FACTORS INFLUENCING CROPPING IN A TROPICAL ENVIRONMENT

Some factors affecting the yield of peanuts and sorghum, under natural rainfall, at Katherine, Northern Territory.

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Thesis for the degree of M.Sc.Agr.
The University of Sydney, N.S.W. November 1956

SUMMARY

Marked yield fluctuations between seasons and within seasons have been observed in peanuts and sorghum at Katherine, Northern Territory. Establishment was uncertain and it was believed that day to day climatic changes during the growing season were important in determining ultimate yields. To investigate this, daily plantings of peanuts and sorghum were made for a period of eleven weeks during the 1954-55 season. Soil moisture under crops of different ages was measured regularly. It was not possible to repeat the experiments on such a scale during the 1955-56 season, but peanut plantings were made at selected intervals and sorghum plantings at intervals of two or three days for a six week period. The behaviour of the crops, particularly the development of their reproductive phases, were observed in both seasons and yields were recorded.

A steady decline in yield with later plantings was demonstrated for peanuts, while a sharp deviation over a short period of time from this trend was shown for sorghum. Both results were related to the development of the plant. A marked drop in temperature inhibited peg development in peanuts. In sorghum the first limitation on yield was imposed during the period prior to head initiation and it is believed that the influence of daylength is important in determining the ultimate yield potential of the crop.

Marked yield fluctuations with plantings made on relatively close days have been demonstrated but not explained, especially in sorghum. It is suggested that these are dependent upon the interrelationship of soil moisture, nutrition and atmospheric conditions.

These results are discussed in relation to the development of agriculture in this region.

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1. INTRODUCTION

1.1 Historical

The history of agricultural endeavour in the Northern Territory has fluctuated between the extremes of optimism and despair. "In most cases the ventures began with the rhapsodies of alleged experts. When the long dry season, inexperience, expensive labour, transport difficulties, and pests such as white ants and rats, brought disillusionment, the press and public condemned the ventures as speculations mismanaged by amateurs and on unsuitable locations and soils." (Grenfell Price 1930).

One of the earliest official reports on the potential of the Northern Territory for tropical agriculture (that of Elliot and Villiers reporting to Lord Russell on the 1837 settlement at Port Essington) remained the soundest summary until recent developments : "The principal tropical crops require certainty of moisture, and no partial experiment can decide a subject of this magnitude. It is not enough for purposes of commerce to know that a certain plant has flourished in a garden, or has grown spontaneously in particular localities. The questions are whether over large tracts of country it can be raised for the protection of the capitalist, and by means of labour not dear in proportion to that of other places producing the same commodity, and moreover being brought to sale of that quality and condition which the established markets of the world require. To form an opinion in the present case, we do not find that enough is known, either of the soil or of the seasons", (quoted by Parsons 1907).

Nevertheless various agricultural ventures were attempted in the Northern Territory, and it is of interest to note some of these.

The Government's initial intention had been to encourage small settlers, but those few who came were obliged to purchase surveyed blocks, which were mainly on swamps or rocky ridges, so that no fair trial of small-scale agriculture was made and peasant proprietorship was deemed to have failed.

Then came an era of plantation schemes (1880 - 1886), one of the most significant efforts being that of De Lissa to grow sugarcane on Cox's Peninsula. His failure discouraged others. A sugar expert from Antigua reporting to the Government Resident ascribed the failure to "improper planting on ridges instead of in furrows, the land being too dry for the former method", (Thompson 1882, quoted by Parsons).

Sugar was also tried near the Adelaide River by Sergison, and by Otto Brandt at Shoal Bay and later at Rum Jungle. Contemporary impression of these efforts is epitomised in the Government Resident's Report : "It is distressing to stand by and see capital and energy thrown away. To assist this matter during the past few years the Government Garden has supplied about 600 tons of cane as plants to the various plantations, and now a tithe of that could not be gathered from the whole of them put together." (McMinn 1884, quoted by Parsons).

Maize was also tried, but succumbed to rats before it could be harvested.

At Beatrice Hills, in 1883, on the Adelaide River, another plantation tried India Rubber and Liberian Coffee. Although reported to be flourishing in 1886, the property was abandoned in 1887, and was subsequently acquired by a pastoral company. However, when making a report on agriculture in the Northern Territory in 1895, Brackenbury commented that these neglected coffee trees were still flourishing, and it was predicted that coffee would be a future paying crop.

A wide range of plants were introduced to the Government Gardens, Darwin, by Maurice Holtze (1885 et seq.) who successfully established some 600 tropical crops, including sugar cane, cotton, broom corn, arrowroot, tobacco, coffee, peanuts, indigo, Chinese oil plant, rice, sorghum and maize. The only unsuccessful crop was tea. Holtze maintained that what had been done at the Government Gardens could be done on the plantation scale, but recommended that plantations keep within a belt of 80 miles around the coast, presumably to ensure greater reliability of rainfall.

Inevitably there was press criticism of his activities, and the Northern Territory Times Almanac and Directory (1886 - 1889), complained of the large sum expended annually (£1,500 p.a.) "owing to the lack of liberal land laws there have been no farmers to avail themselves of Mr. Holtze's experience, or to make use of the young plants to which they would have been welcome. Had the money been used to cultivate a moderate sized farm, where 50 acres could have been sown with rice, another block with maize, another patch of tobacco, coffee, etc., as a trial, such a farm might have been rendered self-supporting and, if successful, have given confidence to other settlers too timid to risk their capital in a new and untested country".

The mention of land laws raises a different issue, which has frequently been associated with discussion of agriculture in the Northern Territory. It has been claimed that no suitable arable land was made available to bona fide cultivators. In 1908 when the administration of the Northern Territory passed from South Australia to the Commonwealth, "there were only three small farms; no roads; and the bulk of the good land was locked up by long leases", (Roberts 1924).

Subsequent attempts to open up the Daly River region were scarcely more successful. £7,255 was advanced to aid agricultural settlers but by 1918 only £498 was repaid, and most settlers had deserted their blocks. Following on Campbell's report (1911), two experimental stations, one at Batchelor, and one on the Daly River had been established to aid these settlers ..... but in return for an expenditure of £50,000 they had produced a revenue of £1,200 and were closed down in 1919. Mismanagement, associated with the problems of a difficult environment, especially pests and floods, resulted in the failure of the first attempt at agricultural experiment.

In spite of a more attractive land tenure system, including perpetual lease for agricultural land, very little farming was practised in the Northern Territory prior to the Second World War. For example the number of settlers engaged in peanut production decreased from 70 in 1929 to 28 in 1935, and to about a dozen in the early 1940's.

The impression emerged that the Northern Territory was unsuitable for agricultural development, and this was confirmed by two official reports : Sir George Buchanan (1925) having first considered various expert opinions especially those of Campbell and Evans, advocating the extensive cultivation of cotton, recommended that the Government should no longer aid the few settlers growing crops, as their results did not warrant it.

Similarly the Payne-Fletcher Report on the Land and Land Industries of the Northern Territory (1937) comments on the poor prospects for agriculture due to unsatisfactory rainfall distribution, limited areas of good soil, absence of markets and difficulty of attracting good agriculturists to a doubtful area. However it recommended that experiments be made to find a dry season crop which could be grown alternatively with wet season crops such as peanuts and tobacco.

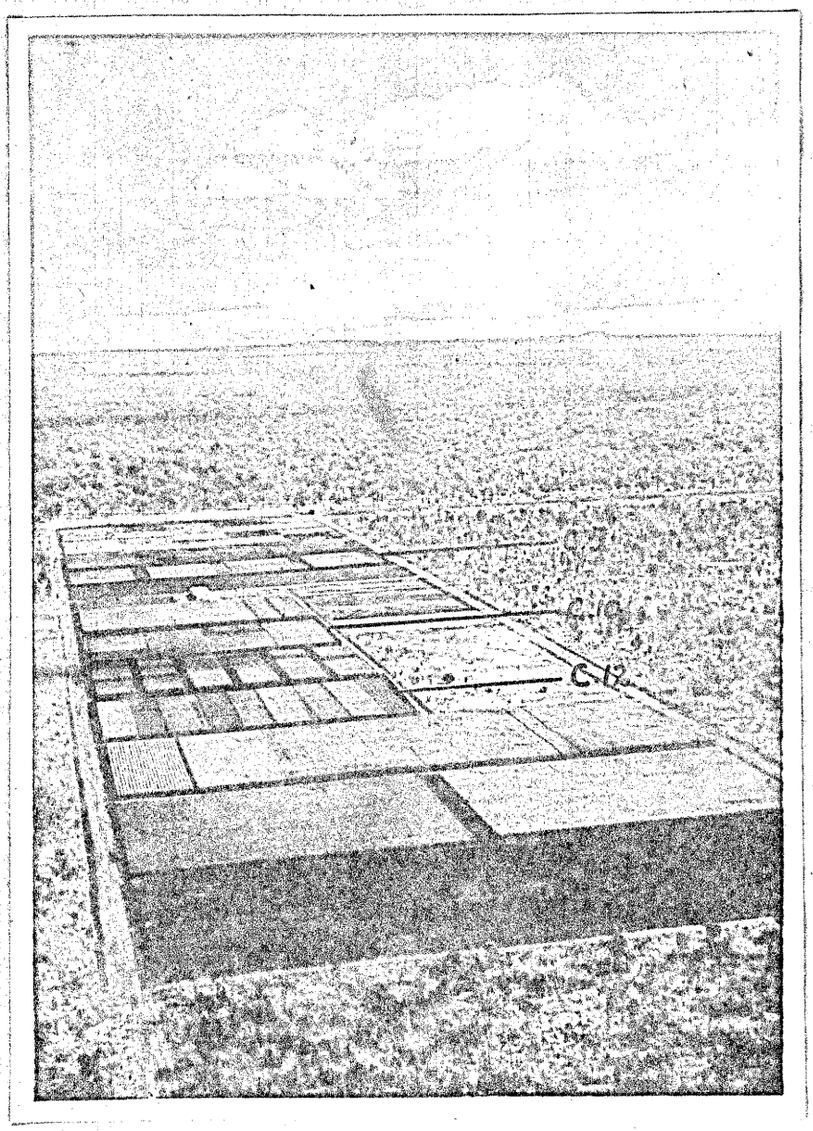


Plate 1. - Aerial photograph of the Dryland Station taken in March 1955, looking from North to South. Blocks C.5, C.10, C.12, the sites of the experiments described, are marked on the photograph.

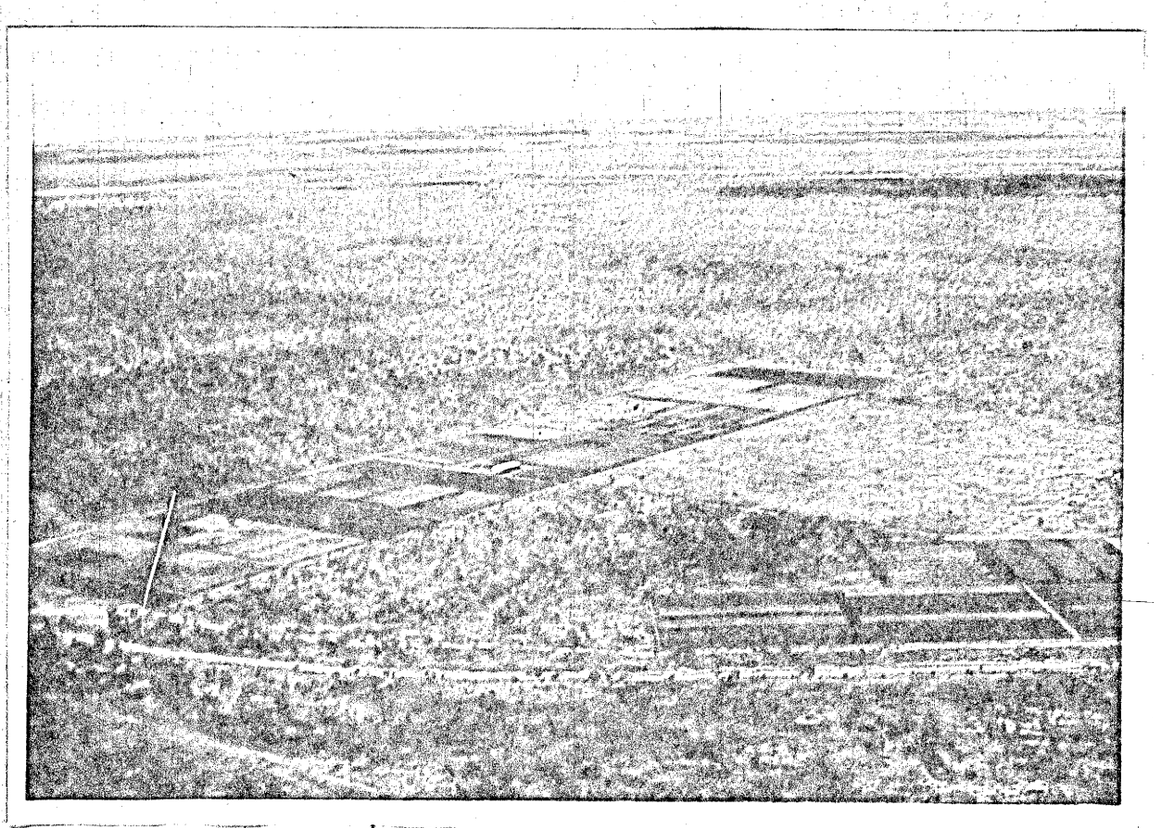


Plate 2. - Aerial photograph of the Dryland Station, Katherine Research Station, taken in March, 1955. The view is from South-East to North-West, and the Stuart Highway is in the foreground.

Scientific investigation of the problems besetting development in these areas has been advocated (Prescott 1938; Lowndes 1941) but no significant steps were taken until the period following the Second World War.

At the request of the North Australian Development Committee, established in 1945, the first of a series of systematic surveys of the natural resources of the main areas of North Australia was carried out by the North Australia Regional Survey (subseqently the Land Research and Regional Survey Section of C.S.I.R.O.) beginning with the Katherine-Darwin Area in 1946. The report of this survey examines the factors which have retarded development in the past and proposes a programme of investigation leading to successful future development. In this plan, adequate investigation followed by demonstration is emphasised before embarking on a programme of production. In a discussion of these proposals it is stated, "The region must be considered climatically to be marginal so far as dry land agriculture is concerned and its actual potentialities can only be determined when factual information concerning various types of crops is available from well conducted field trials", and again later, "unknown factors are so numerous that this period of investigation may only serve to define the real problems, solutions of which must then be found before the basis of sound development can be demonstrated."

As a result of these recommendations the C.S.I.R.O. Research Station at Katherine was established in 1946 and a programme of investigation was initiated at its Dryland Station (Plates 1 and 2) in the 1948-49 season.

The initial work at the Katherine Research Station (Kath. Res. Sta. Progress Rept., in prepn.) was concerned with the testing of new crops to the region and varieties within crops. The next step was an evaluation of the potentialities of the more promising crops and from this evolved a phase of more detailed investigation with certain selected crops, viz. cotton, peanuts and sorghum. As there was no sound agricultural tradition to draw on, much of the earlier work was based on a wide range of trials and it has not been feasible to define the more important problems until the experience of a number of seasons could be put together.

In an assessment of the situation, the results indicated that fertilizer, land husbandry and spacing problems could readily be solved but that the question of establishment and of fluctuating yields within and between

seasons required more detailed study. In the experiments undertaken during 1954-55 some aspects of establishment were examined and yield fluctuations observed in peanuts and sorghum.

1.2 Soils.

The soil on which these investigations were carried out belongs to the great soil group of lateritic earths and its characteristics have been reported (Litchfield 1952; Stewart 1956; Kath. Res. Stn. Progress Rpt., in prepn.). A skeletelal soil of moderate fertility derived from limestone, it is described as a sandy clay loam and is characterised by a high ratio of sand to clay in the surface layers with a high ratio of clay to sand in the subsoil. The chief features of this soil are the ease with which the surface seals under moderate rainfall and a narrow range of available moisture. This ranges from 5% at 8 inches to over 6% at 48 inches and is attributed to a high proportion of Kaolinite in the clay fraction (Slatyer 1953, 1954).

1.3 Climate.

Katherine is nearly 200 miles inland and is situated at 14° 30'S Latitude. The weather is strongly seasonal in nature being divided into a short summer wet season and a long dry season. Most of the total average annual rainfall of 36.45 inches falls between November and March on an average of 59 wet days, the average incidence reaches a peak in late December and early January. A detailed analysis of the climatic components has been made by Slatyer (1956). In addition the Radiation Records (Bur. Meteorology 1953, 1954) for Darwin (12°26'S Latitude) were examined and there appears to be little difference from year to year.

An evaluation of the weather in relation to crops emphasising the limitations of such climatic analyses has been made (Kath. Res. Sta. Progress Rept., in prepn.). The pattern of weather appears to be very similar to that described by Ireland (1952) for the region South of about latitude 19°N in the Sudan. In Katherine, as in the Sudan, the dominant feature is the annual movement of the boundary between dry and moist winds modified by the occurrence of regions of high and low pressure and temperatures; most of the rain is convectional. Similar environmental conditions have also been described by Evans (1955) for Southern Tanganyika, and some parallels

appear to exist, particularly in respect of drought periods.

1.4 Cultural Practices

The average period of adequate rainfall has been calculated at 15 weeks and the length of the growing season has been considered as 19 weeks, extending from early December to the end of April (Christian and Stewart 1953). Though this criterion is strictly limited in its application it serves to indicate the brevity of the growing season. When it is considered that 120 days are required for good crops of sorghum and peanuts it emphasises the narrow margin on which successful agriculture depends and the need for full utilization of the growing season. Under these circumstances the desirability of successful early establishment can well be understood. When climatic conditions are favourable at the beginning of the season no difficulty is experienced in establishing satisfactory stands, but when erratic, establishment is uncertain because of the physical nature of the surface soil (Kleinschmidt, Phillips and Phillis, in prepn.).

The grand period of growth is usually in January-February and generally coincides with the monsoonal influence in this area, which is characterised by overcast skies, low maximum temperatures and humid conditions.

Peanuts commence flowering early, but sorghum flowers in March. The crops generally mature in April, the period from brairding to maturity being of the order of 110 to 120 days. Harvesting of sorghum is usually carried out after rain has ceased and when atmospheric conditions are drier, whilst in the case of peanuts the harvesting date is virtually a compromise between the decay of the earliest nuts and maturation of the late-developing ones.

1.5 Botany of Peanuts and Sorghum

The crops under study were peanuts (Valencia type, variety Coriante) and sorghum (standard Hegari). These varieties have been found to perform well at Katherine under a variety of seasonal conditions. A brief botanical description is given.

Peanuts :- The morphology of the genus Arachis was for many years confounded by superficial and inaccurate observation. Gregory, Smith and Yarbrough (1951) have reviewed present knowledge and Smith (1950) has clarified

the relationship of aerial flower and subterranean fruit. A few unusual features which characterise its reproduction are described. "The flower exhibits an extreme type of perigyny with the stalk like, tubular hypanthium attaining a length of two inches. All the flowers are alike in structure, papilionaceous and potentially fertile. The flower is sessile. Consequently the "flower stalk" or "pedicel" cannot elongate ..... The gynoecium consists of a monocarpellate sessile ovary, and a much elongated filiform style with a minute club shaped stigma. The ovary develops into a stalk like structure called the peg (though this has been described in the literature as a gynophore, this structure is not a "gynoecium bearer") which bears the ovules in its tip, grows geotropically, and penetrates the soil." The peg enlarges at the tip to form the pod, this development taking place underground. Smith (1950) defines the peg of Arachis "As the young fruit during the stalk like phases of development which intervene between syngamy and pod enlargement." Pod enlargement commences with the swelling of the apical region and a simultaneous change of direction of the peg tip through 90°, at this point peg elongation ceases. In the variety used in these experiments :

Sowing to brairding took	6 days
Brairding to first flower	15 days
Brairding to onset of flowering	21 days
Sowing to onset of flowering	27 days

van Rossem and Bolhuis (1954) give a brief account of the development of the first flowers.

A period of approximately five days intervenes between fertilization of the flower and when the peg becomes visible. Elongation then takes place rapidly until the peg penetrates the ground. The peg normally begins to swell 14 - 21 days after syngamy and it takes about 60 days from syngamy to full maturity of the fruit. In a study of reproductive efficiency in the peanut plant, Smith (1954) found that only 13.5% of the flowers produced mature pods, and Shear and Miller (1955) show evidence that this cannot be attributed to failure of pegs entering the soil. Observations at Katherine likewise indicate that there is a large production of surplus pegs (Plate 3) and that only a percentage of the pegs which enter the ground develop into mature fruit.



Plate 3. - Peanut branches raised to show surplus peg production on a crop planted in late December. Some branches can be seen along the ground in the top right hand corner, and a few nuts in the bottom left hand corner.



Plate 4. - A mature Sorghum crop showing the habit of the plant.



Plate 5. - Sorghum plants at the flag stage: the head is enclosed in the terminal leaf sheath.



Plate 6. - Photograph showing some heads emerging, and anthesis beginning in others.

Sorghum : An annual plant with a well developed root system. It is a short-day plant (Martin 1941; Quinby and Karper 1945). The variety Hegari is about 66 inches tall, has thick juicy stalks, relatively large leaves, compact beardless oval heads with white seed, and black glumes (Plate 4). It may produce twelve internodes and can become reproductive at any node provided conditions are favourable. Initiation of flowering commences at the apex of the stalk and in some plantings at Katherine has been observed as early as 17 days after brairding. The inflorescence, usually referred to as the head, develops until all the flowers are formed. At about 47 to 49 days after brairding the head is enclosed in the terminal leaf sheath, and this is generally known as the flag stage (Plate 5). The head then emerges, and anthesis commences at about 53 days after brairding and extends to about the 61st day (Plate 6). Anthesis is basepetal with maximum blooming on about the 3rd or 4th day. Most of the flowers open in the early morning, and there is very little blooming during the day. The blooming habits of sorghum have been described by Stephens and Quinby (1934).

1.6 Agronomic Problems

The problems requiring investigation were the uncertainty of crop establishment, the large fluctuations in yield from season to season and from different plantings made on relatively close days in any one season.

It appears that under Katherine conditions the major factors influencing establishment are

(a) The extent to which the soil dries out the previous season
(b) The nature of the opening rains
(c) The nature of the cultivation techniques and final seed bed preparation.

The extent to which the soil dires out can be gauged from the figures, set out in Table 1, from typical profiles sampled after cropping and before the commencement of the following season.

TABLE 1

Residual Moisture in the Soil after Cropping in the 1954-55 Season and before the beginning of the 1955-56 season

(Samples from unploughed land - mean of 4 replications)
(percent. moisture)

Sampling Depth (ins)	After Guar Sampled 30. viii. 55	After Cotton Sampled 4. ix. 55	After Sorghum Sampled 4. ix. 55	After Peanuts Sampled 4. ix. 55	Field Determination of Permanent Wilting (Slayter 1953)
6	8.6	10.3	10.6	12.2	
8					11.1
12	11.5	13.0	12.3	12.9	
16					12.5
18	13.2	13.8	14.6	14.8	
24	14.7	14.5	15.3	15.6	13.0
30	14.8	14.8	16.1	17.6	13.8
36	15.6	15.2	16.4	18.5	
48	15.2	15.7	16.2	18.8	13.8
60	15.6	16.0	17.1	17.8	
64					14.5
72	15.4	16.0	17.8	18.1	
84	15.6				
96	16.0				
108	16.7				
120	17.7				

Preliminary experiments (Phillips, personal communication) have emphasised the importance of precision planting. Starting with a wet soil, it has been shown that a loss of 7.5% moisture from the top 4 ins. over a three day period - or a loss of approximately ½ in. of water - was not uncommon; a marked diurnal variation in moisture in the zone of seed placement was also demonstrated. If the soil were dry it would require a fall of over 3 ins. to bring the first foot to field capacity. If on the other hand ½ in. of rain were to fall every three to four days without runoff, and without running down any cracks, all the water would be lost through evaporation even if the soil were kept fallow.

It is not easy to define the nature of the cultivation techniques to produce the best seed bed, for the ones that give the most rapid germination are not necessarily the ones that produce the maximum yields. Consequently the type of cultivation required will depend largely on the nature of the opening rains and the temperatures prevailing at the commencement of the season.

It is not surprising, therefore, to find erratic results in the early experiments concerned with time of planting where calendar plantings were made at weekly or fortnightly intervals. In several cases seed remained in the soil for appreciable periods without emergence and finally emerged along with seed of later plantings in response to good rain. Plants which got away to a good start appeared to withstand subsequent adverse conditions much better than poorly established ones, though both had received the same amount of rain. Besides the wide variations in yield from different plantings in any one season, wide variations in yield were obtained in the main crops from season to season. Some data are set out for peanuts in Table 2, and for sorghum in Table 3.

TABLE 2

Influence of Planting Date upon Peanut Yield

Season	Date of Planting	Date of Brairding	Days to Brairding	Yield (lbs/ac)
49-50	29.xi. 49	13.xii.49	14	1780
	6.xii.49	13.xii.49	7	2010
	13.xii.49	17.xii.49	4	1391
	29.xii.49	23.xii.49	3	1255
	27.xii.49	31.xii.49	4	2820
	3. i.50	9. i.50	6	2190
	10. i.50	17. i.50	7	1950
	17. i.50	23. i.50	6	1600
50-51	10. x.50	24. x.50	14	1118 *
	20. xi.50	4.xii.50	14	520
	4.xii.50	10.xii.50	6	378
	18.xii.50	26.xii.50	8	281
⁄ 51-52	3.xii.51	21.xii.51	18	119
	17.xii.51	23.xii.51	6	84

* Wallaby damage severe.

⁄ Season of very low rainfall.

These fluctuated independently for the various crops, and it was felt that the differences were due partly to the natural decline for the season and partly to the day to day climatic effects at planting and subsequent to planting.

TABLE 3

Influence of Planting Date upon Sorghum Yield

Season Season	Date of Planting	Date of Brairding	Days of Brairding	Yield (lbs/ac)
49-50	29. xi.49	12.xii.49	13	1754
	6.xii.49	12.xii.49	6	2130
	13.xii.49	16.xii.49	3	1375
	20.xii.49	22.xii.49	2	1783
	27.xii.49	30.xii.49	3	1240
	3. i.50	6. i.50	3	1042
	10. i.50	17. i.50	7	725
	17. i.50	23. i.50	6	771
	24. i.50	29. i.50	5	650
	31. i.50	5. ii.50	5	287

TABLE 3 (cont.)

Influence of Planting Date upon Sorghum Yield

Season	Date of Planting	Date of Brairding	Days of Brairding	Yield (lbs/ac)
50-51	10. x.50	16. x.50	6	975 *
	20. xi.50	12.xii.50	12	1031
	4.xii.50	10.xii.50	6	1080
	18.xii.50	25.xii.50	7	978
	1. i.51	7. i.51	6	1864
	19. i.51	24. i.51	5	125 /
	30. i.51	6. ii.51	7	264
52-53	2. i.53	5. i.53	3	2940 x
	23. i.53)	28. i.53)	5)	1059
	10. ii.53)	26. ii.53)	16)	
	18.iii.53	21.iii.53	3	452

* Bird damage severe, Sorghum commencing to germinate in heads.

/ Very poor establishment followed by hot weather.

x Includes second crop harvested after April rains. First harvest yielded 1806 lbs/acre.

It was therefore important to design an experiment with a view to overcoming the uncertainty of crop establishment and to explore the large fluctuations in yield that may be obtained from different plantings in any one season. Several approaches to this problem were considered:

(a) Planting under controlled conditions to test various methods of establishment, and to relate these to subsequent yield of the plant and plant parts. This was considered unrealistic at this stage of the investigations.

(b) Planting at intervals in a transect extending from Katherine to Darwin, to sample different climates. Because of soil differences and variability of the climatic components - factors which could not be eliminated - this approach was also rejected.

(c) By sowing precisely to a stand, at fixed depths, at frequent intervals during the growing season, an opportunity is afforded of sampling day to day climatic changes over the growing period.

TABLE 4

Peanut Planting Experiments conducted during 1954-56

SITES	PLANTING	SEASON	
		1954-55	1955-56
C.10	Dates	8.xii.54 to 27.ii.55	5.xii.55 to 6.ii.56
	Numbers	81	4
	Depths	1, 2, 3, 4, 5 ins.	2 ins. - 3 ins.
	Reps.	2	6
	Layout	Contiguous Planting	Randomized
C.12	Dates	16.xii.54 to 26.i.55	
	Numbers	41	
	Depth	2 ins.	
	Reps.	3	
	Layout	Contiguous Planting	

As shown in Tables 4 and 5, three experiments were laid down during the 1954-55 season and two experiments during the 1955-56 season. Day to day plantings were made by hand (Plate 7), at fixed depths, over a period of eleven weeks during the 1954-55 season, in order to eliminate the uncertainties arising from faulty establishment, and to study crop response in relation to weather on as large a range of established material as possible.

