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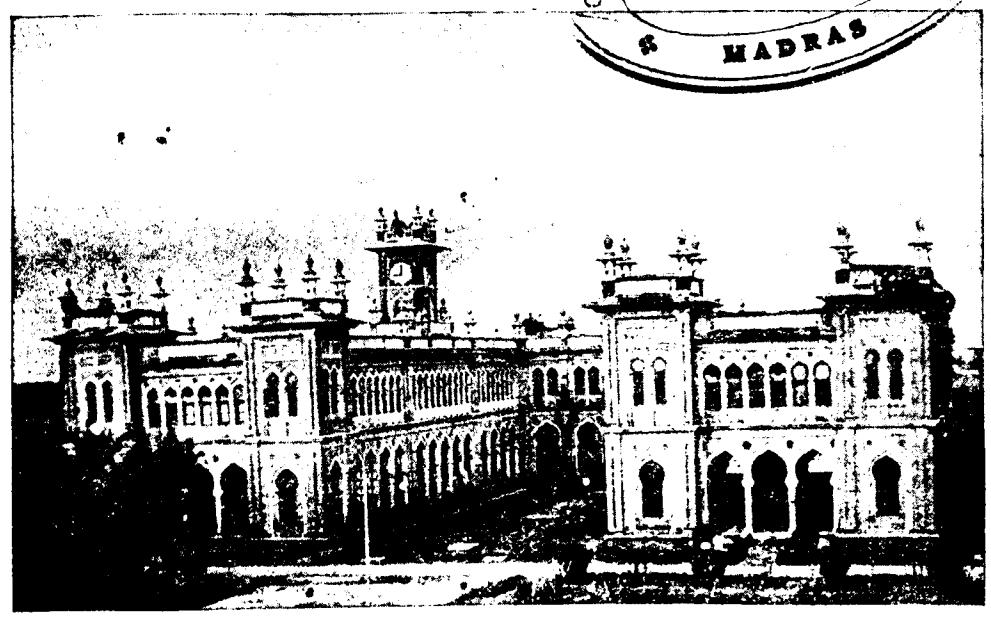

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Madras Agric. J., **45**: (10) 377—391, 1958

Study of Total Solids - Sucrose Content Relationship in Sugarcane Juice with Reference to Varieties *

3. *Determination of Earliness or Lateness of Varieties Using Total Solids - Sucrose Regression.*

by

D. JOHN DURAIRAJ,

Agricultural Research Institute, Coimbatore.

Introduction: The importance of determining the ripening point of growing sugarcane is recognised by all who are connected with the production of sugar or jaggery. The sugarcane grower requires an easy method of determining when a particular variety cultivated by him could be expected to ripen, so that it might be harvested at a period at which, the sucrose content will be at a peak value, and at which utilisation of the sugar produced will be maximum and losses due to deterioration will be at a minimum.

The jaggery manufacturer is interested in ensuring that the sugarcane crop is harvested when it is just satisfactorily ripe, as the setting of jaggery is seriously hampered, by the use of unripe or over-ripe cane, with consequent impairing of jaggery quality. The sugar factory is particular that the cane supplied by the grower attain peak maturity. As payment for sugarcane is mostly made on the basis of cane weight, the payment for unripe or over-ripe canes at the same rate as for optimum ripe canes will affect the economy of the sugar-factory.

In tracts where the climatic conditions requisite for all year planting are lacking, crushing is usually limited to about six months in the year. Among the six months devoted to crushing, the planting and harvesting schedules of varieties have to be so adjusted as to ensure an even and satisfactory supply of canes to the Factory all through the crushing period. An accurate knowledge of the earliness or lateness of varieties, is therefore imperative for the correct preparation of harvest schedules.

The present paper describes an attempt at determining even during the early stages of cane growth, the earliness or lateness of different cane varieties, from a consideration of the total solids-sucrose relationship in sugarcane juice.

* Prize winning article for Ramasastrulu Mungala Prize, awarded during 41st College day and Conference, 1958.

Literature : *Earliness or lateness of varieties :* Several methods are available for the determination of the ripening points of different cane varieties. The most obvious one is to grow the cane itself and conduct maturity observations on the crop over a period of about 6 months round about its ripening point, by analysing the sugarcane juice for Total Solids (Brix) and Sucrose. Although fool-proof and accurate, this method is time-consuming and may take up to 15 months for carrying out. Moreover, it is not possible, according to this method, to predict the ripening point during the early phases of growth of an unknown sugarcane variety.

