STUDIES IN SUGARCANE II**

Performances of canes as influenced by environmental conditions.

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Introduction. The protection granted to sugar industry afforded a fresh impetus for a closer and more intensive study of the several problems relating to sugarcane and its products. One of such problems that is considered of importance is an investigation into the possibilities of extending the existing short milling season, thereby to provide a longer working period for the sugar factories. If one has to make any recommendation in this direction, a knowledge of the behaviours of different cane varieties under the several changing seasonal conditions in different localities is of primary importance.

With a view to study integrated effect of the climatic and the seasonal factors on the growth of cane and on the composition of its juice, a large number of cane varieties like seven sugarcane—sorghum crosses Co. 351 to Co. 357 and cane types Co. 213, Co. 281, Co. 285, Co. 290, J. 247, P. O. J. 2878, and purple Mauritius, were planted every month from September 1932 upto August 1933, on six Agricultural Research Stations, viz., Anakapalli, Samalkot, and Maruteru in the Northern districts and at Coimbatore, Aduturai and Palur in the Southern districts of the Presidency. The actual number of varieties planted on each station however differed.

The canes were periodically analysed and at the time of each analysis data in regard to the average weight, length, girth and the number of internodes for each variety were collected to follow the vegetative development of cane in relation to the chemical composition of its sap (cane juice).

As the bulk of the data collected was very large, it is proposed to deal with it in two parts, viz., (i) the general tendencies of canes as influenced by season and locality and (ii) the detailed examination of the individual varieties under different conditions with a view to explore the possibilities of extending the present short milling season. The present communication deals with the first part. As all the varieties tried exhibited striking similarities in their general behaviour, the variety Co. 352 is chosen for illustration, as this is one of the varieties common for all the stations.

In a previous communication (Viswanath, Ramasubrahmanyam and Varahalu, 1933) results of some preliminary studies in this

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* Paper accepted for Ramasastrulu—Munagala Prize, 1936.

* Visvanath B, et al. The Indian Journal of Agricultural Science, Vol. IV, Part I, February, 1934.

direction were reported. Therein, a brief statement of the chemical studies on the ripening of sugarcane—sorghum hybrids planted in the months of March, April, June and September of 1932 were considered. The results of studies embodied in the present paper constitute an extension of the same.

I

Comparative rainfall and general climatic conditions at the six stations:—The data of monthly rainfall and of the rainy days on the six stations during the experimental period are represented diagramatically (Plate I). The differences in the rainfall conditions as revealed by this are not accidental to the experimental period, but are fairly general.

From the data the following points become clear :—

(1) At all the stations, excepting Coimbatore, the average annual rainfall is nearly the same, only the manner of its distribution is different. At Anakapalli, Samalkot and Maruteru, the greatest portion of the total rainfall for the year occurs during the South West monsoon period, June to September, when the days are long, the nights short, and the weather is generally warm. Thus at these stations a plentiful supply of water, high atmospheric humidity, and greater warmth and sunshine, all the factors conducive to good vegetative growth obtain during this period.

At Aduturai and Palur on the other hand the conditions are the reverse. The period of heavy rainfall—North East monsoon period—synchronises with comparatively cooler months, when the days generally tend to get short and the nights long.

2. The dry period generally commences at Palur and Aduturai only from late January, whereas at the stations in the Northern districts it begins even a month earlier, and extends in all cases upto March. This period is throughout cool.

3. While the hot weather period from April to June is common for all the stations, the following warm months July to September are generally comparatively less humid with less rainfall at Aduturai and Palur, unlike at the stations in the northern districts, Anakapalli, Samalkot and Maruteru. Thus at Aduturai and Palur, unlike at the other places, there is more or less a continuous period of hot or warm months, April to September, with comparatively less of rainfall.

4. It may be mentioned here that the number of rainy days either for the whole year or for any part of it being comparatively less, it is in effect the conditions which obtain during the rainless days which form the greatest part of the year, that go more to tell upon the performance of crops. The easy availability of water, and the degree and duration of the atmospheric humidity caused by the rainfall, only serve either to modify or reinforce the effects of the season.

As will be seen later, these differences in the relative distribution of rainfall and the dry periods at the several stations are reflected in the performances of canes.

II

Some factors influencing the growth of cane and the concentration of juice:—In this section it is proposed to study the influence of the external seasonal conditions on the vegetative growth of sugarcane and on the concentration of its juice. For this purpose the vegetative growth of canes as represented by the progressive height measurements, and the periodical variations in the concentration of juice as represented by the brix values (Table I) are followed. For illustration the data for the variety Co 352 at Anakapalli are chosen. The data are represented graphically (Plates 2 and 3). The periodical variations in the concentration of juice are shown separately for each of the crops planted in the several months (Plate 3 A). The graphs pertaining to individual crops are juxtaposed to bring out the integrated effect of the climatic and the changing seasonal conditions on the concentration of the juice. The curve represented by the broken line (Plate 3 B) illustrates the general trend of the progress of concentration during the several seasons of the year.

Comparing the growth curves with the concentration curves the following points are noticeable:—

1. The growth curves are very steep during months from June to September—October indicating vigorous vegetative growth. It was already mentioned that the seasonal and the weather conditions during this period are the most favourable for growth, as there obtain plentiful water, high humidity and greater warmth and sunshine.

2. During the months from June to October when the growth curves are steep, the concentration curve is showing a trough, thereby pointing that during this period the balance of solids in the sap is very low and that all the material synthesised is used up as quickly as it is formed in the building up of the vegetative tissues.

Thus the concentration of the juice tends to be a minimum when the growth tends towards a maximum.

3. The slopes of the curves from the month of October onwards indicate that all the crops are tending to slow down in growth from about this time of the year. The curves actually become flat, and continue to be so from about November—December to April—May. This period coincides with the one covered by the steepest part of the concentration curve, and the maximum concentration is attained at a time when the stationary part of the growth curve ends. Thus from October onwards, all the crops irrespective of their times of planting hasten to enter upon another phase of their life's activity, viz., that of quickly enriching the concentration of their juices.

Now, it is generally cool and the rainfall less from October onwards, unlike in the period immediately preceding it. The period from November—December to April—May can be split up into two parts:

(a) December to March, and

(b) March to May.

The first part of the period is characterised by being (i) clear and bright (ii) cool and dry, and (iii) windy. Further, the nights during this part of the year are long and the days short. The second part is characterised by (i) being hot with comparatively high temperature both during day and night, (ii) having a bright sunshine for a large number of hours in the day and (iii) inadequacy of water and low humidity. All these conditions tend to cause the loss of moisture and arrest growth.

From this it becomes clear that for quick accumulation of solids in the juices and for the attainment of full maturity, cool and dry conditions followed by increasing warmth are essential, and it may be expected that whenever such conditions prevail, the crop hastens to accumulate solids, irrespective of the state of its development at that time.

5. Again, two maxima are indicated in the concentration curves of different magnitudes. What is interesting is that both the maxima occur during about the same part of the year, thereby emphasising upon the greater potency of the season in controlling the concentration development in the cane juice. The differences in the magnitudes are owing to differences in the vegetative preparedness of the crops at this time of the year.

Thus, whatever be the stage of growth of cane, with the onset of proper seasonal conditions the crops hasten to enter upon the phase in its development which tends to lead on towards maturity.

6. While the tendencies considered so far are general, the crops planted in the several months show striking differences among themselves, as evidenced by the relative positions of the growth curves. It is easy to see that all those crops which had enough time to establish themselves before entering upon the period from June to October made good vegetative progress. When this time was insufficient, the vegetative growth suffered correspondingly.

From the foregoing it would appear that in the cycle of the seasons of the year, there is a season specific for the development of each one of the phases in the life of the cane. There is a season during which the vegetative growth alone is promoted more, and another during which the growth is arrested and the concentration of the juice is enriched quickly at greater rates until final maturity is attained. On any cane crop which passes during these seasons their

independent effects are impressed, and the degree of the impress of each season is conditioned mainly by the state and the preparedness of the crop to receive it at that instant. The performance of the cane at any given time in the year is thus a resultant of the effects of (i) the several seasons through which it passes, (ii) the preparedness of the crop, and (iii) the inherent capacity of the cane. This latter aspect will be considered in a separate part as was already indicated.

It will be seen that all these general observations find confirmation from the detailed analytical data to be examined hereafter.

III

Examination of the analytical data. As the canes are planted in several months, they should obviously be of different ages, on any day of harvest or analysis. Therefore the performances, at any given time, of these crops, planted in the several months should go to indicate the influence of the seasonal conditions which happen to prevail at that time, and perhaps for some time previously, irrespective of their ages. For illustration, the brix values representing the concentrations of juices (Table I) are plotted against their respective ages (Plate 4).

(a) *Concentration of juice as influenced by season.* An examination of the data and of the graphs leads to the inference that irrespective of the age of the crops on any one day, the juice of cane generally indicates almost the same degree of concentration.

Barring minor differences due to differences in location and other causes, all the graphs in each station showing the brix values run almost parallel to the age axis. Again, the several graphs in each station range themselves in regular stairs one above the other. In the more advanced months of the period from June to April, the levels of the graphs are in general progressively higher in the scale of brix values.