TABLE 5

Sorghum Planting Experiments conducted during 1954-56

SITES	PLANTING	SEASON	
		1954-55	1955-56
C. 5	Dates	7.xii.54 to 23.ii.55	13.xii.55 to 15.ii.56
	Numbers	78	18
	Depths	1, 2, 3, 4 ins.	approx. 2 ins.
	Reps.	2	4
	Layout	Contiguous Planting	Randomized
C.12	Dates	16.xii.54 to 26.i.55	
	Numbers	41	
	Depth	2 ins.	
	Reps.	3	
	Layout	Contiguous Planting	



Plate 7. - This photograph illustrates the contiguous planting of Peanuts on C.10 during the 1954-55 season. The older plantings are in the middle distance and the later ones in the foreground. Planting is going on in the left hand background.

The results of the 1954-55 season were clear cut and daily plantings were not considered necessary during the 1955-56 season, particularly as facilities and labour were limiting. The experiments during the 1955-56 season were largely of a confirmatory nature, and were conducted on a much reduced scale, being designed so that they could be handled mechanically.

As the 1954-55 experiments represent the major portion of this programme they will be described in greater detail than the 1955-56 experiments throughout this thesis, and unless otherwise stated, reference is to these experiments.

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2. METHODS

2.1 Design of Experiments

(a) 1954-55 Season.- Because of the magnitude and duration of the 1954-55 experiments referred to in Tables 4 and 5, separate blocks were established for each crop. These were C. 5 for sorghum (Plate 8) and C.10 for peanuts (Plate 9). A random layout was examined, but in view of the practical difficulties involved, it could not be adopted. Such considerations as shading from early established plantings, the areas lost to guard material, and the difficulties of cultivating the growing crop with a random layout, led to the adoption of contiguous plantings, in two replications, moving in opposite directions as shown in Diagram 1.

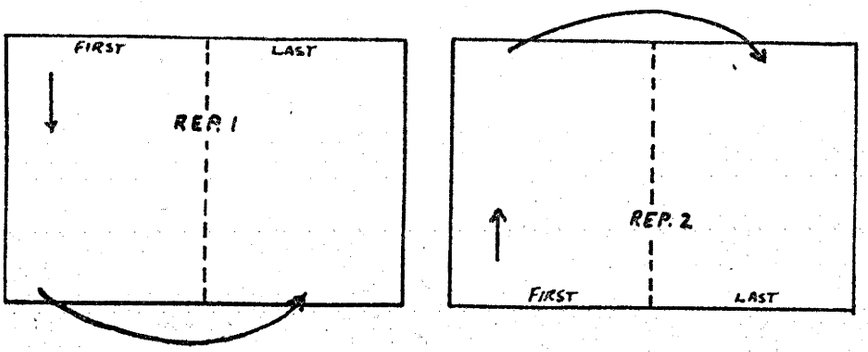


Diagram 1
General Layout of Contiguous Planting Experiments conducted in 1954-55. C.10 Peanuts and C.5 Sorghum.

In order to overcome the lack of replication and to confirm on another piece of land any trends that may be established in the main blocks, a further site C.12, (Plate 10) was selected, in which both peanuts and sorghum were sown together. As this was a smaller block, the planting period was of shorter duration but covered the main part of the sowing period.

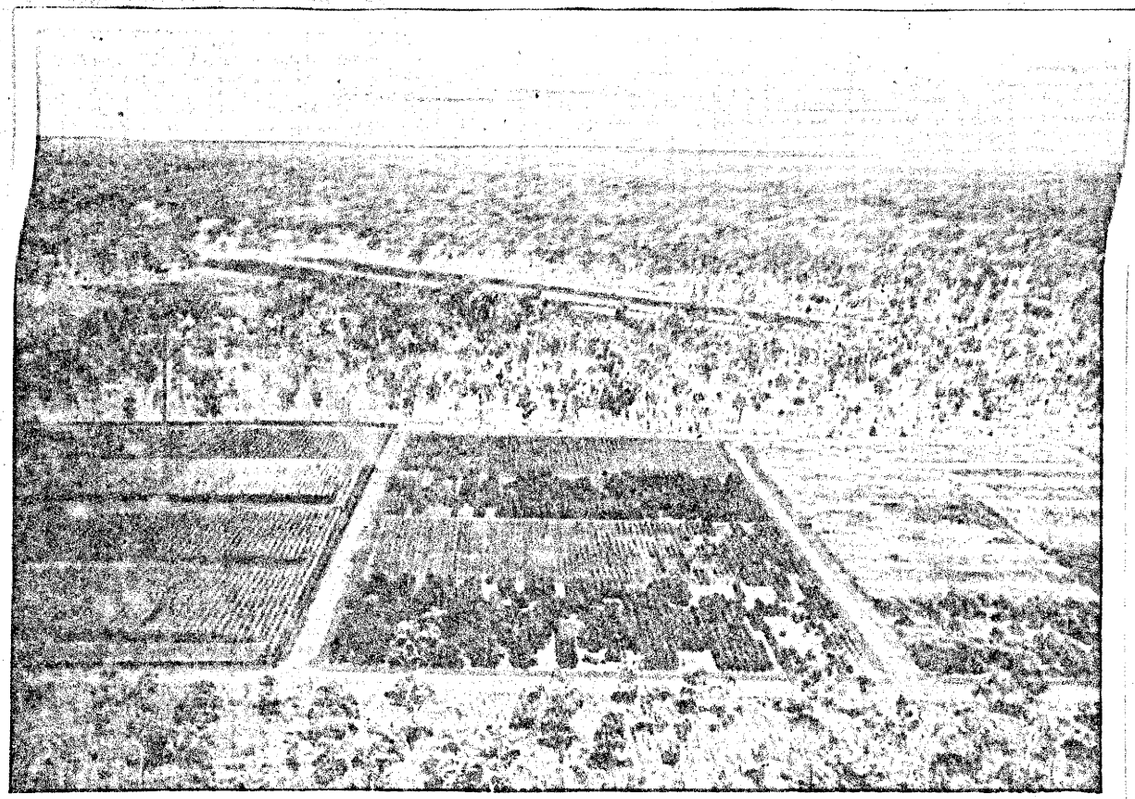


Plate 8. - An aerial photograph showing block C.5 on the left hand side; this illustrates the contiguous plantings of Sorghum during the 1954-55 season. Replication 1 is closer to the camera. The older plantings in replication 2 are lighter in colour.

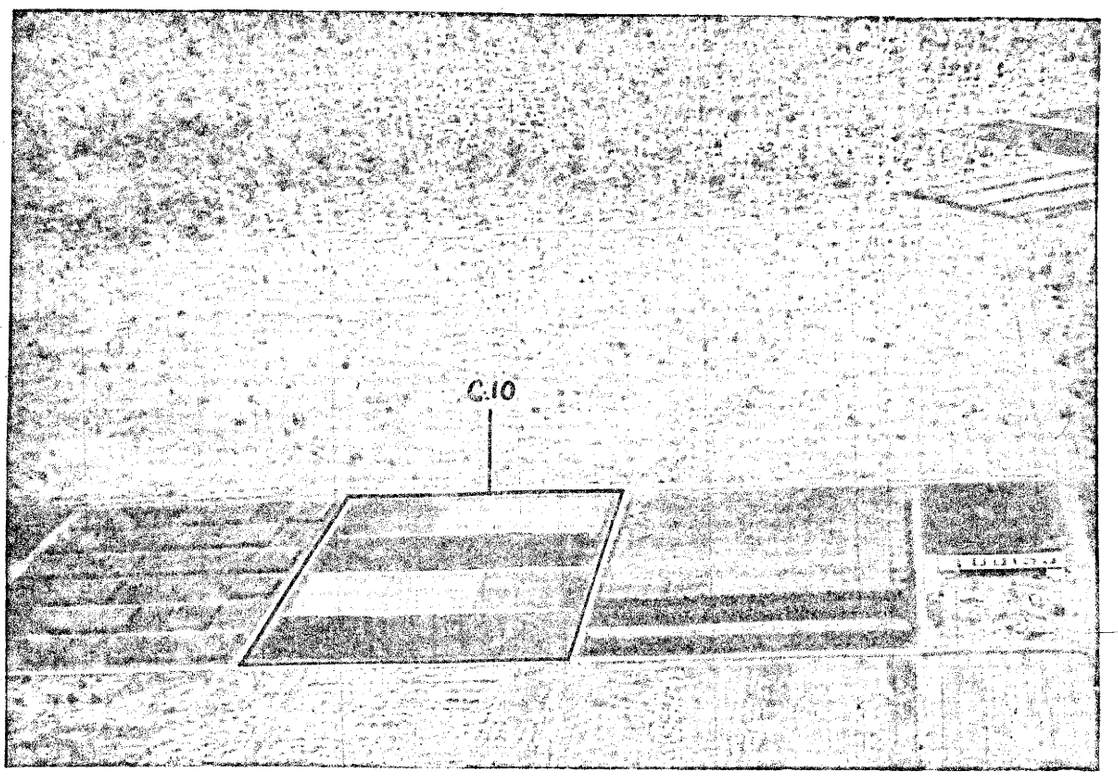


Plate 9. - An aerial view of block C.10 (the second block from the left) showing two replications of contiguous plantings of Peanuts during the 1954-55 season. Replication 1 is nearest the camera and the oldest planting is in the left hand bottom corner.

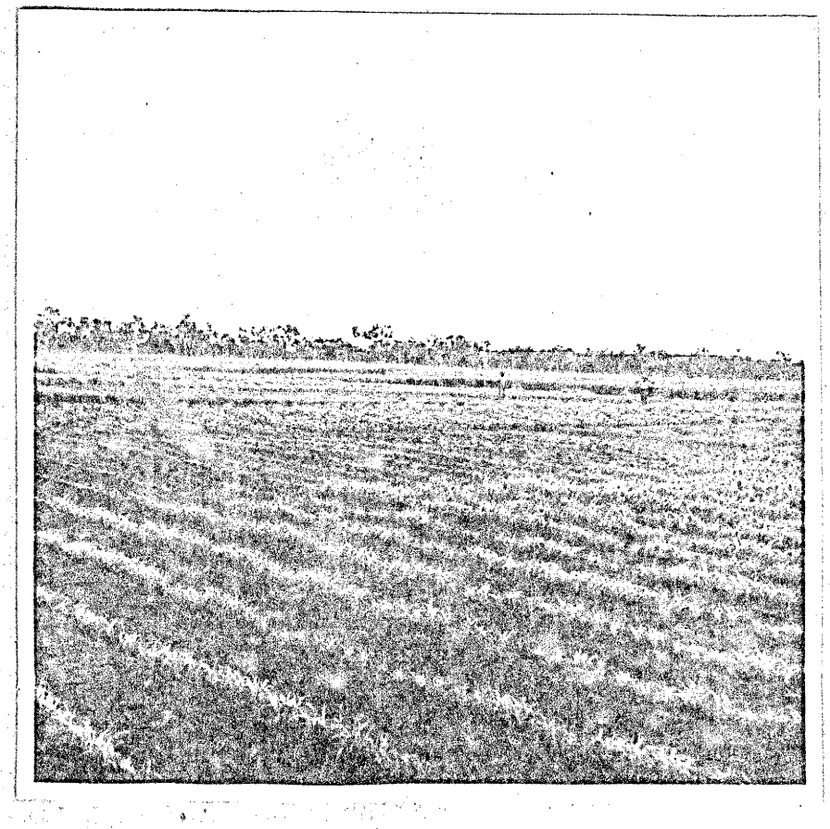


Plate 10. - Showing establishment in contiguous plantings of Sorghum (foreground) and Peanuts (middle distance) on block C.12 during the 1954-55 season.



Plate 11. - Hand methods were used to plant the 1954-55 experiments. Depth of sowing was adjusted by means of a washer on the pipe; the T-piece ensured accurate placement of seed and prevented clogging of pipe. The planting chain can be seen in the foreground.



Plate 12. - Sorghum time of planting experiment on block C.5 during the 1955-56 season. A randomised replicated layout was used. Only the centre two rows of each plot were harvested.



Plate 13. - Soil moisture sampling during the planting phase, 1954-55 season. The tube contains the soil sampling tins; empty tins are drawn from below and full tins replaced at the top.

Sorghum. C. 5.- Plots were 0.0124 acres each. Fertilizer was applied at planting at the rate of 240 lbs. per acre of a mixture consisting of one part of sulphate of ammonia to two parts of superphosphate.

2.2 Observations

2.2.1 Emergence

(a) 1954-55.- Observations on emergence at all depths were made each day over the sowing period until establishment was assured. Each planting point or hill was considered as a single unit and the emergence of a healthy plant at that point was sufficient to record it as successful.

Under the conditions of these experiments the longest period from planting to brairding was six to seven days, while the normal period was five and three days for peanuts and sorghum respectively. It can be seen that under these conditions, emergence was regular and very uniform.

(b) 1955-56.- Establishment counts were made on peanuts and head counts on sorghum just before harvest.

2.2.2 Surface Moisture

1954-55.- Soil moisture samples were taken at each inch down to the 5 in. zone, and at 12 ins., in the areas planted, in order to determine available moisture in the planting zone (Plate 13).

2.2.3 Peanuts

The following observations were made during the 1954-55 season :

(1) The appearance of the first flower and the time when flowering became general.

(2) Yield at harvest. As the plots were uniform, and 2 ins. to 3 ins. is the recommended sowing depth for peanuts, only the 2 in. and 3 in. plots were harvested. Harvest dates are shown in Table 20 in the Appendix.

(3) Kernel size and Shelling percentage were determined on the 1st., 21st., 42nd., 49th., 56th., 63rd., 70th. and 71st. plantings.

2.2.4 Sorghum

Observations in the 1954-55 season were as follows:-

(1) Height for sowings of different depths in each day's plantings, at varying times during the season.

(2) The development of flowering, anthesis and maturity in one replication only of each block.

(3) Yield. As the development and growth of plantings made at different depths appeared to be generally uniform only the 1 in. and 2 in. sowings were harvested in this experiment. The crop was harvested in groups of eight to ten plantings after the youngest planting had reached maturity; harvest dates are set out in Table 21 in the Appendix.

(4) Grain size and grain number. After harvesting, threshing and weighing for yields, the material from each individual plot was sieved simultaneously through four screens of different sizes to give four grades of grain for each plot. The "separates" were weighed. Each grade of grain was defined by determining the mean weight of 100 grains, based on twelve replications from a number of sub-samples which were retained, as the grain was being bulked up for storage. Table 6 shows the grades into which the grain was separated.

TABLE 6

Grain Sizes of Sorghum

Definition of Grades into which Sorghum Yields were separated

Size of retaining screens	Grade of Grain	Definition of Grade g/100 grains		Approximate number of grains per ounce
		1954-55	1955-56	
1 in. x $\frac{5}{32}$ in.	None retained			
$\frac{9}{64}$ in. round	A	2.714±0.003	2.567±0.014	1075
$\frac{1}{8}$ in. round	B	2.215±0.003	2.065±0.008	1325
1 in. x $\frac{1}{32}$ in.	C	1.667±0.007	1.559±0.011	1750
Remainder (This passed through the above screen)	D	1.375±0.013	1.464±0.066	2000

From these data the relative number of grains per plot was calculated.

2.2.5 Soil Moisture

(a) 1954-55.- Besides the soil moisture samples taken in the surface layers during planting, the soil profile under crop to the depth of the root zone was sampled regularly during the season. In the peanut block, C.10, the 2nd, 20th.,

40th., 58th., and 78th., plantings in each replication were sampled at intervals of approximately 10 days or more, depending on growing conditions. A similar programme was carried out in the sorghum block, C.5, on the 2nd., 20th., 38th., 56th., and 73rd. plantings. In the block containing both crops, C.12, moisture was followed in only one replication of each crop on the 10th, 20th and 30th plantings. Approximately 150-200 grams of soil were retained at each sampling point from 4 in. augur holes and moisture determination was by gravimetric methods after 24 hours in the oven at 100.5° C. Depths at which samples were usually taken were 12 ins., 18 ins., 24 ins., 32 ins., 48 ins., and 64 ins., though as the surface was drying out and roots were penetrating further, samples were also taken at 4 ins., 8 ins., 72 ins., 84 ins., 96 ins. and in some cases at 100 ins. and beyond.

(b) 1955-56.- No soil moisture samples to depth were taken in these experiments during the 1955-56 season, but data from nearby sites with similar land histories were available.

2.2.6 Climatic Data

Standard thermometer readings, evaporation from a standard 36 in. tank, continuous records of rainfall and hours of sunshine on 24-hour charts and temperature and relative humidity on weekly charts, were made in a small meteorological enclosure permanently maintained at the Headquarters of the Research Station. In addition, rainfall was also recorded on the site of the experiments. Some of these data for the 1954-55 season are presented graphically in Fig. 1.

During the 1955-56 season, in addition to the above records, evaporation was measured on the site of the sorghum experiment by means of a Piche Evaporimeter (Prescott and Stirk 1951) exposed in a standard Stevenson screen (Plate 14) and minimum temperatures in the peanut crop by means of minimum thermometers placed among peanut bushes (Plate 15).

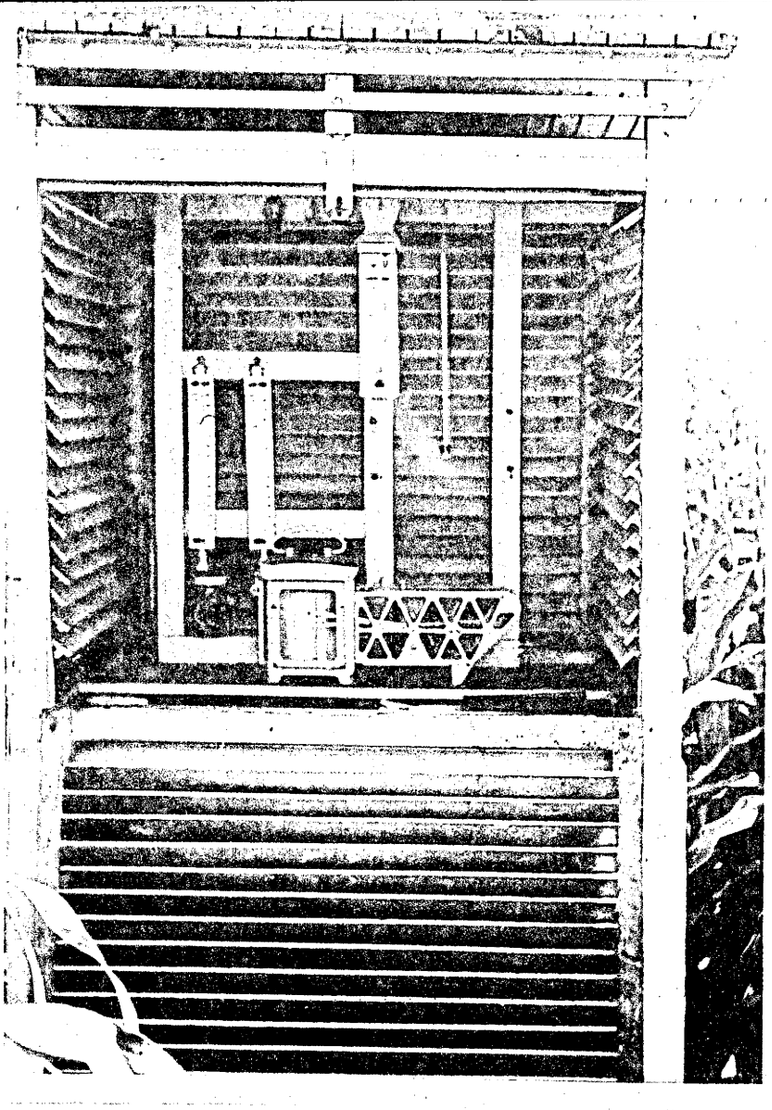


Plate 14. - Meteorological screen, in a crop of Sorghum during the 1955-56 season, containing wet and dry bulb thermometers, maximum and minimum thermometers, Piche Evaporimeter, and thermo-hygrograph.

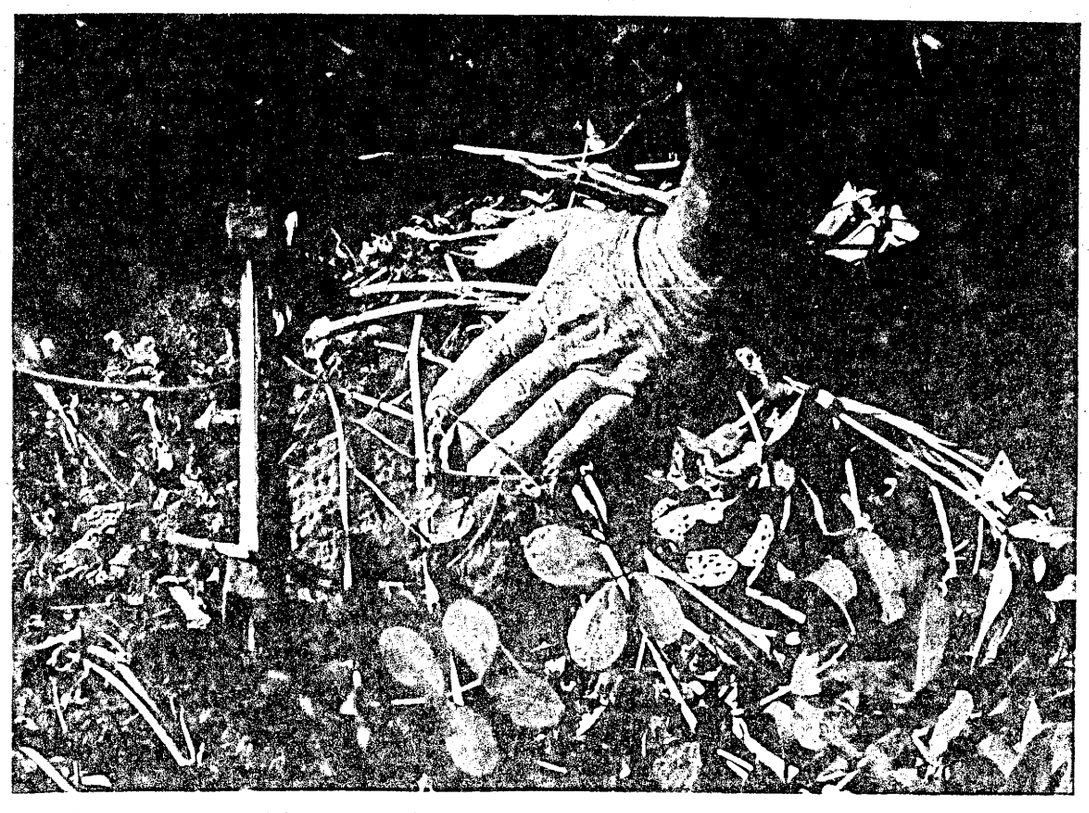
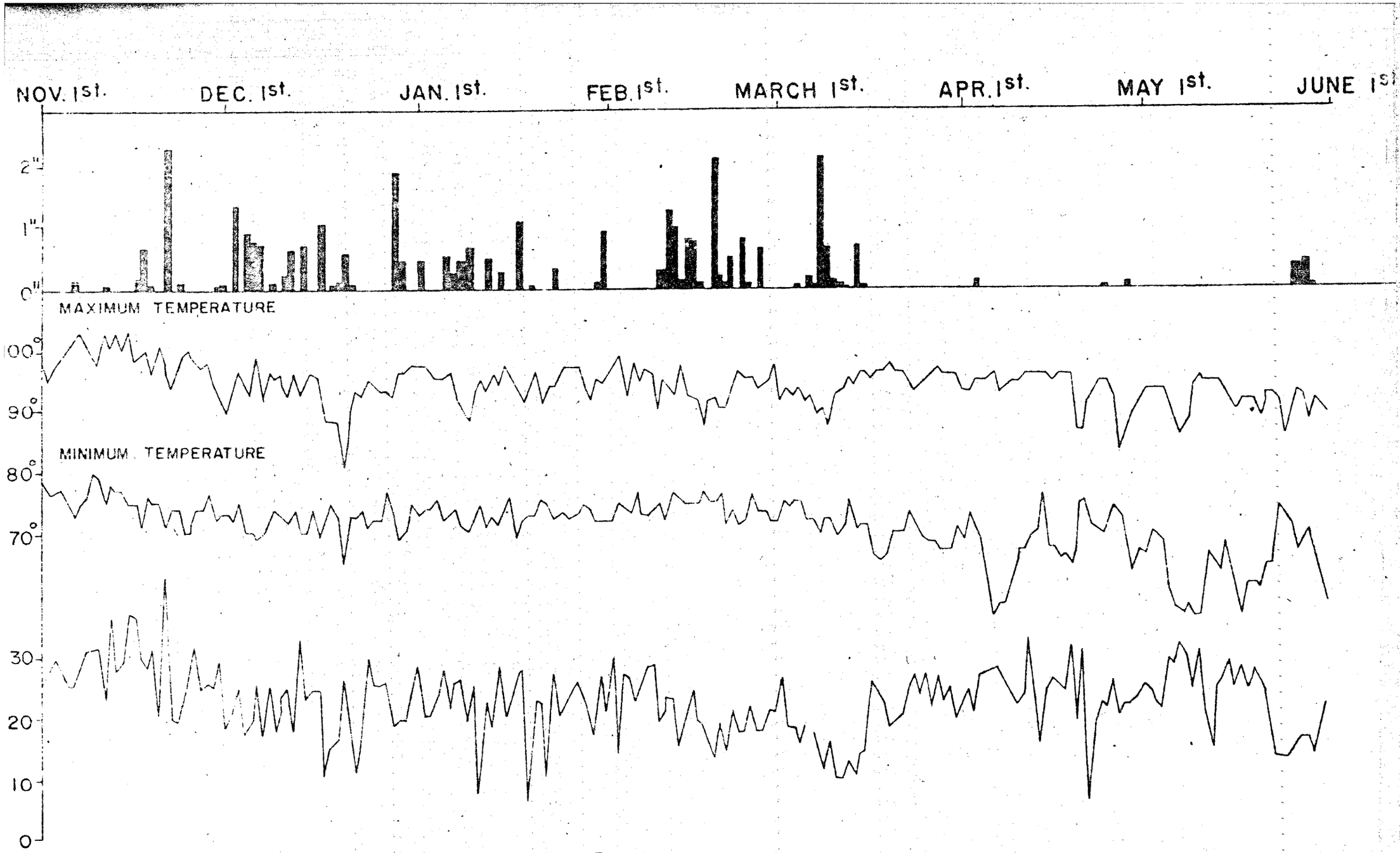


Plate 15. - Peanut bush parted to show minimum thermometer placed just above soil level. 1955-56 season.



1954-55 SEASON

FIGURE 1

L5

3. RESULTS

3.1 Climate

(a) 1954-55.- The salient features of the climatic data during the 1954-55 season are the early opening, its continuity and regularity.

The first rain fell on October 9th and though total rainfall was below average, the longest continuous periods without rain were only of six days' duration towards the end of December and again at the end of January. From October to the end of May, 32.26 ins. of rain fell on 95 wet days and from December 1st to the end of April 24.47 ins. of rain fell on 64 wet days. Rainfall distribution could not have been better, and at no time were there any heavy downpours. The sky was overcast for most of the growing period, clear skies did not become prominent until the latter half of March.

Mean minimum temperatures remained fairly steady until the end of February with a general decline in regime during March and a very sharp drop in early April. The mean temperatures in five-day periods are presented in Figure 2. With the onset of the dry season, minimum temperatures became irregular, as is usual at that time of the year. After initial high temperatures of over 100°F in November the maximum temperature did not exceed 98°F during the season except on three occasions, viz. December 6th, February 3rd and 13th. The maximum temperature regime remained remarkably constant during portion of January and February, fluctuating between 91° and 98°F, but showed much more pronounced variation from mid-February to mid-March. The diurnal variation in temperature remained relatively constant.