A method (1) (1948) based on the moisture content of leaf sheaths attached to elongating stem was developed in Hawaii. According to this method the progressive variation in moisture-content of standard sugarcane leaf-sheaths is followed by determining sheath-moisture at frequent regular intervals towards the ripening period, and harvesting the canes when a constant minimum of sheath moisture is reached. At any point during the growth of a number of varieties planted on the same day the sheath moisture is dependent on the earliness or lateness of the variety, that is, late varieties have higher values for sheath moisture and vice-versa. Fibre content of cane also serves to a certain degree to fix the earliness or lateness of varieties, early canes usually having a higher fibre content than late varieties.

Juice Composition : The general relationship between the Total Solids and sucrose content of sugarcane juice is a matter of common observation. It is well known that as the total solids (Brix) increase, the sucrose also can be expected to increase. Craig (2) (1931) demonstrated a strong positive correlation between the refractometer Brix and Sucrose content of Sugarcane juice and showed that the curve representing the correlation takes the form of one section of a wide second degree curve.

Khanna and Sen suggested the use of the Hand Refractometer as an alternative to the usual polarisation method in the evaluation of sugarcane varieties from the sugar point of view. These authors have also prepared tables for the conversion of Middle internodal Brix of standing canes to True Brix and Sucrose % of cane.

Part of stem to represent whole plant regarding juice quality : Khanna & Sen (4) (1953) have worked out the correlation between the middle internodal Brix of Sugarcane and the Brix of juice from the whole stalk, when crushed, and found out that the correlation co-efficient was positive and very high. They worked out regression equation for conversion of middle internodal Brix into Brix of juice from crushed stalks.

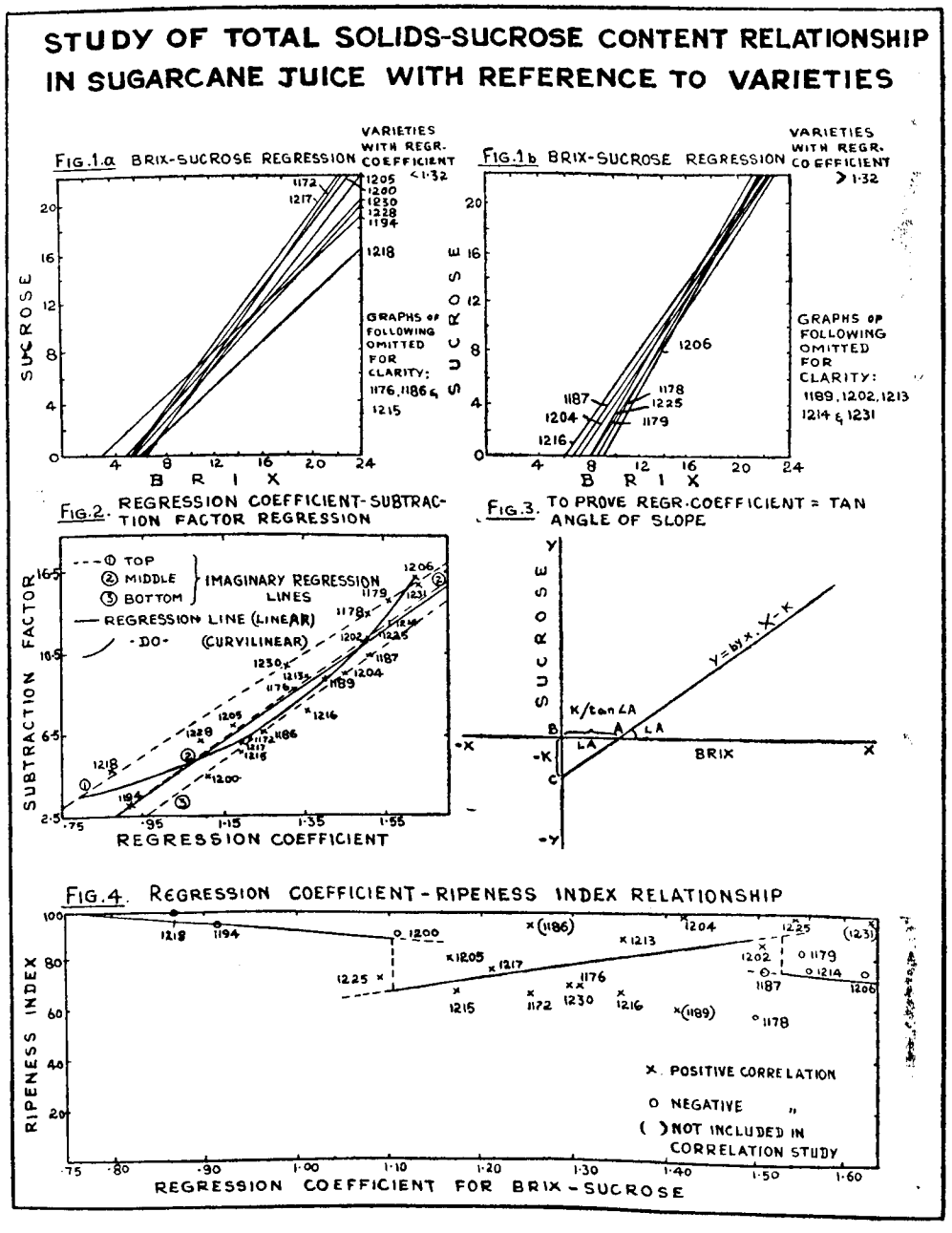
Nature of Brix-Sucrose Correlation in Sugarcane Juice : Durairaj, Ranganathan and Subramanian, from a detailed study of sugarcane juice analytical results of Central Sugarcane Research Stations, Palur and Cuddalore (3) (1957), Madras State, concluded that the Brix-Sucrose relationship of juice of a sugarcane variety, as quantitatively expressed by the relevant regression coefficient, was a varietal characteristic, that the correlation is practically absolutely linear if individual varieties are considered separately and that forms and doses of nitrogenous manures, time of planting, levels of irrigation and age of crop have no perceptible influence in altering the regression coefficient of a particular veriety.