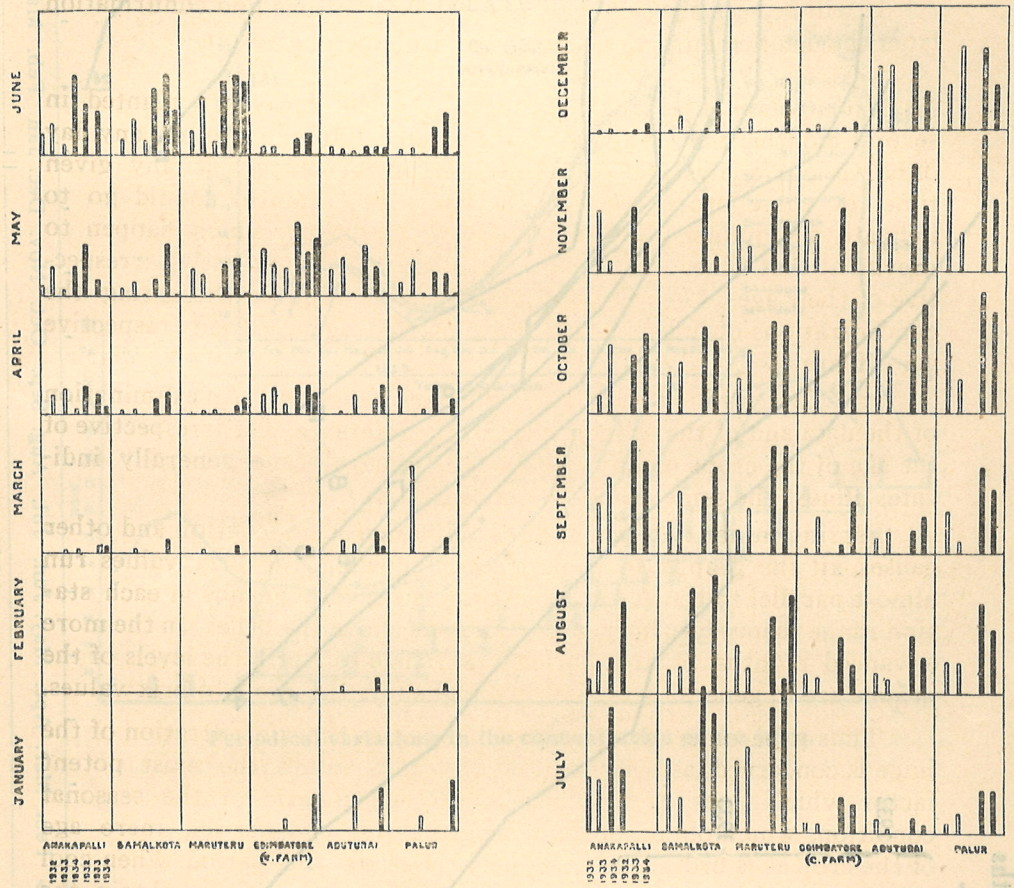
Thus it becomes evident that so far as the concentration of the juice is concerned, as measured by the brix values, the most potent factor which goes to influence it is the climatic or the seasonal conditions which obtain at the time of harvest, and not the mere age of the crop as is ordinarily supposed. During the period when cool and dry conditions prevail, and when high temperatures obtain, the concentrations are fairly good, and during the rainy months they are very poor.

Although the concentrations as seen here are very similar at any one time for crops of different ages, the several crops seem to differ in other respects. The July planted crop for example, has comparatively lower weight, and lower values for T/B (Brix of juice from top half/ Brix of juice from Bottom half) ratios. These differences will be considered presently.

(b) *Relation between the age of the crop and the performance of the cane.* There appears to prevail a general belief that if a cane crop

PLATE I.

Rainfall distribution during the Experimental Period.



= Rainfall in inches.

= No. of Rainy days.

Plate II. GROWTH OF CANE

Co. 352 ANAKAPALLI

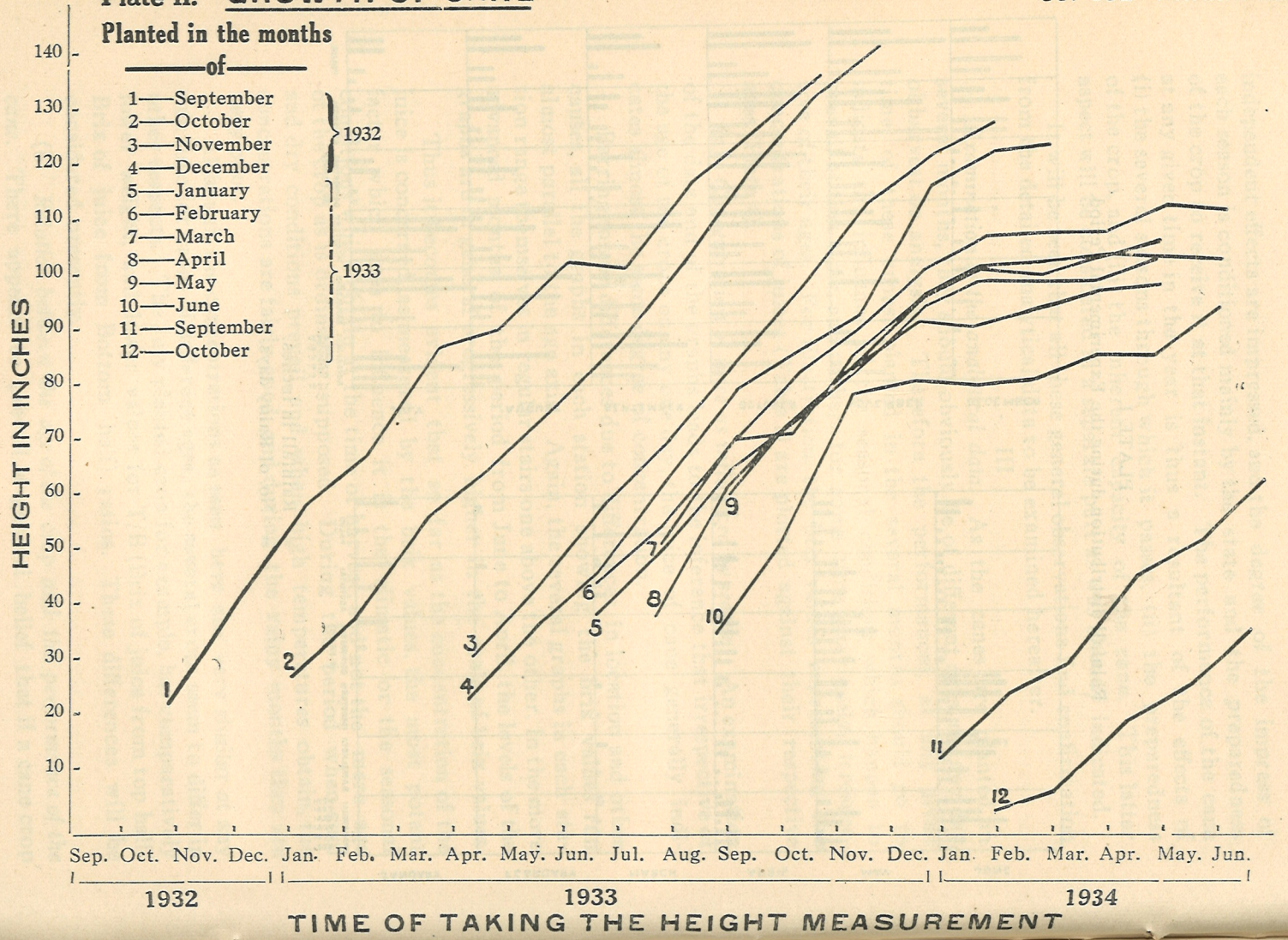
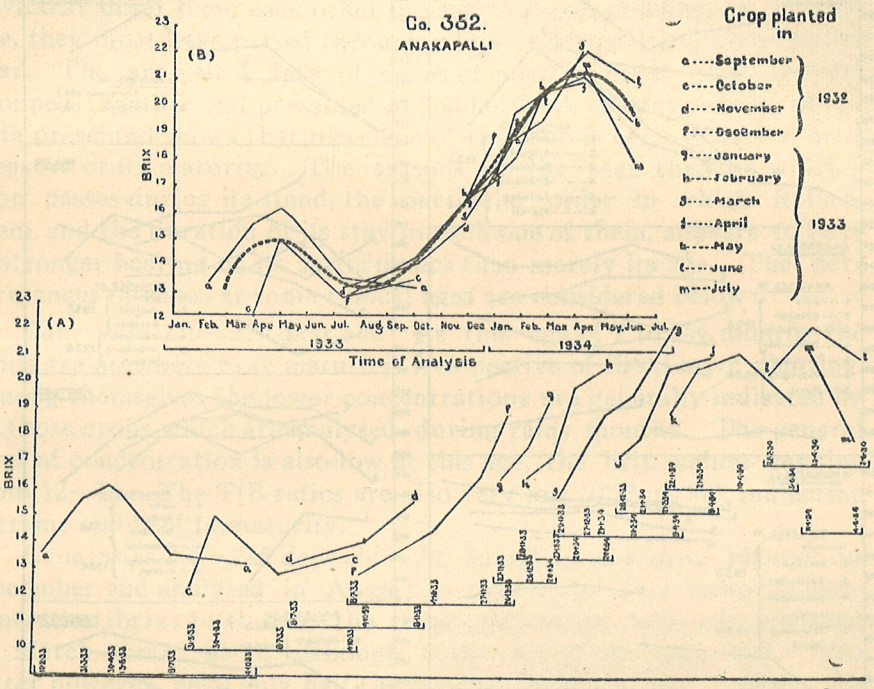