With the exception of a general depression about mid-February-March, associated with very overcast conditions, evaporation remained fairly uniform during the greater part of the growing period. Saturation Deficit (Figure 3) shows a marked increase on March 17th. The values prior to that date are below 28 millibars while subsequent values are at a much higher level (between 33 and 44 millibars). This abrupt change is associated with the transition from wet to dry conditions and expresses well the nature of the climatic changes at that time. The effect on plants of such sudden increases in the dessicating power of the atmosphere are well documented in the literature.

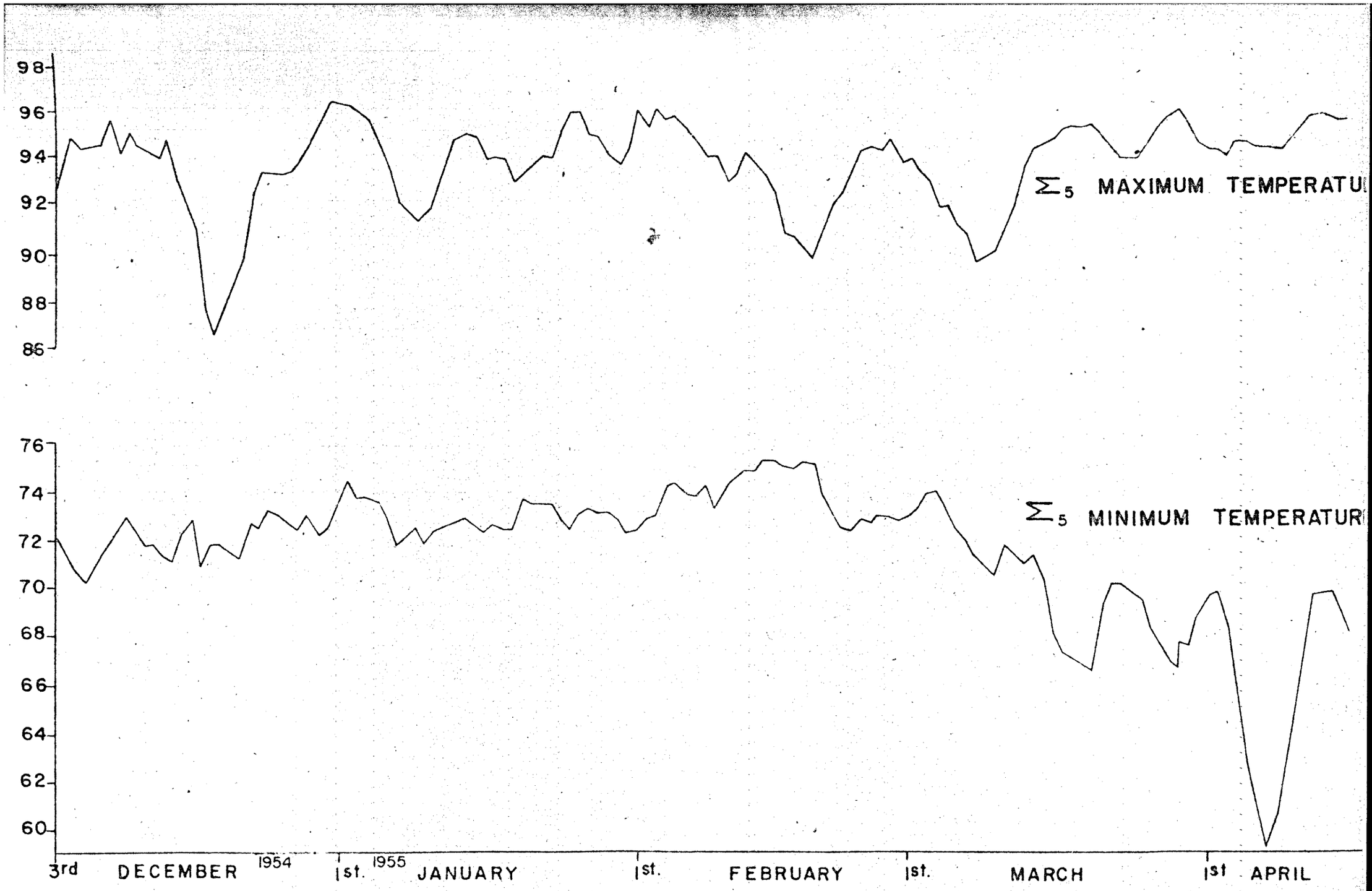

98
96
94
92
90
88
86
Σ_5 MAXIMUM TEMPERATU
76
74
72
70
68
66
64
62
60
Σ_5 MINIMUM TEMPERATUR
3rd DECEMBER 1954
1st. 1955 JANUARY
1st. FEBRUARY
1st. MARCH
1st APRIL

FIGURE 2

L5

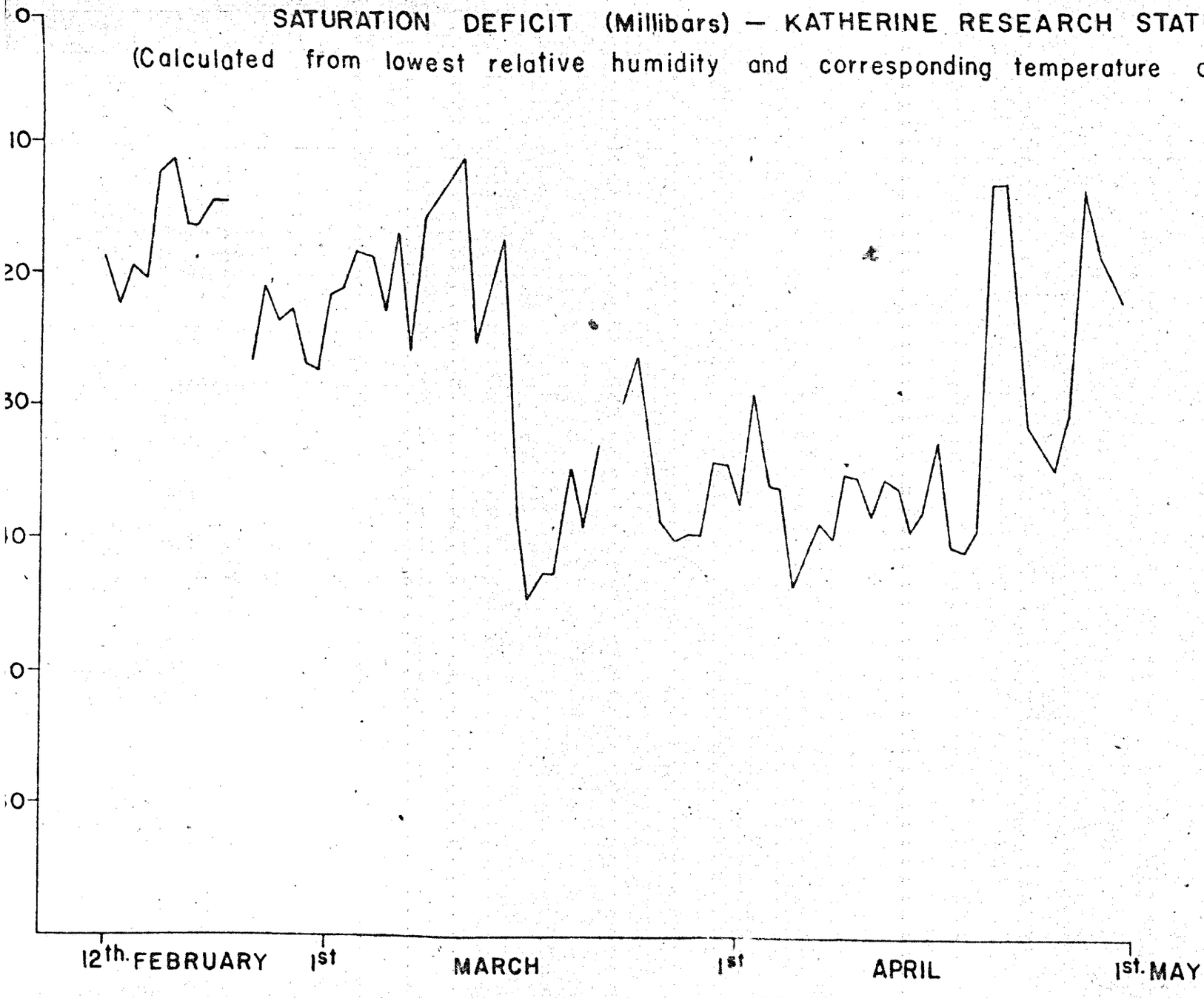

SATURATION DEFICIT (Millibars) — KATHERINE RESEARCH STATION 1955
(Calculated from lowest relative humidity and corresponding temperature on any one day.)
0
10
20
30
10
0
0
12th. FEBRUARY
1st
MARCH
1st
APRIL
1st. MAY

FIGURE 3

(b) 1955-56.- Conditions were somewhat different during the 1955-56 season. 6.35 ins. fell on 15 wet days during October and November while 2.51 ins. fell on 12 wet days during December; the heaviest fall was 1.08 ins. on December 31st. Conditions at this time were hot and humid with period of threatening rain. Total rainfall for the season was 31.19 ins falling on 84 wet days.

Twenty-four recordings of over 100°F were made during December and the first week of January. Satisfactory conditions for planting and subsequent growth did not develop until early January. Minimum temperatures remained high during December and January fluctuating between 71°F and 79°F. During March and April there were marked swings in the maximum and minimum temperature regimes, suggesting unstable weather conditions at that time. The minimum temperature regime did not show any decline until the third week of May and a marked drop at the end of May.

Evaporation as measured by the Piche Evaporimeter showed regular swings during the period from January to May, and a general levelling out during June.

3.2 Soil Moisture

Sampling data for both peanuts (Figure 4) and sorghum (Figure 5) showed that at no stage during the growing season was available soil moisture limiting for plant growth. (See Tables 16, 17, 18, 19 in Appendix). Samples taken from peanut land, Table 7, in mid-July (after the crops had been harvested) show that at 12 ins. the soil was at wilting percentage but that there was adequate moisture available below this depth.

TABLE 7

Soil Moisture under Peanuts, C.10, at the end of the 1954-55 Season - sampled on 13.vii.55.

Depth (ins)	21st Planting (190 days after brairding)	61st Planting (150 days after brairding)	Field Determination of Permanent Wilting (Slatyer 1953)
8	9.2	8.9	11.1
12	11.6	11.7	
16			12.5
18	14.5	14.7	
24	15.9	14.9	13.0
32	16.2	15.2	13.8
48	18.3	16.3	13.8
64	18.6	17.3	14.5
72	17.4	17.5	
84	17.2	17.6	
90	20.0	-	

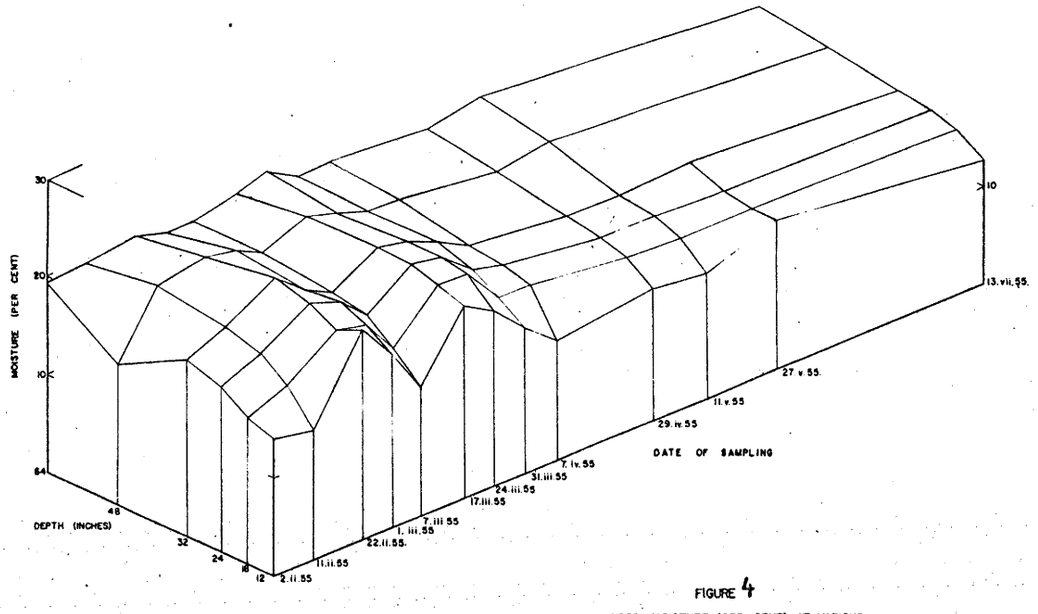


FIGURE 4

SOIL MOISTURE (PER CENT) AT VARIOUS DEPTHS UNDER PEANUTS ~~C.V.~~ C.10 1954-55 SEASON

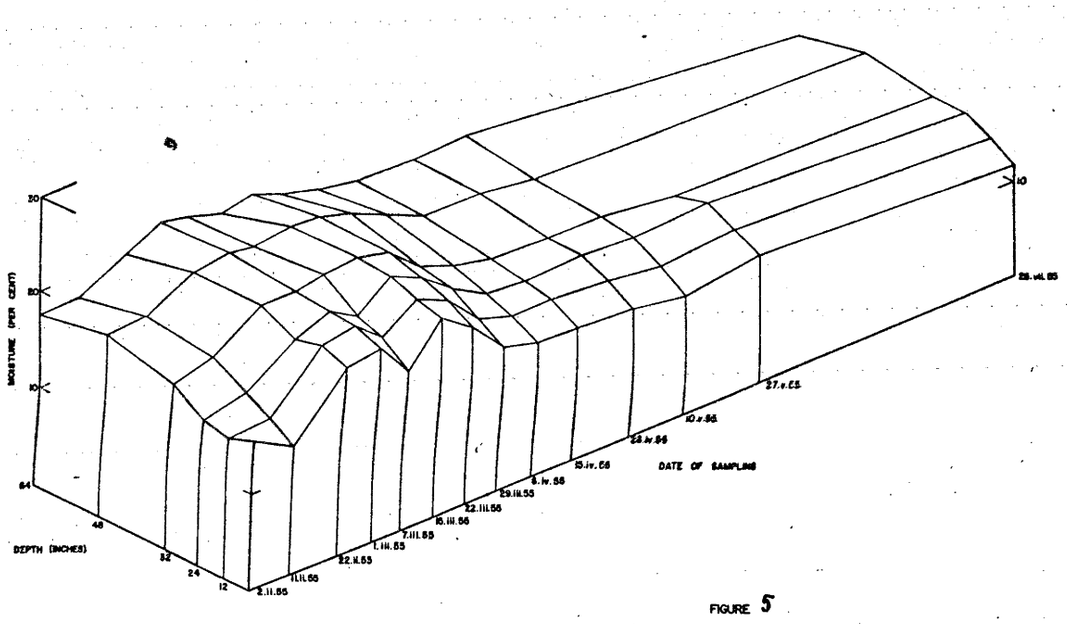


FIGURE 5

SOIL MOISTURE (PER CENT) AT VARIOUS DEPTHS UNDER SORGHUM C.S. 1954-55 SEASON

In the case of sorghum, Table 8, the soil was below the wilting percentage at 8 ins. at the beginning of April, during the period of high saturation deficit. As sorghum roots are capable of exploring the soil to great depths, and are well distributed throughout the profile, there is no doubt that there was adequate soil moisture for growth below 8 ins. Samples taken at the end of July show that the soil reached wilting percentage to 12 ins. only.

TABLE 8

Soil Moisture under Sorghum C.5, during the period of high Saturation Deficit, and at the end of the 1954-55 season

Depth (ins)	2nd Planting		20th Planting		60th Planting		Field Determination of Permanent Wilting (Slayter 1953)
	93 days after brairding	115 days after brairding	97 days after brairding	207 days after brairding	57 days after brairding	166 days after brairding	
	Sampled 15.iii.55	Sampled 6.iv.55	Sampled 6.iv.55	Sampled 25.vii.55	Sampled 6.iv.55	Sampled 25.vii.55	
4		5.8	8.9		9.4		
8		9.3	10.4	7.1	12.2	9.2	11.1
12	20.2	13.6	13.7	10.4	14.0	11.3	
16							12.5
18	20.7	14.9	14.9	14.2	15.1	12.2	
24	21.6	15.4	16.8	14.4	15.8	14.1	13.0
32	21.0	16.7	18.4	15.2	16.2	13.9	13.8
48	21.6	19.3	19.0	15.0	19.7	17.2	13.8
64	19.3	15.7	20.1	13.9	20.3		14.5
72				16.8			
84				16.8			
96				18.5			
108				18.8			
116				18.4			

At no time during the growing season was there any field evidence of water stress in plants. Growth appeared to be uninterrupted.

3.3 Establishment of Peanuts and Sorghum

(a) 1954-55.- When good conditions persisted both peanuts and sorghum emerged from all depths sown. With adverse conditions the 1 in. sowings were slightly retarded, as a result of rapid evaporation from the surface layers, while deeper sowings were impeded or delayed because of crust

formation on the soil surface. Intermediate sowings at 2 in. and 3 in. gave consistent results under the conditions of this experiment.

As the 2 in. and 3 in. plantings for peanuts and the 1 in. and 2 in. plantings for sorghum gave precise and uniform stands and are the recommended sowing depths for these crops, they were harvested for development studies. It has been shown (Rangaswami Ayyangar and Kuhni Krishnan Nambiar 1931; Martin, Taylor and Leukel 1935) that under controlled conditions there was no difference in germination or early growth of Sorghum seedlings with sowings made up to 2½ in.

(b) 1955-56.- The early sowings, particularly those made before early January did not give satisfactory stands. This has been discussed in Climate (Section 3.1). The early planting of peanuts was harvested for yield and in the final analysis correction was made for stand. In the case of sorghum the early planting was not harvested for yield, but the stand was adequate to collect phenological data.

3.4 Yield

3.4.1 Peanuts

(a) 1954-55.- The peanut yields in the main experiment, C.10, (Figure 6) show a decline from 2900 pound per acre in the 4th. planting to 90 pounds per adre in the 71st. planting. (See Appendix for tabular data - Table 10). Plots from the 73rd. planting onwards were not dug, as they produced no nuts worth harvesting. These plants continued to grow slowly and produced flowers and pegs, which however failed to mature into pods. The plantings in C.12 (Figure 7) show a decline in yield from 1980 pound per acre in the 4th. planting to 720 pounds per acre in the 38th. planting in a parallel trend. The greater variability in this smaller experiment was no doubt due to the shorter time that the block had been under cultivation, and the lower order of yields to wider spacing (Kath. Res. Sta. Progress Rept., in prepn.).

(b) 1955-56.- Only three of the four plantings made could be harvested for yield. The yields show a decline from 1500 to 1700 pounds per acre with late December- early January sowings to 785 pounds per acre with early February sowings. When correction for stand was made, the decline in yields was continuous as in the previous season.

3.4.2 Sorghum

(a) 1954-55.- Turning to the sorghum yield data in Figure 8, we find a marked discontinuity between the 26th., and the 27th. and 28th. plantings. A lower order of yield

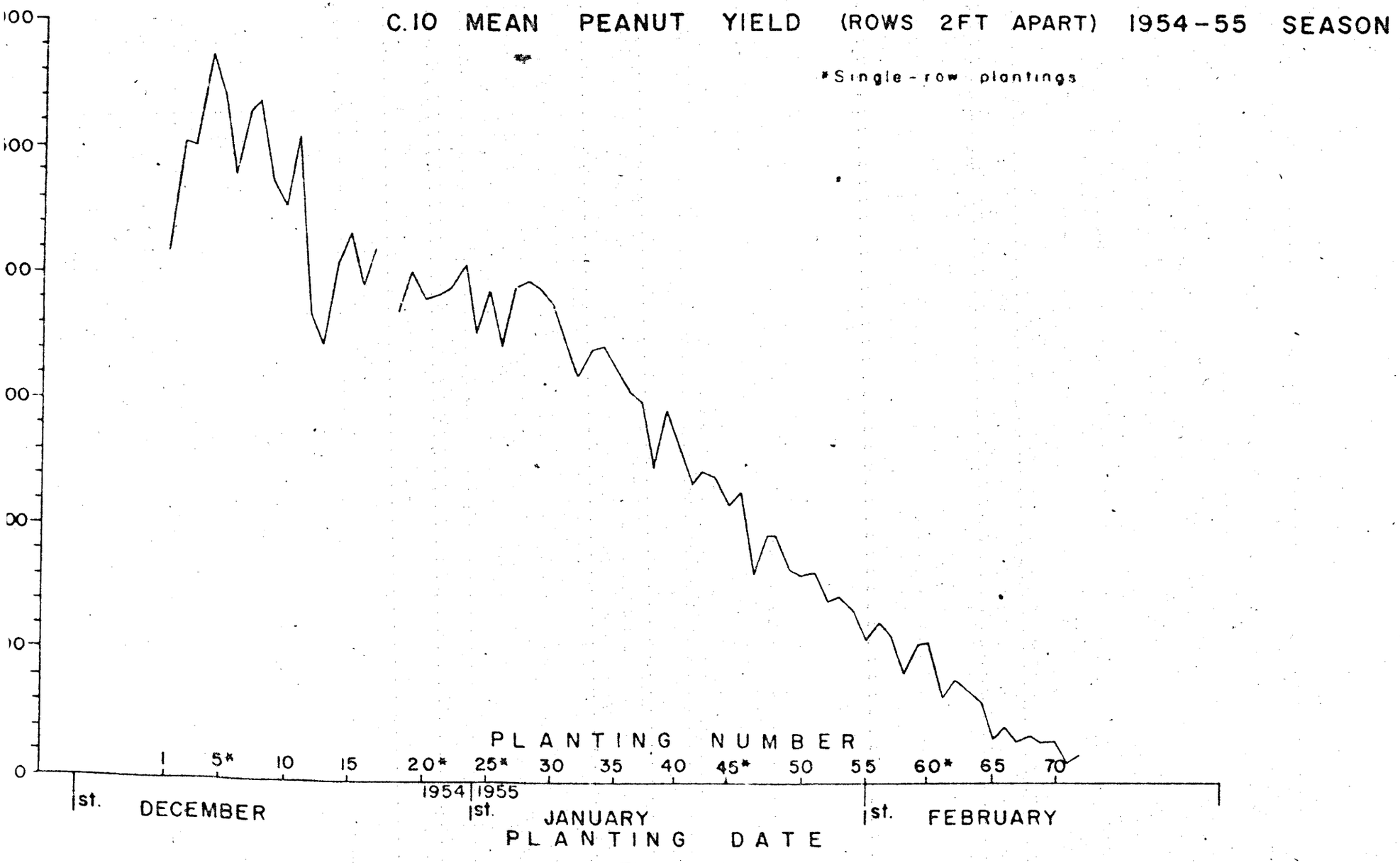

C.10 MEAN PEANUT YIELD (ROWS 2FT APART) 1954-55 SEASON
*Single-row plantings
100
00
00
00
10
0
PLANTING NUMBER
1
5*
10
15
20*
25*
30
35
40
45*
50
55
60*
65
70
1st.
DECEMBER
1954
1955
1st.
JANUARY
1st.
FEBRUARY
PLANTING DATE

FIGURE 6

C.12 — MEAN PEANUT YIELD (ROWS 3FT. APART) 1954-55 SEASON

* Single-row plantings

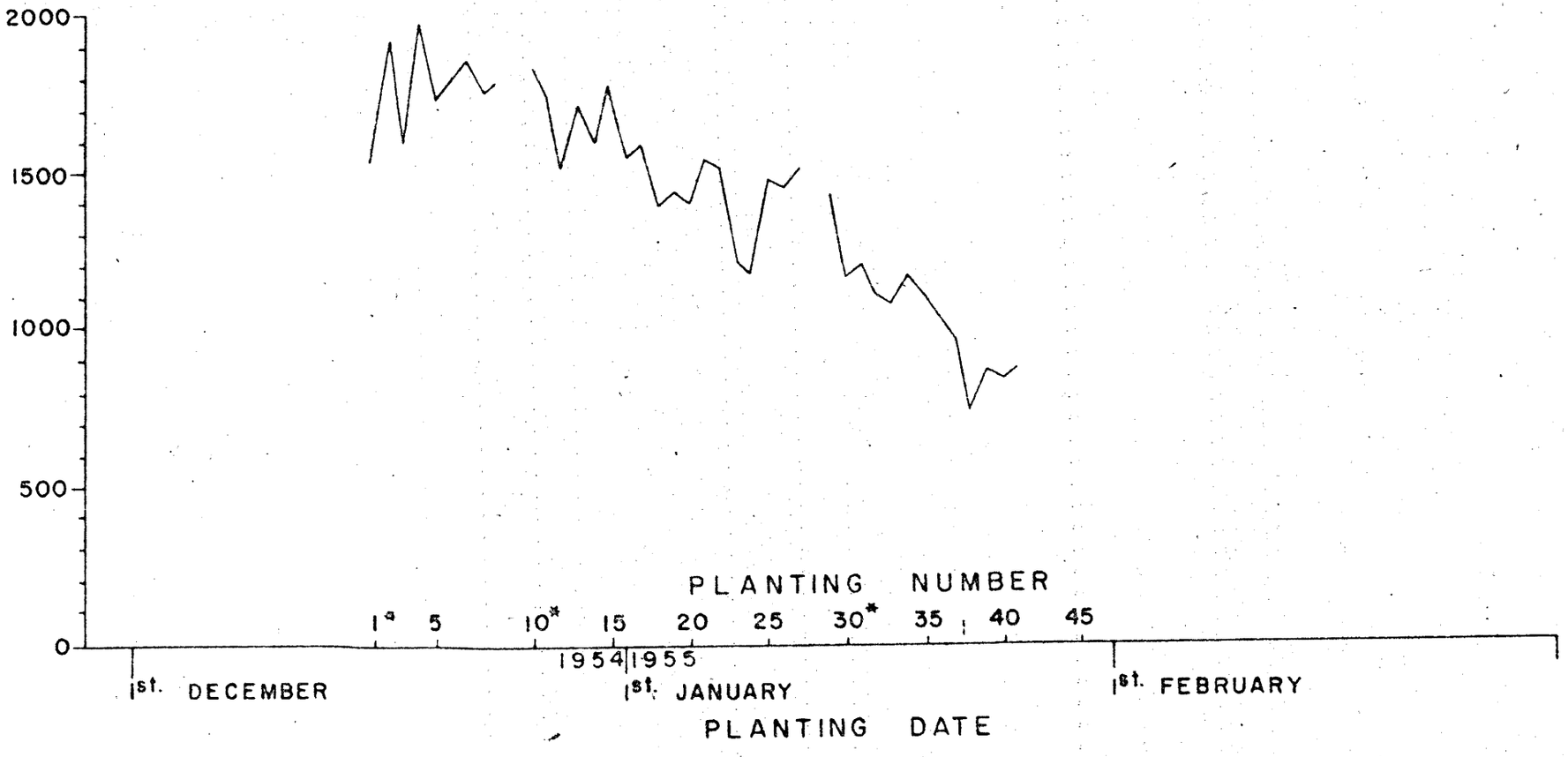


FIGURE 7

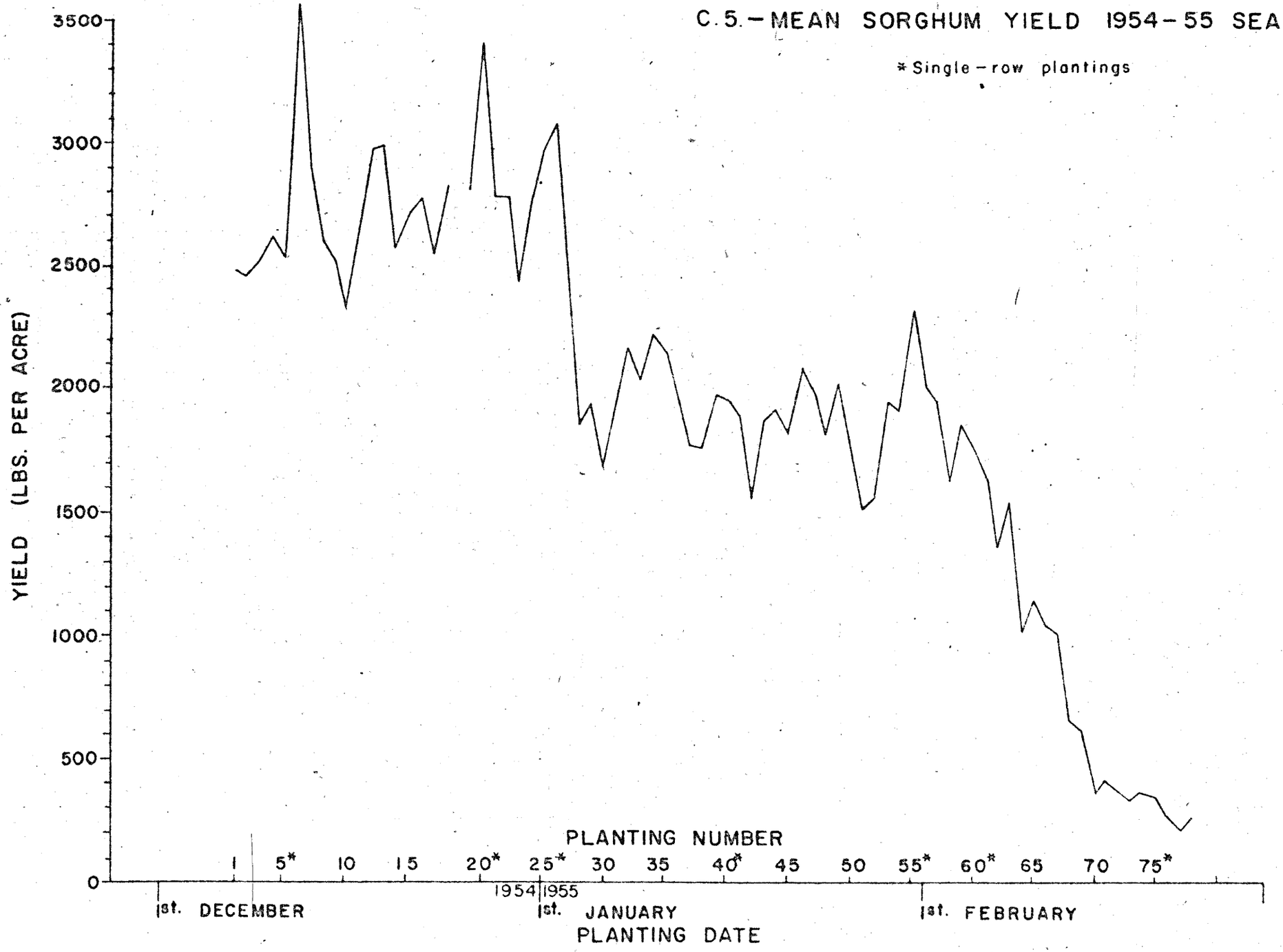


FIGURE 8

L56-9

is maintained from the 29th. to about the 52nd. planting, but rises again slightly to about the 55th. planting. From then on the decline in yield is steady and continuous with very little fluctuation. ~~in yield~~. The yields in the first twenty-seven plantings fluctuate between extremes of 2300 pounds per acre and 3600 pounds per acre, from plantings made on relatively close days. Similarly between the 29th. and 55th. planting yield varied between 1500 pounds per acre and 2200 pounds per acre. Fluctuations amount to 1300 and 700 pounds per acre respectively but are of the order of 50 percent. in both cases. In the experiments on C.12 (Figure 9a) the same trends are evident. The sharp drop in yield is present in each replication, though separated by a period of time. This displacement can be explained on the basis of variation in anthesis between replicates.