Experimental Details : *Variation of Brix-Sucrose Regression Coefficient within the field :* To determine the variations, if any, of the Brix-Sucrose regression coefficient among different spots in the same field, 37 whole clumps of Co. 527 from 2 rows of 50 cents in a plot, with identical manurial and cultural schedule, were crushed separately, and the Brix and Sucrose of the juice determined using the Brix hydrometer, and the Polariscope, respectively, for the two determinations (Table 1.)

Correlation and regression coefficients were worked out for Brix-Sucrose for each of the 2 rows and for two half portions of the 2 rows considered together, so as to have 2 patches of the field with different orientations, (Table 4, serial Nos. 1 & 2.)

Comparative study of Brix-sucrose Regression of a number of varieties : Out of 60 sugarcane varieties, (Co. 1172 to Co. 1231) released during 1957 from the Sugarcane Breeding Institute, Coimbatore, 24 varieties which exhibited favourable agronomic characteristics and juice quality were studied in detail. At harvest at the age of 11 months, each of the 24 varieties was separated mostly into 5 sub-groups according to quality of juice as obtained from the determination of refractometer Brix of the middle internode of each individual cane. Canes having similar middle internodal Brix were grouped together and the total number of sub-groups adjusted to be about five. The sub-groups were crushed separately, and the Brix and Sucrose of the juice obtained were determined as usual in the case of 116 samples (Table 2).

FIGURES



The Brix-Sucrose data for each of 23 varieties were analysed statistically for correlation. The correlation and regression coefficients, standard error and regression equation for varieties were arrived at (Table 5). The regression lines for the varieties were drawn [Figures 1 (a) and (b)].

Discussion of results and further Statistical and Mathematical Studies Variation of Brix-Sucrose Regression Coefficient within the Field : The correlation coefficients for the relationship calculated in either position in the field was positive and very high (about ·99). The regression coefficients ranged from 1·18 to 1·21, and there was practically no difference between the coefficients, thus indicating that the regression coefficient is not perceptibly affected by changes of position within a field.

Comparative study of Brix-Sucrose regression of a number of varieties : The correlation coefficients for Brix-Sucrose were more than ·99 in the majority of cases, indicating a very high degree of correlation, which is practically absolute in its linearity. The regression coefficients varied from ·87 to 1·63. The very high figures obtained for the correlation coefficients, inspite of the fact that only 5 pairs of data were utilized for each calculation are a good indication of the absoluteness of the Brix-Sucrose relationship in Sugarcane juice and of the specific nature of this relationship with reference to the varieties.

Although there was a fairly wide range of Brix-Sucrose values, with low as well as high values, all the points followed the same course determined from the regression line, thus enabling the course to be determined even when the canes were young. As the course is the same during the early as well as late stages, as seen from the behaviour of the points representing low as well as high values, the behaviour at later stages is predictable from a study of it, at the early stages.

It was observed that the regression coefficients did not tend to group together, but were dispressed fairly well all over the observed range. (Figure 2).

The highly specific nature of the Brix-Sucrose relationship with reference to varieties recommended itself as a useful index in the characterisation and classification of varieties. But as the regression equation is the mathematical expression for the Brix-Sucrose relationship, and as it invariably consists, in this particular

case, of the regression coefficient and the subtraction factor, it is difficult to define a variety simultaneously in terms of the regression coefficient and the subtraction factor, both of which are capable of independent variation.

