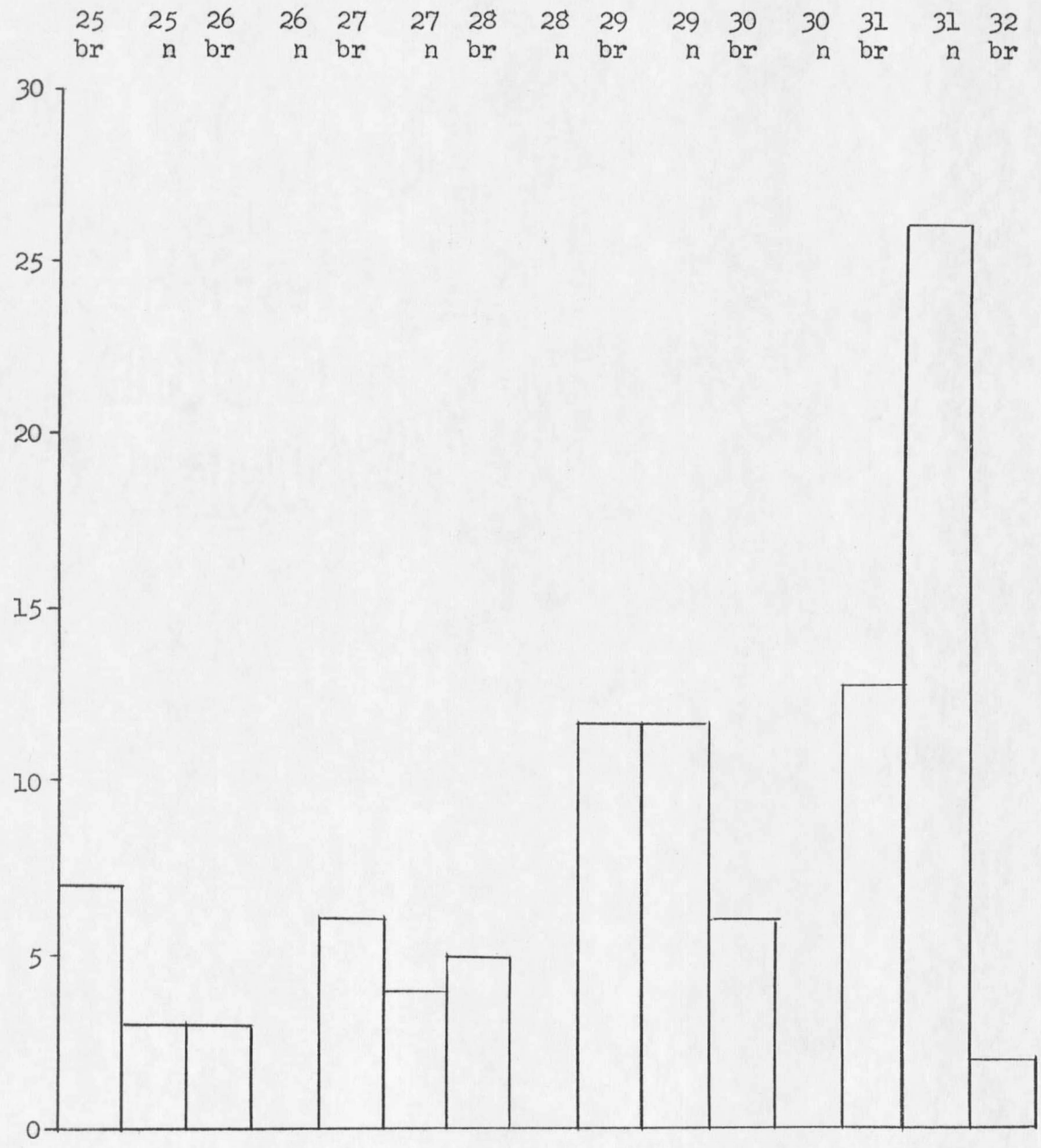
Graph 82. S. tuberosum (S. phureja) P.I. 195,198 (54-62)
Tuberosa (Cultivated)



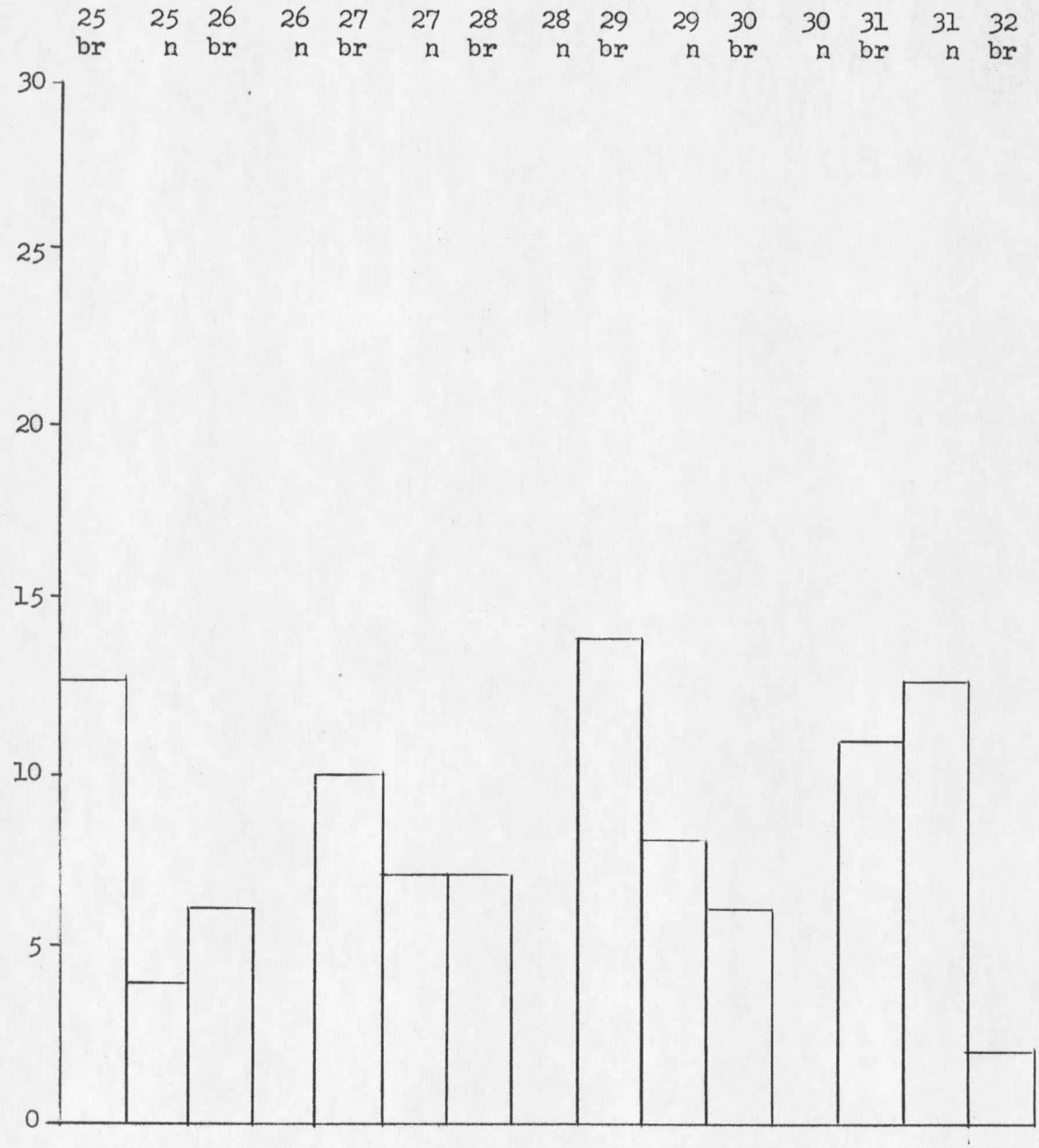
Graph 83. S. tuberosum P.I. 195,162.1 (22-62)
Tuberosa



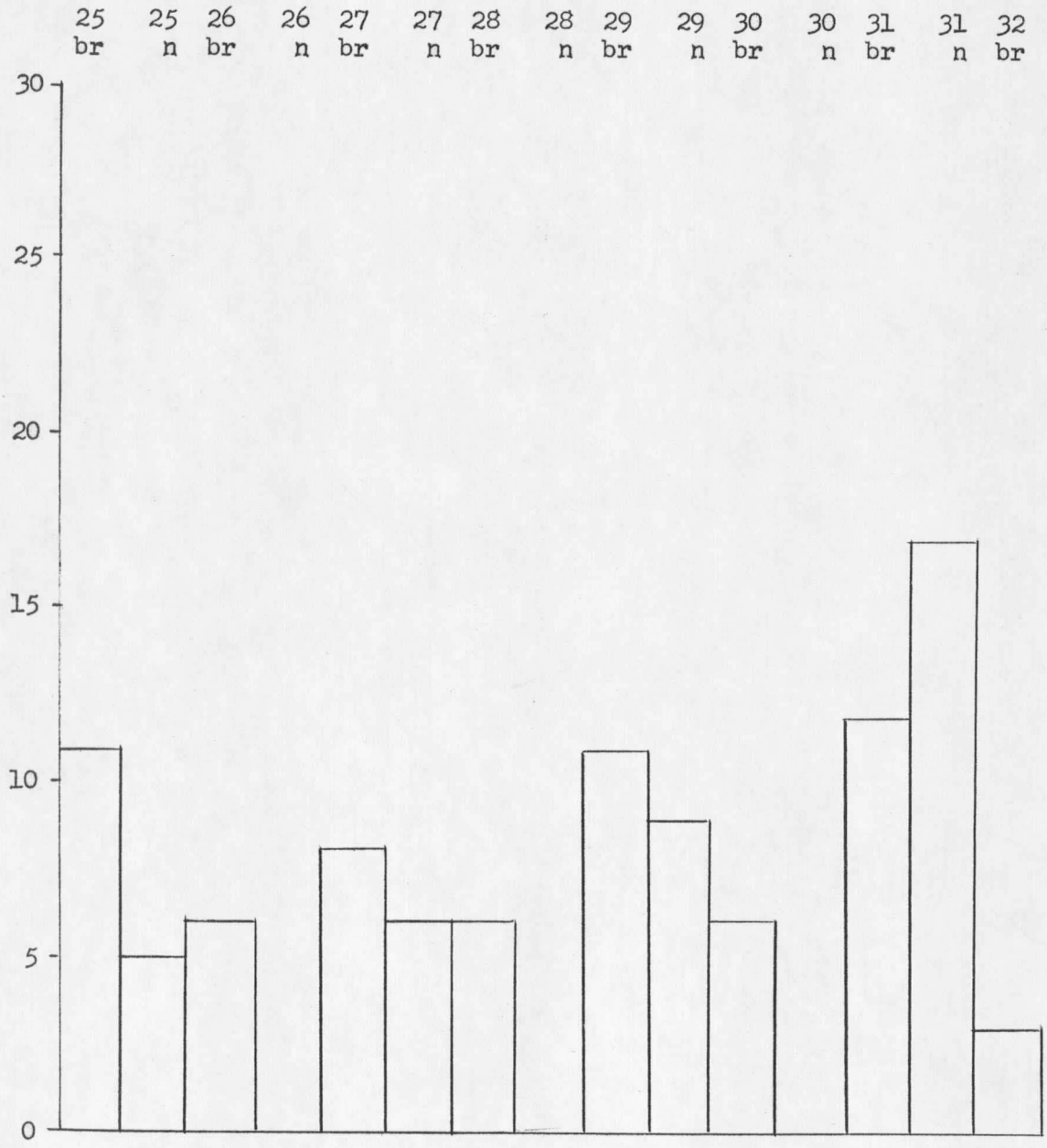
Graph 84. S. tuberosum "Russet Burbank" (102-62)
Tuberosa