It should be noted that yield was correlated with grain number and that the mean size of grain was unaffected by planting date.

(b) 1955-56.- The earliest planting# to give a satisfactory stand was planted on January 1st, 1956 and brairded on January 7th, which coincides approximately with the period at which the marked drop in yield occurred during the previous season. The yields varied between 2453 pounds per acre and 1209 pounds per acre. The decline in yield with February plantings was again demonstrated. (See Appendix for full tabular data).

3.5 Kernel Size and Shelling Percentage of Peanuts

Both Kernel Size and Shelling Percentage were uniform up to and including the 56th. planting. From then on, Shelling Percentage decreased gradually until the 70th. planting when it dropped sharply. (Figure 10). Kernel Size decreased very little over the whole planting period.

These results indicate that the quality of the peanut was maintained with successive plantings until the last three weeks of sowing.

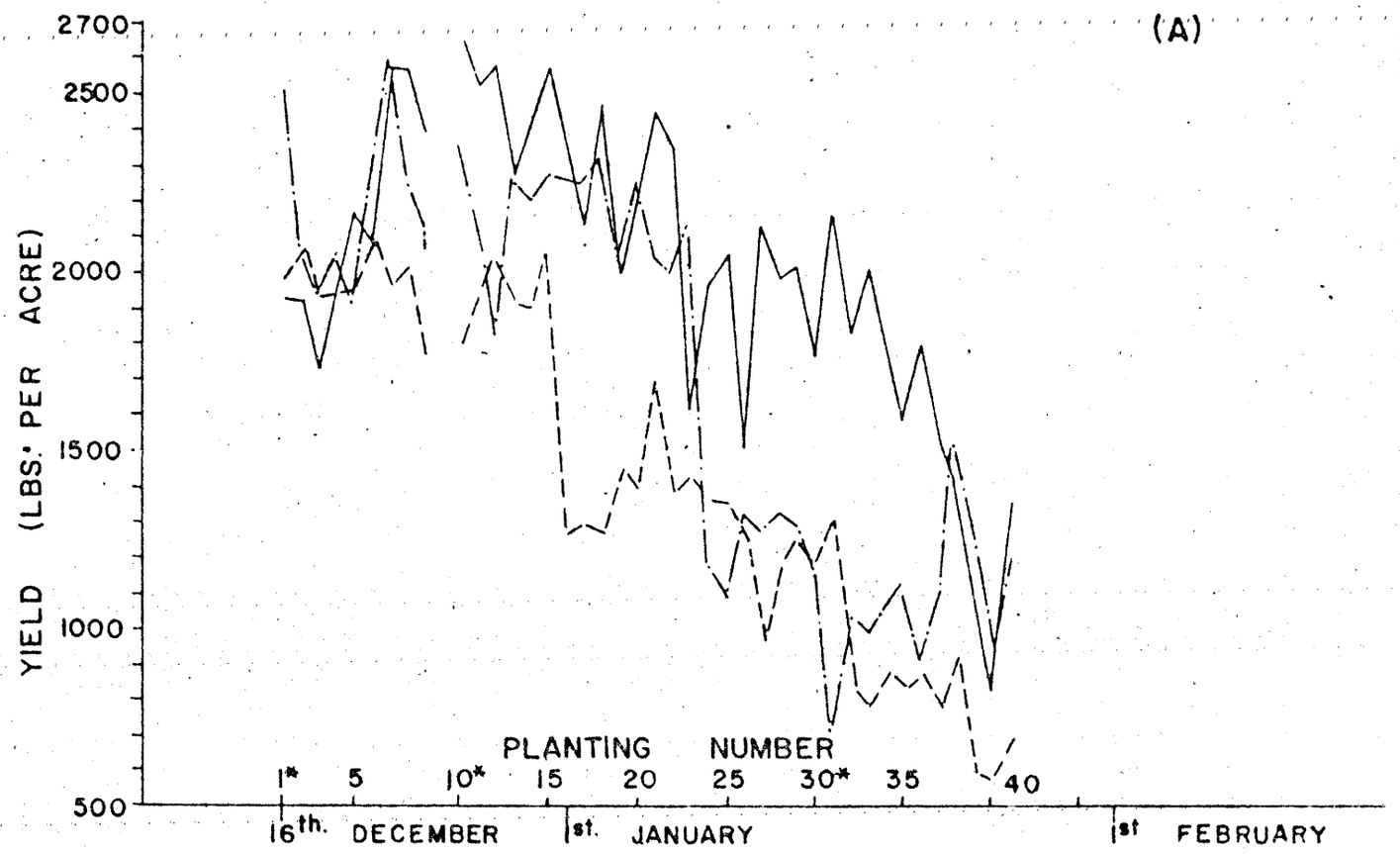
3.6 Grain Number of Sorghum

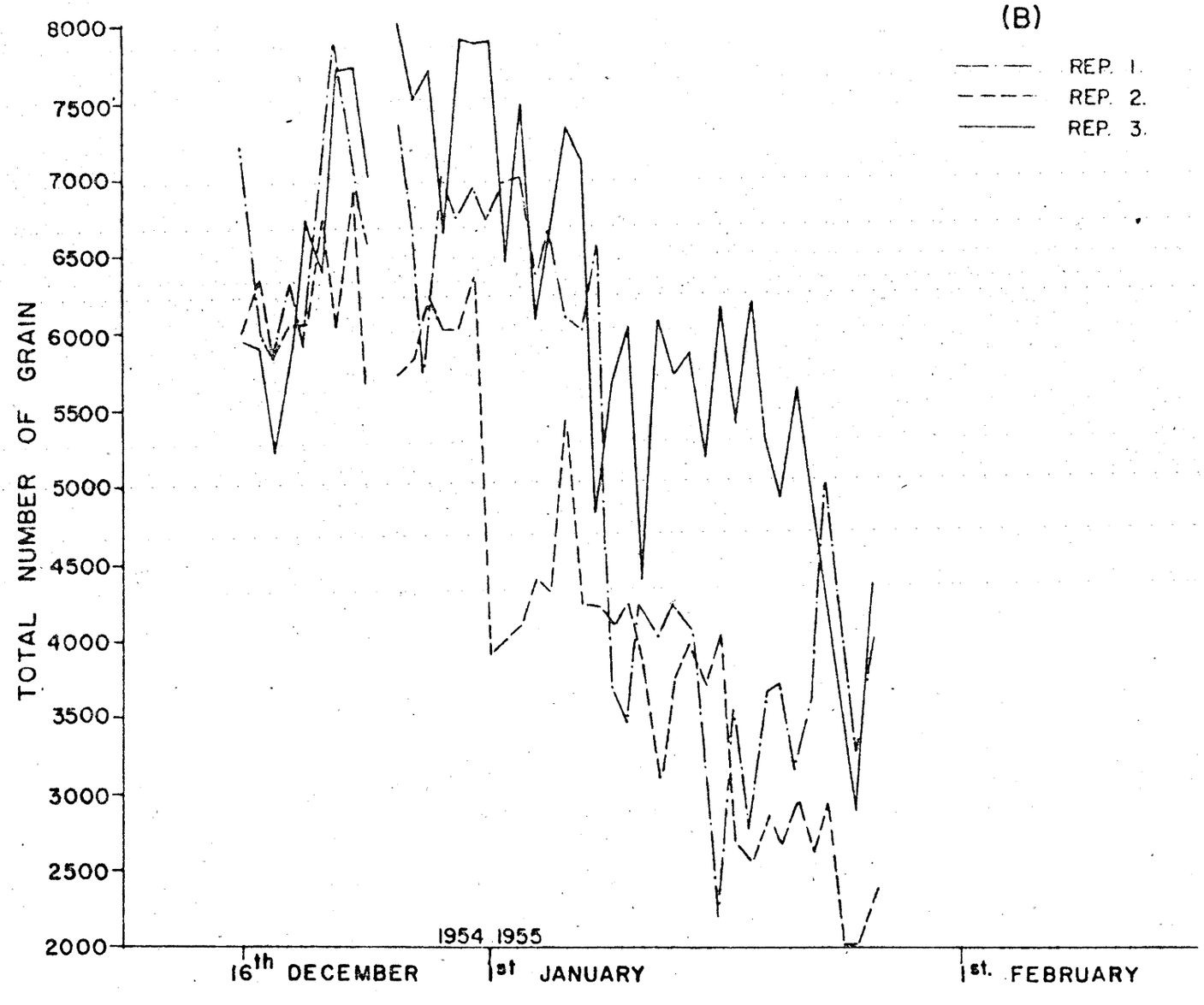
(a) 1954-55.- The data of relative grain number was computed from separated material as outlined in section 2.2.4 (Table 6) and Table 13 of the Appendix (8.1), and is presented graphically in Figures 11 and 12.

The total number of grains produced and the number of B are both correlated with yield. The numbers in grade A show some variation with notable drops in early and mid-January, a peak at the end of December, and a rapid decline with later plantings.

C.12 – SORGHUM YIELD AND TOTAL NUMBER OF GRAIN
1954–55 SEASON

* Single-row plantings





C.S. 10 — PEANUTS: SHELLING PERCENTAGE AND NUT SIZES AT SELECTED INTERVALS OVER THE PLANTING PERIOD 1954-55 SEASON

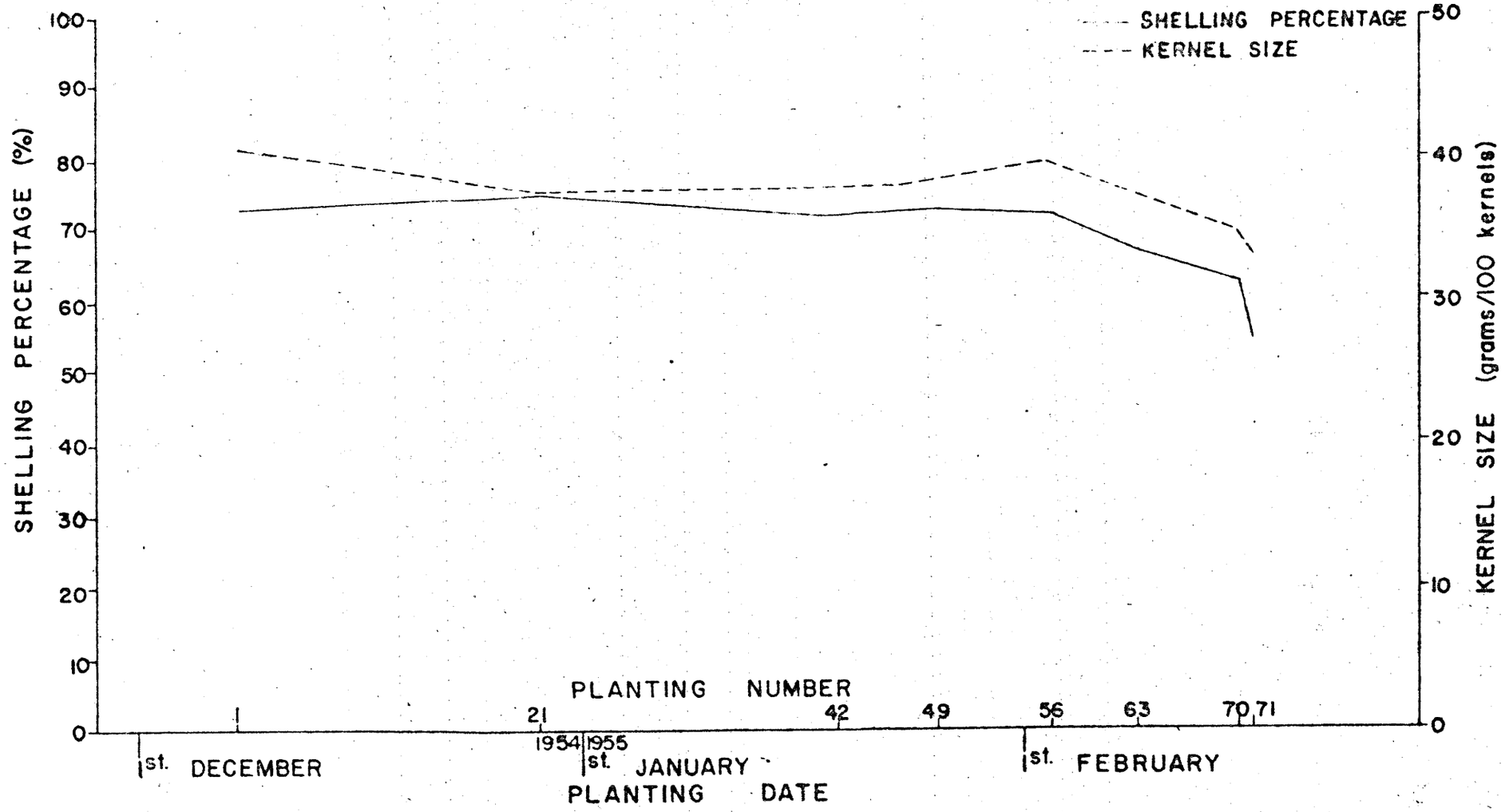


FIGURE 10

L56-9

C.5 — SORGHUM: MEAN NUMBER OF GRAIN IN FRACTIONS A,B,C & D
1954 - 55 SEASON

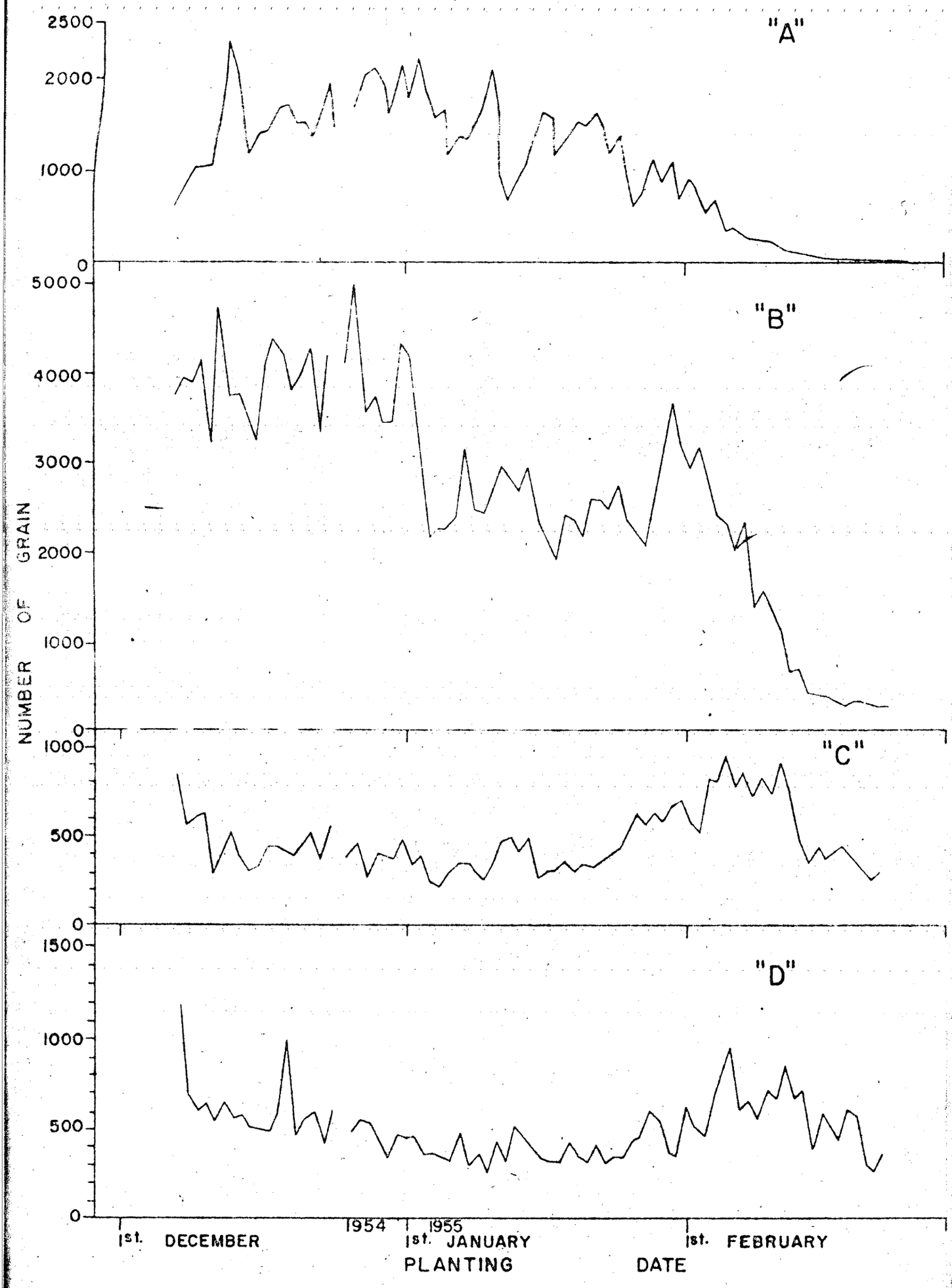


FIGURE 11

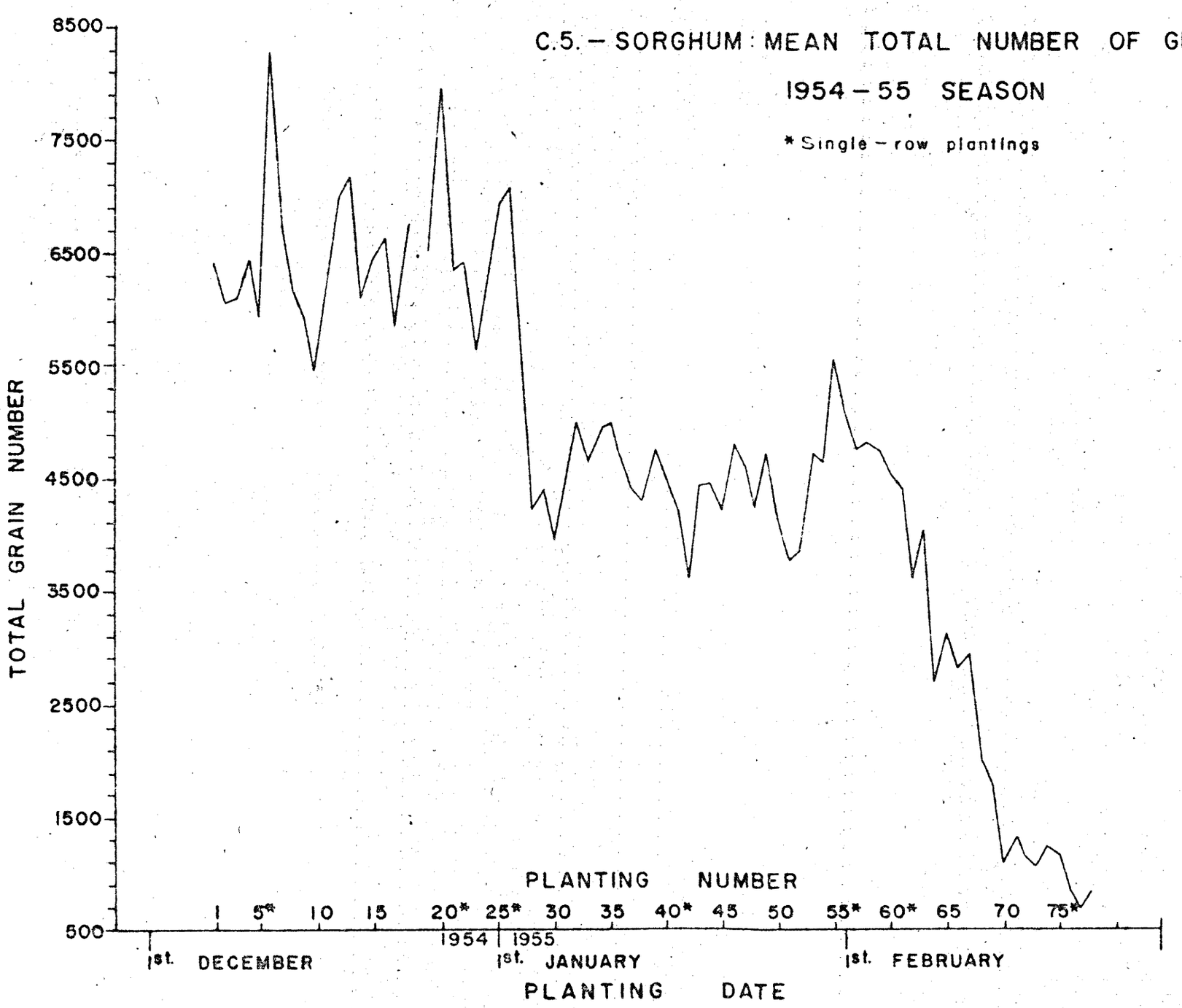

C.5. – SORGHUM: MEAN TOTAL NUMBER OF GRAINS
1954 – 55 SEASON
* Single – row plantings
TOTAL GRAIN NUMBER
8500
7500
6500
5500
4500
3500
2500
1500
500
PLANTING NUMBER
1 5* 10 15 20* 25* 30 35 40* 45 50 55* 60* 65 70 75*
1954
1955
1st. DECEMBER
1st. JANUARY
1st. FEBRUARY
PLANTING DATE

FIGURE 12

The fluctuations in the number of B followed the fluctuations in final yield. The number in grade C remains relatively constant at first, rising to a peak with early February plantings, and decreases rapidly with the last dozen plantings. The numbers in grade D fluctuate at a very low level and the curve is in the general shape of a catena. The numbers of neither C nor D are instrumental in shaping the yield curve and should be considered rather as residues.

The proportion of each grade of grain to the total yield, calculated as a percentage for each day's planting, is presented graphically for A and B in Figure 13. The graphs (Figure 11A and 13A) indicate a close parallel between the absolute number and the percentage of A. On the other hand the percentage of B (Figure 13B) remains relatively constant at about 55-65 percent. until the 63rd. planting and until then does not seem to be associated with any fluctuation in yield. The percentages of C and D remain relatively constant but rise with February plantings, indicating that yields from the later plantings are built up with a much higher proportion of small grain.

(b) 1955-56.- The same sieves were used as in the previous year and the patterns of grain size distribution followed that of the previous year. (See Appendix for tabular data - Table 26).

3.7. Anthesis in Sorghum

Table 9 shows the period from brairding to anthesis both in the 1954-55 and the 1955-56 seasons. Variations in anthesis with plantings made on relatively close days is evident, but the shortening in the period to anthesis with plantings made later in the season is quite distinct. The times to anthesis for plantings which brairded on similar dates, correspond in both seasons.

3.8. Node Number in Sorghum

These data were collected during the 1955-56 season only and are presented in Figure 14. Three distinct steps are evident in the node number over the planting period and these resemble the yield steps of the 1954-55 season. There does not appear to be any relationship between node number and height.

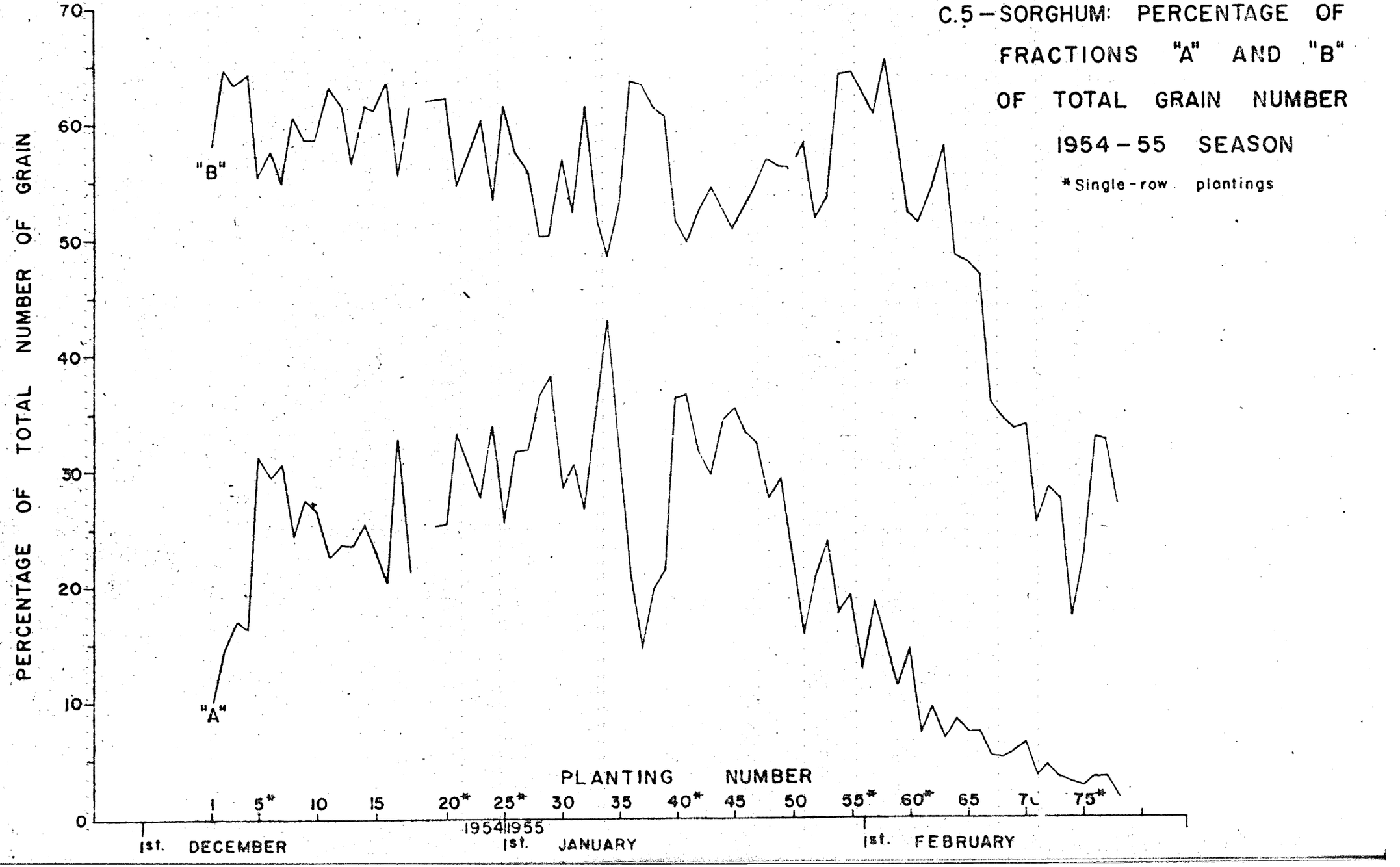
3.9 Height in Sorghum

The height of the crop at maturity was measured for each planting in both the 1954-55 and the 1955-56 seasons. These data are presented graphically in Figures 15 and 14B. The height remains at a relatively constant level, in spite of changes in node number, throughout the greater part of the growing season, but falls gradually with February plantings. This trend is evident in both seasons.