The difficulty could be overcome satisfactorily only if the regression coefficient and the subtraction factor are somehow related mathematically, this possibility being rather remote. Anyway, to test the relationship, if any, between the two factors, correlation coefficient was worked out for the relationship regression coefficient—subtraction factor. Surprisingly, a very high correlation coefficient (about ·95) was obtained for the relationship, thus indicating that the subtraction factor is predictable from the regression coefficient itself.

When the two factors were plotted on a graph (Figure 2) the points arranged themselves along 3 imaginary lines, the middle line being almost the same as the regression line drawn with the regression equation for the regression coefficient — subtraction factor correlation, and the other two lines lying on either side at almost equal distances.

It was thought possible that the varieties examined fell under three different heads with characteristic behaviour with reference to Regression coefficient — subtraction factor relationship. Hence the points lying along each of the three imaginary lines were separated out and correlation coefficients calculated for each of the 3 groups. The separation into the groups had brought about a decided increase in the correlation coefficients, all of which were now of the order of ·99 [Table 4, Serial No. 3 (2) (a), (b) and (c)].

From the dispersion of the points, it was also observed that there was a tendency towards a slight curvilinearity in the relationship. This was statistically tested and the results indicated that there was a slight curvilinearity, and that the curve was a better fit for the observed data than the straight line (Figure 2).

Relationship between Regression Coefficient and Slope of Regression Line : According to definition, the regression coefficient is the rate of change of Sucrose for unit change in Brix. The slope of the regression line expressed in terms of the tangent of the angle that the line subtends to the horizontal is also the rate of change of Sucrose for unit change in Brix. The slope of the regression line can readily be obtained by plotting a few points for Brix-Sucrose, and drawing a smooth representative straight line through them. Hence

if a relationship between the regression coefficient and the tanget of the angle of slope could be established, the method of plotting a few points and measuring the slope of the line passing through them suggested itself as a rapid means of determining the regression coefficient. Mathematical considerations outlined below indicated that the regression coefficient was numerically equal to the tangent of the angle of slope of the regression line, thus rendering the rough and ready determination of regression coefficient rapidly feasible.

Please Refer Fig. 3.

1. $Y = byx.\ X - k$ (Regression equation for Brix-Sucrose, where X = Brix, Y = Sucrose, k = Subtraction factor)
2. When $X = 0$, $Y = -k$.
3. In figure 3, if $BC = k$, then $BA = \frac{k}{\tan BAC}$ or $\frac{k}{\tan \angle A}$
4. BA is the value of X, when $Y = 0$.
5. From equation, when $Y = 0$, $X = \frac{k}{byx}$ or $BA = \frac{k}{byx}$
6. From 3 and 5 above, $\frac{k}{\tan \angle A} = \frac{k}{byx}$; Hence $byx = \tan \angle A$

Thus it is seen that it is possible to build up the regression equation rapidly for any given variety, starting from the slope of the line drawn through a few of the points. As the tangent of this angle is equal to Regression coefficient, and as the subtraction factor also can be derived from the regression coefficient, the approximate regression equation can be rapidly constructed out of a few data and the variation of Sucrose with Brix roughly, but quickly, predicted for a variety.

Relationship between the Earlines or Lateness of Varieties and Brix-Sucrose Regression : As Brix-Sucrose regression was highly characteristic of varieties and was little affected by cultural or manurial variations it was considered worthwhile to determine whether the regression coefficient could be utilised for determining the ripening points of varieties, and classifying them as early or late. The hand refractometer readings for middle internode of the varieties studied had been taken by the Agronomy staff as early as 9–12–'57. The Hydrometer Brix had been determined at harvest (9–3–'58) in connection with the present study of the 24 varieties, and the average for each variety had been worked out by giving weightage for weight of each sub-group in a variety (Table 3). The Hydrometer Brix was converted to Refractometer Brix using the equation $Y = 2\ 3X + 4\cdot9$, arrived at by the author and co-workers in connection with a previous investigation.

The percentage of Refractometer Brix on 9–12–'57 to that at harvest (9–3–'58) gives a quantitative expression to the earliness or lateness of varieties, as early varieties would have reached Brix values very near the Brix at harvest (maximum Brix), and consequently would have registered high percentages, the reverse being true of late varieties. (These percentages are denoted as "ripeness indices" in the following sections).

To determine whether regression coefficient could be related to the earliness or lateness of varieties, correlation coefficient was worked out for regression coefficients and the corresponding ripeness indices. The correletion coefficient came to the low value of ·17 which was not significant.