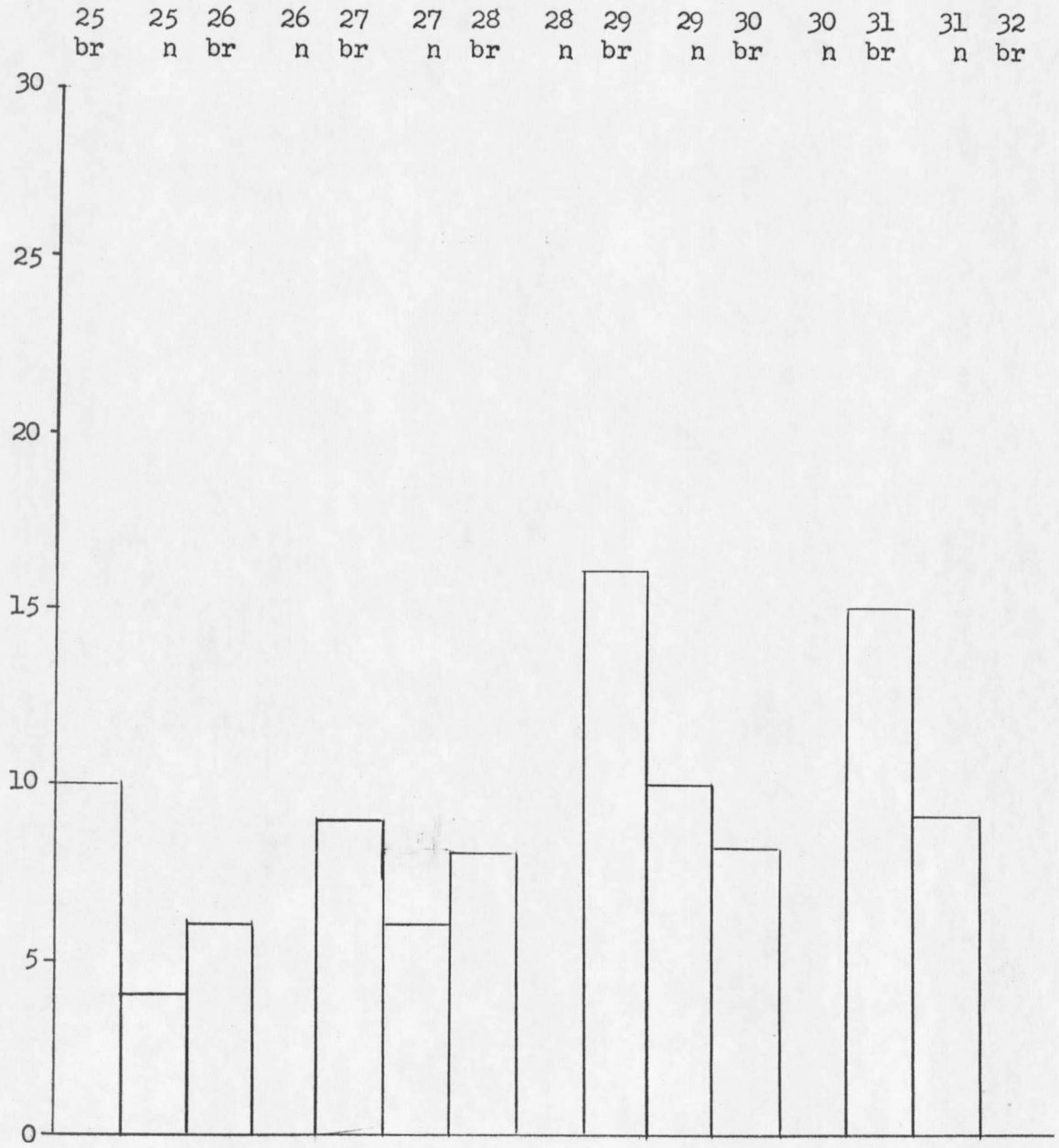
Graph 85. S. tuberosum "Norland" (110-62)
Tuberosa



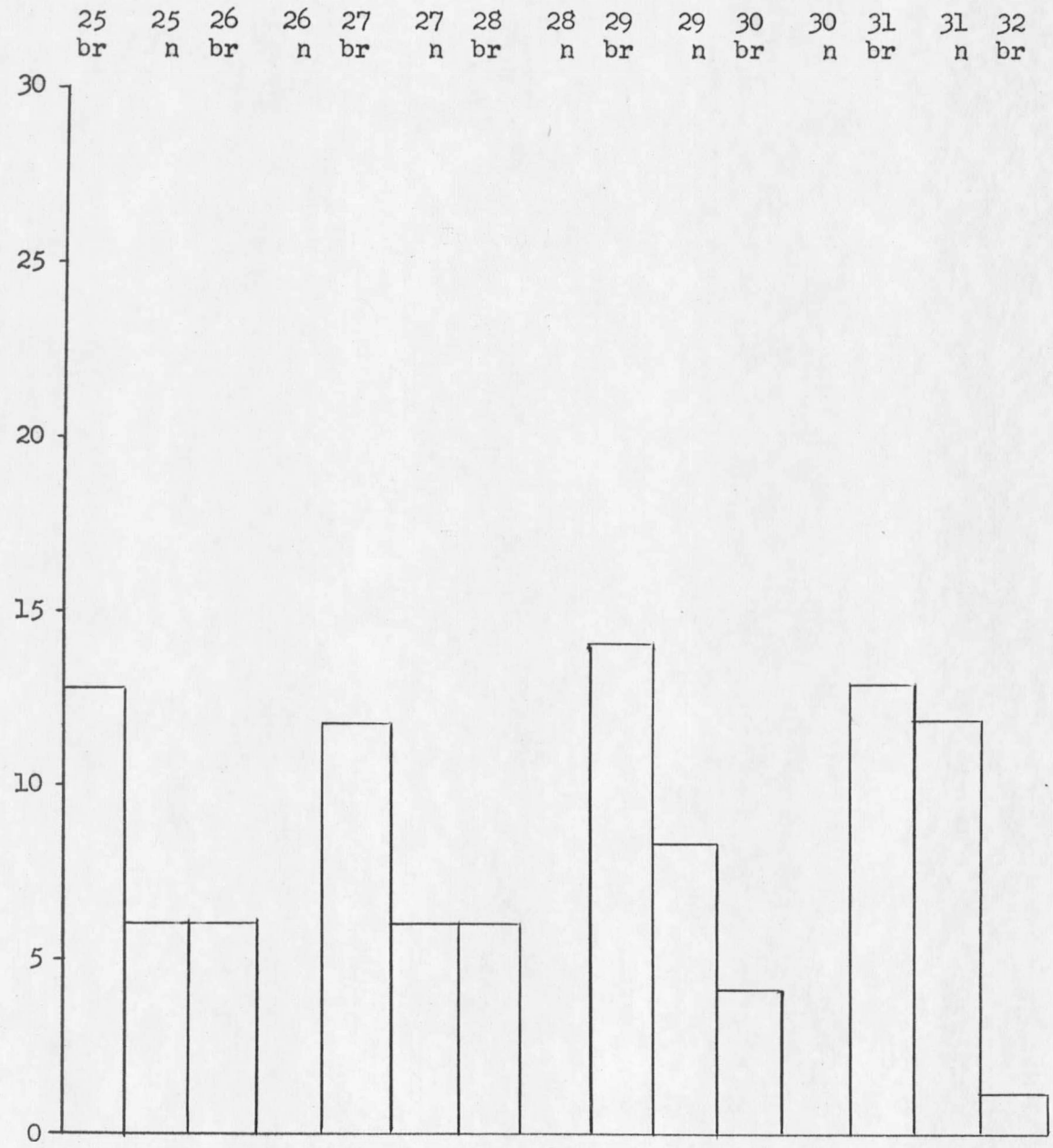
Graph 86. S. tuberosum "Dazoc" (112-62)
Tuberosa



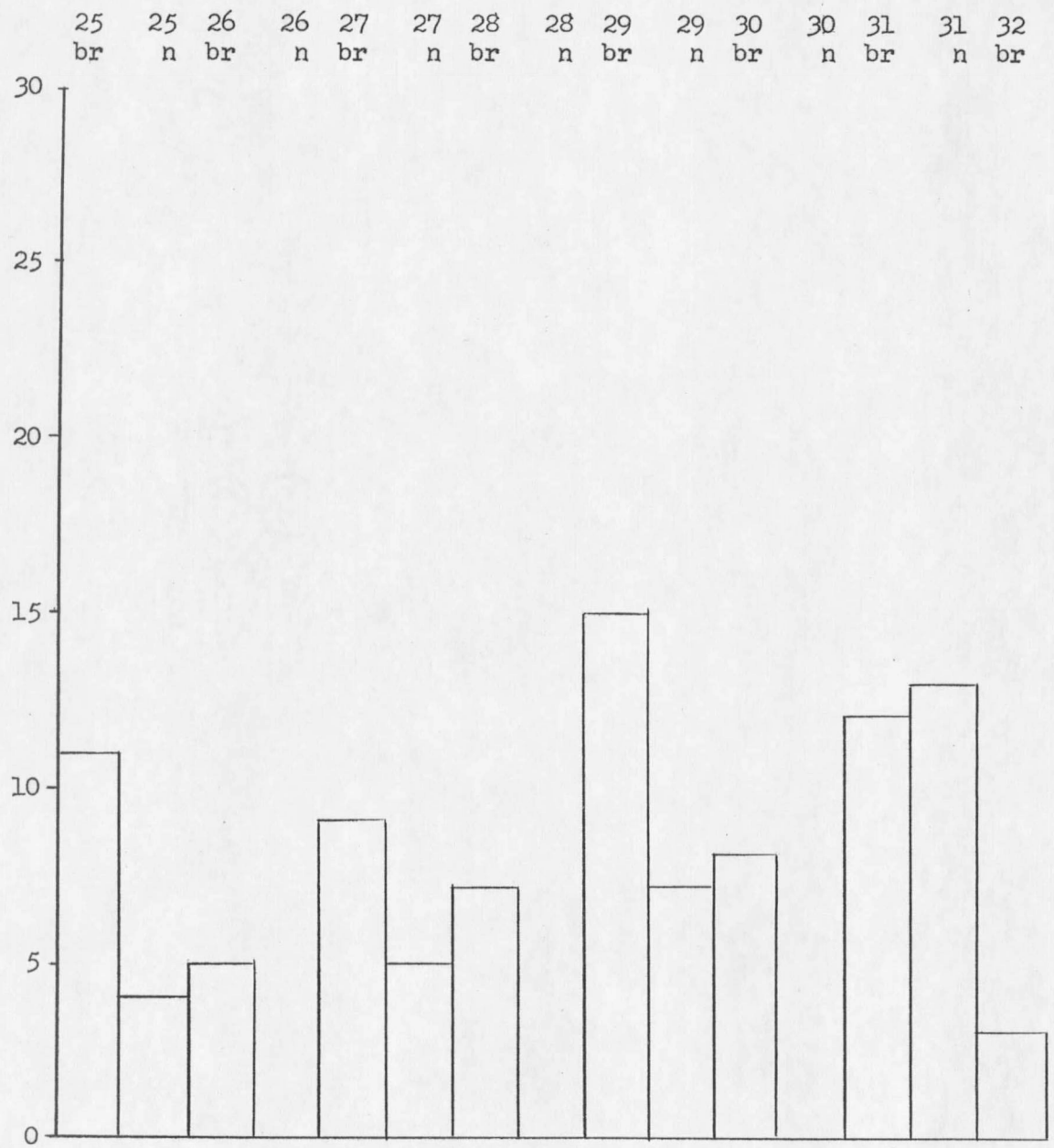
Graph 87. S. tuberosum "Fruhperle" (114-62)
Tuberosa