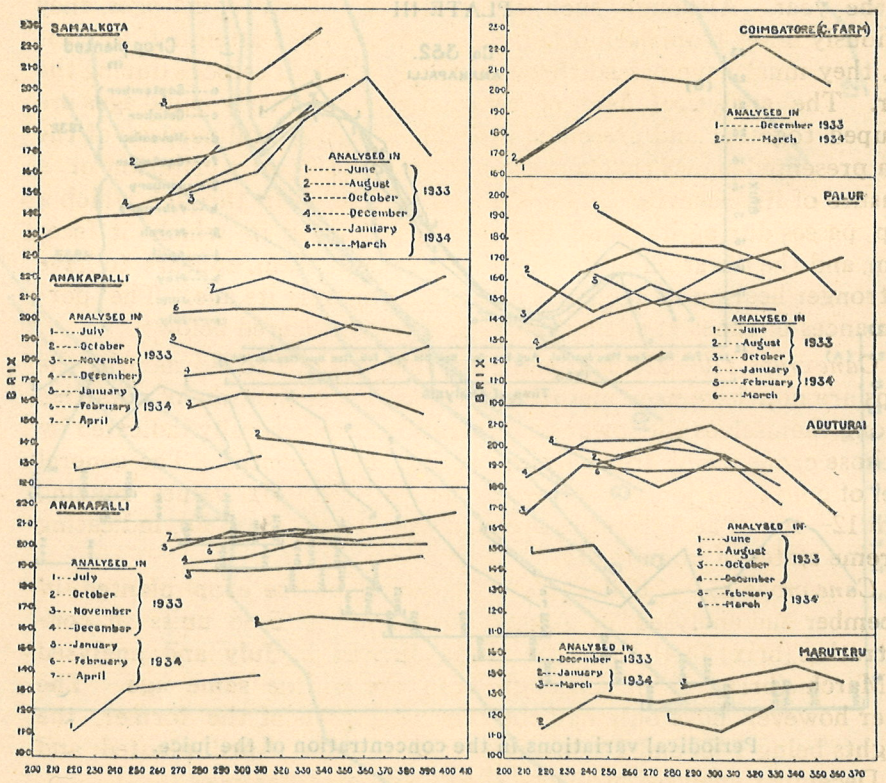
PLATE III



Periodical variations in the concentration of the juice.

PLATE IV.

Influence of season on the concentration of juice.



Age of crop in days.

grows about a year, it will ordinarily be fit for harvesting. In what follows an attempt is made (i) to verify the tenability of this belief, and (ii) to know whether it is merely the age of the crop which controls the maturity of cane, or other factors concomitantly influence it.

As canes are planted in different months of the year and analysed periodically, it is possible to get canes of equal ages at different times of the year. Although such canes are of nearly equal ages, they obviously differ from each other in that, that before attaining to that age, they must have passed through widely different seasons during the year. The analytical data of canes of equal or nearly equal ages are grouped together and presented in Table II. A careful perusal of the data presented shows that mere age of the crop is not a criterion or a measure of its maturity. The seasons of the year through which a crop passes during its stand, the particular order in which it faces them, and the duration of its stay in each one of them, appears to have a stronger bearing on its performance than merely its age. The performances of canes at some typical ages are considered below:

Cane crops 210—220 days old. At this age of 7 to 7½ months the crops are no where near maturity, irrespective of the time of planting. Among themselves the lower concentrations are generally indicated by all those crops which are analysed during rainy months. The general level of concentration is also low at this age, the brix values ranging from 12—16. The T/B ratios are also very low (0·73—0·90), indicating extreme states of immaturity.

Cane crops 235 – 245 days old. At Samalkot the crop planted in December and analysed in August is poorer by 5—6 units in concentration (brix: 14·4) than the crops planted in July and analysed in March (brix: 21·9), although both are of the same age. The latter however have only half the average weights of the former, the weights being 1 lb. and 1·9 lbs. respectively. The April planted and the December analysed crop also shows similar differences.

At Anakapalli, the crop analysed in April has a better average weight per cane than what was planted in November and analysed in July, the respective weights being 2·3 lbs. and 1·2 lbs. The compositions of juices in both cases are poor. But between the two the April analysed crop is comparatively much better both in purity and in concentration. (Purity: 79·43 & 73·34; and Brix: 16·1 &] 13·2 respectively.)

Again, at Aduturai, the July planted crop is at its best in March in respect of its composition, while the average weight of the cane is poor (Av. wt.: 0·90 lb. & Brix: 19·5; Purity: 88·0; & T/B: 0·97).

The crop planted in December and analysed in August has also a high brix (19·5) and high purity (88·0) but very low T/B ratio (0·90). The crops analysed in October and December also indicated immaturity.

Cane crops 250—265 days old. At this age of about 8½ to 9 months the differences in the performances of canes planted in the different months are more strikingly exhibited than at the younger ages. All those that are analysed in May, June and December show high purity (82—85) but have extremely low T/B ratios (0·83—0·88). As such they cannot be taken to be quite mature. Their concentrations are also generally poor. (Brix : 14—17).

Cane crops 276—285 days old. At Aduturai the crop planted in the middle of May is very ripe at this age as revealed by the analysis done towards the end of February (Brix : 20 ; Purity : 89·8 ; T/B : 1·03). At Anakapalli, the two crops, the one planted in October and analysed in July, and the other planted in July and analysed in April, exhibited marked differences. In the one case the composition was poor and the average weight of its cane is comparatively much higher, (Brix : 12·89 and Wt. : 1·70 lbs.), while in the other it is the reverse, (Brix : 21·3 and Wt. : 0·95 lbs.). At Samalkot the September planted and the June analysed crop, and the crop planted in June and analysed in March, exhibited similar differences. Differences of like nature are also to be seen among crops at Maruteru.

Cane crops (286—296) & (297—307) days old. When planted between March and May the cane appears to come to full maturity in about 9½ to 10 months. The poor analyses recorded are all for those crops which are planted in the months of August, October and December and analysed in August and October. Between the performances of canes in August and October at Aduturai and at the stations in the northern districts, there are wide differences, and these are in favour of Aduturai. It will be noted that between August and October, the conditions at Aduturai are comparatively more favourable for the cessation of growth and for leading the cane towards maturity. This point will be referred to again later.

Cane crops 360 days old and above. To take a typical example, the analysis of the crop planted at Anakapalli in September 1932, and analysed in October 1933 is very poor even after standing for 14 months (Brix : 13·2), while it has a very high average weight per cane (3·55 lb.) A crop of the same age but planted in the month of March and analysed in the month of April of the subsequent year stands in striking contrast. It has half the average weight of the first (1·53 lbs.) and nearly double its concentration, (Brix : 22·2).

All other data also show similar differences in their performances in spite of their advanced ages.

Thus the data discussed appear to point to the following :—

1. Mere age of the crop without reference to the time of its planting affords no indication of its maturity.

2. It is not only the age, but more potent than this in controlling the performance and the maturity of a cane, are the seasons of the

year through which the crop passes during its stand, the order in which it faces the several seasons, and the duration of its stay in each one of them.

3. Depending upon these differences, in crops of equal ages, either vegetative growth alone is promoted in some, or improvements in the concentration of the juice alone are caused in others. In properly timed plantings, normal development, both in vegetative growth and in concentration, takes place.

4. These observations lead to the necessity for a proper choice of the time of planting and of harvesting with reference to the seasons and the rainfall conditions which obtain in any given locality.

IV

Differential behaviours of canes planted in several months on any one station, and on different Stations. The detailed analytical data of the several plantings on the six stations are tabulated and appended, (Table 1). An examination of the data reveals that the crops planted in the several months, while exhibiting a similarity of behaviour in their general tendencies, showed among themselves marked differences in their performances. The differences in any one station are exhibited in a number of ways, viz., in the matter of the progress of (a) vegetative growth as shown by weight and height of cane, (b) concentration of juice as evidenced by brix value, and (c) quality of juice as indicated by the values for the purity, glucose, glucose ratio and T/B ratios. Again, the performances of canes planted in certain months on the stations at Aduturai and Palur on the one hand, and at Anakapalli, Samalkot and Maruteru on the other, differ markedly in important respects, consequent on the differences, as already noted, in the sequence and durations of the seasons and conditions obtaining on the two sets of stations.

a) *Vegetative growth:* At the stations in the Northern districts for example the following points are observable:—

1. With increase in age the average weight of cane is steadily increasing during the months after May upto October—November. In all the crops the weights do not indicate any considerable increases from November onwards to April—May, in spite of advancement in ages. These observations on the weights of canes comfirm those made earlier from a consideration of the growth curves that during June to October growth is promoted more, while it is arrested from about October to April—May.