Examining the pairs of data, it was observed that two groups were distinguishable, the first one consisting of regression coefficients ranging from about 1·0 to 1·5 and the other one of coefficients below 1·0 and above 1·5. Correlation coefficients were worked out separately for the two groups of data, when a striking increase in the correlation coefficient was noticed, the value for the first group [regression coefficients (1·0—1·5)] being positive, and increasing to ·74 and the value for the second group (below 1·0 and above 1·5) being negative and increasing to ·87 (Data for Co. 1186, 1189 and 1231 were omitted, as they followed an irregular trend). *

* NOTE: Further investigation on the subject made after the preparation of the present paper indicated that the varieties could be devided into two groups, i. e. those having regression coefficients lower thon 1·35 or higher then 1·35. This grouping, which was more satisfactory in some respects, also indicated high degrees of correlation between regression co-efficient (Brix-Sucrose) and Ripeness index.

There was also slight overlapping of the two groups at the dividing line. The relevant statistical data are given below:

	Group	No. of pairs of values	Correlation co-efficient	Standard error	't' value (calculated)	't' value for 1% level of significance	Regression equation
I	Below 1·35 Reg. coefficient	13	—·84	·16	5·16	3·0	Y = 138·2—50·1X
II	Above 1·35 reg. coffiicient	8	—·76	·265	2·87	3·5	Y = 165·9—54·3X

(X = Regression coefficient for Brix-Sucrose regression)
(Y = Ripeness index)

For more accurate prediction of the Ripeness index (Y) the use of the subtraction factor (X_2) from the Brix-Sucrose Regression equation along with the relevant regresssion coefficient (X_1) in the following multiple regression equations, will be advantageous.

	Group	Multiple regression Equations
I	Below 1·35 regression coefficient	$Y = 148·0 - 65·2\ X_1 + 1·14\ X_2$
II	Above 1·35 regression coefficient	$Y = 169·2 - 58·0\ X_1 + ·181\ X_2$

The points denoting regression coefficient - Ripeness index were plotted (Fig. 4). The regression equations for the two groups of data were calculated and the two regression lines drawn. It was observed that the negative correlation line took off from the 100% Ripeness index line at ·79 regression coefficient. This probably is the lower limit for the coefficient. From this point the indices decreased gradually with increase in the coefficient till about 1·1 for the coefficient, when there was a sharp decline from about 90% to about 70%. From this point onwards, the relationship was reversed, and increases in coefficient were accompanied by increases in the index, till about 1·5 for coefficient was reached. Here the corresponding index was again about 90% and there was a sudden drop to about 80%. At this point also the relationship was reversed and thereafter it followed the negative correlation which held good for values of coefficients less than about 1·1. It was noteworthy that the regression at this end of the graph was identical with that at the other end, and also that sudden drops occurred at 2 points at almost the same value for index (about 90).

Expressing the results in terms of earliness or lateness, at the initial stages (about ·8 to 1·1 regression coefficient) increase in coefficient results in a transition from extreme earliness to one represented by about 90% (Fig. 4). At this point, there is a reversal of relationship and the graph starts once more at a point represented by about 70%. which indicates pronounced lateness. From now on an increase of coefficient results in the graph passing through mid-varieties and reaching early varieties once more at about 90% index. Here also there is an abrupt reversal of relationship, and, in the changed relationship, the point represents conditions of mid-varieties, and further increase in the coefficient is accompanied by further change of the varieties to late ones. Certain slight overlappings of the negative and positive correlations were observed near the two points where they met.

Procedure for Determining Earliness or Lateness of Varieties: The cane varieties are to be grown under normal cultural and manurial schedules, and at about the 6th or 7th month a fairly large number of canes (about 60) are crushed individually, and the number of samples reduced to half by determining the refractometer Brix of all the samples, arranging them in the order of their Brix, with the maximum possible range of values, and mixing every two samples having successive values for Brix. The Hydrometer Brix and Sucrose are determined as usual.

Regression coefficient and regression equation are arrived at by statistically working out Brix-Sucrose correlation. Earliness or lateness of varieties is determined following the graph discussed in detail in the previous section (Fig. 4).

For rapid determination, and in cases where only a few canes of a particular variety are available, the Brix-Sucrose of a few points (say 6) are plotted, covering as wide a range as possible, and a representative straight line graph drawn through them. The tangent of the angle subtended by this graph to the horizontal is determined. This is equal to the regression coefficient. Further details are the same as for the detailed method. In the rapid method, the Brix-Sucrose regression equation can readily be built up by calculating the appropriate subtraction factor for the regression coefficient in question, applying the relevant regression equation for Regression coefficient — subtraction factor. (Table 4, Serial No. 3).

The earliness or lateness of the varieties studied was determined from the two regression lines (Fig. 5) and compared with those given by Sugarcane Breeding Institute, Coimbatore when the varieties were released. The conclusions drawn from the regression lines were found to agree well with those given by Sugarcane Breeding Institute, as can be seen from Table 1 (a).