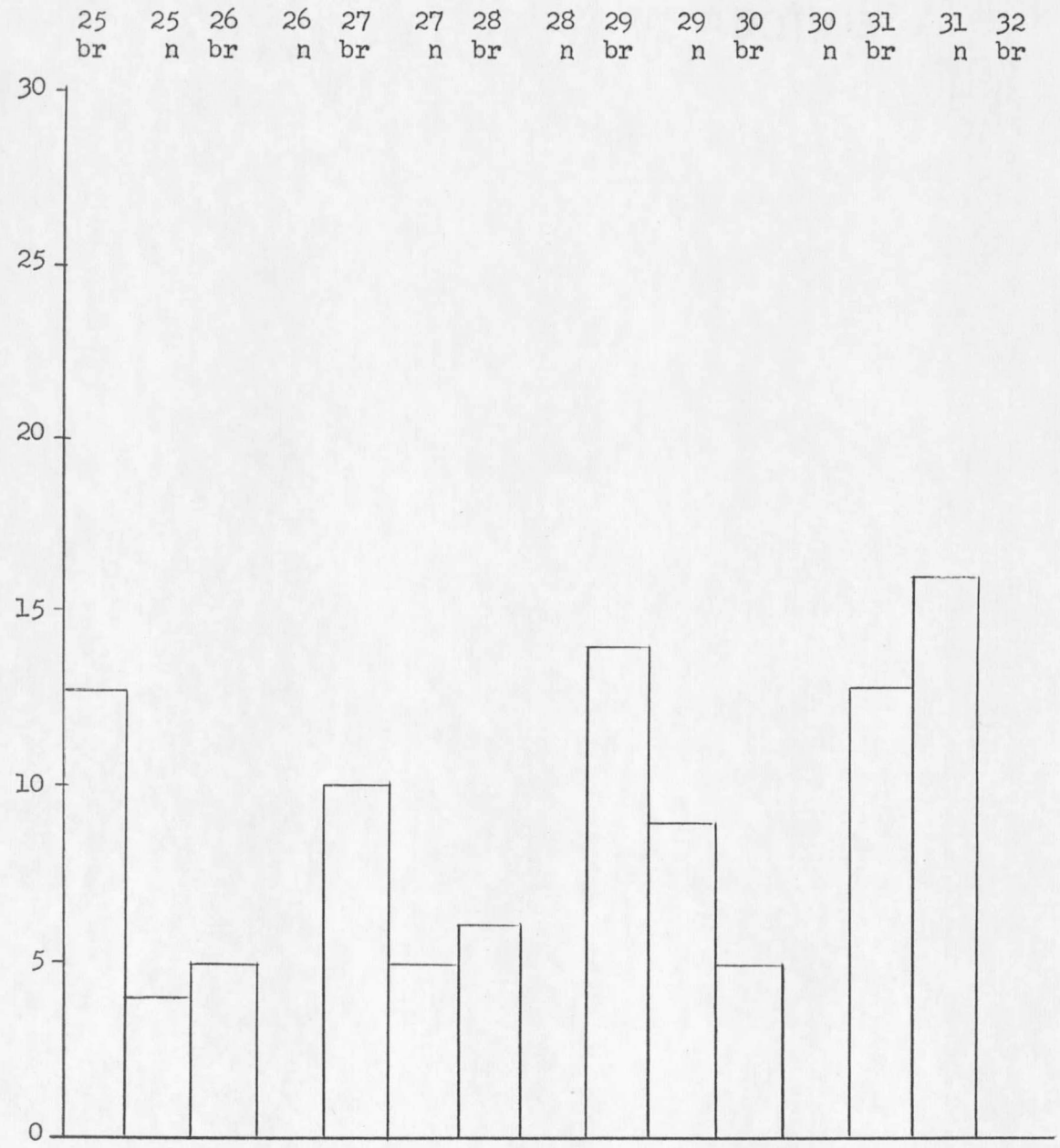
Graph 88. S. tuberosum "Bliss Triumph" (118-62)
Tuberosa



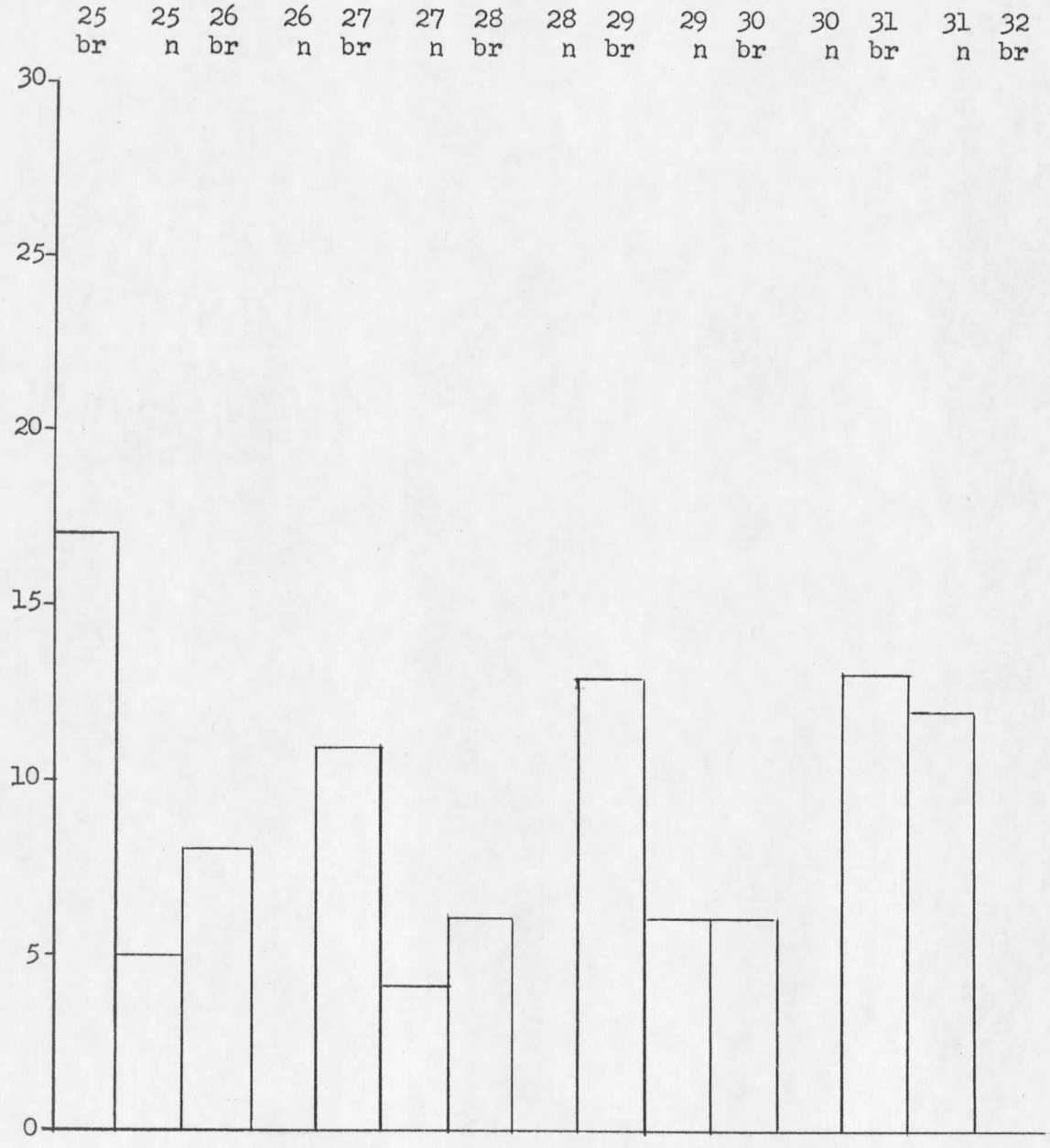
Graph 89. S. tuberosum "Blanca" (120-62)
Tuberosa



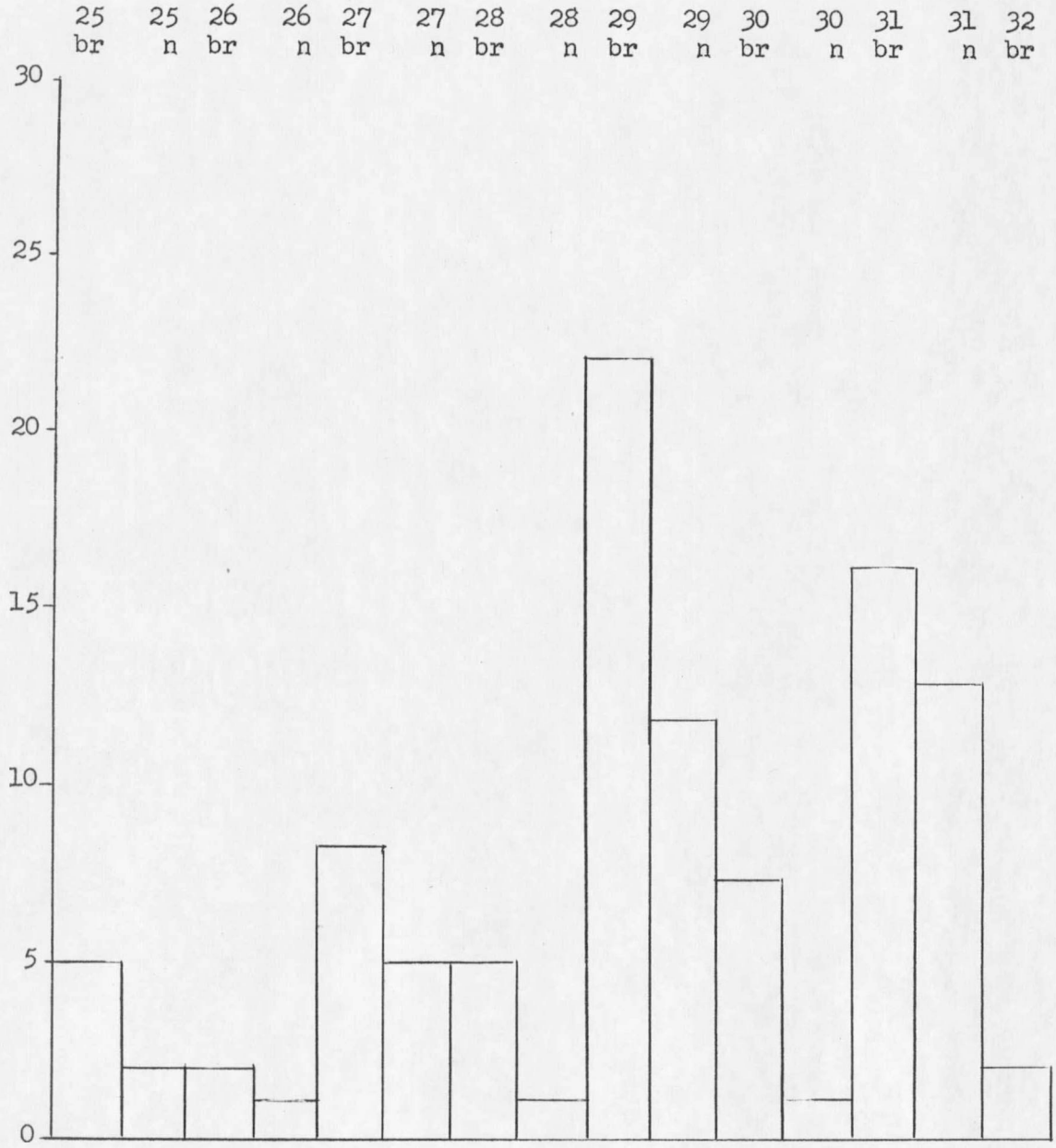
Graph 90. S. tuberosum "Bounty" (121-62)
Tuberosa