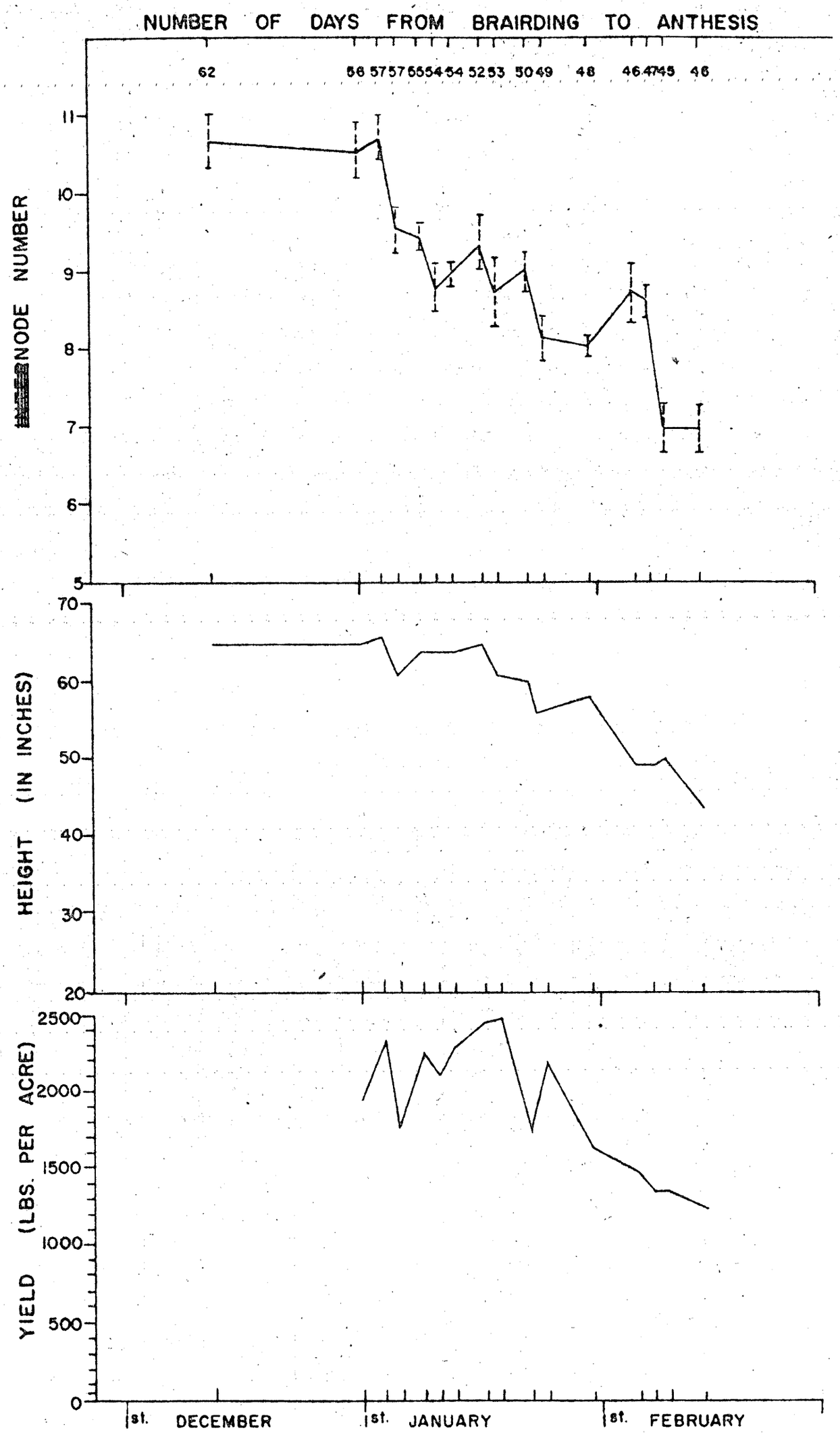
TABLE 9

Sorghum, C. 5. - Days from Brairding to Anthesis during two successive Seasons.

Date of Brairding	December		January		February	
	54-55	55-56	54-55	55-56	54-55	55-56
1			59		50	
2			61		50	
3						
4			57			48
5			57			
6			57			
7			57	56		
8			57			
9			57	57		
10			57		51	46
11	58		56	57	50	
12	58			55		47
13					51	
14	58			54	51	45
15	58		59		49	
16	57		59	54		
17	59		57			46
18	59					46
19						
20	58					
21	61			52		
22	59					
23	60		54		48	
24	59		54	53		
25						
26	57		54			
27			53			
28	57	62				
29	57		51	50		
30	56					
31	56		51	49		


C.5 – SORGHUM: PERCENTAGE OF FRACTIONS "A" AND "B" OF TOTAL GRAIN NUMBER 1954 – 55 SEASON
* Single-row plantings
PERCENTAGE OF TOTAL NUMBER OF GRAIN
70
60
50
40
30
20
10
0
"B"
"A"
PLANTING NUMBER
1 5* 10 15 20* 25* 30 35 40* 45 50 55* 60* 65 70 75*
1954 1955
1st. DECEMBER
1st. JANUARY
1st. FEBRUARY

C. 5 – SORGHUM 1955–56 SEASON



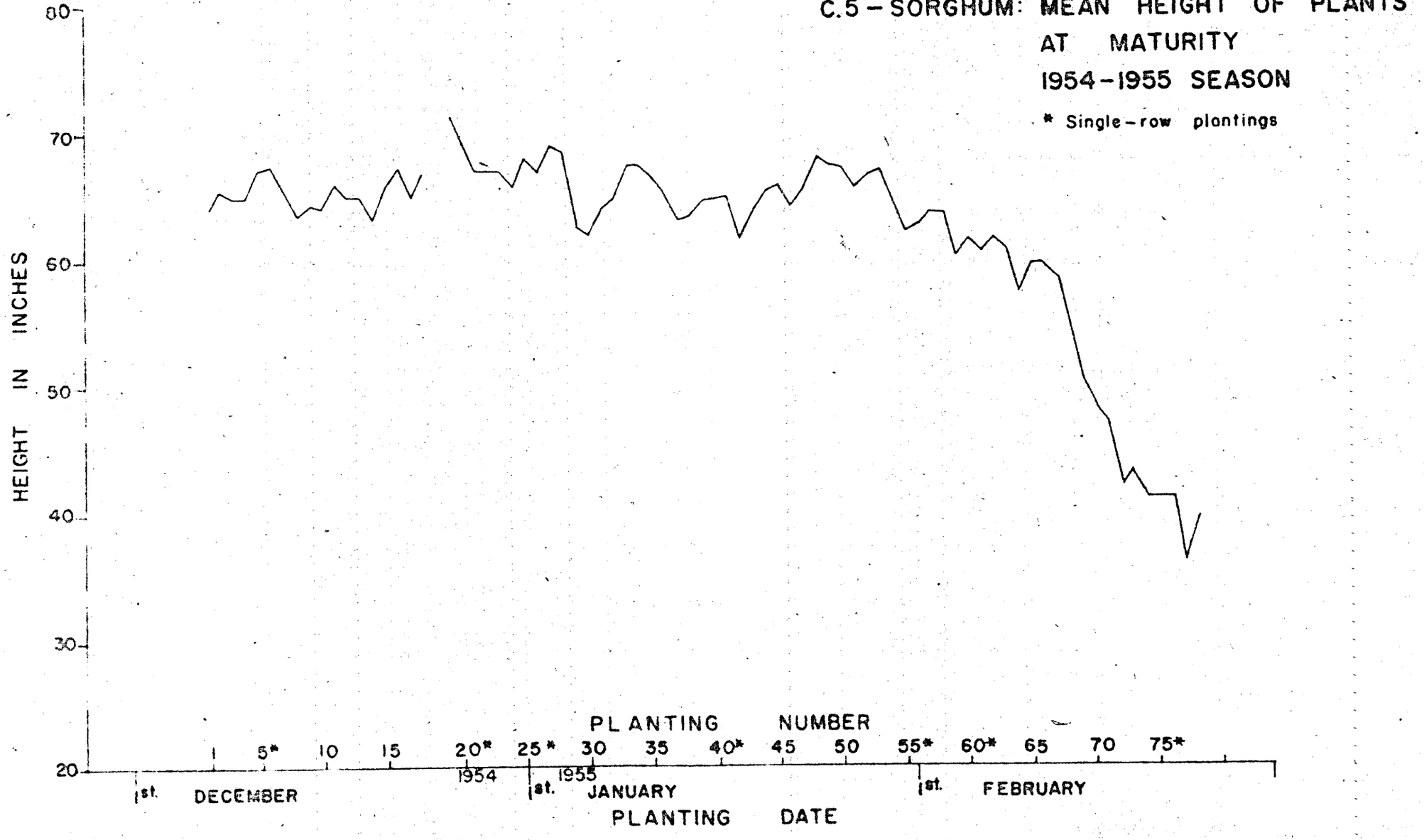

C.5 – SORGHUM: MEAN HEIGHT OF PLANTS AT MATURITY 1954–1955 SEASON
* Single-row plantings
HEIGHT IN INCHES
80
70
60
50
40
30
20
PLANTING NUMBER
1
5*
10
15
20*
25*
30
35
40*
45
50
55*
60*
65
70
75*
1954
1955
1st. DECEMBER
1st. JANUARY
1st. FEBRUARY
PLANTING DATE

FIGURE 15

4. DISCUSSION

4.1 General

The favourable climatic conditions which persisted during the bulk of the sowing period in the 1954-55 season have already been outlined, and the care taken in precision planting has been described. Crop establishment did not feature as a problem in the experiments conducted during this season, and variations due to establishment may be discounted in considering the influence of other factors. (Plate 16).

Previously it had been assumed that the brevity of the rainfall season in some years, and the inadequacy of soil moisture storage, have been the chief factors limiting crop production at Katherine (Stewart 1956). A sudden cessation of growth at the end of the season, referred to as a "shut-down of crops" has been observed but not defined. This phenomenon was attributed to moisture stress at the conclusion of the rainy period (Slatyer 1955). It is intended to show with the results presented in this thesis, that soil moisture stress is not the single determining factor in limiting crop growth which causes a "shut-down" of crops in this environment, but that other factors can also contribute towards variations in yield within seasons and between seasons. Before considering the crops individually, the essential difference between peanuts and sorghum is reiterated. The peanut plant is indeterminate in growth and can survive as a perennial provided conditions are favourable. "The flowering and fruiting phases of development occur concurrently and extend over relatively long periods." (Smith 1954). Sorghum is a plant of determinate growth.

4.2 Peanuts

The steadily declining yields with time suggests that some single factor in the environment was operating at a given time in controlling yields.

Considering the 73rd. planting, made on February 19th we find general flowering developing on the March 18th, the first pegs entering the ground about March 25th. The pegs were due to commence enlarging at the tips in the first week in April. This planting however did not produce any nuts, and fruit development did, in point of fact, cease when pegs entered the ground. The first week of April was characterised by a marked and sudden depression in minimum screen temperatures culminating in a temperature of 56°F on

April 6th. Growth of the plant did not cease, but continued at a much slower rate. Branches continued to develop and flowers were produced. Lower flower frequencies are known to occur when nights are cool, even when growth is satisfactory (Sellschop 1955). Plantings made at Katherine and the Kimberley Research Stations under irrigation in the dry season were reported to have made good to fair growth in the early stages and continued growth into May and June; March plantings flowered at the end of April and continued to grow into the following wet season; but pods failed to develop until the onset of warmer conditions when a crop was formed on the late-developed pegs. Turning to the data in Figure 10 the drop in nut quality was not as marked between the 56th. and 63rd. plantings as it was between the 70th. and 71st., and from the 73rd. planting onward no nuts were produced.

Jacob (1951) in an observation on a few peanut plants grown in the air conditioned greenhouse at the California Institute of Technology reported that no pegs developed in plants grown at 64°F day and 72°F night and 64°F day and 61°F night, but pegs developed at the 79°F day and 81°F night temperatures. Shear and Miller (1955) reported a close correlation between decreasing temperature and decreasing growth rate of late-formed fruit. These authors claim that "other factors such as decreasing day-length, declination of the sun, and the presence of older formed fruit may also be contributing to the reduced growth rate of later formed fruit." Smith (1954) states, and in this he is supported by other authors, that "the species appears indeterminate with respect to day-length." It is considered that if the presence of older fruit is of importance, it is likely to influence subsequent flower development (Smith 1954) rather than the growth of young fruit, the latter being more dependent on moisture in the fruiting zone (Bolhuis and Stubbs 1955). It is interesting to note that in the 1954-55 experiments the formation of pegs was not restricted until the latest plantings. Plate 3 taken at the end of the season illustrates the extent of surplus peg production in a mid-season sowing. It is evident that the marked drop in temperature in early April suddenly inhibited further growth of the pegs already formed. As each day's planting was a little ahead in growth and development of the next day's planting, so further fruit development and consequently yield was restricted in the same way. A progression of this nature would account fully for the steady fall in yield with time.

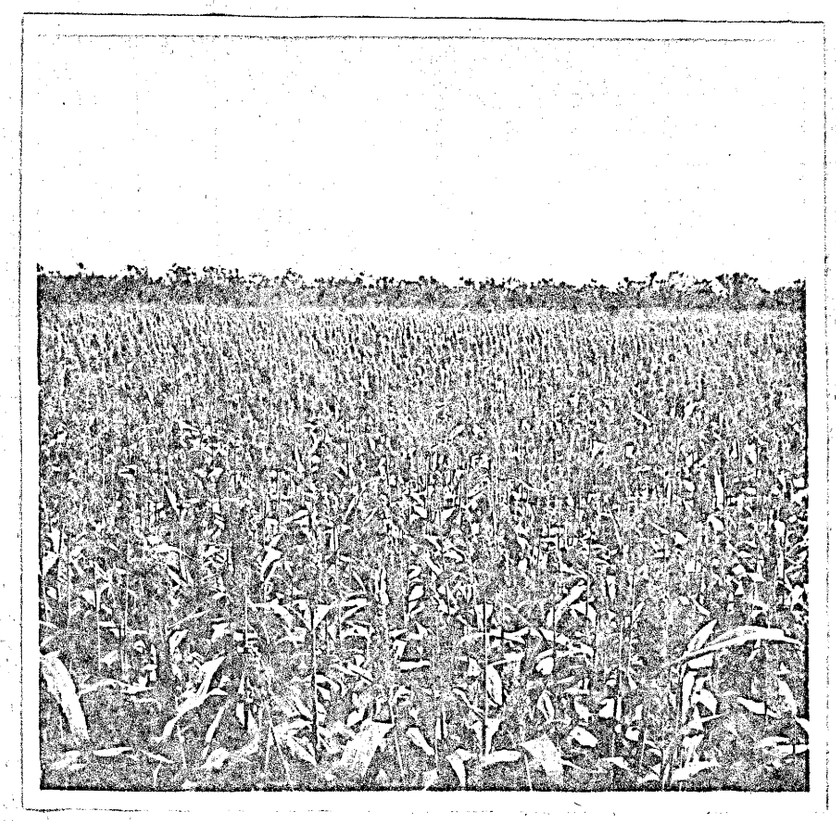


Plate 16. - Sorghum, C.5, in the 1954-55 Season approaching maturity. Note the even stand and the even heads.



Plate 17. - A view of portion of block C.12 during the 1954-55 season. Peanuts in the foreground and Sorghum in the background. Photographed at the end of February.

The similarity in trends between the plantings on C.10 and C.12 confirms the hypothesis that some marked and sudden change in the environment caused further development to cease at a given point in the history of the crop. That this is due to the change in minimum temperature in the first week of April fits in with the pattern of development with successive plantings and the observation that from the 73rd. planting onwards no pods were formed. The variations over the yield curve could well be explained on the basis of abrupt alteration of high and low flower frequencies during the major portion of the flowering period, as described by Smith (1954).

It is well known that the flower frequency curves follow a normal distribution pattern: Smith (1954) places the peak production at 4 to 6 weeks after the first flower appears. Shear and Miller (1955) quoting Shibuya working on small seeded bunch type place the peak at the 3rd. or 4th. week of the flowering period. Allowing 5 weeks from the formation of the first flower to the peak of flower production in the variety used in the Katherine experiments, and a further 60 days from syngamy to maturity of the fruit, it can be seen that 116 days (21 + 35 + 60) should elapse from planting# to peak fruit production. This means that all the plantings made subsequent to December 11th would encounter the minimum temperatures of April 6th at some stage of their development before reaching maturity, and that this sudden lowering of the minimum temperatures would inhibit further development of the peg. The generally dry atmospheric conditions which set in during March also played their part in restricting the growth of the aerial parts, but the temperature effect is undoubtedly the dominant one. In this connection the discrepancies which exist between screen temperatures and temperatures on the ground need no elaboration. Readings taken in the 1955-56 season with minimum soil thermometers amongst peanut bushes (Plate 15) show readings of the order of $1^{\circ}F$ or $2^{\circ}F$ below screen temperatures when nights are warm and differences of $3^{\circ}F$ to $5^{\circ}F$ and even more, when nights are cool and skies are clear.

Finally, it is suggested that this effect of change of temperatures, causing a sudden cessation of fruit development, has operated in past years and that its significance has not been recognised, since it has generally coincided with the conclusion of the rainy period.

Further implications will be discussed in conjunction with sorghum.

4.3 Sorghum

Sieglinger (1936) states that the number of leaves and nodes are identical, and shows a trend towards fewer leaves from later emergence or planting. He demonstrated a close relationship between leaf number and vegetative period and showed that, within varietal or heritable limits, differences in photoperiodism and temperature could alter the expression of leaf or node character. Quinby and Karper (1947) demonstrated that Hegari is a variety which responds to photoperiodic treatments. The times to anthesis presented in Table 9, show a close parallel between the two seasons and a small but consistent decline in the vegetative period. Skerman (1953) drawing from Queensland experience states that "the same variety planted late in the season takes fewer days to mature than when planted early." Quinby and Karper (1947, 1948) showed that once a head is initiated, the size of plant, leaf number and the time to anthesis are fixed, and that the time from head initiation to anthesis in a variety is approximately constant.

The pattern of the yield data during the 1954-55 season in both series of plantings, C.5 and C.12, shows yields and grain numbers at two levels during the season and a marked decline from the 63rd. planting onward in the plantings made on C.5. The yields from January sowings onwards are at much the same level in both the 1954-55 and the 1955-56 seasons. The discontinuity of the yield curve is not shown by the height graphs (Figures, 15, 14b) but appears again in the decline of node numbers (Figure 14a) in the subsequent year.

During the sowing period of the 1954-55 season the temperature conditions remained relatively uniform at a moderate level as shown in Figure 2, but the crops were entering a period of decreasing daylength: from 13 hours on about the January 7th to 12 hours 20 minutes at the end of February. The period of maximum daylength (13 hours or more) occurs from about December 15th to January 7th. It can be inferred therefore that plantings prior to January 2nd, which were subject to 13 hours or more of daylight during their early stages of growth, laid down more nodes than plantings made after January 4th, which were subject to decreasing daylength. The differences were expressed as node numbers, differences in time to anthesis, yield and grain number, but not in height or grain size.

The time lag of the drop in yield between replications in C.12 as shown in Figure 9a is due to different times to anthesis and can therefore be attributed to different periods to head initiation, which in turn can be modified by soil moisture and the nitrogen nutrition level (Quinby and Karper 1945; Whyte 1946). The plantings in replications 1 and 3 grew more rapidly than those in replication 2 during the period prior to head initiation, probably because of greater nitrogen supply and better available moisture, before the effects of photoperiod became limiting. Hamner (1938), in a review of the literature, expresses the view that "above the critical period the addition of Nitrogen does increase the degree of vegetativeness and the total net weight of the plants. Within certain ranges the number of flowers and fruits produced may also be augmented." Quinby and Karper (1947) distinguish between critical photoperiod and sensitivity to photoperiod. Differences in critical photoperiod are expressed by difference in maturity - as in these experiments. There is also a natural variation in the period to flowering. In their experiments these authors observed that "in an occasional plant, induction of flowering was delayed by a day or two as compared with other plants of the same variety."

The influence of temperature during sowing must not be overlooked (Thompson 1939). The cumulative effect of temperature together with the plane of nutrition and the available soil moisture at the time of planting and before head initiation could account for some of the marked swings in yield with close planting days.

The final portion of the curve, in which there is a marked and rapid decline in height as well as yield after the 63rd. planting, could be explained by the marked drop in temperature in early April 1955. The effect of low temperature on sorghum has been known for some time (Vinall and Reed 1918); Martin (1941) has pointed out "The minimum temperature for the germination of sorghum seed is 45° - 50°F and the minimum for subsequent plant growth about 60°F." The drop in yields with late February plantings in the 1955-56 season was not as pronounced as in the previous year (1200 pounds per acre compared with 400 pounds per acre grain yields from plantings on February 15th) because the temperatures did not drop until the third week in May when the crop was already maturing.

The decline in height with later plantings which was observed in both seasons (Figures 14b and 15) could not therefore be attributed to the temperature effect alone. Curtis and Clark (1950) have described how stem elongation is checked when photoperiod is shortened; "This is the usual effect for both short day and long day plants as well as those which are indeterminate" and appears to apply to monocotyledons as well as dicotyledons.

A decline in plant height is not necessarily accompanied by a decline in plant weight and the variation in yield appears to be much greater than the variation in height. At Katherine a high positive correlation between total plant growth and weight of grain has been established (Phillis and Stern, in prepn.) on a wide range of material. Quinby and Martin (1954) have concluded that "actual plant size may be increased by longer days, ample soil moisture and soil fertility and optimum growing temperatures." Each of these factors acting independently or jointly in varying degrees, have probably contributed to the fluctuations in yield observed at each step.

The correspondence between Figure 8 and Figure 12 suggests that yield is determined by grain number. In this connection Quinby and Karper (1948) are quoted as saying "the size of the head is determined by the size of the growing point out of which it develops....." and as plant stands were precise in the 1954-55 season it is believed that the total number of grains were determined by the factors already enumerated, viz. day length, soil moisture, soil fertility and optimum temperatures before head formation began.

The sudden decline in yields of the 1954-55 season and the drop in node number in the 1955-56 season appear to be related and are no doubt due to photoperiodic effects, the threshold values of which are not known for sorghum and which have already been referred to as "critical photo-period."

There remains the marked correspondence of the drop in yield of the plantings made in early January and the increase in Saturation Deficit on March 17th which coincides approximately with anthesis of these plantings. There is no doubt that such a change in atmospheric conditions can have a profound effect on the growth of plants and many instances of such effects are quoted in the literature (Russell 1950, p. 366; Crafts, Currier and Stocking 1949, p. 208; Richards and Wadleigh 1952, p. 111; Gates, 1955a, 1955b). Anthesis in any particular planting

can continue for some time, and sudden adverse conditions could markedly affect the physiology of the plant especially during the development of the later formed heads, with a consequent reduction in grain number and therefore yield. Balls (1953) has emphasised the day by day influence of adverse environmental factors on the subsequent day's growth, and its ultimate effect on yield.

In the 1954-55 a number of distinct climatic influences came into operation during a relatively short period after mid-March. Clear skies developed; periods of very low relative humidity were recorded during the day, leading to low surface soil moisture levels; maximum temperatures levelled out at about 95°F and minimum temperatures showed increased variability with a general downward trend. All of these contributed in some degree to what Maximov (1941) called "an acceleration of the ageing process." This tendency towards senescence in a partially developed plant could explain the general depression in yield from the February plantings in the 1954-55 season, and since such climatic conditions did not occur in the 1955-56 season until May, could explain why yields were maintained at a higher level.

4.4 A consideration of both crops

In a general appraisal of crop growth in the environment under consideration the following factors should be taken into account:

(a) Rainfall distribution and soil moisture storage
(b) Temperature regime
(c) Humidity levels during the season
(d) Those factors which become limiting at the end of the season, and which have been described as causing a "shut-down" of crops.

The rainfall distribution is generally variable at the commencement of the season and this has emphasised moisture storage in the soil from early rains, and successful early crop establishment. In some years rainfall distribution may be adequate at the beginning, but can become critical late in the season. This will naturally affect crop growth and ultimate yield, but the climatic conditions during such rainless periods are generally associated with other variables in the weather such as temperature, clear skies and humidities which in themselves are as limiting to crop growth as lack of moisture. It is suggested that even with adequate soil moisture, restrictive influences on yield are apparent, as demonstrated in the experiments described, and that these factors could be operating every year.

It should be recognised that although the duration of the growing season is usually adequate, there is not a wide margin, and it is only rarely that it is not interrupted by rainless periods, periods of high minima, or low humidities. The seasonal influence is from the north-west and since Katherine is situated towards the southern end of the region in which agriculture is deemed feasible, the seasons begin later and are of shorter duration (Christian and Stewart 1953). On the whole the conditions are marginal and are influenced by a continuous interplay between dry and moist air masses modified by local pressure and wind systems. Riehl (1954) has discussed the meteorology of such systems. It should be recognised that growing conditions are not uniform, and depending on the stage of the life of the crop at which these changes occur, yield will be in some way affected.

In the case of peanuts - the indeterminate flowerer - growth and development continued while conditions were satisfactory, but were checked as conditions became unfavourable. This has given the effect of a progressive decline in yield with contiguous planting.

In the case of sorghum - the determinate flowerer - growth and development could be separated into three phases; brairding to head initiation, head initiation to head emergence, anthesis to maturity. Each phase of development responds differently to a set of environmental conditions. (Whyte 1946, p. 189). In the first phase the size of plant and therefore the general level of yield potential is being developed, while during the second phase the final grain number and therefore the actual yield is being determined. The degree of response can be influenced by the cumulative effects of individual factors which could act together or which may or may not have threshhold values. The final phase, which takes place during and after anthesis determines the grain size and is dependent on the environmental conditions existing at that time. The integrated effect of such responses is to produce a curve which shows marked departures from smooth line trends, with wide fluctuations, such as the sorghum yield curve. (Figure 8).

Assuming adequate soil moisture, and successful early establishment, there occurs every year a period of sufficient duration to enable the bulk of the crops to make adequate growth, but the onset of the subsequent period of climatic change can bring about a reduction of yield.

Not any one factor can be specified as the limiting one in all seasons, but as one or another become more pronounced, e.g. soil moisture stress, marked increase in saturation deficit, marked decrease in minimum temperatures, or the transition to clear skies, it can become the dominant one in influencing the development of the crop. Furthermore, at Katherine, these factors can all become operative within a very short period, especially toward the end of the season and bring about a marked retardation of growth and consequent restriction of ultimate yield.

5. CONCLUSION

These results emphasise the desirability of planting Peanuts early in the wet season in order to take advantage of as long a growing season as possible. There are, however, certain hazards associated with early planting which should not be overlooked: if harvest is delayed too long, the early nuts can germinate in the shell; in prolonged heavy wet years Cercospora leaf spot can bring about serious defoliation of early-planted crops thus hastening senescence. In considering peanut growing at Katherine, the probability of receiving temperatures below 65°F increases markedly at the end of March, and during the last week of April and the first week of May temperatures below 60°F can be expected in 28 years out of 100 (Slatyer 1956). It can be inferred that in most years temperatures become unsatisfactory for the development of peanut fruit at the end of April and certainly during May, even if soil moisture may be adequate. It is desirable that for late season plantings, quick maturing varieties, particularly with closer spacing, should be used.