Summary and Conclusions: A detailed study of Brix sucrose relationship was made in respect of 24 varieties recently released from Sugarcane Breeding Institute, Coimbatore. The effect of position of canes in field on the relationship was also studied. Data were statistically analysed for correlation and the relationship between angle of slope of regression line, regression co-efficient and subtraction factor was established. Relationship between earliness or lateness of varieties and regression coefficients was assessed and expressed quantitatively.

The position of canes in a particular plot was not observed to have a marked influence on the Brix-sucrose regression.

From a study of the 23 varieties the striking absoluteness of the Brix-Sucrose relationship was borne out clearly. The relationship was specific to each variety, so that, once the regression had been derived for a variety, it was unnecessary that Sucrose be determined, along with Brix, as the former is almost absolutely correlated with the latter. Moreover, for the same variety the relationship was exactly the same for low as well as high values of Brix and Sucrose, so that the Brix-Sucrose relationship at later stages could be accurately predicted from a study of the same at the early stages of cane-growth.

In the regression equation for Brix-Sucrose regression, the subtraction factor was highly correlated with the regression coefficient and there was a slight curvilinearity also in the relationship. The existence of a relationship between regression coefficient and subtraction factor results in the singular behaviour of varieties with low rates of sugar increase for unit Brix increase (regression coefficient) to have a low value for the minimum Brix at which sucrose formation starts, and for this minimum Brix to increase progressively with the regression coefficient. In other words, lines taking off farther away from O on X - axis are steeper. The relationship also makes it possible for building up any regression equation from the regression coefficient without the usual statistical calculations, as the other component of the equation, the subtraction factor, can be readily calculated from the regression coefficient.

Mathematical proof has been offered for proving that the regression coefficient is numerically equal to the tangent of the angle subtended by the regression line to the horizontal.

It was observed that the regression coefficient was related to the earliness or lateness of varieties. The relationship was peculiar in that there were positive and negative correlations over different ranges. The course followed by the regression coefficient-ripeness index relationship has been traced in detail.

A method for the determination of the degree of earliness or lateness of varieties mid-way during the growth of cane has been outlined.

Utility of Findings: The experimental findings provide a rapid method for determining the degree of earliness or lateness of varieties. A rapid method has also been devised for determining the regression coefficient and for constructing the regression equation. By developing this method, and perfecting it, there is scope for effecting economies in the time and money spent on field experiments for determining the earliness or lateness of cane varieties.

A knowledge of the earliness or lateness of varieties will result in considerable additional income for factories by the preservation of sugar losses due to the crushing of immature or over-ripe,

and hence, deteriorating canes. By crushing canes at the optimum ripe period high quality jaggery can be manufactured and losses resulting from bad quality induced by preparation from under-or over-ripe cane can effectively be avoided.

As the regression coefficient appears to be a specific varietal characteristic, it may be possible to breed canes of the required regression coefficients for Brix-Sucrose relationship, and also to produce early, mid or late varieties, by choosing the parents with the required regression coefficients.

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TABLE 1

Brix & Sucrose Data for Co. 527: Study of Correlation Variation in the Same Field

	First Row.						Second Row.					
Clump No.	Brix %	Sucrose %	Clump No.	Brix %	Sucrose %	Clump No.	Brix %	Sucrose %	Clump No.	Brix %	Sucrose %
1.	15 8	12 9	11.	17·7	14·8	1.	18·5	16·1	11.	16·5	14·0
2.	16·3	13·1	12.	18·0	15 6	2.	18·6	16 8	12.	16·4	14·2
3.	15·4	11·9	13.	17·1	15·0	3.	18·5	16·0	13.	11·1	7·4
4.	11·9	8·2	14.	17·7	15·3	4.	17·2	15·0	14.	11·1	7·4
5.	10·8	6·8	15.	15·7	12·5	5.	17·9	15·4	15.	15·8	13·3
6.	13·1	9·3	16.	16·9	14·6	6.	17·8	15·6	16.	15·6	12·1
7.	14·1	10·7	17.	12·4	9 0	7.	17·1	14·8		..	..
8.	17·3	15·2	18.	13·9	10·3	8.	16·9	14·5		..	..
9.	15·8	12·6	19.	9·6	5·8	9.	16·1	13·3		..	..
10.	19·2	16 2	20.	14·1	11·1	10.	15·1	12·2		..	..
	..	..	21.	14·7	12·0		..	..		..	..

TABLE 1-A

Comparison of Earliness or Lateness of Varieties Determined by Regression, and as given by Sugarcane Breeding Institute, Coimbatore.