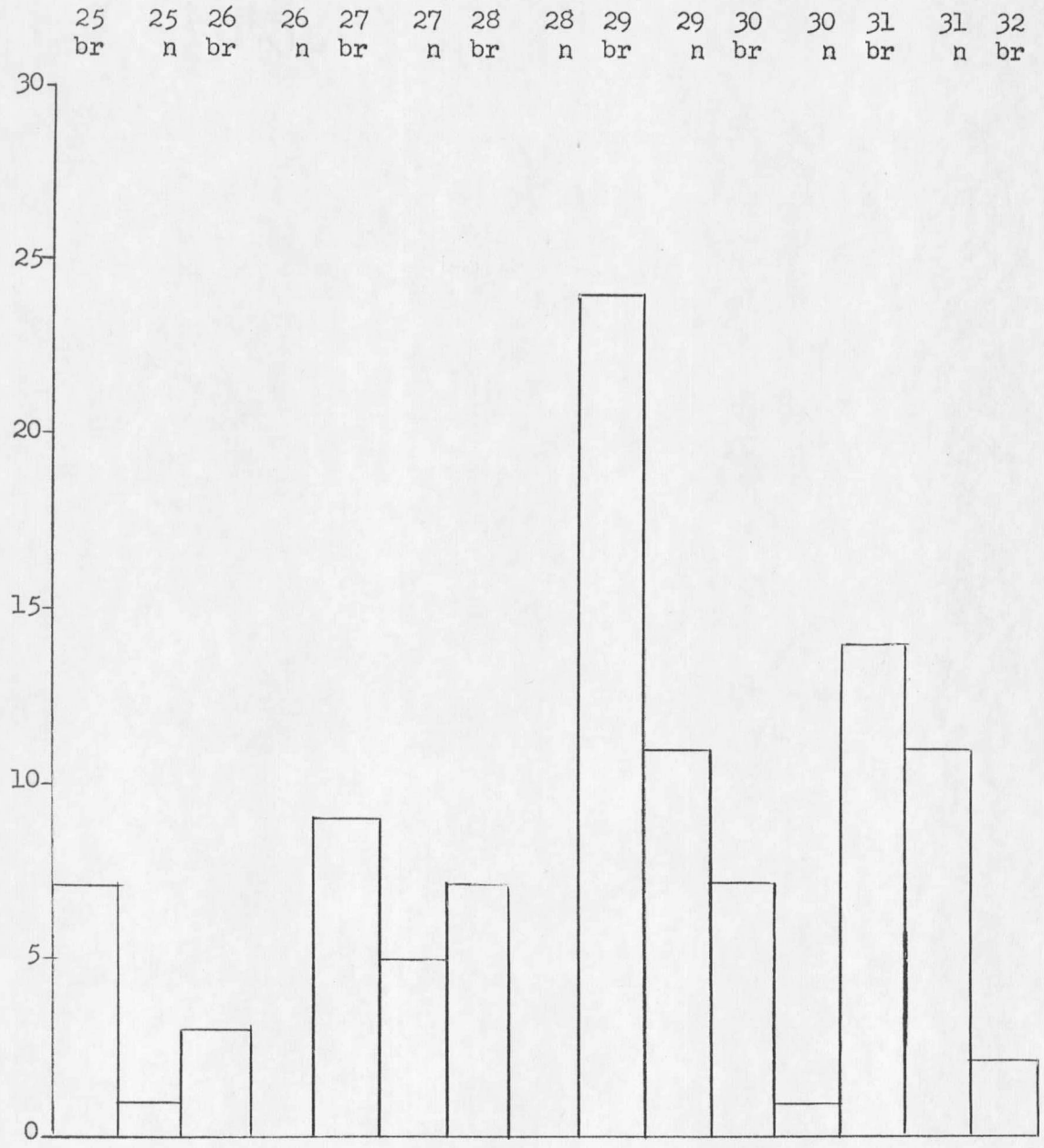
Graph 91. S. tuberosum 60131 (122-62)
Tuberosa



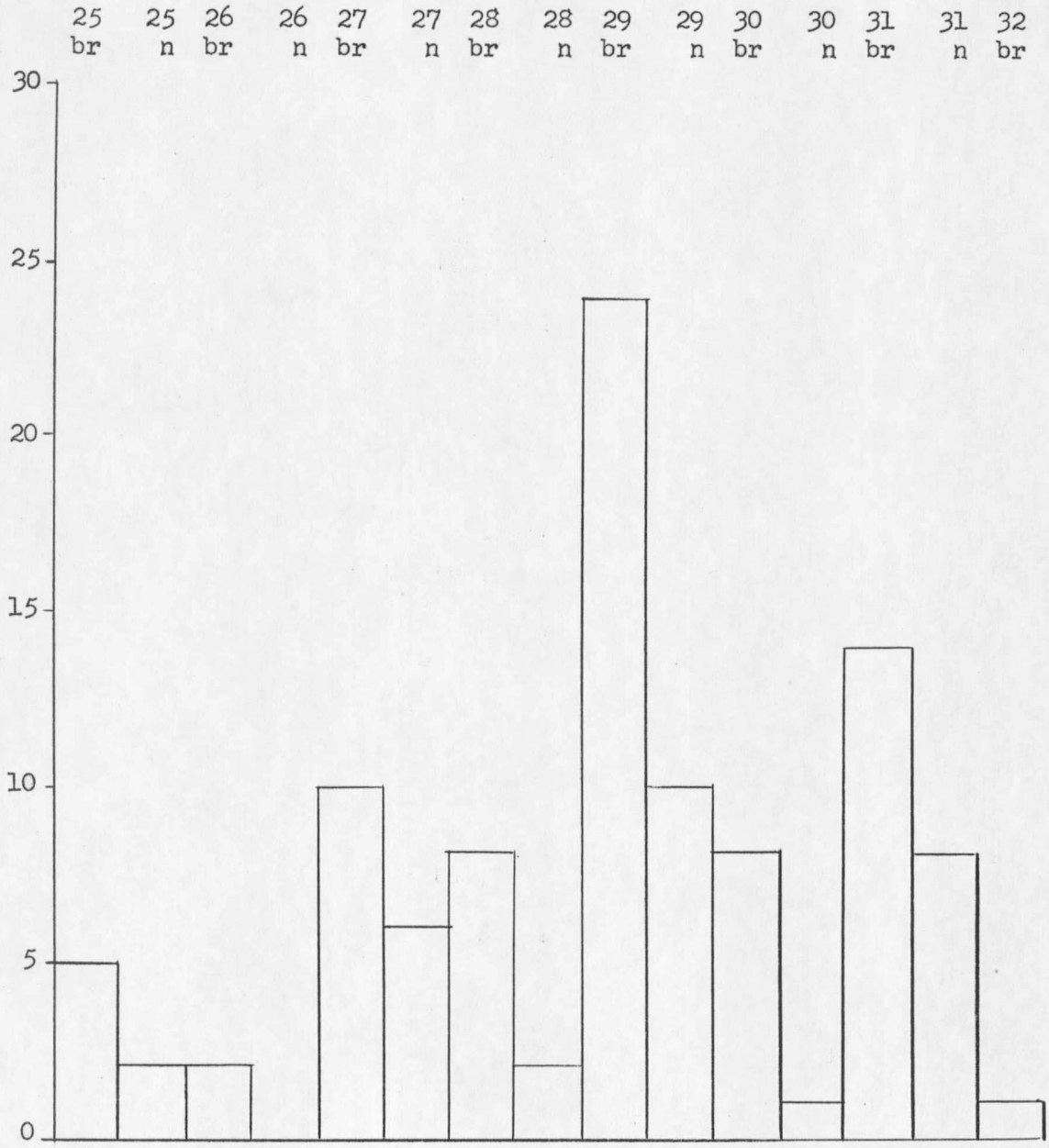
Graph 92. S. x curtilobum P.I. 195,181 (64)
Tuberosa (cultivated)



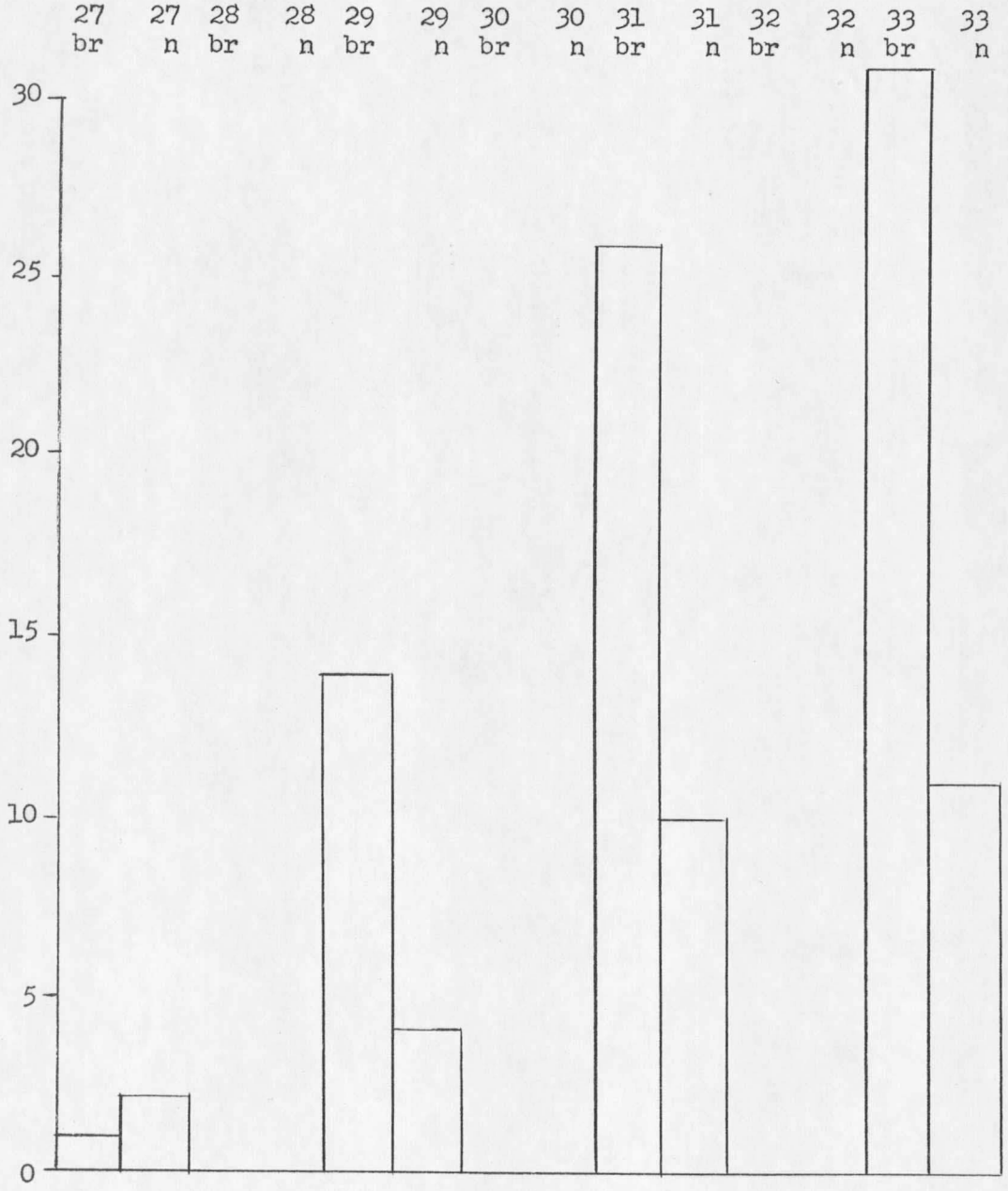
Graph 93. S. x curtilobum P.I. 195,181 (33-62)
Tuberosa (cultivated)



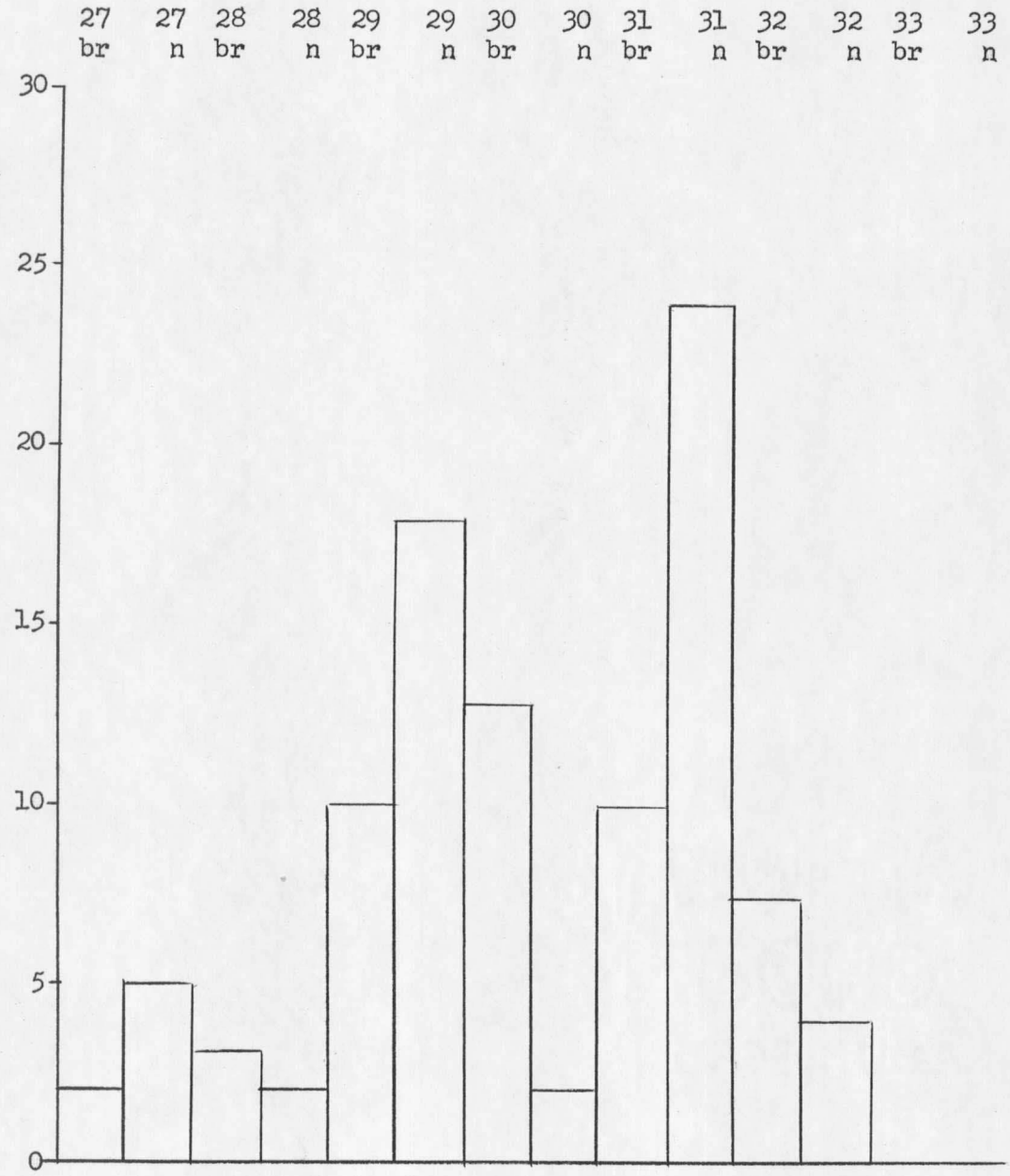
Graph 94. S. x curtilobum P.I. 225,651 (62-62)
Tuberosa (cultivated)