A number of factors should be considered in the case of Sorghum. If the crop is to be grown for fodder, early planting is indicated to obtain bulk of vegetative material. For high grain yields early planting is also preferable but not always practicable because of the likelihood of wet weather at harvest. In varieties sensitive to photoperiod, e.g. Hegari, longer days prior to inception of the flowering head lead to greater node and therefore leaf production; but this can also be modified by nutrition and soil moisture. Heavy dressings of nitrogen, early in the life of the crop, to increase the production of vegetative material should be considered, especially when good soil moisture reserves are available early in the season. It is known that drought delays the vegetative period of sorghum without increasing vegetative growth (Quinby and Martin 1954) and this has been borne out by experience at Katherine and early planting should not be attempted unless adequate soil moisture is available.

Gaps in the knowledge of the physiology of fruiting of both Peanuts and Sorghum are evident, and a series of experiments conducted concurrently in the field and under controlled conditions, could lead to a better

understanding of the behaviour of these crops. In general, the results emphasise early planting and indicate that by virtue of the peg's sensitivity to lower temperatures, the peanut yield is subject to one more variable than the sorghum yield.

The type of experiment reported in this thesis can also be applied to other crops in the region or to other regions, and emphasises that a thorough investigation of climatic components is necessary before predictable results with a known expenditure of effort can be achieved. Sound experimentation, followed by adequate demonstration of the potential of a crop should precede any extension of that particular crop into a new region, otherwise failures of the kind experienced in the past, will only serve to impede the further development of the region, as outlined in the introductory historical section.

6. ACKNOWLEDGEMENT

The guidance and counsel of Dr. E. Phillis of the Land Research and Regional Survey Section of C.S.I.R.O. is gratefully acknowledged. The candidate also acknowledges his indebtedness to Mr. G.A. McIntyre of the Division of Mathematical Statistics, C.S.I.R.O., who undertook the statistical analyses of the 1954-55 experiments, to the Chief Librarian and her staff, C.S.I.R.O., and the Librarian-in-Charge, Darwin Public Library for making available scientific and historical references respectively. The co-operation of colleagues at the Katherine Research Station has made this work possible; the loyal assistance given by C.V. Fuller and I.T. Zimmin throughout planting, the soil sampling period and during harvest is acknowledged. Thanks are due to Mr. L. Leslie and Mrs. J. Belford, C.S.I.R.O., Canberra for the printing of photographs and graphs, and Mr. L.R. Smith of Katherine who has given of his own time in typing the tables in the Appendix.

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8. APPENDIX

8.1 Tabular Data: 1954-55 Season

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The following tables are presented :

Table 10. - Peanut yields on C.10 in pounds per acre. Rows in this experiment were 2 ft. apart. These data are presented graphically in Figure 6. 44

Table 11. - Peanut yields on C.12 in pounds per acre. Rows in this experiment were 3 ft. apart. These data are presented graphically in Figure 7. 46

Table 12. - Sorghum yields on C.5 in pounds per acre. These data are presented graphically in Figure 8. 47

Table 13. - Sorghum grain number on C.5. The numbers in grades, A, B, C, D and the totals are presented. These values are relative and are calculated from the grain size determinations shown in Table 6. The grain numbers were calculated by multiplying the reciprocal of the defined grade by the actual weight of grain obtained by sieving, and multiplied by 100. The percent. distribution refers to the proportion of each grade to the total number of grain produced, for each day's planting. These data are presented graphically in Figures 11, 12, and 13. 49

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(b) in C.12 74

TABLE 10

PEANUT YIELDS - C.10.

Yields in lbs. per acre.

Planting Date.	Planting Number.	REP. 1		REP. 2		MEAN.	
		2" Depth	3" Depth	2" Depth	3" Depth		
8.xii.54	1	2314	2254	1853	2012	2108	
9.xii.54	2	2428	1951	2874	2874	2532	
10.xii.54	3	1649	2723	3101	2677	2538	2565
11.xii.54	4	2972	2473	3154	2995	2899	
12.xii.54	5	2723	2155	2949	3176	2751	
13.xii.54	6	2155	2745	2420	2685	2401	
14.xii.54	7	2586	2004	2791	3252	2658	
15.xii.54	8	2443	2919	2806	2647	2704	2493
16.xii.54	9	2533	2314	2329	2322	2375	
17.xii.54	10	1959	2511	2390	2239	2275	
18.xii.54	11	2927	2314	2700	2246	2547	
19.xii.54	12	2065	2155	1452	1747	1855	
20.xii.54	13	1762	1981	1369	1830	1736	
21.xii.54	14	1800	2284	2178	1989	2063	1794
22.xii.54	15	2201	1928	2231	2397	2189	
23.xii.54	16	2140	1928	1951	1921	1985	
24.xii.54	17	2110	2261	2140	2042	2138	
25.xii.54							
26.xii.54	18	1702	1679	2065	2042	1872	
27.xii.54	19	1906	1565	2632	1997	2025	
28.xii.54	20	2291	1928	1747	1724	1923	1964
29.xii.54	21	1878	1800	1944	2140	1941	
30.xii.54	22	1747	2087	1966	2080	1970	
31.xii.54	23	2004	2133	1906	2170	2053	
1. 1.55	24	1792	2110	1770	1475	1787	
2. 1.55	25	2518	2065	1520	1702	1951	
3. 1.55	26	1815	1928	1747	1407	1724	
4. 1.55	27	2049	2125	1807	1928	1977	1899
5. 1.55	28	1997	2102	1906	1959	1991	
6. 1.55	29	2042	1966	2057	1782	1962	
7. 1.55	30	1717	1966	1997	1928	1902	
8. 1.55	31	1497	1906	1634	2042	1770	
9. 1.55	32	1565	1792	1611	1543	1628	
10. 1.55	33	1739	1747	1724	1679	1722	
11. 1.55	34	1732	1656	1747	1823	1740	1656
12. 1.55	35	1679	1702	1641	1611	1658	
13. 1.55	36	1629	1588	1490	1505	1553	
14. 1.55	37	1649	1603	1535	1301	1522	
15. 1.55	38	1066	1452	1339	1089	1237	
16. 1.55	39	1543	1452	1520	1429	1486	
17. 1.55	40	1429	1422	1452	1248	1388	
18. 1.55	41	1369	960	1286	1112	1182	
19. 1.55	42	1286	1089	1475	1134	1246	

TABLE 10

PEANUT YIELDS - C.10. (Cont'd).

Yields in lbs. per acre.

Planting Date.	Planting Number.	REP. 1		REP. 2		MEAN.
		2" Depth	3" Depth	2" Depth	3" Depth	
20. 1.55	43	1127	1097	1369	1346	1235
21. 1.55	44	1142	923	1240	1165	1118 1270
22. 1.55	45	1202	794	1475	1112	1162
23. 1.55	46	839	726	930	726	805
24. 1.55	47	968	885	1059	1066	995
25. 1.55	48	839	802	1089	1195	981 4=926
26. 1.55	49	726	915	741	1074	864
27. 1.55	50	885	764	658	960	835
28. 1.55	51	771	839	991	749	838
29. 1.55	52	817	658	726	613	704
30. 1.55	53	703	817	794	613	732
31. 1.55	54	681	635	771	113	696
1. 11.55	55	771	522	545	461	575 5=624
2. 11.55	56	552	718	673	605	637
3. 11.55	57	582	673	688	378	580
4. 11.55	58	628	446	257	454	446
5. 11.55	59	726	340	613	522	550
6. 11.55	60	567	476	590	613	562
7. 11.55	61	166	552	393	250	340
8. 11.55	62	-	378	507	333	406 6=389
9. 11.55	63	-	514	242	348	368
10. 11.55	64	-	-	272	363	318
11. 11.55	65	227	-	174	129	177
12. 11.55	66	363	-	136	189	229
13. 11.55	67	182	227	144	151	176
14. 11.55	68	204	272	174	113	191
15. 11.55	69	166	174	144	250	184 7=164
16. 11.55	70	106	136	144	144	177
17. 11.55	71	136	76	30	113	89
18. 11.55	72	68	98	182	61	102

Note: Planting Number 54, Rep. 2, 3" depth; Wallaby damage to stook after harvest; mean based on remaining 3 plots.

TABLE 11

PEANUT YIELDS - C.12.

Yields in lbs. per acre.

Planting Date.	Planting Number.	Rep. 1	Rep. 2	Rep. 3	Mean.
16.xii.54	1	2110	-	998	1554
17.xii.54	2	1970	-	1891	1932
18.xii.54	3	1944	1467	1286	1566
19.xii.54	4	2080	-	1868	1974
20.xii.54	5	1634	-	1834	1734
21.xii.54	6	1755	-	1834	1795
22.xii.54	7	1985	1573	1997	1852
23.xii.54	8	1577	1668	2019	1751
24.xii.54	9	1777	1709	1902	1796
25.xii.54					
26.xii.54	10	2004	1671	1853	1843
27.xii.54	11	1807	1656	1785	1749
28.xii.54	12	1694	1346	1490	1510
29.xii.54	13	1660	1709	1811	1727
30.xii.54	14	1543	1528	1709	1593
31.xii.54	15	1747	1985	1622	1785
1. 1.55	16	1399	1573	1649	1540
2. 1.55	17	1482	1581	1709	1591
3. 1.55	18	1361	1354	1467	1394
4. 1.55	19	1184	1505	1637	1442
5. 1.55	20	1218	1600	1384	1401
6. 1.55	21	1494	1615	1490	1533
7. 1.55	22	1531	1448	1547	1509
8. 1.55	23	1414	1142	1074	1210
9. 1.55	24	1437	930	1142	1170
10. 1.55	25	1350	1471	1588	1470
11. 1.55	26	1426	1490	1444	1453
12. 1.55	27	1494	1630	1407	1510
13. 1.55	28	121	185	163	156
14. 1.55	29	1388	1539	1305	1411
15. 1.55	30	1081	1195	1233	1170
16. 1.55	31	1361	1112	1127	1200
17. 1.55	32	1055	1233	1081	1123
18. 1.55	33	938	1475	839	1084
19. 1.55	34	1297	1070	1104	1157
20. 1.55	35	1365	1025	972	1121
21. 1.55	36	1168	1081	843	1031
22. 1.55	37	960	892	1036	963
23. 1.55	38	839	885	446	723
24. 1.55	39	798	926	858	861
25. 1.55	40	926	745	851	841
25. 1.55	41	813	991	779	861

Faulty seed was used on planting number 28 made on 13. 1.55.

TABLE 12

SORGHUM YIELDS - C.5.

Yields in lbs. per acre.

Planting Date.	Planting Number.	Rep. 1		Rep. 2		MEAN.	
		1"Depth.	2"Depth.	1"Depth.	2"Depth.		
7.xii.54	1	2897	2203	2798	2066	2491	
8.xii.54	2	2354	2226	2585	2704	2467	
9.xii.54	3	2349	2959	2411	2292	2503	2522
10.xii.54	4	2770	2666	2585	2491	2628	
11.xii.54	5	3006	2080	2392	2637	2539	
12.xii.54	6	3772	3999	3507	2921	3598	
13.xii.54	7	2756	3143	2931	2765	2899	
14.xii.54	8	2070	2614	2883	2879	2612	2738
15.xii.54	9	2567	2084	2737	2737	2531	
16.xii.54	10	2174	2240	2269	2519	2301	
17.xii.54	11	2240	2879	2732	2893	2686	
18.xii.54	12	2543	3148	2893	3309	2973	
19.xii.54	13	3091	3356	2685	2827	2990	
20.xii.54	14	2770	2368	2434	2784	2589	
21.xii.54	15	2812	2732	2827	2458	2707	2770
22.xii.54	16	3068	3186	2316	2481	2763	
23.xii.54	17	3091	1976	2741	2382	2548	
24.xii.54	18	2359	3403	2756	2760	2820	
25.xii.54							
26.xii.54	19	3072	2808	2505	2817	2805	
27.xii.54	20	3016	3602	3554	3441	3403	
28.xii.54	21	3554	3375	2146	2004	2770	
29.xii.54	22	3129	2718	2477	2822	2787	2826
30.xii.54	23	2032	3181	2231	2236	2420	
31.xii.54	24	2368	3611	2316	2793	2772	
1. 1.55	25	3687	3101	2694	2420	2976	
2. 1.55	26	3810	2893	2723	2949	3094	
3. 1.55	27	3025	2666	2231	2004	2482	
4. 1.55	28	1777	2165	1725	1697	1841	2276
5. 1.55	29	1768	2070	2075	1862	1944	
6. 1.55	30	1314	1234	1928	2207	1671	
7. 1.55	31	2089	1739	1758	2113	1925	
8. 1.55	32	2127	2136	2051	2382	2174	
9. 1.55	33	2051	2562	1843	1683	2035	
10. 1.55	34	2292	2165	2075	2349	2220	
11. 1.55	35	1957	2023	1895	2740	2154	2010
12. 1.55	36	1801	2340	1862	1768	1943	
13. 1.55	37	1238	1352	1980	2533	1776	
14. 1.55	38	1631	1300	2023	2132	1772	
15. 1.55	39	1919	1210	2647	2212	1997	
16. 1.55	40	1815	1976	1834	2222	1962	
17. 1.55	41	2127	1569	1900	1999	1899	1864
18. 1.55	42	1201	1810	1442	1711	1541	

TABLE 12

SORGHUM YIELDS - 0.5 (Cont'd).

Yields in lbs. per acre.

Planting Date.	Planting Number.	Rep. 1		Rep. 2		MEAN.	
		1"Depth.	2"Depth.	1"Depth.	2"Depth.		
19. 1.55	43	1706	2226	1966	1664	1895	
3 20. 1.55	44	2094	2354	1848	1432	1932	
21. 1.55	45	2439	1536	1735	1583	1823	
22. 1.55	46	2704	2099	1891	1664	2090	
23. 1.55	47	2420	1985	1711	1881	1999	
24. 1.55	48	1834	2014	1777	1602	1807	
25. 1.55	49	2392	2066	1966	1763	2047	1817
4 26. 1.55	50	1692	2165	1404	1569	1708	
27. 1.55	51	1706	1735	1352	1253	1512	
28. 1.55	52	2018	2075	1238	898	1557	
29. 1.55	53	2571	2571	1134	1531	1952	
30. 1.55	54	1919	2136	2222	1437	1929	
31. 1.55	55	2448	2420	2212	2316	2342	
1. 11.55	56	2330	2042	1943	1777	2023	1956
5 2. 11.55	57	1895	2179	2136	1607	1954	
3. 11.55	58	2274	2439	1820	2358	1633	
4. 11.55	59	1461	2061	2439	1475	1859	
5. 11.55	60	1891	1843	2193	1153	1770	
6. 11.55	61	2099	1683	1182	1598	1641	
7. 11.55	62	1527	1725	1130	1101	1371	1363
6 8. 11.55	63	1910	1806	1309	1196	1555	
9. 11.55	64	1517	837	1191	501	1012	
10. 11.55	65	1314	1399	1215	681	1152	
11. 11.55	66	1016	1082	1116	945	1040	
12. 11.55	67	1531	1030	879	624	1016	
13. 11.55	68	775	520	822	529	662	
7 14. 11.55	69	581	468	799	581	607	548
15. 11.55	70	558	378	288	288	378	
16. 11.55	71	539	553	213	444	437	
17. 11.55	72	397	312	492	345	387	
18. 11.55	73	430	303	312	345	348	
19. 11.55	74	340	548	321	312	380	
20. 11.55	75	369	501	284	312	367	
8 21. 11.55	76	251	303	293	298	286	304
22. 11.55	77	246	203	194	260	226	
23. 11.55	78	402	288	165	189	261	

TABLE 13

SORGHUM GRAIN NUMBERS - C.5.

PLANTING Date.	Number.	GRADE.	REP. 1 1" Depth	REP. 1 2" Depth	REP. 2 1" Depth	REP. 2 2" Depth	MEAN.	PERCENT.
7.xii.54	1	A	949	461	617	627	664	10.3
		B	3228	3770	4651	3443	3773	58.5
		C	975	765	1020	585	836	13.0
		D	2891	564	818	455	1182	18.3
		Total	8043	5560	7106	5110	6455	
8.xii.54	2	A	774	1179	737	894	896	14.7
		B	3962	3364	4323	4154	3951	64.9
		C	570	270	690	690	550	9.1
		D	455	491	691	1109	687	11.3
		Total	5761	5304	6441	6847	6088	
9.xii.54	3	A	1327	967	894	986	1044	17.0
		B	3262	4888	3860	3556	3892	63.7
		C	465	810	510	570	589	9.6
		D	600	618	673	455	587	9.6
		Total	5654	7283	5937	5567	6110	
10.xii.54	4	A	1170	894	1198	1013	1069	16.6
		B	4447	4222	4064	3770	4126	64.3
		C	555	735	450	675	604	9.4
		D	509	800	491	691	623	9.7
		Total	6681	6651	6203	6149	6421	
11.xii.54	5	A	2930	1511	1235	1677	1088	31.2
		B	3070	2686	3589	3702	3262	55.4
		C	210	240	330	240	255	4.3
		D	574	395	574	574	529	9.0
		Total	6784	4832	5728	6193	5884	
12.xii.54	6	A	2838	3740	2045	1235	2465	29.8
		B	4718	4425	5147	4741	4758	57.6
		C	510	210	450	390	390	4.7
		D	681	610	610	681	646	7.8
		Total	8747	8985	8252	7047	8258	
13.xii.54	7	A	1492	2985	2008	1879	2091	30.9
		B	3973	3375	3838	3691	3719	54.9
		C	525	300	435	390	413	6.1
		D	618	473	600	509	550	8.1
		Total	6608	7133	6881	6469	6773	
14.xii.54	8	A	1050	1787	1400	1806	1511	24.4
		B	3194	3601	4255	4007	3764	60.7
		C	390	225	465	375	364	5.9
		D	273	455	909	600	559	9.0
		Total	4907	6068	7029	6788	6198	
15.xii.54	9	A	1594	1640	1741	1603	1145	27.7
		B	3849	2528	3702	3905	3496	58.9
		C	150	270	285	480	296	5.0
		D	346	382	782	491	500	8.4
		Total	5939	4820	6510	6479	5937	

TABLE 13

SORGHUM GRAIN NUMBERS - C.5. (Cont'd).

PLANTING Date.	Number.	GRADE.	REP. 1 1" Depth	REP. 1 2" Depth	REP. 2 1" Depth	REP. 2 2" Depth	MEAN.	PERCENT.
16.xii.54	10	A	1142	1539	1585	1446	1428	26.3
		B	3296	2935	2856	3714	3200	58.9
		C	360	300	375	240	319	5.9
		D	364	491	546	564	491	9.0
		Total	5162	5265	5362	5964	5438	
17.xii.54	11	A	1087	1686	1474	1548	1449	22.8
		B	3477	4222	4120	4301	4030	63.3
		C	420	420	375	405	405	6.4
		D	364	364	509	655	473	7.4
		Total	5348	6692	6478	6909	6357	
18.xii.54	12	A	1308	1548	1732	2137	1681	23.9
		B	3680	5012	4018	4696	4352	61.8
		C	540	510	330	270	413	5.9
		D	610	359	825	610	601	8.5
		Total	6138	7429	6905	7713	7046	
19.xii.54	13	A	1732	2082	1972	1124	1728	23.8
		B	4176	4831	3341	4064	4103	56.6
		C	330	510	420	300	390	5.4
		D	1327	395	681	1722	1031	14.2
		Total	7565	7818	6414	7210	7252	
20.xii.54	14	A	1686	1106	1889	1465	1537	25.2
		B	3928	3680	3003	4380	3748	61.5
		C	480	405	285	300	368	6.0
		D	418	509	455	400	446	7.3
		Total	6512	5700	5632	6545	6097	
21.xii.54	15	A	2073	1179	1686	1069	1502	23.3
		B	3589	4199	4086	3951	3956	61.3
		C	405	660	300	405	443	6.9
		D	455	618	600	527	550	8.5
		Total	6522	6656	6672	5952	6451	
22.xii.54	16	A	1649	1852	1041	838	1345	20.2
		B	4685	4786	3612	3827	4227	63.6
		C	464	435	465	615	495	7.4
		D	436	364	473	1055	582	8.8
		Total	7234	7437	5591	6335	6649	
23.xii.54	17	A	2801	2045	1511	1290	1912	32.5
		B	3465	2009	3973	3510	3239	55.0
		C	300	210	465	405	345	5.9
		D	418	73	600	473	391	6.6
		Total	6984	4337	6549	5678	5887	
24.xii.54	18	A	1382	2340	1253	866	1461	21.6
		B	3273	4583	4120	4718	4174	61.7
		C	525	435	615	570	536	7.9
		D	436	564	746	618	591	8.7
		Total	5616	7922	6734	6772	6761	
25.xii.54								

TABLE 13

SORGHUM GRAIN NUMBERS - C.5. (Cont'd).

PLANTING Date.	Number.	GRADE.	REP. 1 1" Depth	REP. 1 2" Depth	REP. 2 1" Depth	REP. 2 2" Depth	MEAN.	PERCENT.
26.xii.54	19	A	1658	2027	1437	1529	1663	25.3
		B	4538	3702	3680	4402	4081	62.0
		C	600	300	300	270	368	5.6
		D	502	466	502	395	466	7.1
		Total	7298	6495	5919	6596	6577	
27.xii.54	20	A	2174	2414	1769	1806	2041	25.6
		B	3951	5034	5508	5350	4961	62.2
		C	390	450	510	360	428	5.4
		D	466	430	681	610	547	6.9
		Total	6981	8328	8468	8126	7976	
28.xii.54	21	A	2672	2672	1621	1548	2128	33.3
		B	4560	4154	2732	2551	3499	54.8
		C	390	240	210	120	240	3.8
		D	574	717	395	395	520	8.1
		Total	8196	7783	4958	4614	6388	
29.xii.54	22	A	1898	2709	1723	1520	1962	30.4
		B	4583	2754	3499	3973	3702	57.3
		C	435	285	300	495	379	5.9
		D	382	327	127	855	423	6.5
		Total	7298	6075	5649	6843	6466	
30.xii.54	23	A	931	2331	1456	1474	1548	27.4
		B	3240	4210	3093	3104	3412	60.5
		C	435	360	390	285	368	6.5
		D	236	418	255	346	314	5.6
		Total	4842	7319	5194	5209	5641	
31.xii.54	24	A	1649	4293	1096	1658	2174	34.0
		B	3138	2833	3657	4018	3412	53.4
		C	315	180	450	450	349	5.5
		D	418	636	309	455	455	7.1
		Total	5520	7942	5512	6581	6389	
1. 1.55	25	A	2727	2101	1345	940	1778	25.5
		B	4854	4244	4154	3973	4306	61.7
		C	420	420	420	540	450	6.4
		D	466	430	502	395	448	6.4
		Total	8467	7195	6421	5848	6983	
2. 1.55	26	A	2616	2874	1787	1824	2275	32.0
		B	5192	2957	3883	4312	4086	57.4
		C	450	330	240	210	308	4.3
		D	574	287	395	538	449	6.3
		Total	8832	6448	6305	6884	7177	
3. 1.55	27	A	3114	1935	958	1327	1832	32.0
		B	3048	3589	3409	2777	3206	55.9
		C	180	300	600	330	353	6.2
		D	359	323	466	215	341	5.9
		Total	6701	6147	5433	4649	5733	

TABLE 13

SORGHUM GRAIN NUMBERS - C.5. (Cont'd).

PLANTING Date.	Number.	GRADE.	REP. 1 1" Depth	REP. 1 2" Depth	REP. 2 1" Depth	REP. 2 2" Depth	MEAN.	PERCENT.
4. 1.55	28	A	1575	1778	1437	1419	1552	36.7
		B	1953	2438	2054	2021	2114	50.0
		C	165	345	210	150	218	5.1
		D	382	473	236	291	346	8.2
		Total	4075	5034	3937	3881	4232	
5. 1.55	29	A	1585	2202	1529	1437	1688	38.1
		B	1919	1862	2630	2472	2221	50.1
		C	210	150	255	165	195	4.4
		D	327	436	418	146	332	7.5
		Total	4041	4650	4832	4220	4436	
6. 1.55	30	A	1207	1179	820	1317	1131	28.9
		B	1298	1321	3070	3228	2229	57.0
		C	150	60	420	375	251	6.4
		D	400	218	346	236	300	7.7
		Total	3055	2778	4656	5156	3911	
7. 1.55	31	A	2110	1327	949	1198	1396	30.9
		B	2054	2054	2641	2630	2345	52.0
		C	240	255	360	360	304	6.7
		D	273	455	200	946	469	10.4
		Total	4677	4091	4150	5134	4513	
8. 1.55	32	A	1621	1806	1050	866	1336	26.3
		B	2754	2641	3138	4041	3144	62.0
		C	240	180	330	510	315	6.2
		D	251	179	359	323	278	5.5
		Total	4866	4806	4877	5740	5072	
9. 1.55	33	A	2543	2524	645	866	1645	35.1
		B	1535	2709	2957	2483	2421	51.7
		C	120	210	390	390	278	5.9
		D	251	251	574	287	341	7.3
		Total	4449	5694	4566	4026	4684	
10. 1.55	34	A	2405	2847	1520	1640	2103	42.2
		B	2212	1456	2664	3251	2396	48.1
		C	180	165	330	270	236	4.7
		D	291	164	291	236	246	4.9
		Total	5088	4632	4805	5397	4981	
11. 1.55	35	A	1612	1898	663	2405	1645	32.9
		B	2201	2156	3127	3048	2633	52.6
		C	300	240	465	270	319	6.4
		D	436	273	382	546	409	8.2
		Total	4549	4567	4637	6269	5006	
12. 1.55	36	A	654	1972	498	691	954	20.5
		B	2946	2890	3228	2777	2960	63.8
		C	525	225	525	495	443	9.5
		D	255	182	346	364	287	6.2
		Total	4380	5269	4597	4327	4643	

TABLE 13

SORGHUM GRAIN NUMBERS - C.5. (Cont'd).

PLANTING Date.	Number.	GRADE.	REP. 1 1" Depth	REP. 1 2" Depth	REP. 2 1" Depth	REP. 2 2" Depth	MEAN.	PERCENT.
13. 1.55	37	A	276	120	719	1446	640	14.5
		B	1975	2258	3172	3770	2794	63.3
		C	525	570	450	405	488	11.0
		D	400	636	546	400	496	11.2
		Total	3176	3584	4887	6021	4417	
14. 1.55	38	A	369	221	1262	1566	852	19.9
		B	2732	2122	2901	2788	2636	61.3
		C	615	360	255	300	383	8.9
		D	400	709	346	255	428	9.9
		Total	4116	3412	4764	4909	4301	
15. 1.55	39	A	682	313	2045	1142	1046	21.8
		B	3048	1874	3409	3273	2901	60.6
		C	510	510	360	480	465	9.7
		D	502	395	215	395	377	7.9
		Total	4742	3092	6029	5290	4788	
16. 1.55	40	A	958	1235	1603	2782	1645	36.5
		B	2799	2845	2054	1558	2314	51.3
		C	300	210	300	180	248	5.5
		D	215	466	215	323	305	6.8
		Total	4272	4756	4172	4843	4511	
17. 1.55	41	A	1336	498	2220	2211	1566	36.9
		B	2969	2574	1095	1806	2111	49.7
		C	270	480	180	180	278	6.5
		D	436	327	218	200	295	7.0
		Total	5011	3879	3713	4397	4250	
18. 1.55	42	A	461	1050	1244	1778	1133	31.4
		B	1840	2528	1614	1569	1888	52.3
		C	405	315	225	225	293	8.1
		D	255	436	218	273	296	8.2
		Total	2961	4329	3301	3845	3609	
19. 1.55	43	A	645	1686	1907	1004	1311	29.4
		B	2822	2765	1975	2111	2418	54.3
		C	375	300	270	345	323	7.3
		D	291	418	291	600	400	9.0
		Total	4133	5169	4443	4060	4451	
20. 1.55	44	A	1281	2054	1437	1327	1525	34.2
		B	2912	2698	2235	1501	2337	52.4
		C	330	225	345	195	274	6.1
		D	436	382	255	236	327	7.3
		Total	4959	5359	4272	3259	4462	
21. 1.55	45	A	2386	525	1640	1382	1483	35.2
		B	2472	2540	1795	1704	2128	50.5
		C	285	360	315	285	311	7.4
		D	346	382	164	273	291	6.9
		Total	5489	3807	3914	3644	4214	

TABLE 13

SORGHUM GRAIN NUMBERS - C.5. (Cont'd).