S. No.	Variety No.	Earliness or lateness from regression lines. (1)	Earliness or lateness from Sugarcane Br. Inst. information (2)	Agreement of (1) & (2)	S. No.	Variety No.	Earliness or lateness from regression lines. (1)	Earliness or lateness from S. B. I. information (2)	Agreement of (1) & (2)
1.	1172	Late-mid	Mid	V. Fair	10.	1206	Late	Mid	Poor
2.	1176	Mid	Mid	Good	11.	1213	Late-mid	Late	V. Fair
3.	1178	Late	Early	Poor	12.	1217	Late	Mid	Fair
4.	1179	Late	Late	Good	13.	1215	Late	Late	Good
5.	1187	Late-mid	Mid	Fair	14.	1216	Mid	Mid	Good
6.	1200	Mid	Mid	Good	15.	1217	Late	Late	Good
7.	1202	Mid-Early	Mid	V. Fair	16.	1218	Early	Late	Poor
8.	1204	Mid	Mid	Good	17.	1228	Late	Late	Good
9.	1205	Late	Mid	Fair	18.	1230	Late-mid	Early	Poor

Classification: Ripeness index: (1) 70—80: Late: (2) 80—90: Mid; & (3) 90—100. Early.

TABLE 2

Brix Sucrose Data for Sugarcane Varieties Studied

S. No.	Variety No. (Co.)	Group 1		Group 2		Group 3		Group 4		Group 5	
		Brix	Sucrose	Brix	Sucrose	Brix	Sucrose	Brix	Sucrose	Brix	Sucrose
1.	1172	16·04	12·65	17·19	14·68	18·86	15·95	19 06	17·00	19·68	17·48
2.	1176	14 68	11·62	17·26	13·92	18·06	15·70	19·09	17·17	20·09	18·46
3.	1178	16 63	12·13	16·91	12·72	17·68	14·20	18·64	15·82	19·38	16·30
4.	1179	16·42	11·76	16·51	11·45	17·82	13·67	18·00	14·08	19·21	15·85
5.	1186	14·82	11·58	15·26	11·63	17·26	14·91	17·81	15·90	19 26	16·58
6.	1187	17·30	13·92	18·31	16·22	18·51	16·95	19·78	18·03	21·43	20·52
7.	1189	11·98	6 74	12·48	7·62	15·43	11·75	16·94	13·52	18·49	12·16
8.	1194	14·88	10·67	14·58	10·38	15·08	9·81	15·88	11·68	16·18	11·80
9.	1200	15·14	11·85	18·11	14 69	19 84	17·48	20·52	18·20	20·87	18·59
10.	1202	15·24	10·47	15·15	10·26	15·94	12 04	18·53	16·10	19·59	16·76
11.	1204	13·96	9·50	15·06	12·09	16·74	14·45	17·84	15·80	18·78	16·28
12.	1305	15·38	11·39	16·98	12·70	17·88	13·97	18·88	15·29	19·46	16·29
13.	1206	17·83	13·89	18·46	15·30	20·24	17·76	20·36	18·20	20·80	18·85
14.	1213	13·44	8·44	15·01	10 62	18·71	15·57	...	...	...	...
15.	1214	13·78	8·70	16·28	12·35	17·08	13·70	18·29	15·60	19·04	16·81
16.	1215	13·54	10·10	14·04	11·00	16·64	14·00	18·62	16·36	20·42	18·39
17.	1216	15·64	12·70	16·83	14·21	17·29	15·03	19·82	18·08	20·03	18·78
18.	1217	13·03	9·69	13·62	9 87	14·84	11·42	18·75	16·24	19·36	17·49
19.	1218	9·84	3·55	9 90	3·80	13·24	6·22	13·98	9·87	15·14	8·38
20.	1225	13·43	8·01	13·66	8·20	14·82	10·38	15·10	10·08	16·07	12·14
21.	1228	13·30	8·15	14·00	8·71	16·78	11·87	18·06	12·57	19·98	14·68
22.	1229	18·84	15·09	19·04	16·16	20·80	17·92	...	...	...	...
23.	1230	15·97	10·61	16·07	11·05	16·77	10·99	17·66	12·68	18·80	14·39
24.	1231	15·36	10·88	15·37	11·15	16·66	13·56	17 45	14·58	18·56	16·37

TABLE 3

Percentage of Refractometer Brix on 9—12—'57 to 9—3—'58

Ripeness index

(Y=2/3 x + 4·9, where X & Y are refractometer and Hydrometer Brix respectively)