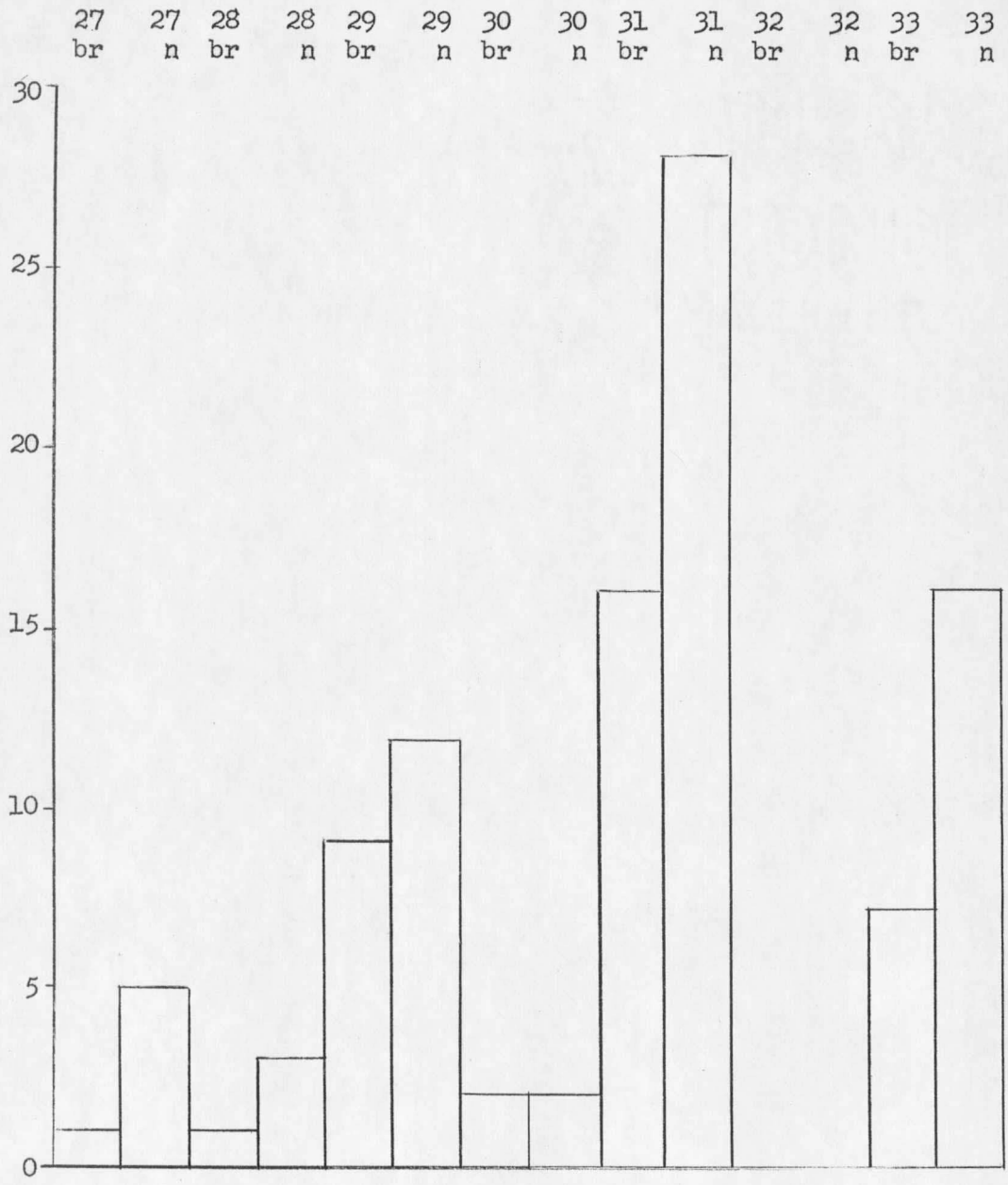
Graph 95. S. quitoense P.I. 263,169



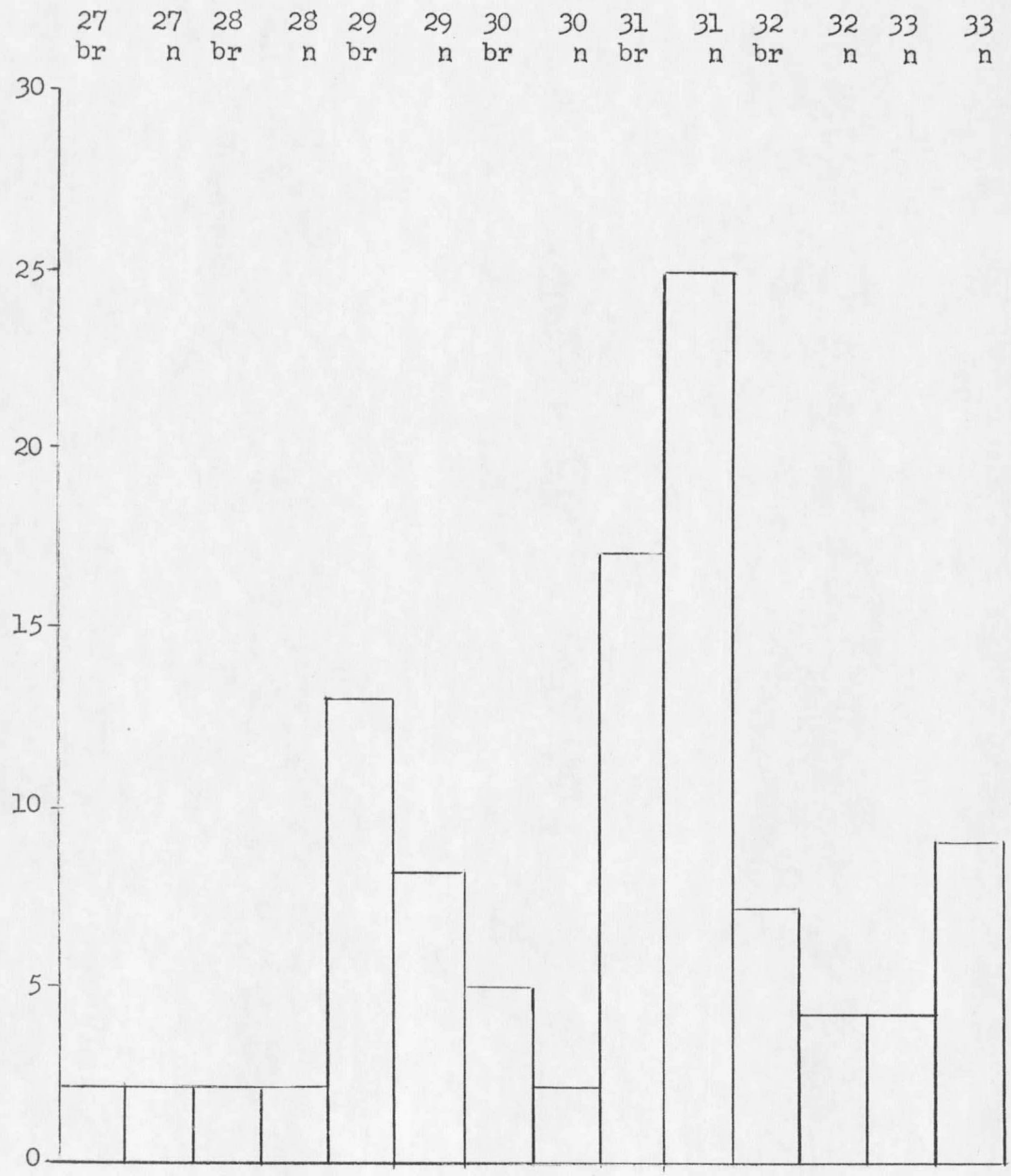
Graph 96. Nicotiana (tobacco)



Graph 97. Capsicum (pepper)



Graph 98. Lycopersicon (tomato)



APPENDICES

PLEASE NOTE:

Appendix 1 (pages 155-160)
omitted according to
information found in
Table of Contents, page iv.

UNIVERSITY MICROFILMS

Appendix 2. Inventory of P.I.-numbered Solanum species, with Planting Record, received from Inter-regional Potato Introduction Station, Sturgeon Bay, Wisconsin (Listed by series).

Series	P.I. Number	Species	**See key below 1	2	3	4
10. Piurana	210,040.2	S. marinasense	x	x		
	210,046.1	S. pampasense	x			
11. Conicibaccata	218,217*	S. colombianum				x
	230,479*	S. oxycarpum				x
15. Tarijensa	195,206	S. tarijense				x
	218,215.2	S. berthaultii	x	x	x	
	230,466*	S. tarijense				x
	230,466.3	S. tarijense				x
	265,857.3	S. berthaultii	x	x	x	
	265,858.5	S. berthaultii	x	x	x	
16. Polyadenia	230,480.2	S. polyadenium	x	x		
	251,745	S. polyadenium	x			
	275,237*	S. polyadenium				x
	275,238*	S. polyadenium				x
	275,238.5	S. polyadenium	x			
17. Morelliformia	243,357*	S. morelliforme				x
	275,223*	S. morelliforme				x
18. Clara	243,355.1	S. clarum	x	x		
	275,202.2	S. clarum	x			
	275,205.4	S. clarum	x	x		
19. Circaeifolia	205,560.1	S. capsicibaccatum				x
	205,560.2	S. capsicibaccatum	x	x		
	205,560*	S. capsicibaccatum				x
	210,036.2	S. capsicibaccatum	x	x		x
20. Trifida	255,536.3	S. trifidum				x
	255,538*	S. trifidum				x
	255,538.4	S. trifidum				x
21. Bulbocastana	161,156	S. bulbocastanum	x			
	230,484	S. bulbocastanum	x			

*Seed

**1—Greenhouse 1962; 2—Field 1963; 3—Field 1964; 4—Greenhouse 1964

Appendix 2 (Continued)