Again, the crops planted from September to December of 1932 made a more rapid progress in growth during the South West monsoon period of 1933 than those planted in the months from January to July of 1933, during the same period. Even among the latter plantings themselves, the growth was somewhat progressively diminishing, the growth put on by the July planted crop being the least.

Obviously, the rate at which the vegetative progress is made, even during periods when conditions most favourable for it are prevailing, depends upon the prior preparedness of the crop by way of previous establishment to take advantage of these conditions.

b) *The progress of concentration of juice*: In all the crops tendency is noticeable that the concentration is moving towards a maximum by the month of April. Even much earlier than April, the crops planted from January to April of 1933 attained a fairly high level of concentration late in January of 1934. Not only this, they further continued to improve both in magnitude of concentration and in the quality of the juice.

The May and the June planted crops showed higher levels of concentration in February and March. Judged by their performances in February, it would look as though that they would have also fared well in January, like the previous ones, at ages of 8 to 8½ months.

The July planted crop was good and in fact was at its best in composition in April at an age of about 9½ months. Like the May and the June crops, it might also be expected to show a fairly high degree of concentration a fortnight or two earlier at an age of about 8 to 8½ months, in March.

Although its composition taken by itself is very good, it differs from those which preceded it in that it has very low weight and very low T/B ratio, indicating that if this cane is crushed even in the month of April, the yield of cane would be less, and that the top half of even this small cane would be very immature, and so would adversely affect the quality of the composite juice.

The September and the October planted crops also tended to show a maximum brix by about April—May at ages of about 8—8½ months, as was already noted. But the performances of these crops differed from those of the plantings made from January to June in the following respects:—

(i) The magnitude of the maximum itself is less,

(ii) The quality of the juice is poor, and

(iii) Even this maximum value did not remain at that level for long. It quickly fell hardly standing even for more than a month, whereas in the rest considered so far, a high brix value was not only attained early in the season, but they also went on improving further for more than 2½ to 3 months, the period decreasing in all the later plantings.

Thus the September and the October plantings could not show at the ages of about 8 to 8½ months what the crops planted from May to July could show at similar ages far as the quality of the juice is concerned, these crops showed more pronouncedly what the July planted crops tended to indicate in the month of April.

The November and the December planted crops were too young to show even this tendency in the crushing season immediately following their planting. These considerations show that while the influence of the season in controlling the juice concentration is fully exhibited as revealed by the brix values, yet it appears essential, as evidenced by the data here considered, that the crop has to put on certain minimum amount of vegetative growth to be able to take full advantage of the favourable conditions of the season, and that this minimum is attained only by the crops planted from January to June. The rest of the plantings are defective either in weight, or in concentration, or in quality of juice, or in all these respects, in the milling season immediately following their planting.

Again, comparing the behaviours of the November and the December planted crops, it will be seen that in the month of December of the subsequent year, at ages of about 13 to 14 months, they exhibited a fairly high level of concentration. The quality of the juice and the T/B ratios were good. Further, they possessed the additional advantage of a good average weight for cane. Now, December is the earliest part of the period favourable for improvements in concentration to take place. How the September and the October planted crops would have also fared, had they also been allowed to remain till December of the subsequent year, it would have been interesting to follow, but no analysis was however made. From the foregoing considerations, it would appear that those canes, which are vegetatively fully prepared, by the time the seasonal conditions favouring concentration of juice occur, are the first to take advantage of these conditions. It would also become evident that the mere attainment of a high degree of concentration does not always connote an equally high degree of quality in the juice. The improvements in quality follow the improvements in concentration, as indicated by the brix values.

Again, comparing the performances of canes on the three stations in the Northern districts, representing one tract of the presidency, one sees that while at Samalkot and Maruteru the several crops behaved almost similarly as they did at Anakapalli, the crops on these two stations, were comparatively much better throughout both in weight and in concentration and quality of juice. These differences in all corresponding crops are probably attributable to the differences in the local conditions of soil.

Comparative study of the several plantings made in the northern and southern districts. The general behaviours of the plantings made from January to May and also partly in June on all the six stations are very similar.

2. The plantings made in other months, especially in months from September to December showed marked differences probably

consequent upon the differences in the conditions obtaining on the two sets of stations.

3. The average weights for individual canes at Aduturai and Palur are very low. Between these two stations in the south, those at Palur are higher. The weights of canes for corresponding crops grown at Anakapalli, Samalkot and Maruteru, are very high. For example the weights of canes grown at Anakapalli varied from 2·0 to 3·0 lbs, while those raised at Aduturai ranged from 0·34 to 0·62 lb.

4. So far as the cencentrations of the juices are concerned, even by the month of August all the plantings made from September to December indicated at Aduturai considerably higher values. At this place, at ages of 11, 10, 9, and 8 months they showed the following ranges of values: brix: 17·3 to 19·6; purity: 84 to 89; T/B raio: 0·88 to 0·91. These latter values however indicate immaturity, In the crops at Palur, the purity values ranged round about 81, and the T/B ratios varied from 0·95 to 1·0.

At Anakapalli and Samalkot on the other hand the positions were the reverse. The concentrations were considerably lower in the month of August, the brix values for all the crops at Anakapalli being below 15, and the values for purity being between 70 and 80. The T/B ratios also were low. At Samalkot too, similar low values were noticeable. (Brix: 14–16: Purity 67–78; T/B: 0·78–0·82).

5. While at Aduturai and Palur between the analyses in June at the age of 9, 8, 7, and 6 months and again in August at ages of 11, 10, 9 and 8 months there were invariably observable improvements in concentration by big jumps, by about 4–5 units at Aduturai, and by 3—4 units at Palur, it will be seen that at Anakapalli and Samalkot there is particularly no improvements in concentration taking place during this period. Similar improvements in big strides however are noticeable at these latter stations during periods after August onwards as already mentioned.

6. Between June and August at Aduturai and Palur, the glucose ratios fell considerably lower, indicating a better improvement in quality of juice, while at Anakapalli and Samalkot, they were throughout comparatively very high. In the first two stations the values fell from (0·98—2·0) in June to (0·1 – 0·4) in August, indicating improvements in quality. At Anakapalli and Samalkot, these values were throughout very near 1·0 and of the two stations, they are more conspicuously so at Anakapalli.

7. Again, between the June and the July planted crops at the two groups of stations, similar differences are noticeable. The values for glucose contents of juices at Aduturai for these crops during the

months of February, March and April, are considerably lower, being less than a third of those for the corresponding crops at Anakapalli.

8. Again, for the July planted crop, T/B ratios are very low at Anakapalli indicating immaturity during months when these crops at Aduturai were showing high values, very near unity, indicating maturity.

All these differences in the behaviours of corresponding crops on the two sets of stations are easily explainable on the basis of the difference obtaining in the seasonal and the rainfall conditions on these stations, which were considered in an earlier section.

VI

Thus far, the differential behaviours of the canes as influenced by the seasonal conditions on the several stations were considered and their similarities compared. It will be seen however that there occur occasionally certain apparent contradictions to the general observations made in respect of the variations in the concentrations, It may be noted that such exceptions occur only during periods of transition from season to season. This is owing more to the inertia in their readiness or capacity to adjust and respond to the changing conditions. The degree of the inertia exhibited varies with variety, e.g., of the two varieties Co. 351 and Co. 352, representing respectively the early and the late types, Co. 351 responds more quickly, while the other exhibits greater inertia. These and other similar differences in the behaviours of the same variety, and of different varieties, will be considered in a separate communication. It is enough for the present to say, that any contradictions or exceptions noted are only apparent, are but particular cases of a general phenomenon which has been considered in this paper in its broad outline.

Summary and conclusions: 1. The performances of a number of sugarcane varieties planted during 11 months of the year from September 1932 to July 1933 at six stations in the presidency, were followed, at several stages of their growths and the general tendencies revealing the integrated influence of the seasons on their performances were discussed choosing Co. 352 as a type.

2. Rainfall and seasonal conditions in the different localities are studied, and correlated with the differential behaviours of the canes in the several localities.

The research stations in the Madras Presidency appear to be classifiable as (i) the Circars group, and (ii) the Southern group, according to the prevalent climatological conditions. The Circars group appears to enjoy a sequence of climatic factors more favourable for the growth of cane than the southern group. Canes planted in certain months at

the two different groups of stations therefore exhibited differences in their behaviour. In tracts which Aduturai and Palur represent, it looks as though that the period from August to October is useful additionally for harvesting purposes.

3. From this study it would appear that sugarcane has four major phases in its life cycle: (a) establishment, (b) growth, (c) elaboration and accumulation of the necessary raw materials and (d) final ripening or maturity. There are a set of seasonal conditions specifically favourable for each of these phases in the development of cane. The conditions occur in different months of the year in different localities.

There are no clear cut lines of demarcation between these several phases of activity or between the times when these conditions favourable for these activities occur. They in fact overlap. All the processes take place simultaneously at any given time, but only at varying rates: the process most favoured by the particular seasonal conditions takes place at the greatest speed and the rest only more slowly at that time. The performance of a cane crop at a given instant is thus the resultant of the effects of the several conditions operating on it at that instant.

For any cane crop to come up normally and yield good results, the time of planting must be so chosen with reference to the sequence of the seasonal conditions in any given locality, that the crop is enabled to pass through the several phases in its life cycle in the order indicated, and stay for sufficient time in each one of the seasons favourable for these phases of activity.