PLANTING Date.	Number.	GRADE.	REP. 1 1" Depth	REP. 1 2" Depth	REP. 2 1" Depth	REP. 2 2" Depth	MEAN.	PERCENT.
22. 1.55	46	A	3077	1069	1235	1050	1608	33.1
		B	2325	3093	2528	2258	2551	52.6
		C	180	360	300	360	300	6.2
		D	389	538	395	251	393	8.1
		Total	5971	5060	4458	3919	4852	
23. 1.55	47	A	2064	1032	1161	1695	1488	32.2
		B	2912	2957	2303	1942	2529	54.7
		C	180	360	390	420	338	7.3
		D	323	395	108	251	269	5.8
		Total	5479	4744	3962	4308	4623	
24. 1.55	48	A	802	1281	1152	1437	1168	27.4
		B	2743	2811	2416	1716	2422	56.9
		C	480	300	345	330	364	8.5
		D	473	327	255	164	305	7.2
		Total	4498	4719	4168	3647	4258	
25. 1.55	49	A	1658	1179	1566	1161	1391	29.1
		B	3093	2980	2416	2291	2965	56.3
		C	420	405	285	480	398	8.3
		D	436	327	236	218	304	6.4
		Total	5607	4891	4503	4150	4788	
26. 1.55	50	A	442	1769	774	829	955	23.1
		B	2619	2551	1851	2235	2314	56.1
		C	780	300	315	465	465	11.3
		D	473	364	509	236	396	9.6
		Total	4314	4984	3449	3765	4128	
27. 1.55	51	A	571	1235	212	341	590	15.6
		B	2709	2224	2100	1738	2193	58.0
		C	585	285	675	765	577	15.3
		D	364	309	582	418	418	11.1
		Total	4229	4053	3569	3262	3778	
28. 1.55	52	A	829	1806	258	249	786	20.2
		B	3172	2382	1602	858	2004	51.5
		C	585	255	750	555	536	13.8
		D	309	273	764	909	564	14.5
		Total	4895	4716	3374	2571	3889	
29. 1.55	53	A	1474	2432	203	387	1124	23.7
		B	3635	2822	1377	2258	2523	53.2
		C	660	270	660	780	593	12.5
		D	323	215	933	538	502	10.6
		Total	6092	5739	3173	3963	4742	
30. 1.55	54	A	903	608	1437	313	815	17.4
		B	2912	3680	2980	2416	2997	64.1
		C	510	540	540	600	548	11.7
		D	287	430	251	287	314	6.7
		Total	4612	5258	5208	3616	4674	

TABLE 13

SORGHUM GRAIN NUMBERS - C.5. (Cont'd).

PLANTING Date.	Number.	GRADE.	REP. 1 1" Depth	REP. 1 2" Depth	REP. 2 1" Depth	REP. 2 2" Depth	MEAN.	PERCENT.
31. 1.55	55	A	774	1161	774	1658	1092	19.4
		B	4041	4154	3364	2935	3624	64.2
		C	810	300	930	450	623	11.0
		D	395	36	430	359	305	5.4
		Total	6020	5651	5498	5402	5643	
1. 11.55	56	A	479	875	792	470	654	12.9
		B	3748	3240	2957	2698	3161	62.3
		C	930	495	660	555	660	13.0
		D	855	309	346	891	600	11.8
		Total	6012	4919	4755	4614	5075	
2. 11.55	57	A	884	811	1364	451	878	18.3
		B	2878	3657	2969	2054	2890	60.4
		C	450	405	360	945	540	11.3
		D	364	400	309	836	477	10.0
		Total	4576	5273	5002	4286	4784	
3. 11.55	58	A	829	737	599	958	781	16.2
		B	3748	3985	2946	1885	3141	65.1
		C	435	765	540	180	480	10.0
		D	546	582	418	146	423	8.8
		Total	5558	6069	4503	3169	4825	
4. 11.55	59	A	240	479	1170	249	535	11.2
		B	1806	3352	3702	2303	2791	58.7
		C	1200	810	480	660	788	16.6
		D	782	600	527	673	646	13.6
		Total	4028	5241	5879	3888	4758	
5. 11.55	60	A	553	479	1364	240	659	14.5
		B	2912	2483	2890	1219	2376	52.3
		C	690	1050	450	840	758	16.7
		D	646	861	540	968	754	16.6
		Total	4081	4873	5244	3267	4546	
6. 11.55	61	A	498	461	111	184	314	7.1
		B	3138	2325	1129	2438	2258	51.1
		C	960	750	900	990	900	20.4
		D	861	897	1399	646	951	21.5
		Total	5457	4433	3539	4258	4422	
7. 11.55	62	A	617	359	175	230	345	9.6
		B	2325	2528	1388	1524	1941	54.0
		C	435	915	870	735	739	20.6
		D	382	746	709	436	568	15.8
		Total	3759	4548	3142	2925	3594	
8. 11.55	63	A	276	249	322	258	276	6.8
		B	3296	3115	1355	1659	2356	58.0
		C	660	750	1185	645	810	19.9
		D	691	527	782	491	623	15.3
		Total	4923	4641	3644	3053	4065	

TABLE 13

SORGHUM GRAIN NUMBERS - C.5. (Cont'd).

PLANTING Date.	Number.	GRADE.	REP. 1 1" Depth	REP. 1 2" Depth	REP. 2 1" Depth	REP. 2 2" Depth	MEAN.	PERCENT.
9. 11.55	64	A	433	221	194	92	235	8.6
		B	2077	971	1659	531	1310	48.1
		C	915	630	735	375	664	24.4
		D	527	455	636	436	514	18.9
		Total	3952	2277	3224	1434	2722	
10. 11.55	65	A	332	258	230	120	235	7.5
		B	1659	1987	1750	621	1504	47.8
		C	840	885	705	525	764	23.5
		D	709	600	546	818	668	21.2
		Total	3540	3730	3231	2084	3146	
11. 11.55	66	A	203	194	258	157	203	7.1
		B	1151	1580	1535	1061	1332	46.9
		C	810	555	495	915	694	24.4
		D	673	564	709	509	614	21.6
		Total	2837	2893	2997	2642	2842	
12. 11.55	67	A	258	147	129	92	157	5.4
		B	1987	1106	722	384	1049	36.0
		C	1080	960	840	600	870	29.8
		D	861	717	933	861	843	28.9
		Total	4186	2930	2624	1937	2919	
13. 11.55	68	A	111	55	166	74	102	5.0
		B	1016	384	677	294	593	29.4
		C	1230	360	780	420	698	34.5
		D	-	825	789	897	628	31.1
		Total	2357	1624	2412	1685	2020	
14. 11.55	69	A	37	147	120	74	95	5.2
		B	531	406	1027	474	610	33.6
		C	435	255	510	525	431	23.8
		D	782	546	709	673	678	37.4
		Total	1785	1354	2366	1746	1813	
15. 11.55	70	A	111	65	55	55	72	6.5
		B	531	350	294	305	370	33.8
		C	375	330	240	270	304	27.7
		D	618	364	236	182	350	32.0
		Total	1635	1109	825	812	1095	
16. 11.55	71	A	55	65	18	55	48	3.6
		B	429	440	147	350	342	25.5
		C	435	570	180	420	401	29.9
		D	746	600	327	527	550	41.0
		Total	1665	1675	672	1352	1341	
17. 11.55	72	A	65	55	37	46	51	4.4
		B	316	294	373	350	333	28.5
		C	255	210	480	300	311	26.7
		D	582	364	636	309	473	40.1
		Total	1218	923	1526	1005	1168	

TABLE 13

SORGHUM GRAIN NUMBERS - C.5. (Cont'd).

PLANTING Date.	Number.	GRADE.	REP. 1 1" Depth	REP. 1 2" Depth	REP. 2 1" Depth	REP. 2 2" Depth	MEAN.	PERCENT.
18. 11.55	73	A	37	28	46	37	37	3.5
		B	327	237	294	282	285	27.1
		C	375	390	240	405	353	33.5
		D	600	255	346	309	378	35.9
		Total	1339	910	926	1033	1052	
19. 11.55	74	A	37	37	37	37	37	3.1
		B	226	226	248	136	209	17.3
		C	240	720	300	330	398	32.9
		D	574	789	395	502	565	46.8
		Total	1077	1772	980	1005	1209	
20. 11.55	75	A	55	37	18	18	32	2.8
		B	361	271	181	226	260	22.8
		C	300	510	210	300	330	28.9
		D	359	789	502	430	520	45.5
		Total	1075	1607	911	974	1142	
21. 11.55	76	A	28	28	28	28	28	3.3
		B	294	282	260	271	277	32.8
		C	210	315	285	345	289	34.2
		D	182	273	309	236	250	29.6
		Total	714	898	882	880	844	
22. 11.55	77	A	28	18	18	28	23	3.4
		B	248	181	192	248	217	32.5
		C	210	150	180	285	206	30.8
		D	236	273	182	200	223	33.3
		Total	722	622	572	761	669	
23. 11.55	78	A	18	18	9	9	13	1.7
		B	282	271	124	192	217	27.0
		C	375	255	180	180	248	30.7
		D	600	327	200	182	327	40.6
		Total	1275	871	513	563	806	

TABLE 14

SORGHUM YIELDS - C.12

Yields in lbs. per acre.

Planting Date.	Planting Number.	Rep. 1	Rep. 2	Rep. 3	Mean.	
16.xii.54	1	2488	1989	1936	2138	
17.xii.54	2	2053	2072	1932	2019	
18.xii.54	3	1966	1928	1724	1873	
19.xii.54	4	2057	1944	1906	1702	
20.xii.54	5	1925	1959	2170	2018	2086
21.xii.54	6	2333	2121	2092	2182	
22.xii.54	7	2632	1966	2579	2391	
23.xii.54	8	2280	2231	2568	2366	
24.xii.54	9	2118	1792	2367	2092	
25.xii.54						
26.xii.54	10	2360	1800	2654	2271	
27.xii.54	11	2150	1928	2526	2201	
28.xii.54	12	1845	2087	2594	2175	2211
29.xii.54	13	2265	1936	2261	2154	
30.xii.54	14	2223	1910	2666	2266	
31.xii.54	15	2291	2072	2586	2316	
1. 1.55	16	2284	1263	2344	1964	
2. 1.55	17	2276	1293	2125	1898	
3. 1.55	18	2322	1286	2481	2030	
4. 1.55	19	2087	1441	1997	1842	1906
5. 1.55	20	2265	1388	2186	1946	
6. 1.55	21	2061	1732	2447	1747	
7. 1.55	22	2015	1380	2352	1916	
8. 1.55	23	2163	1429	1603	1732	
9. 1.55	24	1210	1369	1966	1515	
10. 1.55	25	1119	1358	2065	1514	
11. 1.55	26	1339	1259	1501	1366	
12. 1.55	27	1297	968	2144	1470	1517
13. 1.55	28	1342	1184	1993	1506	
14. 1.55	29	1301	1206	2038	1515	
15. 1.55	30	1157	1195	1792	1381	
16. 1.55	31	666	1316	2178	1387	
17. 1.55	32	1051	862	1876	1263	
18. 1.55	33	1006	771	2031	1269	1277
19. 1.55	34	1089	870	1789	1249	
20. 1.55	35	1138	824	1596	1186	
21. 1.55	36	919	896	1804	1206	
22. 1.55	37	1089	771	1543	1134	
23. 1.55	38	1550	934	1399	1294	
24. 1.55	39	1308	594	1078	993	
25. 1.55	40	979	567	832	793	1059
26. 1.55	41	1172	696	1376	1081	

TABLE 15

SORGHUM GRAIN NUMBERS - C.12.

PLANTING Date.	Number.	GRADE.	REP. 1	REP. 2	REP. 3	MEAN.	PERCENT.
16.xii.54	1	A	1990	1161	1013	1388	21.7
		B	4425	3748	3612	3928	61.3
		C	390	540	690	540	8.4
		D	430	574	646	550	8.6
		Total	7235	6023	5961	6406	
17.xii.54	2	A	1327	1059	1023	1136	18.6
		B	3973	4097	3680	3917	64.2
		C	465	420	660	515	8.4
		D	291	764	546	534	8.8
		Total	6056	6340	5909	6102	
18.xii.54	3	A	1106	958	958	1007	17.8
		B	3973	3860	3273	3702	65.6
		C	420	600	540	520	9.2
		D	359	430	466	418	7.4
		Total	5858	5848	5237	5648	
19.xii.54	4	A	1124	811	866	934	15.3
		B	3996	3883	3770	3883	63.8
		C	600	750	630	660	10.8
		D	646	574	610	610	10.0
		Total	6366	6018	5876	6087	
20.xii.54	5	A	912	728	1133	924	14.8
		B	3939	4018	3962	3973	63.8
		C	495	795	750	680	10.9
		D	509	546	909	655	10.5
		Total	5855	6087	6754	6232	
21.xii.54	6	A	1170	728	1170	1023	15.2
		B	4752	4176	3917	4282	63.7
		C	600	930	690	740	11.0
		D	527	891	600	673	10.0
		Total	7049	6725	6377	6717	
22.xii.54	7	A	1557	820	1373	1250	17.3
		B	5079	3973	5158	4737	65.6
		C	555	735	720	670	9.3
		D	727	473	509	570	7.9
		Total	7918	6001	7760	7226	
23.xii.54	8	A	1059	912	1345	1105	15.2
		B	4345	4515	5079	4646	64.0
		C	675	780	705	720	9.9
		D	1018	709	655	794	10.9
		Total	7097	6916	7784	7266	
24.xii.54	9	A	755	479	1640	958	14.9
		B	4380	3702	4267	4116	63.8
		C	810	945	540	765	11.9
		D	655	564	618	612	9.5
		Total	6600	5690	7065	6452	
25.xii.54							

TABLE 15

SORGHUM GRAIN NUMBERS - C.12. (Cont'd).

PLANTING Date.	Number.	GRADE.	REP.1	REP.2	REP.3	MEAN.	PERCENT.
26.xii.54	10	A	590	534	1437	854	12.1
		B	5170	3589	5215	4658	66.1
		C	1080	870	660	870	12.3
		D	538	753	717	669	9.5
		Total	7378	5746	8029	7051	
27.xii.54	11	A	774	590	1548	971	14.5
		B	4447	3883	4876	4402	65.9
		C	780	960	600	780	11.7
		D	681	395	502	526	7.9
		Total	6682	5828	7526	6679	
28.xii.54	12	A	663	737	1400	933	14.2
		B	3838	4199	5260	4432	67.3
		C	690	900	540	710	10.8
		D	538	430	574	514	7.8
		Total	5729	6266	7774	6590	
29.xii.54	13	A	673	755	1603	1010	15.4
		B	4966	3894	4154	4338	66.0
		C	810	840	540	730	11.1
		D	582	527	364	491	7.5
		Total	7031	6016	6661	6569	
30.xii.54	14	A	627	544	1557	909	13.2
		B	5147	3962	5294	4801	69.4
		C	810	975	570	785	11.4
		D	182	546	527	418	6.1
		Total	6766	6027	7948	6914	
31.xii.54	15	A	848	700	1419	989	13.9
		B	5012	4425	4967	4801	67.6
		C	690	795	540	675	9.5
		D	436	491	982	636	9.0
		Total	6986	6411	7908	7102	
1. 1.55	16	A	737	498	1142	792	13.4
		B	4854	2506	4921	4094	69.2
		C	930	510	540	660	11.2
		D	251	430	430	371	6.3
		Total	6772	3944	7033	5916	
2. 1.55	17	A	811	516	977	768	13.2
		B	4831	2551	4357	3913	67.1
		C	930	660	600	730	12.5
		D	430	287	538	418	7.2
		Total	7002	4014	6472	5829	
3. 1.55	18	A	1198	313	1142	884	14.2
		B	4538	2596	5057	4064	65.0
		C	750	780	720	750	12.0
		D	574	430	646	550	8.8
		Total	7060	4119	7565	6248	

TABLE 15

SORGHUM GRAIN NUMBERS - C.12. (Cont'd).

PLANTING Date.	Number.	GRADE.	REP. 1	REP. 2	REP.3	MEAN.	PERCENT.
4. 1.55	19	A	1317	562	1041	973	17.4
		B	3928	2969	3973	3623	64.8
		C	510	600	645	585	10.5
		D	564	309	364	412	7.4
		Total	6319	4440	6023	5594	
5. 1.55	20	A	1419	461	995	958	16.2
		B	4357	2765	4526	3883	65.8
		C	615	735	765	705	11.9
		D	327	418	327	357	6.1
		Total	6718	4379	6613	5903	
6. 1.55	21	A	1179	580	1437	1065	16.9
		B	4052	3533	4583	4056	64.2
		C	585	900	840	775	12.3
		D	346	400	527	424	6.7
		Total	6162	5413	7387	6321	
7. 1.55	22	A	1087	525	1281	964	16.5
		B	3973	2799	4605	3792	65.0
		C	615	585	705	635	10.9
		D	400	382	546	443	7.6
		Total	6075	4291	7137	5834	
8. 1.55	23	A	940	1087	995	1007	19.3
		B	4538	2528	3025	3364	64.3
		C	720	330	420	490	9.4
		D	359	323	430	371	7.1
		Total	6557	4268	4870	5232	
9. 1.55	24	A	479	608	1806	964	21.3
		B	2461	2890	3228	2860	63.2
		C	420	390	330	380	8.4
		D	395	251	323	323	7.1
		Total	3755	4139	5687	4527	
10. 1.55	25	A	479	507	1621	869	18.8
		B	2201	2664	3567	2811	60.8
		C	390	510	420	440	9.5
		D	418	618	473	503	10.9
		Total	3488	4299	6081	4623	
11. 1.55	26	A	442	572	1244	752	18.0
		B	2641	2482	2619	2581	61.9
		C	600	420	225	415	10.0
		D	582	418	273	424	10.2
		Total	4265	3892	4361	4173	
12. 1.55	27	A	562	461	2183	1069	24.4
		B	2528	1806	3330	2555	58.3
		C	525	345	300	390	8.9
		D	418	418	273	370	8.4
		Total	4033	3030	6086	4383	

TABLE 15

SORGHUM GRAIN NUMBERS - C.12. (Cont'd).

PLANTING Date.	Number.	GRADE.	REP. 1	REP. 2	REP. 3	MEAN.	PERCENT.
13. 1.55	28	A	516	470	1769	918	20.0
		B	2596	2291	3319	2735	59.5
		C	540	525	390	485	10.6
		D	600	509	273	461	10.0
		Total	4252	3795	5751	4599	
14. 1.55	29	A	497	461	1732	897	19.2
		B	2495	2461	3454	2803	59.9
		C	615	555	435	535	11.4
		D	509	527	291	442	9.5
		Total	4116	4004	5912	4677	
15. 1.55	30	A	369	516	1492	792	18.8
		B	2167	2348	3115	2543	60.3
		C	600	420	300	440	10.4
		D	610	430	287	442	10.5
		Total	3746	3714	5194	4218	
16. 1.55	31	A	203	608	2101	971	23.1
		B	1197	2551	3319	2356	56.1
		C	330	390	420	380	9.1
		D	466	538	466	490	11.7
		Total	2196	4087	6306	4196	
17. 1.55	32	A	240	313	1474	676	17.2
		B	1693	1558	3161	2137	54.6
		C	750	375	390	505	12.9
		D	946	455	400	600	15.3
		Total	3629	2701	5425	3918	
18. 1.55	33	A	249	203	1041	498	12.9
		B	1987	1355	3928	2423	62.9
		C	510	450	570	510	13.2
		D	-	582	691	424	11.0
		Total	2746	2590	6230	3855	
19. 1.55	34	A	203	359	1069	544	13.8
		B	2020	1501	3398	2306	58.3
		C	720	450	450	540	13.7
		D	709	509	473	564	14.3
		Total	3652	2819	5390	3954	
20. 1.55	35	A	341	332	857	510	13.4
		B	1998	1400	2980	2126	56.0
		C	750	435	420	535	14.1
		D	673	527	673	624	16.5
		Total	3762	2694	4930	3795	
21. 1.55	36	A	157	313	626	365	9.3
		B	1682	1501	3612	2265	57.8
		C	615	420	735	590	15.1
		D	655	709	727	697	17.8
		Total	3109	2943	5700	3917	

TABLE 15

SORGHUM GRAIN NUMBERS - C.12. (Cont'd).

PLANTING Date.	Number.	GRADE.	REP. 1	REP. 2	REP. 3	MEAN.	PERCENT.
22. 1.55	37	A	350	221	608	393	10.5
		B	1783	1264	2822	1956	52.4
		C	840	450	600	630	16.9
		D	646	681	933	753	20.2
		Total	3619	2616	4963	3733	
23. 1.55	38	A	442	313	387	381	9.1
		B	2799	1625	2845	2423	58.1
		C	1080	510	570	720	17.3
		D	753	502	681	645	15.5
		Total	5074	2950	4483	4169	
24. 1.55	39	A	341	147	212	233	7.1
		B	2495	1016	1964	1825	55.4
		C	870	405	735	670	20.4
		D	546	436	709	564	17.1
		Total	4252	2004	3620	3292	
25. 1.55	40	A	101	74	286	154	5.7
		B	1738	926	1422	1362	50.4
		C	945	390	480	605	22.4
		D	564	618	564	582	21.5
		Total	3348	2008	2752	2703	
26. 1.55	41	A	92	221	663	325	9.1
		B	1987	1129	2303	1806	50.2
		C	1260	450	750	820	22.8
		D	717	538	681	645	17.9
		Total	4056	2338	4397	3597	

TABLE 16

PEANUTS - C.10. SOIL MOISTURE (per cent) UNDER CROP.

Sampling Date, Planting Number, & Age in days.	Sampling Depth (Inches).										
	4	8	12	18	24	32	48	64	72	84	96
2. 11.55			14.1	15.0	17.0	18.0	19.4	18.9			
11. 11.55 11 @ 49			13.4	16.7	18.6	19.8	20.7	19.7			
15. 11.55 16 @ 48			21.4	21.5	20.2	19.2	17.8	20.1			
21. 11.55 21 @ 48			20.6	19.3	21.1	20.5	19.4	19.7			
22. 11.55 22 @ 48			21.6	20.4	21.9	22.7	21.6	20.5			
24. 11.55 41 @ 31			18.5	20.3	21.1	20.9	21.1	20.6			
25. 11.55 41 @ 32			18.1	20.8	21.0	20.9	20.9	20.1			
28. 11.55 43 @ 34			17.6	20.7	20.8	20.6	19.7	20.2			
1.111.55 29 @ 47			17.8	19.6	20.8	20.3	21.0	19.5			
3.111.55 31 @ 49			17.5	20.7	19.5	21.6	20.5	19.4			
4.111.55 32 @ 49			17.1	19.0	20.2	20.6	20.2	20.3			
7.111.55 35 @ 48			13.2	16.1	18.3	18.9	19.8	19.6			
17.111.55											
1 @ 92			19.8	20.4	22.0	21.1	20.6	19.6			
20 @ 73			20.0	20.7	21.1	20.3	21.2	19.3			
39 @ 54			18.5	20.0	21.1	21.0	21.6	20.7			
58 @ 36			20.8	22.6	22.6	23.0	22.1	21.3			
78 @ 15			19.9	20.2	21.2	23.2	22.1	21.7			
Mean			19.8	20.8	21.6	21.7	21.5	20.5			
24.111.55											
2 @ 99			18.5	20.6	20.6	20.9	21.1	21.8			
21 @ 79			17.3	18.8	21.2	20.7	21.7	21.7			
40 @ 61			17.1	18.6	20.6	19.7	19.9	20.4			
58 @ 43			18.4	22.7	21.2	21.4	22.1	22.4			
78 @ 22			18.9	21.9	21.6	22.5	20.9	21.0			
Mean			18.0	20.5	21.0	21.0	21.1	21.5			

TABLE 16

PEANUTS - C.10. SOIL MOISTURE (per cent) UNDER CROP.

(Cont'd).

Sampling Date, Planting Number, & Age in days.	Sampling Depth (Inches).										
	4	8	12	18	24	32	48	64	72	84	96
31.iii.55											
2 @ 106	12.0	12.4	14.6	16.2	18.3	19.6	19.6	19.6			
21 @ 86	10.4	12.2	14.3	17.2	19.0	19.4	19.7	19.7			
40 @ 68	9.7	10.6	13.5	15.4	15.4	18.6	19.3	19.8			
58 @ 50	9.8	13.1	15.4	18.2	19.1	20.1	19.1	20.0			
78 @ 29	11.9	13.3	16.7	17.0	20.2	20.1	20.0	19.4			
Mean	10.8	12.3	14.9	16.8	18.4	19.6	19.5	19.7			
7. iv.55											
2 @ 113	10.6	13.6	14.8	16.1	16.5	18.2	19.1	18.8			
21 @ 93	9.5	11.5	16.4	15.7	16.3	17.5	18.8	20.2			
40 @ 75	8.7	10.5	13.9	15.2	16.7	19.1	19.5	19.5			
58 @ 57	10.0	13.5	15.6	18.0	18.3	17.8	19.4	19.9			
78 @ 36	9.7	11.7	15.2	18.6	19.8	20.1	20.3	21.1			
Mean	9.7	12.2	15.2	16.7	17.5	18.5	19.4	19.9			
18. iv.55											
21 @ 104			14.9	16.3	16.4	17.8	18.9	18.7	19.4	18.9	
40 @ 85			14.1	16.5	17.2	16.3	18.4	19.1	19.3		
59 @ 66			14.4	15.7	15.9	17.5	19.6	19.6	19.0		
78 @ 47		11.4	14.4	17.1	16.7	18.7	18.6	19.9	19.5		
Mean		11.4	14.5	16.4	16.6	17.6	18.9	19.3	19.3	18.9	
29. iv.55											
40 @ 96		9.1	12.9	15.4	15.9	15.9	16.8	18.0	17.6		
58 @ 79		11.1	13.3	15.3	15.4	16.1	18.4	19.9	19.4		
78 @ 58		11.4	14.4	15.9	17.2	18.9	19.0	19.4	18.6		
Mean		10.5	13.5	15.5	16.2	16.8	18.1	19.1	18.5		
11. v.55											
58 @ 91		11.2	12.8	15.4	16.0	15.9	19.1	20.7	19.6		
78 @ 70		11.0	12.9	15.2	16.6	17.7	18.9	19.6	19.3		
Mean		11.1	12.9	15.3	16.3	16.8	19.0	20.2	19.5		
27. v.55											
50 @ 114		14.9	14.2	12.9	16.8	17.3					
60 @ 104		14.8	17.6	15.9	14.7	16.7					
70 @ 94		15.8	14.1	17.2	15.7	17.6					
Mean		15.2	15.3	15.3	15.7	17.2					
13.vii.55											
21 @ 190		9.2	11.6	14.5	15.9	16.2	18.3	18.6	17.4	17.2	20.0
40 @ 171		10.3	13.2	14.7	15.4	16.0	15.9	17.4	16.4		
61 @ 150		8.9	11.7	14.7	14.9	15.2	16.3	17.5	17.6		
Mean		9.5	12.2	14.6	15.4	15.8	16.8	17.8	17.1	17.2	20.0

TABLE 17

PEANUTS - C.12. SOIL MOISTURE (per cent) UNDER CROP.

Sampling Date, Planting Number, & Age in days.	Sampling Depth (Inches).										
	4	8	12	18	24	32	48	64	72	84	96
2. 11.55			18.2	20.0	20.9	21.0	20.9	19.7			
11. 11.55 5 @ 46			16.2	17.2	20.3	21.6	20.5	20.3			
14. 11.55 8 @ 48			19.3	20.8	21.6	22.3	23.8	21.6			
15. 11.55 9 @ 48			22.0	22.6		20.9	20.4	20.0			
21. 11.55 13 @ 48			19.6	21.8	20.4	21.5	21.4	21.2			
22. 11.55 32 @ 30			21.7	22.1	23.9	22.8	23.2	24.0			
24. 11.55 15 @ 48			17.4	18.3	19.8	22.0	21.4	21.2			
25. 11.55 17 @ 48			19.5	20.4	21.8	22.3	22.0	22.0			
28. 11.55 20 @ 48			17.1	18.6		19.9	20.0	19.9			
1.111.55 23 @ 47			16.5	19.0	20.0	19.2	23.2	21.2			
3.111.55 22 @ 49			15.6	17.7	18.6	18.8	20.7	19.2			
7.111.55 27 @ 48			14.8	16.8	18.6	19.4	18.5				
18.111.55											
11 @ 75			17.5	19.0	20.0	21.7	22.6	21.9			
20 @ 67			17.9	17.9	19.2	21.4	21.1	20.4			
30 @ 57			13.0	17.6	17.2	19.5	15.4	15.1			
Mean			16.1	18.2	18.8	20.9	20.0	19.1			
28.111.55											
11 @ 85	13.1	13.3	15.6	18.9	19.3	20.3	20.4	22.4			
20 @ 76	8.5	12.2	13.8	17.5	20.2	20.1	21.6	20.9			
30 @ 66	6.5	8.9	13.7	15.3	17.2	18.4	19.2	18.9			
Mean	9.4	11.5	14.4	17.2	18.9	19.6	20.4	20.7			

TABLE 17

PEANUTS - C.12. SOIL MOISTURE (per cent) UNDER CROP.