Series	P.I. Number	Species	**See key below 1	2	3	4
21. Bulbocastana (continued)	239,389	S. bulbocastanum	x			
	275,191*	S. bulbocastanum				x
22. Cardiophylla	186,549.7	S. ehrenbergii	x	x		
	251,725	S. ehrenbergii	x	x	x	
	255,519.1	S. ehrenbergii	x	x	x	
23. Pinnatisecta	184,764.3	S. pinnatisectum	x	x	x	
	184,764 (C-2)	S. pinnatisectum	x	x		
	186,553.3	S. pinnatisectum	x	x		
	195,189.1	S. jamesii	x			
	195,190.1	S. jamesii	x	x		
	275,171	S. jamesii	x	x	x	
	275,243.3	S. sambucinum				x
24. Commersoniana	133,664	S. chacoense				x
	189,217 (C-19)*	S. chacoense				x
	189,217.1	S. chacoense				x
	189,220.9	S. chacoense				x
	197,759.1	S. chacoense				x
	243,503*	S. commersonii				x
25. Megistacroloba	275,149*	S. megistacrolobum				x
27. Acaulia	175,395.3	S. acaule	x	x		
	195,160.4	S. acaule	x	x		
	205,507.1	S. acaule	x			
	205,520.1	S. acaule	x	x		
	210,033.1	S. acaule	x	x	x	
	230,494.1	S. acaule	x			
	230,529.1	S. acaule	x	x		
	230,530.1	S. acaule	x	x	x	
28. Demissa	160,227.4	S. demissum	x	x	x	
	160,228*	S. verrucosum				x
	160,228.1	S. verrucosum	x	x	x	
	161,153.5	S. demissum	x			

*Seed

**1--Greenhouse 1962; 2--Field 1963; 3--Field 1964; 4--Greenhouse 1964

Appendix 2 (Continued)

Series	P.I. Number	Species	**See key below 1	2	3	4
28. Demissa (continued)	161,174*	S. hougasii				x
	161,174.5	S. hougasii	x	x		
	161,727.1	S. guerreroense	x			
	161,730.13	S. guerreroense	x			
	161,740.4	S. hougasii	x			
	175,411.1	S. demissum	x	x		
	195,170.1	S. verrucosum	x	x		
	230,459.1	S. brachycarpum	x			
	239,423	S. hougasii	x	x	x	
	275,180.5	S. brachycarpum	x			
	275,183*	S. brachycarpum				x
	275,183.5	S. brachycarpum				x
	275,255.1	S. verrucosum	x	x		
	283,107.1	S. hougasii				x
29. Longipedicellata	160,224.10	S. stoloniferum	x			
	184,768.1	S. polytrichon	x	x		
	184,772	S. polytrichon	x	x		
	184,773*	S. polytrichon				x
	184,773.1	S. polytrichon				x
	186,545.11	S. polytrichon	x			
	186,555.4	S. stoloniferum	x			
	195,164.3	S. stoloniferum	x			
	195,167.10	S. stoloniferum	x			
	195,195.1	S. stoloniferum	x	x	x	
	205,522	S. stoloniferum	x			
	205,522.3	S. stoloniferum	x	x		x
	251,062	S. fendleri	x	x		
	275,157.2	S. fendleri	x	x	x	
	275,158.1	S. fendleri	x	x		
31. Transaequatorialia	175,434.1	S. kurtzianum	x	x		x
	175,435*	S. kurtzianum				x
	175,435.1	S. kurtzianum	x			
	175,435 (C-1)	S. kurtzianum	x			x
	208,866.1	S. simplicifolium	x	x	x	
	210,035.2	S. canasense	x	x		

*Seed

**1—Greenhouse 1962; 2—Field 1963; 3—Field 1964; 4—Greenhouse 1964

Appendix 2 (Continued)

Series	P.I. Number	Species	**See key below 1	2	3	4
31. Transaequatorialia (continued)	210,035.4	S. canasense				x
	210,042.1	S. canasense v. neohawkesii	x			
	210,051.1	S. canasense v. neohawkesii	x	x		
	212,799.2	S. vernei	x	x	x	
	218,218.2	S. velascanum	x	x	x	
	218,222.1	S. simplicifolium	x	x	x	
	230,465.2	S. sparsipilum v. llallaguanianum	x	x	x	
	230,468.1	S. vernei	x	x	x	
	230,502.2	S. sparsipilum	x	x		
	230,504.2	S. lignicaule	x	x	x	
	230,506.1	S. canasense v. neohawkesii	x			
	230,511.4	S. soukupii	x	x	x	
	230,562.2	S. vernei	x	x	x	
	233,690	S. oplocense	x			
	233,693	S. sparsipilum	x	x		
	233,961.4	S. brevicaule	x			
	243,502	S. candolleanum	x	x		
	265,862.1	S. sparsipilum	x			
	265,864*	S. canasense				x
	265,864.1	S. canasense	x	x		x
	265,881.1	S. simplicifolium	x	x		
	265,882.1	S. sparsipilum v. llallaguanianum	x	x	x	
	275,143.1	S. velascanum	x	x	x	
	275,144.1	S. velascanum	x	x	x	
32. Tuberosa	208,563	S. maglia	x	x	x	
	210,045.4	S. medians	x	x		
	210,813	S. maglia	x			
	230,507.1	S. medians	x			
	265,872.4	S. medians	x			
	133,667	S. tuberosum	x	x	x	
	195,162.1	S. tuberosum	x	x	x	

*Seed

**1—Greenhouse 1962; 2—Field 1963; 3—Field 1964; 4—Greenhouse 1964

Appendix 2 (Continued)

Series	P.I. Number	Species	**See key below 1	2	3	4
32. Tuberosa (continued)	205,528.1	S. tuberosum	x			
Cultivated Groups:						
Group Stenotomum	195,204 (C-13)	(S. stenotomum)	x	x		
	230,512.3	(S. stenotomum)	x	x	x	
	233,980.3	(S. ajanhuiri)	x	x		
	234,012.1	(S. stenotomum)	x	x	x	
	255,490.1	(S. ajanhuiri)	x	x	x	
Subgroup Goniocalyx	195,214.2	(S. goniocalyx)	x	x	x	
	195,188	(S. goniocalyx)	x	x	x	
Group Phureja	195,191	(S. phureja)	x	x	x	
	195,198	(S. phureja)	x			
	205,561.1	(S. phureja)	x	x	x	
Group Curtilobum	186,181.12	S. x curtilobum	x	x	x	
	195,181	S. x curtilobum	x	x	x	
	225,651.4	S. x curtilobum	x	x		

*Seed
**1--Greenhouse 1962; 2--Field 1963; 3--Field 1964; 4--Greenhouse 1964

Appendix 3. Descriptions of Solanum species grown in the greenhouse in 1962.

S. acaule

Rosette-forming herbs; rugose leaves odd-pinnate, up to 24 cm. long; leaflets as many as 15, 2.5-4.5 cm. long; interstitial leaflets present; corolla rotate, varying in color from nearly white to dark purple; fruit bright to dark green, elongated, sometimes flattened. This species set abundant fruit in the greenhouse. It retained its rosette growth habit when grown in the field.

S. berthaultii

Upright plant to 70 cm. tall; leaves odd-pinnate, to 24 cm. long, slightly pubescent; leaflets as many as 13, to 7 cm. long; interstitial leaflets present; corolla sub-stellate, sometimes reflexed, purple.

S. brachycarpum

Upright plant to 30 cms.; leaves odd-pinnate, slightly rugose, to 23 cms. long; leaflets as many as 11, to 7 cm. long; interstitial leaflets present; corolla rotate, light purple or white with purple mottling; fruit pale green, end pointed.

S. brevicaule

Rosette-forming herbs with smooth odd-pinnate leaves to 15 cm. long; leaflets 9, to 5 cm. in length; interstitial leaflets present; corolla rotate-stellate, bluish purple.

S. bulbocastanum

Upright plant, up to 50 cm. tall, highly pubescent; leaves simple, rugose, to 10 cm. long; no interstitial leaflets; corolla stellate, creamy yellow.

S. canasense

Plant to 40 cms., vining habit; leaves odd-pinnate, rugose, with edges curled, up to 13 cm. long; leaflets as many as 13, 3.5 cm. long; numerous interstitial leaflets; corolla purple to dark purple, rotate-stellate.

v. neohawskii

Plant vining, with flowers high above the foliage; leaves odd-pinnate, rugose with curled edges; leaflets 13-21, 2-3 cm. long;

interstitial leaflets numerous; corolla rotate; reflexed, deep purple.

S. candolleanum

Plant upright, with heavy stem, 35 cm. long; leaves to 25 cm. long, odd-pinnate; leaflets to 11, 7 cm. long; interstitial leaflets present; corolla rotate-stellate, purple.

S. capsicibaccatum

Plant upright with staking, to 50 cm. tall; leaves odd-pinnate, very slightly pubescent and almost smooth, 8.5 cm. long; leaflets 5, to 4.5 cm. long; no interstitial leaflets; corolla white or light purple, stellate, sharply reflexed.

S. clarum

Upright plant to 30 cm. tall; leaves simple, to 7 cm. long; no interstitial leaflets; corolla stellate, dark purple on tips, fading toward center.

S. x curtilobum

Plants upright with staking, to 70 cm. high; leaves odd-pinnate, to 24 cm. long; leaflets 9-13, to 7 cm. long; interstitial leaflets numerous, also on leaflet petiole; corolla rotate, lilac-purple.

S. demissum

Plant upright, to 30 cm. high, pendulous; leaves odd-pinnate, 13-25 cm. long; leaflets 9-11, 4-8 cm. long; corolla rotate, light purple on face, darker purple on reverse side. Fruit bright green, round.

S. ehrenbergii

Plant upright, to 60 cm. tall, leaves odd-pinnate, slightly rugose, slightly pubescent, 11-13 cm. long; leaflets 5-7 cm. long; interstitial leaflets very few to none; corolla white, stellate.

S. fendleri

Plant upright with staking, to 45 cm. high; leaves odd-pinnate, rugose, to 16 cm. long; leaflets 7-9, to 6 cm. long; corolla rotate-stellate, medium to dark purple; fruit bright green with dark stripes, round.

S. guerreroense

Plant upright, to 55 cm. tall (twice as tall as in Correll's description); leaves odd-pinnate, with winged petioles, to 13 cm. long; leaflets 9, 7-8 cm. long; corolla rotate, white in center, with purple streaks toward edges.

S. hougasii

Plant upright, to 60 cm. tall, leaves odd-pinnate, becoming pubescent and rugose with age, to 23 cm. long; leaflets 7-9, to 7 cm. long; interstitial leaves present; corolla rotate to rotate-stellate, white with purple mottlings.

S. jamesii

Plants upright to 40 cm. tall; leaves odd-pinnate, smooth, not appearing pubescent; leaflets 9, to 7 cm. long; interstitial leaflets few or lacking; corolla stellate, white.

S. kurtzianum

Plants upright, to 40 cm. tall; leaves odd-pinnate, almost smooth, very slightly pubescent, 12-15 cm. long; leaflets 7-9, 4.5-5 cm. long; interstitial leaflets few; corolla rotate-stellate, white with purple mottlings on reverse.

S. maglia

Plants upright, to 60 cm. tall; leaves odd-pinnate, with winged petioles, to 20 cm. long; leaflets 7-9 to 8.5-10.5 cm. long; corolla white, rotate.

S. medians

Plants variable, mostly upright with staking; to 60 cm. tall; leaves odd-pinnate, to 17 cm. long; interstitial leaflets present; corolla rotate-stellate, light to dark purple.

S. pampasense

Plant very sparse, low-growing; leaves odd-pinnate, to 16 cm. long; leaflets 7, to 8 cm. long; interstitial leaflets present, very small; corolla stellate, light purple.

S. pinnatisectum

Plant upright with staking to 60 cm. tall; leaves odd-pinnate, smooth, to 12 cm. long; leaflets 15, to 4.5 cm. long; interstitial leaflets absent; corolla stellate, white.

S. polyadenium

Plant upright, to 80 cm. tall, with unpleasant odor; leaves smooth, odd-pinnate, pubescent, to 25 cm. long; leaflets 9-13, 6.5-7.5 cm. long; interstitial leaflets present; corolla white, sub-stellate.

S. polytrichon

Plant upright, to 45 cm. tall; leaves slightly rugose, to 16 cm. long; leaflets 7, to 5 cm. long; interstitial none to few; corolla rotate-stellate, white to light purple.

S. simplicifolium

Plant upright, with very heavy stem, distinctly winged; leaves simple, to 20 cm. long, with no interstitial leaflets, or odd-pinnate, 25 cm. long, with 5 leaflets up to 14 cm. long with interstitial leaflets; corolla rotate to rotate-stellate, white.

S. soukupii

Plant vining, rugose, non-pubescent; leaves to 14 cm. long; leaflets 13, 4.2 cm. long; interstitial leaflets numerous; corolla rotate-stellate, medium purple.