Any deviation in this order, or any undue shortage of stay in any of these seasons, imposes a handicap on the crop to the extent of such deviation or shortage of stay. These deviations affect either the vegetative development, or the concentration, or the quality of the juice, or all these.

4. A minimum of prior vegetative growth appears to be an essential condition for the crop to take advange of the seasonal conditions favourable for either good vegetative growth or for improvements in concentration.

5. The concentration of juice tends towards a minimum when the vegetative growth tends towards a maximum. The concentration tends to improve in rapid strides to attain a maximum, when the growth tends to stop.

6. The age of the crop is by itself no criterion of its maturity as is ordinarily believed, for the reason that the sequence of the seasons during which its life cycle is spent, has more effect on its growth, devevlopment and ripening, than age.

7. The concentration as expressed by brix values does not always appear to indicate the quality of juice. Improvements in quality follow improvements in concentration.

8. A cane crop can be allowed to stand for a period of about three months after maturity without deterioration setting in, but the period is shortened with the incidence of hot dry weather.

Plantings made very late attain high concentration only very late in the season favourable for the process. Further, they also quickly fall off.

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References.

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Table I.

Age of crop at time of analysis. days.	Date of analysis.	Average weight of single cane. lbs.	Brix %	Sucrose %	Glucose %	Purity %	Glucose ratio.	Top/Bottom ratio.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
			Anakapalli. Co. 351. (Field No. 2).					
			September 1932 planted crop.					
161	10—2—33	0·87	14·37	9·88	1·75	68·77	17·69	0·69
210	31—3—33	1·33	15·38	12·54	0 91	81·55	7 22	0 82
240	30—4—33	1·45	17·07	14·71	1·50	86·20	10·16	0·83
253	13—5—33	2·05	16 54	13·92	1·34	84·14	9·65	0·87
309	8—7—33	2·12	13·90	11·12	1·70	80·00	15 29	0 90
397	4—10—33	2·85	16·10	12·64	1·35	78 52	10·68	1·00
			October 1932.					
181	31—3—33	0·82	10·55	7·28	1·99	69·0	27·34	0·60
211	30—4—33	1·28	14·27	10·57	2·54	74·1	21·02	0·75
280	8—7—33	1·64	13·60	10·66	1·70	78·4	15·95	0·83
368	4—10—33	2 55	16·57	13·48	1 16	81·4	8 61	0 94
			November 1932.					
245	8—7—33	0 86	13·2	9 67	2·22	73 24	22 94	0·97
333	4—10—33	1 59	16·77	13 47	1·32	80 30	9 80	0 87
388	28—11—33	1·60	19·68	18·26	0 61	92 76	3 34	1·00
			December 1932.					
219	8—7—33	0·76	11·18	6 53	2·48	58·42	35·80	0·79
307	4—10—63	1·43	16 27	12 64	1·61	77·71	12·74	0·85
361	27—11—33	1·60	19 31	17·87	0·86	92 53	4·81	1·02
390	26—12—33	1·60	20·24	18·52	0·29	91·52	1·56	1·03
			Anakapalli. Co. 352. (Field No. 2).					
			September 1932.					
161	10—2—33	1 02	13·37	8·68	0·91	64·90	10 53	0·79
210	31—3—33	1·88	15·68	12·52	1·13	79·85	8.91	0 80
240	30—4—33	2 30	16·09	12·75	1·55	79·43	12·16	0·79
253	13—5—33	2·43	15·74	13·47	0 92	85·59	6 86	0·84
309	8—7—33	3 10	13·50	10·90	1 42	80·74	13 00	0·96
397	4—10—33	3·55	13·18	9·04	1·79	70·24	19·81	1·14
			October 1932					
181	31—3—33	1·05	12·25	7·71	1·32	63·00	17 08	0·71
211	30—4—33	1·63	14·97	10 85	1·54	72·20	23 35	0 78
280	8—7—33	1·74	12·80	10 03	2·22	78·30	22·12	0·86
368	4—10—33	3·23	13·52	9·24	1·16	64·40	12·55	0·93
			November 1932.					
245	8—7—33	1·15	13·20	9·67	2·68	73·30	27·76	0·80
333	4—10—33	2·00	14·12	10·07	1·35	71·30	13·40	0·90
388	28—11—33	2 00	15·56	13·99	0 98	89·93	7·02	1·02
			December 1932.					
219	8—7—33	1·10	12·80	9·18	2·22	71·71	24·16	0·95
307	4—10—33	1·86	14·37	11·17	1·25	77·71	11·19	0·89
361	27—11—33	2 20	16 49	15·40	0·61	93·40	3·96	1·04
390	26—12—33	2·20	8·81	16·94	0·39	90·07	2·29	0·98

TABLE I (*Continued*).

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
			Anakapalli. Co. 352. (Field No. 2-A).					
			January 1933.					
328	27--11--33	1·0	16·36	14·67	0·73	89·7	4 97	0·99
357	26—12—33	1·3	17·61	15 80	0·45	89·7	2·81	1·03
381	26—1—34	1·35	19·34	17·67	0·29	91·4	1·64	1·02
			February 1933.					
299	27—11—33	1·50	16·49	15·16	0 85	91·9	5·62	1·02
328	27—12—33	1·40	17·24	15 10	0·75	87·6	4·99	1·05
353	20—1—34	1·60	19 84	18 11	0·30	91·3	1·65	1·05
384	20 –2—34	1·52	20·55	17 94	0 50	87 3	2·80	1·07
			March 1933.					
2 3	29—11—33	1·50	15·83	13·73	1·00	86·7	7·29	0 97
301	27—12—33	1·38	17·64	15·34	0·68	87·0	4·43	1·03
326	21--1—34	1·56	18·94	17·36	0 53	91·6	3·11	1·04
356	20—2—34	1·36	19 55	17·10	0 77	87·48	4·52	1·05
404	9—4—34	1·53	22·19	19·93	0 45	90·10	2 26	1·08
			April 1933.					
271	28—12—33	1 34	17·31	14 66	1·09	84·70	7 42	1·01
295	21—1--34	1·02	18·04	15·53	0·83	86·10	5·36	1·05
326	1--2—34	1·67	20·58	18·52	0·41	89 99	2 21	1·09
374	9--4—34	1·54	21 07	19·01	0·69	90·20	3·63	1·05
			May 1933.					
264	2?—1—34	1·34	19·04	16·91	0 48	88·8	2·86	1·02
294	21 –2—34	1·47	20·58	18·38	0·46	89·32	2·51	1 04
342	10—4—34	1·45	21·17	19·01	0·63	89·80	3 33	1·09
396	3—6—34	...	19·52	15·97	0·95	81·85	5 92	1·04
			June 1933.					
266	22—2—34	1·2)	20 42	17·93	0·74	88·08	4·15	1·01
313	10—4—34	1·34	22·17	19·84	0·47	89 54	2 39	1·05
367	3—6—34	...	21·03	19·00	0·53	90 36	2·80	0·99
			July 1933.					
284	11—4—34	0·95	21·32	19 22	0·39	90·24	2·05	0 88
338	4—6—36	...	17·94	15·59	0·62	87·08	3·97	0 89
			Samalkot. Co. 351.					
			September 1932.					
286	22—6—33	1·55	19 90	16·91	0·76	84·90	4 47	0·90
332	7—8—33	1·65	21·07	18·05	0·23	8 69	1 28	0·99
392	6—10—33	2·08	19·63	16·75	0 56	85·31	3·34	0 96
			October 19 2.					
253	23--6—33	0·80	15·98	12·77	1·45	79·91	11·39	0·82
299	8—8—33	1·35	16·63	13 01	1·00	78·21	7·68	0 8?
359	7—10—33	1·78	20·79	17·70	0 63	85·13	3·56	0 96
			November 1932.					
221	23—6--33	0·70	15·16	11·33	2 52	74·73	22·7	0 77
268	8—8—33	1·18	16 13	11·76	1 43	72·93	12·15	0·81
329	9—10—33	...	2) 87	17·17	0·61	82·24	3 55	0·92
			December 1932.					
197	24—6—33	0·83	15·16	11 34	1·41	76·12	12·26	0·84
242	7--8—33	1·70	14 12	9 49	1 19	67 70	12·54	0·78
306	10—10--33	2·08	17·88	13·10	1·02	73·26	7 79	0 91

TABLE I (*Continued*).