(Cont'd).

Sampling Date, Planting Number, & Age in days.	Sampling Depth (Inches).										
	4	8	12	18	24	32	48	64	72	84	96
13. iv.55											
11 @ 101	11.2	12.0	15.2	16.4	18.8	20.7	20.8	21.4			
20 @ 93	7.0	14.1	14.7	14.4	17.2	18.9	20.9	19.0			
30 @ 83	7.0	10.6	10.4	14.0	13.1	13.9	18.1	18.5			
Mean	8.4	12.2	13.4	14.9	16.4	17.8	19.9	19.6			
26. iv.55											
12 @ 113		12.1	14.2	15.4	16.9		19.2	19.3	21.1		
20 @ 105		11.0	13.1	16.2	16.9	17.3	19.6	20.9	18.8	20.0	
30 @ 95		9.6	11.2	12.8	13.2	14.7	16.7	17.9	19.8		
Mean		10.9	12.8	14.8	15.7	16.0	18.5	19.4	19.9	20.0	
12. v.55											
30 @ 111		9.4	10.6	12.4	14.0	13.7	15.6	16.2	14.6		
13.vii.55											
20 @ 153		6.6	13.4	16.0	15.8	16.2	16.7	18.2	19.3	20.2	19.2

TABLE 18

SORGHUM - C.5. SOIL MOISTURE (per cent) UNDER CROP.

Sampling Date, Planting Number, & Age in days.	Sampling Depth (Inches).										
	4	8	12	18	24	32	48	64	72	84	96
2. 11.55 4 @ 50			15.4	14.4	15.1	17.0	18.7	17.6			
11. 11.55 16 @ 47			13.2	14.8	16.2	18.3	19.1	17.7			
14. 11.55 39 @ 27			23.3	19.9	22.5	21.9	24.2	17.8			
15. 11.55 19 @ 48			19.9	19.1	16.7	16.7	19.2	18.7			
17. 11.55 21 @ 49			18.5	19.6	19.4	19.5	19.4	18.4			
21. 11.55 46 @ 26			19.2	18.9	21.2	22.2	23.2	23.3			
22. 11.55 11 @ 64 26 @ 48 32 @ 42 Mean			18.4 20.8 18.7 19.3	19.0 20.6 21.6 20.4	19.7 20.5 19.1 19.8	20.6 22.1 22.3 21.7	21.6 22.2 21.2 21.7	17.7 22.7 20.1 20.2			
24. 11.55 48 @ 27			18.9	20.4	20.2	20.5	22.3	21.4			
25. 11.55 29 @ 48			17.5	19.3	20.4	21.1	20.6	18.9			
28. 11.55 52 @ 27			17.2	18.3	19.7	20.5	22.8	21.2			
1.111.55 33 @ 48			19.7	20.9	21.2	21.6	22.3	22.1			
3.111.55 56 @ 27			17.0	18.5	19.2	19.7	20.9	19.9			
4.111.55 36 @ 48			18.9	19.1	21.5	21.6	22.1	21.1			
7.111.55 39 @ 48			16.2	18.5	19.5	22.3	21.8	21.6			
15.111.55 2 @ 93 19 @ 75 37 @ 57 56 @ 39 73 @ 24 Mean			20.2 21.1 20.8 20.8 18.5 20.3	20.7 22.0 21.7 21.7 19.5 21.1	21.6 22.2 23.2 22.2 21.2 22.1	21.0 22.1 23.9 23.6 21.8 22.5	21.6 22.5 22.9 22.8 22.5 22.5	19.3 19.4 22.5 19.9 21.3 20.5			

TABLE 18

SORGHUM - C.5. SOIL MOISTURE (per cent) UNDER CROP. (Cont'd).

Sampling Date, Planting Number, & Age in days.	Sampling Depth (Inches).										
	4	8	12	18	24	32	48	64	72	84	96
22.iii.55											
2 @ 100			17.8	19.5	20.4	20.5	20.0	20.2			
20 @ 82			17.2	18.4	20.4	21.9	22.2	21.0			
38 @ 64			20.0	21.1	21.8	23.1	24.1	22.6			
56 @ 46			17.1	19.4	20.4	21.5	21.8				
74 @ 28			18.0	19.5	20.7	21.4	22.9	21.2			
Mean			18.0	19.6	20.7	21.7	22.2	21.3			
25.iii.55											
9 @ 97			18.9	19.0	21.3	31.0	22.0	21.9	21.0	20.8	20.3
29.iii.55											
3 @ 107	8.5	12.0	15.4	16.9	20.9	18.7	20.5	16.3			
21 @ 89	8.7	12.3	12.8	16.3	16.5	18.5	20.7	20.4			
38 @ 71	8.7	12.0	15.2	16.0	17.4	18.5	20.9				
57 @ 53	9.2	11.7	14.8	15.8	17.3	18.4	22.2	20.3			
74 @ 35	8.9	12.8	15.5	17.2	19.2	20.8	22.0	22.9			
Mean	8.8	12.2	14.7	16.4	18.3	19.0	21.3	20.0			
6. iv.55											
2 @ 115	5.8	9.3	13.6	14.9	15.4	16.7	19.3	15.7			
19 @ 97	8.9	10.4	13.7	14.9	16.8	18.4	19.0	20.1			
37 @ 79	9.4	11.5	14.0	15.6	16.2	17.9	18.9	18.9			
56 @ 61	9.4	12.2	14.0	15.1	15.8	16.2	19.7	20.3			
73 @ 43	7.7	11.4	13.5	14.9	17.2	19.0	21.2	20.0			
Mean	8.2	11.0	13.8	15.1	16.3	17.6	19.6	19.0			
15. iv.55											
2 @ 124	6.0	8.7	12.8	14.6	15.6	16.4	15.8	14.7			
20 @ 106	9.3	12.0	15.8	16.1	16.3	16.4	18.4	19.1			
37 @ 88	8.0	11.6	14.1	15.6	16.5	17.0	19.5				
56 @ 70	7.8	8.1	11.8	13.9	15.5	15.6	17.2	17.2			
73 @ 52	8.0	10.6	13.2	15.9	15.5	17.5	17.9	21.8			
Mean	7.8	10.2	13.5	15.2	15.9	16.6	17.8	18.2			
28. iv.55											
21 @ 119		9.5	12.7	14.3	15.6	16.4	16.8	17.4	18.3	17.1	
38 @ 101		12.1	14.4	15.4	17.1	17.1	18.5	19.0	17.1		
57 @ 83		10.6	12.8	15.3	16.4	15.7	16.8	17.9	19.1		
74 @ 65		9.2	12.3	14.1	15.5	16.2	18.9	17.7			
Mean		10.4	13.1	14.8	16.2	16.4	17.8	18.0	18.2	17.1	
10. v.55											
37 @ 113		10.4	12.9	14.7	16.4	17.6	18.4	20.6	20.8	19.3	
56 @ 95		10.2	10.4	13.2	14.8	15.6	16.2	17.4	18.1	18.3	
73 @ 77		8.9	13.1	14.2	15.8	16.1	16.5	16.9	19.0	20.2	
Mean		9.8	12.1	14.0	15.7	16.4	17.0	18.3	19.3	19.3	
27. v.55											
20 @ 148		14.6	12.3	14.2	18.2	16.0					
40 @ 128		15.9	13.6	14.6	15.7	15.1					
60 @ 107		13.8	13.9	15.4	14.6	15.0					
Mean		14.8	13.3	14.7	16.2	15.4					

TABLE 18

SORGHUM - C.5. SOIL MOISTURE (per cent) UNDER CROP.

(Cont'd).

Sampling Date, Planting Number, & Age in days.	Sampling Depth (Inches).										
	4	8	12	18	24	32	48	64	72	84	96
25.vii.55											
20 @ 207		7.1	10.4	14.2	14.4	15.2	15.0	13.9	16.8	16.8	18.5
40 @ 187		12.6	13.0	13.7	15.5	14.9	16.2	15.4			
60 @ 166		9.2	11.3	12.2	14.1	13.9	17.2				
Mean		9.6	11.6	13.4	14.7	14.7	16.1	14.7	16.8	16.8	18.5

TABLE 19

SORGHUM - C.12. SOIL MOISTURE (per cent) UNDER CROP.

Sampling Date, Planting Number, & Age in days.	Sampling Depth (Inches).										
	4	8	12	18	24	32	48	64	72	84	96
2. 11.55			14.8	15.8	17.0	16.5	17.0	20.7			
11. 11.55 7 @ 48			15.7	16.8	17.0	17.9	19.3	19.8			
14. 11.55 30 @ 27			27.4	24.4	25.8	18.6	22.4	24.0			
15. 11.55 11 @ 47			29.2	21.5	15.7	17.1	21.8	18.6			
17. 11.55 33 @ 27			22.2	22.6	23.6	25.4	24.0				
21. 11.55 15 @ 48			23.7	23.6	23.2	22.1	21.2	20.0			
22. 11.55 39 @ 25			20.6	21.3	16.8	24.7	28.9	31.2			
24. 11.55 39 @ 27			17.2	26.2	20.1	21.7	20.7	20.7			
25. 11.55 20 @ 48			20.7	21.3	22.9	23.4	23.4	21.1			
28. 11.55 22 @ 48			19.7	27.6	22.6	22.8	24.4	21.2			
1.111.55 24 @ 47			21.1	22.9	21.5	24.8	24.4	24.4			
3.111.55 26 @ 48			18.6	20.4	21.2	21.2	20.7	20.7			
4.111.55 27 @ 48			18.1	19.8	20.0	22.3	22.1	21.6			
7.111.55 30 @ 48			19.0	19.6	20.9	22.6	23.1	23.8			
18.111.55											
10 @ 79			21.3	22.7	22.6	23.3	23.6	22.4			
20 @ 69			23.2	21.8	24.0	22.4	20.5	22.4			
30 @ 59			23.1	23.8	23.5	23.0					
Mean			22.5	22.8	23.4	22.9	22.1	22.4			
25.111.55 10 @ 86			17.1	19.1	21.0	19.9	20.3	18.9	18.8	19.0	19.7

TABLE 19

SORGHUM – C.12. SOIL MOISTURE (per cent) UNDER CROP.

(Cont'd).

Sampling Date, Planting Number, & Age in days.	Sampling Depth (Inches).										
	4	8	12	18	24	32	48	64	72	84	96
28.iii.55											
11 @ 88	9.5	16.4	17.9	20.3	20.2	20.6	22.8	22.2			
20 @ 79	11.2	15.4	18.5	20.0	20.0	21.4	20.6	21.4			
30 @ 69	11.8	16.0	15.9	17.6	19.0	21.3	22.2	21.0			
Mean	10.8	15.9	17.4	19.3	19.7	21.1	21.9	21.5			
13. iv.55											
11 @ 104	10.7	12.4	15.7	17.4	17.6	17.5	19.3	20.0			
20 @ 95	9.9	13.0	16.2	17.7	18.0	19.2	18.9	19.0			
30 @ 85	11.8	15.4	15.1	17.1	16.1	16.7	17.5	19.2			
Mean	10.8	13.6	15.7	17.2	17.2	17.8	18.6	19.4			
26. iv.55											
11 @ 117		14.8	14.0	17.0	17.7	17.8	18.8	20.2	18.7		
20 @ 108		11.3	14.8	17.0	17.2	17.7	19.0	19.0	19.8	18.8	
30 @ 98		13.1	16.7	18.4	17.1	19.2	18.7	20.0	20.4		
Mean		13.1	15.2	17.5	17.3	18.2	18.8	19.7	19.6	18.8	
12. v.55											
20 @ 124			14.6	17.0	16.8	17.4	16.7	17.5	17.8	18.9	
30 @ 114			15.0	17.0	17.1	16.8	17.1	17.0	16.7		
Mean			14.8	17.0	17.0	17.1	16.9	17.3	17.3	18.9	
13.vii.55											
20 @ 186		10.4	12.5	14.3	16.3	16.8	14.8	18.9	18.5	17.5	18.3

TABLE 20

HARVEST DATES.

PEANUTS - C.10.

Planting Dates.	Planting Numbers. (Inclusive).	Digging Dates.
8.xii.54 - 17.xii.54	1 - 10	4. iv.55
18.xii.54 - 29.xii.54	11 - 21	12. iv.55
30.xii.54 - 8. i.55	22 - 31	19. iv.55
9. i.55 - 20. i.55	32 - 43	4. v.55
21. i.55 - 1. ii.55	44 - 55	26. v.55
2. ii.55 - 13. ii.55	56 - 57	27. v.55
14. ii.55 - 18. ii.55	68 - 72	1. vi.55
19. ii.55 - 27. ii.55	73 - 81	Not dug

PEANUTS - C.12.

Planting Dates.	Planting Numbers. (Inclusive).	Digging Dates.
16.xii.54 - 26.xii.54	1 - 10	22. iv.55
26.xii.54 - 5. i.55	11 - 20	4. v.55
6. i.55 - 15. i.55	21 - 30	13. v.55
16. i.55 - 26. i.55	31 - 41	23. v.55

TABLE 21

HARVEST DATES.

SORGHUM - C.5.

Planting Dates.	Planting Numbers. (Inclusive).	Harvest Date.
7.xii.54 - 16.xii.54	1 - 10	13. iv.55
17.xii.54 - 27.xii.54	11 - 20	20. iv.55
28.xii.54 - 7. i.55	21 - 31	3. v.55
8. i.55 - 16. i.55	32 - 40	17. v.55
17. i.55 - 26. i.55	41 - 50	30. v.55
27. i.55 - 5. ii.55	51 - 60	6. vi.55
6. ii.55 - 15. ii.55	61 - 70	15. vi.55
16. ii.55 - 23. ii.55	71 - 78	20. vi.55

SORGHUM - C.12.

Planting Dates.	Planting Numbers. (Inclusive).	Harvest Date.
16.xii.54 - 26.xii.54	1 - 10	21. iv.55
27.xii.54 - 5. i.55	11 - 20	5. v.55
6. i.55 - 15. i.55	21 - 30	16. v.55
16. i.55 - 26. i.55	31 - 41	31. v.55

8.2 Statistical Analysis of the Results of the 1954-55 Season

The limitations in analysing statistically results of this nature have already been pointed out by Glenday (1955). A polynomial of the 2nd. or 3rd. order was fitted to the data for each of the replicates to correspond with a seasonal effect. The residues for the fitted curves for each replicate were then correlated with one another. If there is a significant correlation between residues of replicates after a trend defined by a polynomial of low order has been fitted, it indicates that a significant improvement would be made by fitting a polynomial of higher degree. It must be pointed out that a very high order polynomial may be required to accomodate correlated deviates associated with a sharp deviation from the general trend, over a short period of time. However from the point of view of searching for causal relations it is profitable to examine the trends of the residues from the polynomial in relation to possible departures from regular trends in relevant weather factors. The significance or correlation of residues between replicates in this content means that one can take the pattern of deviates from the fitted trends yields as something real and not the result of chance sampling effects.

Peanuts. - Analyses in the main peanut experiment (C.10) are of 2 in. and 3 in. sowings for replicates 1 and 2 extending over 62 plantings (up to and including the 61st. planting made on 8.11.55 in C.10). A comparison of the cubic fitted, with the replicate data shows little departure from the smooth trend. The correlation of residues follows:

	3" Rep. 1	2" Rep. 2	3" Rep. 2
2" Rep. 1	0.0345	0.2841^{xx}	0.3228^{xx}
3" Rep. 1		0.2635^{x}	0.089
2" Rep. 2			0.5691^{xxx}

Correlation of Rep. 1 and the pooled Rep. 2 values is 0.3835^{xxx}. Though the results in the parallel peanut planting (C.12) are not as clear cut as the above, they show a similar trend. The striking feature of these results is the steady progression of declining yields with later planting date.

Sorghum. - Yields from contiguous planting are represented in Table 12 for the main body of the experiment (C.5), in Table 14 for the shorter period of planting (C.12), and graphically in Figures 8 and 9a. A correlation of residues after fitting a cubic to the results at 1 in. and 2 in. sowings in replications 1 and 2 over 78 plantings (C.5) shows :

	2" Rep. 1	1" Rep. 2	2" Rep. 2
1" Rep. 1	0.5905^{xxx}	0.6012^{xxx}	0.2785^{x}
2" Rep. 1		0.4684^{xxx}	0.3450^{xx}
1" Rep. 2			0.5934^{xxx}

and a correlation of the sum of deviates of Replication 1 with deviates of replication 2, 0.5347^{xxx}. When plotting the cubic to each replicate, the yield figures fall consistently below the curve for the 30th. to 44th. day, indicating a departure from regularity in the weather, affecting the yield of the sorghum crops over these particular plantings. The corresponding plantings in the shorter experiment C.12 shows this same general departure from regularity but with a displacement in time for the replicates.

8.3 Tabular Data and Analyses: 1955-56 Season

Page

Table 22. - Peanut yields on C.10 in pounds per acre 77

Table 23. - Establishment counts in peanuts on C.10. 78

Table 24. - Ratio of yield to plants established in peanuts on C.10. 79

Peanuts show a marked response to spacing (Kath. Res. Sta. Progress Rept., in prepn.). When the yield obtained for the first planting is corrected for stand, the trend obtained in the previous season, that is, a steady decline in yield with later planting, is confirmed.

Table 25. - Sorghum yields on C.5 in pounds per acre These data are presented graphically in Figure 14c. 80

In view of the poor establishment conditions during December the stand obtained for the first planting was unsatisfactory and the yields from this planting were not included. Number 12 in the series was not planted and the stand for Number 17 was inadequate as the machine was not operating satisfactorily at sowing. The crops for planting Numbers 1 and 17 however were good enough to collect phenological data.

Table 26. - Sorghum grain number on C.5. The numbers in grades A, B, C, D and the totals are presented. These values are relative and are calculated from the grain size determinations shown in Table 6. The percent. distribution refers to the proportion of each grade to the total number of grain produced for each day's planting. 81

Table 27. - Sorghum node number for each planting in the series. These are based on 10 observations in one replication only. These data are presented graphically in Figure 14a. 83

TABLE 22

PEANUT YIELDS - C.10.

Yields in lbs. per acre.

Planting Date.	Planting Number.	REP.1	REP.2	REP.3	REP.4	REP.5	REP.6	MEAN.
5.xii.55	1	1493	1379	1710	1760	1175	1482	1500
3. i.56	2	1508	1661	1883	1560	1795	1817	1704
19. i.56	3	Stooks destroyed by wild pigs.						-
6. ii.56	4	-	888	451	-	870	933	785

Analysis of the First Two Plantings.

	Degrees of Freedom.	Sum of Squares.	Mean Square.	Variance Ratio. (F)
Blocks	5	148,332	29,666	<1
Treatments	1	125,052	125,052	3.16
Error	5	198,099	39,620	
Total	11	471,483		

No significance at P = 0.05

TABLE 23

PEANUT STAND - C.10.

Number of Plants established per Plot.

Planting Date.	Planting Number.	REP.1	REP.2	REP.3	REP.4	REP.5	REP.6	MEAN.
5.xii.55	1	596	570	526	520	387	537	523
3. i.56	2	800	780	813	811	766	864	806
6. ii.56	4	-	779	833	-	818	864	812

Analysis of the First Two Plantings.

	Degrees of Freedom.	Sum of Squares.	Mean Square.	Variance Ratio. (F)
Blocks	5	20,596	4,119	1.81
Treatments	1	240,267	240,267	105.38
Error	5	11,401	2,280	
Total	11	272,264		

Significant at P = 0.001.

TABLE 24

PEANUT YIELD PER PLANT ESTABLISHED - C.10.

Ratio of Yield to Stand.

Planting Date.	Planting Number.	REP.1	REP.2	REP.3	REP.4	REP.5	REP.6	MEAN.
5.xii.55	1	2.50	2.42	3.25	3.38	3.04	2.76	2.49
3. 1.56	2	1.89	2.13	2.32	1.92	2.34	2.10	2.12
6. 11.56	4	-	1.14	0.54	-	1.06	1.08	0.93

Analysis of the First Two Plantings.

	Degrees of Freedom.	Sum of Squares.	Mean Square.	Variance Ratio. (F)
Blocks	5	5,766	1,153	1.49
Treatments	1	18,019	18,019	23.28
Error	5	3,872	774	
Total	11	27,657		

Significant at P = 0.01

TABLE 25

SORGHUM YIELDS - C.5.

Yields in lbs. per acre.

Planting Date.	Planting Number.	Rep. 1.	Rep. 2.	Rep. 3.	Rep. 4.	Mean.
1. 1.56	2	2466	2142	1068	1945	1905
4. 1.56	3	2317	1982	2759	2214	2318
6. 1.56	4	1464	1465	1542	2423	1723
9. 1.56	5	2481	1656	3086	1606	2207
11. 1.56	6	2326	1189	2831	1931	2069
13. 1.56	7	2238	2355	2656	1768	2254
17. 1.56	8	2516	2446	2759	2012	2433
19. 1.56	9	2555	2375	2703	2182	2453
23. 1.56	10	1939	1258	1733	1880	1702
25. 1.56	11	1977	1944	2566	2191	2169
31. 1.56	13	1689	1765	1302	1684	1610
6. 11.56	14	1318	1602	1621	1249	1447
8. 11.56	15	1471	1050	1307	1479	1327
10. 11.56	16	1485	1266	1194	1407	1338
15. 11.56	18	1283	1188	1398	968	1209

	Degrees of Freedom.	Sum of Squares.	Mean Square.	Variance Ratio. (F).
Blocks	3	10,056	3,352	2.39
Treatments	14	102,380	7,313	5.21
Error	42	58,924	1,403	
Total	59	171,360		

Planting dates significant at P = 0.05
Standard error of treatment means ± 187 lbs/acre

There is a real difference between plantings made before the end of January and those after the 25th January.

TABLE 26

SORGHUM GRAIN NUMBERS - 0.5.

PLANTING Date.	Number.	GRADE.	REP. 1	REP. 2	REP. 3	REP. 4	MEAN.	PERCENT.
1. 1.56	2	A	6106	5357	1943	4081	4372	53.6
		B	3977	3414	2543	4014	3487	42.7
		C	321	248	200	305	269	3.3
		D	43	34	26	34	34	0.4
		Total	10447	9055	4712	8434	8162	
4. 1.56	3	A	1758	2294	4028	2795	2719	25.4
		B	7857	6084	7809	6471	7055	66.0
		C	1395	754	537	842	882	8.2
		D	43	17	43	68	43	0.4
		Total	11053	9149	12417	10176	10699	
6. 1.56	4	A	2508	1894	1413	3301	2279	28.8
		B	3590	4298	4843	6574	4826	60.9
		C	401	473	1018	1195	772	9.7
		D	26	34	51	77	47	0.6
		Total	6525	6699	7325	11147	7924	
9. 1.56	5	A	3453	2080	5200	1856	3147	31.4
		B	6858	4915	7845	4898	6129	61.2
		C	962	569	626	641	700	7.0
		D	51	34	51	34	42	0.4
		Total	11324	7598	13722	7429	10018	
11. 1.56	6	A	2391	1894	4806	2079	2793	29.5
		B	7058	3153	6961	6059	5808	61.3
		C	1459	241	850	786	834	8.8
		D	51	8	43	51	38	0.4
		Total	10959	5296	12660	8975	9473	
13. 1.56	7	A	1251	3267	2216	2036	2193	20.6
		B	7664	6556	8802	5254	7069	66.5
		C	1948	866	1539	890	1311	12.3
		D	77	51	51	42	55	0.5
		Total	10940	10740	12608	8222	10628	
17. 1.56	8	A	2508	4236	2999	1870	2903	25.6
		B	7506	5654	8433	6380	6993	61.7
		C	1860	1002	1379	1210	1363	12.0
		D	77	94	68	59	75	0.7
		Total	11951	10986	12879	9519	11334	
19. 1.56	9	A	4397	4037	5074	3847	4339	39.7
		B	6283	5817	5896	5152	5786	53.0
		C	633	714	970	682	750	6.9
		D	60	42	60	42	52	0.5
		Total	11373	10610	12000	9723	10927	
23. 1.56	10	A	3097	2829	3326	2279	2883	37.7
		B	4898	2312	3765	5321	4074	53.3
		C	697	241	538	1114	648	8.5
		D	51	43	26	43	40	0.5
		Total	8743	5425	7655	8757	7645	

TABLE 26

SORGHUM GRAIN NUMBERS - C.5. (Cont'd).

PLANTING Date.	Number.	GRADE.	REP. 1	REP. 2	REP. 3	REP. 4	MEAN.	PERCENT.
25. 1.56	11	A	2478	1880	4246	3905	3127	31.7
		B	5738	6332	6416	5218	5926	60.1
		C	834	834	762	553	748	7.6
		D	60	51	77	43	57	0.6
		Total	9110	9097	11501	9719	9858	
31. 1.56	13	A	2046	2250	1529	3029	2213	29.8
		B	4594	5018	3693	3632	4234	56.9
		C	1235	834	834	874	944	12.7
		D	60	42	42	42	48	0.6
		Total	7935	8144	6098	7577	7439	
6. 11.56	14	A	1091	1047	1758	1573	1367	19.5
		B	3862	4679	4443	3233	4054	57.8
		C	1403	2181	1476	1010	1518	21.6
		D	68	103	60	68	75	1.1
		Total	6424	8010	7737	5884	7014	
8. 11.56	15	A	1217	1096	920	1641	1219	19.0
		B	4346	2821	3958	3977	3776	58.7
		C	1532	1075	1492	1364	1365	21.2
		D	68	68	68	77	70	1.1
		Total	7163	5060	6438	7059	6430	
10. 11.56	16	A	1286	794	1139	1354	1143	17.5
		B	4534	3341	3299	3954	3782	57.8
		C	1258	2237	1283	1412	1548	23.6
		D	68	85	68	77	74	1.1
		Total	7146	6457	5789	6797	6547	
15. 11.56	18	A	1879	2119	2557	1096	1913	34.7
		B	3214	2663	2997	2688	2890	52.4
		C	754	489	665	746	664	12.0
		D	60	51	51	51	53	1.0
		Total	5907	5322	6270	4581	5520	

TABLE 27

SORGHUM - C.5. NODE NUMBER.

Planting Date.	Planting Number.	Node Number.
13.xi1.55	1	10.7 ± 0.34
1. 1.56	2	10.6 ± 0.34
4. 1.56	3	10.8 ± 0.29
6. 1.56	4	9.6 ± 0.27
9. 1.56	5	9.5 ± 0.17
11. 1.56	6	8.8 ± 0.31
13. 1.56	7	9.0 ± 0.15
17. 1.56	8	9.4 ± 0.34
19. 1.56	9	8.8 ± 0.42
23. 1.56	10	9.1 ± 0.23
25. 1.56	11	8.2 ± 0.26
31. 1.56	13	8.1 ± 0.10
6. 11.56	14	8.8 ± 0.36
8. 11.56	15	8.7 ± 0.15
10. 11.56	16	7.0 ± 0.30
15. 11.56	18	7.0 ± 0.30

These observations are based on ten readings in one replication.

8.4 Land Histories

In view of the comparatively recent establishment of the Katherine Research Station, it is felt that a brief account of the histories of the land on which these experiments were carried out would be of interest.

C. 5. Bulldozed in February, 1950.
Cleared during the 1950 dry season.
Dry ploughing commenced on August 28th, 1950.
First cross ploughing commenced on October 2nd, 1950, when the soil was quite moist, and a second cross ploughing begun on November 1st, 1950.
The land was prepared for a seed bed in September 1950.
Has since been under crop cultivation.

C.10. Bulldozed in February, 1951.
Ploughed in March, 1951 and cross ploughed in mid-November, 1951.
Prepared for planting during the 1951-52 season and has since been under crop cultivation.

C.12. Bulldozing commenced in February, 1951 and completed during the 1952 dry season.
Dry ploughed to 4 inches in mid-October, 1952.
Prepared for planting in December, 1952-January, 1953.
Has since been under crop cultivation.

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