S. sparsipilum

Plant upright, to 55 cm. tall; leaves odd-pinnate, to 25 cm. long; leaflets 7-9, to 7.5 cm. long; interstitial leaflets few; corolla rotate-stellate, medium purple.

v. llallaguanianum (S. suorense)

Plant upright, to 75 cm. tall; stem winged; leaves to 25 cm. long; leaflets 13, to 6 cm. long; interstitial leaflets present; corolla rotate-stellate, light purple, mottled with dark purple.

S. stenotomum

Plant vining, to 100 cm. long; leaves rugose, odd-pinnate, to 23 cm. long; leaflets 11-13, 5-6.5 cm. long; interstitial leaflets present; corolla white, stellate.

S. stoloniferum

Plant upright, to 75 cm. tall; leaves almost smooth to rugose, 9-18 cm. long; leaflets 9-11, 3-5 cm. long; interstitial leaflets present; corolla rotate-stellate to stellate, sometimes reflexed, white to purple; fruit bright green, round.

S. tuberosum

Plant upright, to 6 cm. tall, stems winged; leaves moderately rugose, to 21 dm. long; leaflets 11, to 8 cm. long; interstitial leaflets present; corolla rotate-stellate, white.

(S. ajanhuiri)

Upright plant (with staking) up to 100 cm. high; leaves slightly rugose, odd-pinnate, to 15.5 cm. long; leaflets to 11, to 5 cm. long; petiole forming bright green winging on mottled brown stem; interstitial leaves present; corolla rotate, purple.

(S. goniocalyx)

Plant of vining habit, with heavy stem; leaves odd-pinnate, 14-15 cm. long; leaflets 13, to 5.5 cms. long; interstitial leaflets numerous; corolla rotate-stellate, medium purple.

(S. phureja)

Plants upright with staking to 40 cm.; leaves odd-pinnate, slightly rugose, to 18 cm. long; leaflets 9-13, 3.5-5.5 cm. long; interstitial leaflets present, in several sizes; corolla rotate to rotate-stellate, varying in color from pinkish-lavender to deep purple.

S. velascanum (S. famatinae)

Plant upright with staking, to 60 cm. tall; leaves odd-pinnate, to 18 cm. long, slightly rugose; leaflets to 11, 6-7 cm. long; interstitial leaflets present; corolla rotate-stellate, light purple.

S. vernei

Plant upright when staked, to 45 cm. high; leaves odd-pinnate, slightly rugose, to 21 cm. long; leaflets 11, to 6 cm. long; interstitial leaflets numerous; rotate-stellate, medium purple.

S. verrucosum

Plant upright, to 35 cm. high; leaves odd-pinnate, 12-13 cm. long; leaflets 5-7, 3-5 cm. long; interstitial leaflets of two sizes; corolla rotate-stellate, light to dark purple. This species was found to be very susceptible to aphids.

Appendix 4. Percentages of branched and normal hydrocarbons in the C_{25} to C_{32} range found in flowers of Solanum species examined.

25 br	25 n	26 br	26 n	27 br	27 n	28 br	28 n	29 br	29 n	30 br	30 n	31 br	31 n	32 br	Graph No.
11. Series Conicibaccata S. oxycarpum (seed) P.I. 230,479 ('64)															
3.5	3.2	1.4	1.2	4.1	8.4	3.1	2.2	19.3	14.0	6.1	1.4	15.3	14.8	1.8	38
15. Series Tarijensa S. berthaultii P.I. 218,215.2 (17-62)															
1.4	0.8	0.2	0.2	3.5	2.8	2.8	—	18.6	8.6	8.2	—	33.0	15.5	4.3	24
S. tarijensa P.I. 195,206 ('64)															
0.5	1.7	0.3	1.4	2.5	3.6	2.5	1.4	12.9	6.8	6.7	1.0	30.5	23.5	4.7	25
P.I. 230,466.3 ('64)															
0.7	0.6	0.2	0.4	1.8	2.6	1.8	1.1	16.0	9.2	7.6	1.9	29.6	22.0	4.8	26
16. Series Polyadenia S. polydenium P.I. 275,237 (seed) ('64)															
4.9	2.2	3.1	0.3	5.4	3.2	3.8	0.5	12.1	4.5	9.3	0.8	27.8	12.3	9.8	35
P.I. 275,238 (seed) ('64)															
5.1	1.4	2.9	—	6.6	2.0	3.1	—	13.7	3.2	10.3	—	30.7	10.4	10.7	36
P.I. 275,238.5 (69-62)															
11.5	3.0	5.9	—	8.4	3.5	4.6	—	12.0	4.1	10.3	—	21.3	7.6	7.8	37
18. Series Clara S. clarum P.I. 243,355.1 (18-62)															
1.4	1.7	0.7	—	3.3	5.1	2.0	2.0	17.5	10.7	5.8	2.1	20.9	22.8	3.8	9
P.I. 275,202.2 (4-62)															
2.4	1.9	0.2	0.7	4.7	7.1	2.8	1.9	15.8	13.4	5.7	1.9	15.7	22.2	3.6	10
P.I. 275,205.4 (16-62)															
2.0	1.2	0.4	0.7	3.4	5.5	2.6	2.0	17.9	12.6	7.8	3.5	20.5	20.8	4.8	11

Appendix 4 (continued)

25 br	n	26 br	n	27 br	n	28 br	n	29 br	n	30 br	n	31 br	n	32 br	Graph No.
19. Series Circaeifolia S. capsicibaccatum P.I. 205,560.1 ('64)															
0.9	9.0	0.4	4.4	1.6	5.2	1.7	3.6	10.6	11.5	7.9	2.3	11.7	24.2	5.0	49
P.I. 205,560.2 (65-62)															
1.8	1.4	0.3	0.3	3.0	3.6	3.4	2.3	16.9	19.4	7.6	1.8	9.1	26.0	3.0	50
P.I. 210,036.2 (64-62)															
2.6	2.2	0.4	0.3	2.5	4.8	3.5	2.2	14.5	19.6	9.4	1.7	8.7	24.3	3.2	51
20. Series Trifida S. trifidum P.I. 255,538 (seed) ('64)															
0.2	0.3	0.1	0.1	1.2	4.1	1.3	1.4	14.5	13.5	5.4	3.0	21.1	28.6	5.3	7
P.I. 255,538.4 ('64)															
0.8	1.0	0.2	0.6	2.1	5.5	2.4	4.5	14.0	11.9	5.5	2.9	18.3	24.5	5.9	8
22. Series Cardiophylla S. ehrenbergii P.I. 251,725 (67-62)															
2.5	2.6	0.4	0.3	3.0	4.6	2.0	2.2	18.5	15.2	8.4	2.6	18.9	14.4	4.2	27
P.I. 255,519.1 (15-62)															
1.9	2.2	0.1	1.0	2.8	2.9	1.6	2.2	20.9	15.8	6.8	2.8	22.4	11.9	4.7	28
23. Series Pinnatisecta S. jamesii P.I. 195,190.1 (89-62)															
0.6	1.3	--	1.2	1.5	3.8	1.1	1.3	16.6	9.7	7.5	--	35.8	14.6	4.9	21
P.I. 275,171 (42-62)															
0.7	2.4	0.1	1.5	4.7	5.3	1.9	2.9	24.9	13.3	6.3	2.0	21.9	9.7	2.3	22
S. pinnatisectum P.I. 184,764.3 (14-62)															
0.4	0.4	0.1	0.2	1.0	1.9	1.5	0.6	18.7	6.3	8.9	2.1	38.1	11.3	8.5	29

Appendix 4 (continued)

25 br	n	26 br	n	27 br	n	28 br	n	29 br	n	30 br	n	31 br	n	32 br	Graph No.
P.I. 184,764 C-3 ('64)															
0.7	0.5	0.3	0.2	1.7	1.9	1.5	--	15.6	5.9	8.6	0.9	43.9	6.7	11.6	30
S. sambucinum P.I. 275,243.3															
0.4	0.7	0.2	0.4	2.1	2.9	2.4	0.7	18.4	7.8	7.5	1.8	31.0	15.8	8.0	23
24. Series Commersoniana S. chacoense P.I. 133,664 ('64)															
2.4	1.0	0.6	0.4	2.3	3.7	3.8	0.8	11.3	9.1	9.8	2.4	23.6	21.4	7.4	31
P.I. 189,217 C-19 ('64) (seed)															
1.7	1.6	0.6	1.1	3.4	4.7	3.0	1.2	12.2	7.2	7.6	1.6	27.5	19.2	7.4	32
P.I. 189,220.9 ('64)															
1.3	1.1	0.5	0.5	2.3	3.7	3.2	0.8	13.8	8.3	12.8	1.3	26.0	16.1	8.1	33
S. commersonii P.I. 243,503 (seed) ('64)															
2.2	0.9	0.9	0.6	2.9	3.2	2.9	2.5	15.8	12.1	14.2	--	19.6	16.4	5.9	34
27. Series Acaulia S. acaule P.I. 195,160.4 (48-62)															
7.2	3.7	2.7	0.6	8.3	6.3	5.8	1.2	17.4	12.2	7.2	1.8	8.8	15.4	1.3	52
P.I. 205,507.1 (61-62)															
2.7	2.2	1.6	0.8	7.1	6.0	9.3	--	27.5	15.9	10.4	--	8.5	7.1	1.1	53
P.I. 210,033.1 (40-62)															
6.7	5.6	3.7	--	8.3	7.0	8.8	--	17.4	13.6	9.9	--	7.5	10.7	0.8	54
28. Series Demissa S. brachycarpum P.I. 230,459.1 (45-62)															
9.3	4.5	2.1	1.1	6.9	5.6	2.9	1.3	16.7	8.0	5.3	1.3	20.0	14.1	1.1	45

Appendix 4 (continued)

25 br	n	26 br	n	27 br	n	28 br	n	29 br	n	30 br	n	31 br	n	32 br	Graph No.
P.I. 243,344.4 (90-62)															
6.0	4.3	2.3	0.8	7.8	9.0	4.0	4.5	16.9	10.5	5.5	1.4	14.2	11.7	1.0	46
P.I. 275,183 (seed) ('64)															
2.7	4.3	1.5	1.8	5.0	9.3	4.3	2.2	14.2	10.8	6.4	2.1	18.1	14.5	2.8	47
P.I. 275,183.5 ('64)															
3.8	5.0	2.5	1.8	5.8	10.5	4.3	2.0	14.0	10.5	6.0	2.3	15.5	13.3	2.8	48
S. demissum P.I. 160,227.4 (73-62)															
1.9	3.3	1.1	1.1	4.5	9.4	4.1	3.7	13.9	17.9	7.3	2.3	9.8	18.3	1.9	1
P.I. 160,227.4 ('64)															
1.9	4.0	0.8	2.2	2.9	7.2	2.2	3.0	11.2	16.0	5.9	2.3	13.2	24.3	2.9	2
P.I. 161,153.5 (44-62)															
1.9	6.3	0.9	3.5	3.5	10.3	3.5	3.5	10.8	19.0	7.5	2.2	6.3	18.1	2.4	3
P.I. 175,411.1 (34-62)															
1.7	6.1	0.9	4.2	4.2	8.9	3.4	3.4	13.5	18.2	7.4	2.7	9.3	13.3	2.8	4
S. guerreroense P.I. 161,727.1 (3-62)															
5.9	5.8	2.9	1.5	6.7	8.3	3.3	1.6	13.5	8.1	6.0	1.6	17.9	13.8	2.9	43
P.I. 161,730.13 (21-62)															
2.7	3.3	1.2	0.8	6.7	8.4	4.0	1.6	16.9	9.7	6.6	1.8	19.0	15.8	1.5	44
S. hougasii P.I. 161,174.5 (8-62)															
7.0	2.2	1.1	0.5	6.4	3.2	2.0	1.0	20.7	9.9	4.0	0.8	8.6	5.6	0.6	39

Appendix 4 (continued)