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
			Samalkot. Co. 352.					
			September 1932.					
286	22—6—33	2·78	17·4	14·64	0·68	84·16	4·65	0·84
332	7—8—33	2·75	19·37	15·39	0·45	79·43	2·92	0 95
392	6—10—33	3·15	17·01	14 07	0·31	82·71	2·20	1·05
			October 1932.					
253	23—6—33	1·13	14·16	11 97	1·86	84·55	15·53	0 83
299	8—8—33	1·78	16·63	12·96	0·96	77·94	7·41	0·83
359	7—10—33	2·03	20·79	17·70	0·25	85·13	1·41	0·92
			November 1932.					
221	23—6—33	0·95	13·95	10·69	1·93	77·34	18·10	0 83
268	8—8—33	1·60	15·13	10·83	1·25	71·58	11·54	0·76
329	9—10—33	...	18·67	15·48	0·60	82·92	3 88	0·89
			December 1932.					
197	24—6—33	1·3	12·84	8·76	1·95	68 22	22·21	0·87
242	7—8—33	1·9	14·42	11·34	0·86	77·56	7·59	0 83
306	10—10—33	2·3	16·18	12·40	0·67	76·65	5·40	1 13
			January 1933.					
273	11—10—33	1·98	15·20	11·61	1·14	76·4	9·8	0·90
334	11—12—33	2·47	19·28	16·91	0·42	87·7	2·5	0·98
			February 1933.					
309	12—12—33	2·45	17·88	15·07	0·71	84·3	0·71	1·00
353	25—1—34	2·45	21·01	19·44	Trace	92·5	...	1 05
			March 1933.					
278	13—12—33	2·77	16·88	13·66	0 92	80·9	6·7	1·08
322	26—1—34	2·90	20·01	17·83	0·33	89·1	1·8	1·01
			April 1933.					
246	14—12—33	2·00	16·37	13·69	1·12	83·6	8·2	0·99
290	27—1—34	2·17	19 51	17·49	0·33	89·6	1·9	1·08
337	15—3—34	2·32	23·12	20·67	0.14	89·4	0·69	1 03
			May 1933.					
261	29—1—34	1·65	19·25	16·94	0·33	88·0	2·0	1·00
303	13—3—34	2·00	20·65	18·76	0·27	90·8	1·4	1·02
			June 1933.					
285	13—3—34	1·32	21·35	19·16	0·20	89·73	1·07	0·87
			July 1933.					
242	14—3—34	0·97	21·92	19·64	0·17	89·58	0·85	0·96
			Maruteru. Co. 352. (Field No. A. I. A.)					
			August 1932.					
147	21—1—33	0·80	18·59	14·81	0·92	79 68	6·20	1·02
179	17—2—33	1·05	19·04	16·70	0·71	87·70	4·23	0·87
313	28—6—33	2·00	13·48	9·92	1·47	73·58	14·81	0·86
420	12—10—33	3·00	18·08	15·57	0·42	86·16	2·69	1·05
			September 1932.					
281	28—6—33	2·08	13·85	9·90	1·24	71·5	12·60	0·84
389	13—10—33	3·88	18·10	16·44	0·30	90·5	1·8	0·99
			June 1932. *(Dry). (Field F. 1. B.)*					
212	20—1—33	1·83	16·57	12·48	2·77	75·32	22·22	0·91
237	17—2—33	2·35	19·55	16·33	1·37	83·54	8·38	0·95

TABLE I (*Continued*).

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	
			June 1932. (Wet). Field K. 4 A.						
220	20···1...33	1·67	20·57	18·52	0·15	89 95	0·82	1·05	
247	19···2...33	2·08	21·35	19 66	0·27	92·08	1·38	1·02	
			January 1933.						
334	20 12...33	2·2	18·65	15·63	0·23	83·79	1 49	0·97	
355	12···1...34	1·8	19·64	17·54	0·21	89·30	1·20	1·02	
			February 1933.						
304	21···12···33	2·0	17 4	14·85	0·30	85·37	2·04	0·94	
322	8···1···34	2·4	18 04	15·56	0·31	86·26	2·00	0·97	
			March 19·3.						
279	23···12···33	2·7	17·91	15·41	0 22	86·04	1 44	1·02	
296	10···1···34	2 3	19 12	16·70	0·31	87·36	1·86	1·04	
364	19···3···34	2·3	19·74	16·98	0·18	86·08	1·08	1·05	
			April 1933.						
274	11...1...34	1·6	18 71	16·01	0·29	85·59	1·80	1·04	
340	18...3...34	2·3	20·54	17·85	0·15	86·96	0·81	1·02	
			April 1933 (Swampy).						
257	6...1...34	1·2	13·85	11·11	0·71	80·21	6·39	0 92	
			May 1933.						
245	11...1...34	1·6	19·01	16·72	0·58	87·94	3·48	1·00	
309	15...3...34	1·8	22·84	20·32	0·23	88·98	1·13	1·00	
			June 1933. (Wet).						
218	9...1...34	1·5	17·43	14·63	0·74	83·97	5·08	0·96	
285	17...3...34	1·3	19 46	16·95	0·25	87 12	1·48	1·05	
			June 1933. (Dry).						
221	10--1...34	2·7	16·18	13·24	1·03	81·85	8·00	1·03	
286	16...3...34	2·1	19·81	17·54	0·36	88·50	2·04	1 06	
			Coimbatore. Co. 352.						
			March 1933.						
265	15...12...33	2·10	16·77	13·80	1·23	82·30	8·97	0 94	J. B.
345	23...2...34	2·35	20·12	18·01	0·31	89·52	1·70	1 04	
275	14...12...33	1·65	20·54	18·09	0·10	88·06	0·54	0·96	M B.
274	13...12...33	2·10	19·24	16·65	0·39	86·54	2·32	0·88	
356	6...3...34	2·64	20·39	18·40	0·23	88·96	1·26	0·87	
			April 1933.						
245	15...12...33	1·95	19·20	16·83	0·66	87·64	3·94	0·88	
321	8...3...34	2·19	22·43	20·60	Trace.	91·85	...	0·94	
			May 1933.						
207	15...12...33	1·33	16·69	13·87	1·02	83·05	7·35	...	
292	9...3...34	2 00	20·49	17·55	0·15	85·65	0·88	...	
			June 1933.						
262	10...3...34	1·61	20·89	19·13	0·20	91·56	1·02	0·91	
			July 1933.						
234	12...3...34	1·10	18·51	15·99	0·46	86·4	2·90	0·87	
			August 1933.						
204	13...3...34	0·85	16·75	14·04	0 67	83·81	4·76	0·74	

TABLE I (*Continued*).

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
			Co. 352. Aduthurai.					
			September 1932.					
271	14—6—33	0·69	11·8	7·5	2·1	63·6	27·70	0·77
334	16—8—33	1·50	17·3	14·7	0·4	84·7	2·73	0·88
			October 1932.					
243	15—6—33	0·62	15·3	11·8	1·00	77·4	8·47	0·80
305	16—8—33	0·58	19·6	17·4	0·12	89·0	0·70	0·91
			November 1932.					
212	16—6—33	0·44	14·9	11·3	0·98	75·9		0·79
274	17—8—33	0·34	18·1	15·6	0·15	86·1		0·88
329	12—10—33	0·48	18·9	16·9	0·08	89·5		0·90
			December 1932.					
244	17—8—33	0·62	19·5	17·2	...	88·3		0·90
299	12—10—33	0·62	19·0	16·9	0·09	88·8		0·89
360	11—12—33	0·61	16·8	12·1	1·95	71·9		0 83
			January 1933.					
268	12—10—33	1·12	18·9	16·2	0·24	85·8		0·84
330	11—12—33	0·81	19·4	16·5	0·12	84 9		0·97
			February 1933 .					
237	13—10—33	1·62	19·1	16·6	0·31	86·9		0·87
299	12—12—33	1·36	21·1	19·4	0·08	91·6		0·95
			March 1933.					
209	13—10—33	1·43	16·8	14·4	0·41	85·5		0 84
269	12—12—33	1·13	20·3	18·0	0·13	88·6		0·98
344	...		No material for analysis.					
			April 1933.					
239	13—12—33	2·21	20·3	17·8	0·21	87·84		0·93
311	25—2—34	1·81	19·4	17 2	0·18	88·9		1·00
333	17—3—34	2·37	18·2	16·3	0·16	89·4		1·04
			May 1933.					
210	13—12—33	1·87	18·6	15·6	0·58	84·2		0·93
283	25—2—34	1·36	20·4	18·3	0·20	89·9		1·03
305	17—3—34	1·86	19·7	17·6	0 15	89·5		1·11
			June 1933.					
252	26—2—34	1·53	19·6	17·4	0·18	88·8	1·00	1·00
274	18—3—34	1·49	20·1	17·9	0·11	89·2	0·61	1 03
			July 1933.					
222	26—2—34	1·18	20·2	18·1	0·27	89·6	1·50	0·97
245	19 —3—34	0·88	19·3	16·9	0·22	88·0	1·31	0·97
			Co. 351. Palur.					
			September 1932.					
242	15...5.. 33	0·97	12·3	8·6	2·5	70·0		0·85
277	19...6...33	1·65	14·2	10·7	2·4	75·4		0·91
331	12...8...33	2·15	16·4	13·4	1·1	81·7		0·96
			October 1932.					
246	20...6...33	0·80	11·6	7·6	2·8	64·6		0·89
300	13...8...33	1·25	15·3	11·7	2·2	76·5		0·96

TABLE I (*Continued*).

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
			November 1932.					
215	21—6—33	0·79	11·9	7·2	3.3	60·5		0·89
269	13—8—33	1·59	17·0	13·8	1·5	81·3		1·00
325	9—10—33	1·55	17·5	14·8	1·2	84·9		0·94
			December 1932.					
242	14—8—33	1·25	16·4	13·4	1·4	81·4		0·95
299	10—10—33	1·13	16·8	13·7	0·9	81·9		0·96
			Co. 352. Palur.					
			September 1932.					
242	15—5—33	1·37	11·2	7·7	3·1	68·5		0·93
277	19—6—33	2·00	12·6	9·0	2·3	71·7		0·95
331	12—8—33	2·05	14·7	12·0	1·3	81·7		1·00
			October 1932.					
246	20—6—33	1·20	10·8	6·8	3·1	63·0		0·93
300	13—8—33	1·93	14·8	11·4	1·6	77·2		0·95
			November 1932.					
215	21—6—33	0·91	11·9	7·5	2·9	62·8		0·93
269	13—8—33	1·20	15·8	12·7	1·6	80·5		0·92
329	9—10—33	1·60	16·2	13·5	0 9	83·7		0·92
			December 1932.					
242	14—8—33	1·20	14·5	11·0	1·7	75·6		1·00
298	9—10—33	1·18	17·0	14·4	0·5	84·8		0·98
			January 1933.					
210	14—8—33	1·24	16·27	13·2	1·1	81·1		0·92
266	10—10—33	1·60	17·36	15·1	0·5	85·7		0·99
365	17—1—34	1·65	15·41	13·0	0·5	84·3		0·95
			February 1933.					
236	10—10—33	1·50	16·51	13·9	1·1	84·2	7·98	0·84
337	18—1—34	1·73	17·6	16·0	0·4	90·7	2·25	1·00
363	14—2—34	1·60	17·1	15·3	0·4	89·5	2·65	1·06
			March 1933.					
208	10—10—33	1·48	14·0	10·4	1·7	74·6	16·57	0·81
306	18—1—34	1·48	16·8	14·7	0·8	87·5	5·34	0·97
336	15—2—34	1·33	16·2	14·2	0·8	87·7	5·50	1 03
			April 1933.					
277	19—1—34	1·45	15·1	12·5	1·6	82·9	12·55	0·94
304	15—2—34	2·15	15·2	12·7	1·2	83·4	9·51	0·97
333	12—3—34	1·68	16·7	14·2	1·1	85·2	8·02	0 98
			May 1933.					
247	19—1—34	1·73	14·3	11·6	2·4	81·3	20·45	0·96
274	16—2—34	1·53	14·8	11·8	1·7	79·8	14·24	1·06
303	12—3—34	1·05	17·7	15·3	0·9	86·5	5·86	0·98
			June 1933.					
215	19—1—34	1·15	12·7	9·4	2·4	74·4	25·2	0·90
243	16—2—34	0·78	16·4	14·0	1·0	85·3	6·9	1·01
274	13—3—34	1·30	17·6	15·0	1·0	84·8	6·8	1·02
343	26—5—34	1·05	15·3	12·2	1·35	80·2	11·0	0·92
			July 1933.					
244	13—3—34	0·75	19·3	17·1	0·4	88·6	2·5	1·01
312	26—5—34	0·98	15·0	12·7	1·0	84·7	8·1	0·87

Table II.

Comparative studies of crops of approximately equal ages irrespective of the time of planting.

Co. 352.

Station.	Date of planting.	Date of analysis.	Weight of a cane in lbs.	Brix.	Coefficient of purity.	Top/Bottom ratio.
(1)	(2)	(3)	(4)	(5)	(6)	(7)
		(210–220 days old).				
Anakapalle	2...9...32	31—3—33	1·9	15·7	79·7	0·80
	1—10—32	30—4—33	1·6	15 0	72·2	0·78
	1—12—32	8—7—33	1·1	12·8	71·7	0 95
Palur	18—11—32	21—6—43	0·9	11·9	62·8	0·93
	17—1—33	14—8—33	1·2	16·3	81·1	0·92
	16—3—33	10—10—33	1·5	14·0	74·6	0·81
	17—6—33	19—1—34	1·2	12·7	74·4	0·90
Aduturai	16—11—32	16—6—33	0·4	14·9	75 9	0·79
	17—3...33	13—10—33	1·4	16·8	85·5	0·84
	17—5—33	13—12—33	1·9	18 6	84·2	0·73
	18—7—33	26—2—34	1·2	20·2	89·6	0·97
Coimbatore	22—5—33	15—12—33	1·3	16·7	83·1	0·87
	22—8—33	13—3—34	0·9	16 8	83·8	0·74
Samalkot	14—11—32	23—6—33	1·0	14·0	77·3	0·83
		(235–245 days old).				
Anakapalle	2—9—32	30 - 4 - 33	2·30	16·1	79·43	0·79
	5—11—32	8 - 7 - 33	1·20	13·2	73·30	0·80
Palur	15—9—32	15 - 5 - 33	1·37	11·2	68·5	0·93
	17—10—32	20 - 6 - 33	0·80	11·6	64·6	0·89
	15—12—32	14 - 8 - 33	1·20	14·5	75·6	1·00
	16—2—33	10 - 10 - 33	1·50	16·5	84·2	0 84
	17—5—33	19 - 1 - 34	1 73	14·3	81·3	0·96
	17—6—33	16 - 2 - 34	0 78	16·4	85·3	1·01
	17—7—33	13 - 3 - 34	0·78	19 3	88·6	1·01
Aduturai	15—10—32	15 - 6 - 33	0·60	15·3	77·4	0 80
	16—12—32	17 - 8 - 33	0 60	19·5	88 3	0·90
	17—2—33	13 - 10 - 33	1·60	19·1	86·9	0·87
	17—4—33	13 - 12 - 33	2·20	20·3	87·8	0·93
	18—7—33	19 - 3 - 34	0·90	19·3	88·0	0·97
Coimbatore	14—4—33	15 - 12 - 33	2·00	19 2	87·6	0·88
	22 - 7 - 33	12 - 3 - 33	1·10	18·5	86·4	0·87
Samalkot	8 - 12 - 32	7 - 8 - 33	1·90	14·4	77·6	0·83
	12 - 4 - 33	12 - 12 - 33	2·00	16·4	83·6	0·99
	16 - 7 - 33	14 - 3 - 34	1·00	21·9	89·6	0·96
Maruteru	10 - 5 - 33	11 - 1 - 34	1·60	19·0	87·9	1·00
		(250–265 days old).				
Anakapalle	2 - 9 - 32	13 - 5 - 33	2·40	15·7	85·6	0·84
	1 - 5 - 33	22 - 1 - 34	1·30	19·0	88·8	1·02
Aduturai	18 - 6 - 33	26 - 2 - 34	1·50	19·6	88·8	1·06
Coimbatore	15 - 3 - 33	5 - 12 - 33	1·40	17·0	82·3	0·83
	22 - 6 - 33	10 - 3 - 34	1·60	20 9	91·6	0 91
Samalkot	12 - 10 - 32	23 - 6 - 33	1·10	14·2	84·6	0·83
	5 - 33	29 - 1 - 34	1·70	19·3	88·0	1·00
		(266–275 days old).				
Anakapalle	1 - 3 - 33	29 - 11 - 33	1·50	15·80	86·7	0·97
	1 - 4 - 33	28 - 12 - 33	1·30	14·70	84·7	1·01

TABLE II (*Continued*).

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Palur	15—9—32	19—6—33	2·00	12·56	71·7	0·95
	18—11—32	13—8—33	1·20	15·80	80·5	0·92
	17—3—33	10—10—33	1·60	17·60	85·7	0·99
	17—5—33	16—2—34	1·53	14·80	79·8	1·06
	17—6—33	13—3—84	1·30	17·60	84·8	1·02
Aduturai	16—9—32	14—6—33	0·70	11·80	63·6	0·77
	17—1—33	12—10—33	1·10	18·90	85·8	0·84
	17—3—33	12—12—33	1·10	20·3	88·6	0·98
	18—6—33	18—3—34	1·49	20·1	89·2	1·03
Coimbatore	15—3—33	14—12—33	1·70	19·7	88·3	0·87
Samalkot	14—11—33	8—8—33	1·60	15·1	71·6	0·76
	11—1—33	11—10—33	1·98	15·2	76·4	0·91
	10—3—33	13—12—33	2·80	16·9	80·9	1·08
Maruteru	12—4—33	11—1—34	1·60	18·7	85·6	1·04
		(*276–285 days old*).				
Anakapalle	1—10—32	8—7—83	1·70	12·80	78·3	0·86
	1—7—33	11—4—34	0·95	21·30	90·2	0·88
Palur	15—9—32	19—6—33	2·00	12·60	71·7	0·95
	17—4—33	19—1—34	1·50	15·10	82·9	0·94
Aduturai	17—5—33	25—2—34	1·40	20·40	89·9	1·03
Samalkot	9—9—32	22—6—33	2·78	17·40	84·2	0·84
	10—3—33	13—12—33	2·77	16·90	80·9	1·08
	18—6—33	13—3—34	1·32	21·40	89·7	0·87
Maruteru	20—9—32	28—6—33	2·08	13·85	71·5	0·84
	20—3—33	23—12—33	2·70	17·90	86·0	1·02
(wet)	5—6—33	17—3—34	1·30	19·50	87·1	1·05
(dry)	3—6—33	16—3—34	2·10	19 8	88 6	1·06
		(*286–296 days old*).				
Anakapalle	1 - 4 - 33	21 - 1 - 34	1·02	18·0	86·1	1·05
	1 - 5 - 33	21 - 2 - 34	1·47	20·6	89·3	1·04
Coimbatore	22 - 5 - 34	9 - 3 - 34	2·00	25·5	85·7	0·93
Samalkot	12 - 4 - 33	27 - 1 - 34	2·17	19·51	89·60	1·08
Maruteru	20 - 3 - 33	10 - 1 - 34	2·30	19·12	87·40	1·04
		(*297–307 days old*).				
Anakapalle	1 - 12 - 32	4 - 10 - 33	1·90	14·4	77·7	0·89
	2 - 2 - 33	28 - 11 - 33	1 50	16·5	91·9	1·02
	1 - 3 - 33	27 - 12 - 33	1 38	17·6	87·0	1·03
	1 - 4 - 33	21 - 1 - 34	1·02	18 0	86·1	1·05
	1 - 5 - 33	21 - 2 - 34	1·47	20·6	89·3	1·04
Samalkot	13 - 10 - 32	8 - 8 - 33	1·78	16·60	77·90	0·83
	8 - 12 - 32	10 - 10 - 33	2·30	16·20	76·70	1·13
	6 - 2 - 33	12 - 12 - 33	2·50	17·90	84·30	1·00
	12 - 4 - 33	27 - 1 - 34	2·50	19 20	84·00	1·08
	- 5 - 33	13 - 3 - 34	2·00	20·70	90·80	1·02
Aduturai	15 - 10 - 32	10 - 8 - 33	0·60	19·60	89·00	0·91
	16 - 12 - 33	12 - 10 - 33	0·60	19·00	88·80	0 89
	17 - 2 - 33	12 - 12 - 33	1·00	21·10	91·60	0 95
	17 - 5 - 33	17 - 3 - 34	1·90	19·70	89·50	1·11
Palur	17 - 10 - 32	13 - 8 - 33	1·90	14 80	77·2	0·95
	15 - 12 - 32	9 - 10 - 33	1·20	17·00	84 8	0·98
	16 - 3 - 33	13 - 1 - 34	1·50	16 80	87·5	0·97
	17 - 1 - 33	15 - 2 - 34	2 20	15·20	83·4	0·97
	17 - 5 - 33	12 - 3 - 34	1·05	17·70	86·5	0·98