25 br	n	26 br	n	27 br	n	28 br	n	29 br	n	30 br	n	31 br	n	32 br	Graph No.
P.I. 161,174 (seed) ('64)															
2.1	0.2	0.7	0.3	3.3	3.1	3.1	1.2	18.2	16.5	14.0	2.3	18.0	18.0	1.9	40
P.I. 239,423 ('64)															
3.1	1.8	0.9	0.2	5.5	4.2	2.5	0.6	25.7	17.2	7.1	2.6	14.6	14.2		41
P.I. 283,107.1 ('64)															
5.1	3.2	1.4	2.4	6.9	5.7	3.3	2.0	21.7	11.3	6.3	1.7	16.8	9.1	2.8	42
S. verrucosum P.I. 160,228.1 ('64)															
3.7	3.0	3.9	0.8	3.0	6.2	3.1	1.0	10.3	10.3	9.6	0.8	19.3	13.5	6.7	6
29. Series Longipedicellata S. stoloniferum P.I. 195,167.10 (12-62)															
1.8	2.8	0.7	0.9	2.7	6.5	2.2	2.9	12.3	15.6	9.0	1.5	15.5	21.3	4.2	5
P.I. 195,195.1 (1-62)															
7.5	5.1	1.3	0.8	4.9	8.5	2.3	1.6	15.1	12.6	4.9	1.8	14.6	17.3	2.2	18
P.I. 205,522 (seed) ('64)															
1.4	2.5	0.5	2.6	2.1	7.4	1.9	2.5	15.2	13.1	6.0	2.8	20.3	18.9	2.8	19
P.I. 205,522.3 ('64)															
0.7	1.1	0.2	0.8	6.1	4.9	1.8	1.8	15.7	12.0	6.4	2.3	22.5	20.2	3.5	20
S. polytrichon P.I. 186,545.11 (30-62)															
0.8	1.8	0.5	0.5	2.2	5.7	2.0	1.6	13.7	12.9	9.0	1.6	17.0	25.1	5.6	14
P.I. 184,772 (32-62)															
3.3	2.9	1.2	1.2	3.7	7.7	3.8	1.5	14.7	13.0	8.4	1.6	14.9	17.9	4.0	15

Appendix 4 (continued)

25 br	n	26 br	n	27 br	n	28 br	n	29 br	n	30 br	n	31 br	n	32 br	Graph No.
P.I. 184,773.1 ('64)															
2.4	1.9	0.9	1.2	2.9	5.1	3.2	1.0	13.6	10.8	8.5	1.6	18.2	23.2	5.6	16
P.I. 184,773 (seed) ('64)															
2.2	1.8	0.8	0.5	2.5	5.3	2.6	1.5	13.4	12.7	8.2	3.0	16.6	23.2	5.5	17
S. fendleri P.I. 275,158.1 (43-62)															
1.9	1.7	0.5	0.5	1.5	5.6	1.8	1.0	13.1	14.7	8.2	1.5	19.5	23.8	4.4	12
P.I. 251,062 (27-62)															
3.7	2.9	1.3	0.4	3.5	5.9	2.8	1.2	12.7	10.9	6.5	1.5	18.6	22.4	5.6	13
31. Series Transaequatorialia S. brevicaule P.I. 233,961.4 (57-62)															
2.0	1.3	1.0	--	2.7	4.2	3.2	1.1	21.3	16.3	9.2	2.9	18.4	13.9	2.5	55
S. canasense P.I. 265,864.1 ('64)															
1.9	2.9	2.4	1.1	3.6	5.8	5.2	1.4	12.0	15.4	8.8	2.3	12.1	21.0	4.2	56
P.I. 265,864 (seed) ('64)															
4.4	2.9	3.0	0.6	4.9	9.3	5.6	1.0	12.5	13.2	8.9	0.6	12.2	16.9	4.0	57
P.I. 210,035.4 ('64)															
1.6	3.4	2.2	2.0	4.5	6.6	5.1	1.9	16.3	10.9	8.0	1.0	20.2	13.4	2.9	58
P.I. 210,035.2 (37-62)															
11.4	2.5	6.6	--	6.9	6.2	6.2	--	13.4	9.2	7.5	--	14.1	12.0	4.0	59
v. neohawskii P.I. 230,506.1 (86-62)															
8.3	2.8	4.7	--	8.6	5.9	11.5	--	20.3	8.2	9.2	--	12.4	6.4	1.7	60

Appendix 4 (continued)

25		26		27		28		29		30		31		32	Graph
br	n	br	n	br	n	br	n	br	n	br	n	br	n	br	No.
S. candolleanum P.I. 243,502 (55-62)															
6.9	3.9	4.9	--	6.1	5.8	7.2	--	11.1	6.8	10.0	--	16.8	15.5	5.0	61
S. kurtzianum P.I. 175,434.1 (26-62)															
4.9	5.1	3.5	--	4.6	7.0	5.5	--	12.2	5.4	11.3	--	21.6	12.8	6.3	62
P.I. 175,435.1 (53-62)															
2.2	2.7	1.4	0.8	3.5	6.9	5.9	--	12.4	7.5	14.4	--	23.0	12.8	6.5	63
P.I. 175,435.1 ('64)															
1.9	2.3	0.9	1.3	2.7	4.2	3.7	--	11.2	7.1	12.1	--	27.5	17.2	4.3	64
P.I. 175,435 (seed) ('64)															
1.9	1.3	1.0	0.8	2.5	5.4	3.1	1.3	10.8	7.1	12.5	2.5	24.2	17.5	8.1	65
P.I. 175,435C-1 ('64)															
1.8	2.0	1.4	0.9	2.3	3.5	3.3	1.5	9.4	6.5	13.7	1.5	21.9	18.7	11.4	66
S. lignicaule P.I. 230,504.2 ('64)*															
4.1	1.6	2.2	--	4.9	3.5	5.6	--	14.1	7.5	10.4	--	22.0	18.3	5.8	67
S. simplicifolium P.I. 208,866.1 (56-62)															
6.7	3.5	2.6	0.4	5.4	5.9	3.2	1.0	12.8	9.9	5.7	1.2	19.4	19.0	3.2	68
P.I. 218,222.1 (24-62)															
6.7	5.1	3.0	--	6.5	6.5	5.1	--	14.5	9.4	8.1	--	18.7	13.6	2.9	69

*Field-grown

Appendix 4 (continued)

25 br	n	26 br	n	27 br	n	28 br	n	29 br	n	30 br	n	31 br	n	32 br	Graph No.
S. soukupii P.I. 230,511.4 (28-62)															
8.2	3.5	3.5	0.7	6.1	6.1	5.9	1.2	16.6	14.3	6.8	1.2	11.3	13.1	1.6	70
P.I. 230,511.4 ('64)*															
3.2	1.3	1.2	0.3	5.1	4.6	3.9	0.4	18.4	15.4	6.0	1.3	17.7	19.0	2.2	71
S. sparsipilum P.I. 230,502.2 (84-62)															
3.0	1.5	0.6	0.6	4.5	4.5	3.1	1.2	20.7	8.3	7.2	3.0	22.4	16.0	3.5	72
P.I. 233,693 (25-62)															
1.8	1.0	0.4	0.4	3.4	4.3	3.4	1.7	22.4	16.8	8.3	2.2	17.9	12.9	3.1	73
v. *llallaguanianum* (*S. sucrense*) P.I. 230,465.2 (19-62)															
1.7	1.3	0.6	0.6	4.3	4.7	3.7	1.4	17.3	11.7	9.2	2.6	23.4	13.0	4.6	74
S. velascanum (*S. famatinae*) P.I. 275,143.1 (59-62)															
3.3	2.3	1.2	0.4	5.1	3.7	5.2	0.4	13.3	10.6	7.9	1.0	20.4	18.7	6.4	75
P.I. 275,144.1 (76-62)															
1.1	0.8	0.3	0.2	2.4	1.9	2.9	0.7	17.6	8.5	9.7	1.4	26.9	17.3	8.4	76
S. vernei P.I. 230,562.2 (82-62)															
5.7	2.6	2.4	—	6.2	6.8	5.8	—	16.9	11.0	8.4	—	16.0	15.7	2.5	77
Series Tuberosa *S. tuberosum* (*S. stenotomum*) P.I. 230,512.3 (70-62)															
5.7	2.1	2.8	0.2	7.5	5.0	5.3	1.0	14.8	10.3	7.2	0.4	15.8	18.0	3.9	78

*Field-grown

Appendix 4 (continued)

25 br	n	26 br	n	27 br	n	28 br	n	29 br	n	30 br	n	31 br	n	32 br	Graph No.
(11-62) P.I. 195,204 (C-13)															
5.3	1.6	2.2	0.2	11.1	4.3	7.8	0.3	17.5	5.0	6.2	0.4	22.4	13.0	2.6	79
S. tuberosum (S. goniocalyx) P.I. 195,188 (39-62)															
8.1	4.0	4.7	0.5	7.4	5.3	5.9	1.4	14.5	8.9	5.7	1.3	11.1	18.8	2.3	80
P.I. 195,214 (31-62)															
4.6	2.7	1.6	0.6	8.8	6.3	4.6	2.0	17.2	10.2	6.3	2.4	14.6	15.4	2.6	81
S. tuberosum (S. phureja) P.I. 195,198 (54-62)															
5.0	1.8	1.4	—	5.8	4.8	4.3	—	15.1	9.5	6.6	—	22.0	19.2	4.4	82
S. tuberosum P.I. 195,162.1 (22-62)															
6.8	2.4	3.1	—	8.1	4.4	5.8	5.4	15.6	8.1	7.5	—	16.3	14.9	2.4	83
Commercial Cultivars**															
Russet Burbank (102-62)															
7.4	3.2	3.2	—	6.0	4.4	4.9	—	11.6	11.6	5.9	—	13.2	26.2	2.4	84
Norland (110-62)															
13.2	4.3	5.6	—	10.3	6.5	6.6	—	13.7	8.4	6.1	—	10.8	12.6	1.8	85
Dazoc (112-62)															
10.8	4.8	5.6	—	8.0	5.6	5.9	—	11.4	9.0	6.3	—	12.4	17.4	2.9	86
Fruhperle (114-62)															
10.1	4.4	5.6	—	9.1	6.0	7.6	—	16.3	9.5	8.0	—	14.9	8.5	—	87

*Field-grown

Appendix 4 (continued)

25 br	n	26 br	n	27 br	n	28 br	n	29 br	n	30 br	n	31 br	n	32 br	Graph No.
Bliss Triumph (118-62)															
13.0	6.0	5.7	--	11.7	5.7	6.2	—	14.0	7.5	4.1	--	12.7	12.4	1.0	88
Blanca (120-62)															
11.4	3.8	5.4	—	8.9	5.1	7.0	—	14.6	7.3	7.9	--	12.3	13.3	3.2	89
Bounty (121-62)															
13.1	3.9	4.7	—	9.9	4.9	6.2	—	13.5	9.1	5.4	—	13.3	16.0	—	90
60131 (122-62)															
17.4	4.9	7.8	—	10.7	4.3	6.1	—	12.8	5.5	5.8	—	13.0	11.6	—	91
S. x curtilobum P.I. 195,181 (64)*															
4.1	1.5	1.5	0.6	7.5	4.7	5.2	1.3	22.4	12.0	7.3	1.1	15.9	13.1	1.9	92
P.I. 195,181 (33-62)															
7.2	1.0	2.5	—	8.6	4.8	6.6	—	23.5	10.8	6.9	0.8	13.8	11.4	2.1	93
P.I. 225,651 (62-62)															
4.9	1.6	2.0	0.4	10.0	5.6	7.7	1.8	24.4	10.4	7.7	0.6	13.7	8.0	0.9	94

*Field-grown

Appendix 4 (continued)

27 br	n	28 br	n	29 br	n	30 br	n	31 br	n	32 br	n	33 br	n	Graph No.
S. quitoense P.I. 263,169														
1.3	2.4	<1	<1	13.8	4.1	<1	<1	26.3	9.9	<1	<1	30.8	11.4	95
tobacco														
1.6	5.1	3.2	1.5	10.1	18.1	13.4	2.0	10.1	23.9	7.4	3.6	—	—	96
pepper														
0.8	4.6	1.0	2.6	9.1	11.9	1.8	2.1	15.9	27.5	—	—	7.0	15.8	97
tomato														
1.8	1.8	1.9	1.7	12.9	8.0	4.8	2.3	16.6	24.9	7.3	3.8	3.5	8.9	98

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D378
M466
cop.2
Mecklenburg, H. (Cameron)
Inflorescence hydrocarbons...

NAME AND ADDRESS

1-30-68 [illegible]

D378
M466
cop.2

BOUND BY [illegible]