TABLE II (*Continued*).

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Maruteru	21—2—33	21—12—33	2·00	17·40	90·80	0·94
	20—3—33	10—1—34	2·30	19·10	85·37	1·04
	10—5—33	15—3—34	1·80	22·80	87·36	1·00
		(*308-318 days old*).				
Anakapalle	2—9—32	8—7—33	3·10	13·50	80·70	0·96
	1—6—33	10—4—34	1·30	22·2	89·50	1·05
Aduturai	17—4—33	25—2—34	1·80	19·40	88·92	1·00
Samalkot	6—2—33	12—12—33	2·50	17·90	84·30	1·00
Maruteru	10—5—33	15—3—34	1·80	22·80	89·00	1·00
	19—8—32	28—6—33	2·00	13·50	73·60	0·86
		(*319-330 days old*).				
Anakapalle	3—1—33	27—11—33	1·10	16·36	89·70	0·99
	2—2—33	27—12—33	1·40	17·24	87 60	1·05
	1—3—33	21—1—34	1·60	18·94	91·60	1·04
	1—4—33	21—2—34	1·70	20 58	90·00	1·09
Aduturai	16—11—32	12—10—33	0·50	18·94	89·50	0·90
	17—1—33	11—12—33	0·80	19·41	84·90	0·97
Samalkot	14—11—32	9—10—33	...	18·70	82·90	0·89
	10—3—33	26—1—34	2·90	20·00	89·10	1 01
Maruteru	21—1—33	8—1—34	2·40	18·00	86·30	0·97
Coimbatore	14—4—33	8—3—34	2·19	22·40	91·85	0·94
Palur	18—11—32	9—10—33	1·60	16·20	83·70	0·92
		(*331-340 days old*).				
Anakapalle	5—11—32	4—10—33	2·00	14·10	71·30	0·90
Samalkot	9—9—32	7—8—33	2 80	19·40	79·40	0·95
	11—1—33	11—12—33	2·50	19·30	87·70	0·98
	12—4—33	15—3—34	2·30	23·20	...	1 03
Maruteru	22—1—33	20—12—33	2·20	18·70	83·80	0·97
	12—4—33	18—3—34	2·30	20·50	87·00	1·02
Aduturai	16—9—32	16—8—33	1·50	17·30	84·70	0 88
	17—4—33	17—3—34	2·40	18·20	89·40	1·04
Palur	15 - 9 - 32	12 - 8 - 33	2·00	14·70	81·70	1·00
	16 - 2 - 33	18 - 1 - 34	1·70	17·60	90·70	1·00
	16 - 3 - 33	15 - 2 - 34	1·30	16·20	87 70	1·03
		(*341-350 days old*).				
Anakapalle	1 - 5 - 33	10 - 4 - 34	1·50	21·17	89·80	1·09
Coimbatore	15 - 3 - 33	23 - 2 - 34	2·40	20·12	89·52	1·04
		(*351-360 days old*).				
Anakapalle	3 - 1 - 33	26 - 12 - 33	1·30	17·60	89·7	1·03
	2 - 2 - 33	20 - 1 - 34	1·60	19 80	91·3	1·05
	1 - 3 - 33	20 - 2 - 34	1·40	19·60	87·48	1·05
Samalkot	13 - 10 - 32	7 - 10 - 33	2·00	20·80	85·10	0·92
	6 - 2 - 33	25 - 1 - 34	2·50	21·00	97·20	1·05
Maruteru	22 - 1 - 33	12 - 1 - 34	1·80	19·60	89·30	1·02
Coimbatore	15 - 3 - 33	6 - 3 - 34	2·60	20·40	89·00	0·97
Aduturai	16 - 12 - 32	11 - 12 - 33	0·61	16·80	71·90	0·83
		(*361-370 days old*).				
Anakapalle	1 - 10 - 32	4 - 10 - 33	3·23	13 50	68·4	0·93
	1 - 12 - 32	27 - 11 - 33	2·20	16·50	93·4	1·04
Maruteru	20 - 3—33	19 - 3 - 34	2·30	19·74	86·08	1·05

TABLE II (*Continued*).

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Palur	17 - 1 - 33	17 - 1 - 34	1·65	15·40	84·30	0·95
	6 - 2 - 33	14 - 2 - 34	1·60	17·10	89·50	1·06
		(*371–380 days old*).				
Anakapalle	1--4—33	9—4—34	1·54	21·00	90·20	1·05
		(*381–390 days old*).				
Anakapalle	5 - 11 - 32	28 - 11 - 33	2·00	15·56	89·90	1·02
	1 - 12 - 32	26 - 12 - 33	2·20	18·80	90·07	0·98
	3 - 1 - 33	20 - 1 - 34	1·35	19·30	91·40	1·02
	2 - 2 - 33	20 - 2 - 34	1·52	20·55	87·30	1·07
Maruteru	20 - 9 - 32	13 - 10 - 33	3·90	18·20	90·50	0·99
		(*391–400 days old*).				
Anakapalle	2 - 9 - 32	4 - 10 - 33	3·55	13·20	70·20	1·14
	1 - 3 - 33	9 - 4 - 34	1·53	22·20	90·10	1·08
Samalkot	9 - 9 - 32	6 - 10 - 33	3·15	17·00	82·70	1·05
Maruteru	19 - 8 - 32	12 - 10 - 33	3·00	18·08	86·16	1·05
		(*less than 200 days old*).				
Anakapalle	2 - 9 - 32	10 . 2 - 33	1·02	13 40	64·90	0·79
	1 - 10 - 32	31 - 3 - 33	1·05	12·30	63·00	0·71
Samalkot	8 - 12 - 32	24 - 6$_1$- 33	1·30	12·80	68·20	0·87

Research Note

A new and important weed host of the cotton stem weevil *(Pempheres affinis F.)*

In the course of an intensive field study of the alternative food plants of the weevil, various species belonging to Malvaceae, Tiliaceae and allied orders were collected and examined. A few among them such as *hibiscus vitifoleus sida spinosus corchorus olitorus* were noted to harbour a small but varying proportion of weevil stages. But the highest infestation was observed in a hitherto unrecorded weed host *malvastrum coromandelianum* (Garcke). This weed is widely distributed and abundant on all wastelands, sometimes also associated with cultivated crops, in borders of fields, along road sides, tank bunds, sides of water channels, fences and other neglected places.

The younger plants were generally free and not attacked while the majority of the medium sized and large ones were infested. The mode of attack of the weevil is approximately similar to that in cotton. The nature of the injury and the character and course of the tunnels are also roughly similar. In a small number of cases galls are also produced. As many as three galls have been noted to be developed in the same plant. A small percentage of mortality is also seen to be caused among such plants. A maximum of nine attacks with six live grubs of varying stages has been noted in a single plant. The following table presents the data obtained in regard to the weevil population in the different lots of this plant material.

Total No. of plants examined.	% of attacked plants.	Total number of live stages.				Emergence apertures.	Mere infestations	No. of infestations per 100 plants.	No. of live stages per 100 plants.
		Larva.	Prepupa.	Pupa.	Adult.				
558	42	116	9	2	7	14	154	54	24