S. No.	Variety No. (Co.)	Refractometer Brix on 9-12-'57 (A)	Hydrometer Brix on 9-3-'58	Hyd. Brix on 9-3-'58 converted into Ref. Brix (B)	Percentage of A on B	S. No.	Variety No. (Co.)	Refractometer Brix on 9-12-'57 (A)	Hydrometer Brix on 9-3-'58	Hyd. Brix on 9-8-'58 converted into Ref. Brix (B)	Percentage of A on B
1	2	3	4	5	6	1	2	3	4	5	6
1.	1172	13·8	18·2	20·0	69	13.	1206	17·2	19·9	22·5	76
2.	1176	15·6	18·6	20·6	76	14.	1213	18·6	18·7	20·7	90
3.	1178	13·2	18·1	19·1	67	15.	1214	15·2	17·9	19·5	78
4.	1179	16·0	17·6	19·1	34	16.	1215	13·4	18·1	19·8	68
5.	1186	18·2	17·6	19·1	95	17.	1216	16·0	19·8	22·4	72
6.	1187	15·8	18·8	20·9	76	18.	1217	16·4	19·1	21·3	77
7.	1189	13·0	17·2	18·7	70	19.	1218	13·0	11·3	9·6	100*
8.	1194	15·6	15·8	16·4	95	20.	1225	14·6	14·8	14·9	98
9.	1200	17·8	17·9	19·5	91	21.	1226	14·8	18·2	20·0	74
10.	1022	18·6	18·9	21·0	89	22.	1229	16·4	19·0	21·2	78
11.	1204	17·6	16·8	17·9	98	23.	1230	13·6	16·8	17·9	76
12.	1205	16·0	18·0	19·7	81	24.	1231	17·0	16·5	17·4	98

N. B. * Assumed.

TABLE 4

Statistical Data for Correlations

S. No.	Correlation of	No. of Data	Correlation coefficient	Standard error	t	t for ·1% level of significance	Regression coefficient	Regression Equation	Values for X & Y in regression equation
1.	(a) Brix & Sucrose 'A' position in field								
	Block 1	21	·992	·029	33·8	3·9	1·18	Y=1·18X—5·8	X=Brix & Y=Sucrose
	Block 2	16	·994	·029	34·8	4·1	1·21	Y=1·21X—6·1	,,
2.	—Do— 'B' position								
	Block 1	19	·995	·026	38·8	3·9	1·19	Y=1·19X—5·7	,,
	Block 2	19	·990	·035	28·3	4·0	1·18	Y=1·18X—5·9	,,

TABLE 4 *(Contd.)*

S. No.	Correlation of	No. of data	Correlation coefficient	Standard error	t	t for ·1% level of significance	Regression coefficiant	Regression Equation	Values for X & Y in regression equation
3.	Regression coefficient & subtraction factor								X & Y are regression coefficient & subtraction factor for Brix-Sucrose reg equation
(1)	(a) Linear	23	·95	·068	14·0	3·8	15·3	Y=15·3X—11·1	
	(b) Curvilinear							Y=9·29—17·54X +12·18X²	
(2)	(a) Top group	6	·992	·062	16·2	6·9	13·9	Y=13·9X— 7·8	,,
	(b) Middle group	9	·997	·031	31·7	5·0	15·3	Y=15·3X—11·0	,,
	(c) Bottom group	8	·992	·053	18·7	5·4	16·0	Y=16·0X—13·0	,,
4.	Regression coefficient and Ripeness factor								
	(1) All values	20	—·17	·23	..	..	..	..	..
	(2) Mid. values	12	+·74	·22	3·42	*3·1	57·5	Y=57·5X+3·5	X=Reg. coefficient
	(3) Lower and extremes	8	—·88	·19	4·53	*3·5	—37·8	Y=125—37·8X	Y=Ripeness factor

* For significance at 1%

TABLE 5

Statistical Data for Brix-Sucrose Correlations in Sugarcane Varieties Studied.

S. No.	Variety No. Co.	No. of Data	Correlation coefficient	Standard error	t	t for ·1% level of significance	Regression coefficient	Regression Equation (X: Brix; Y=Sucrose, Numeral=Subtraction Factor.)
1.	1172	5	·985	·098	10·1	8·6	1·24	Y=1·24 X — 7·0
2.	1176	5	·987	·093	10·6	,,	1·31	Y=1·31 X — 8·0
3.	1178	5	·965	·151	6·4	*4·6	1·49	Y=1·49 X — 13·0
4.	1179	5	·996	·054	18·5	8·6	1·54	Y=1·54 X — 13·8
5.	1186	5	·976	·125	7·8	,,	1·25	Y=1·25 X — 7·1
6.	1187	5	·979	·119	8·2	,,	1·50	Y=1·50 X — 11·4
7.	1189	4	·998	·040	25·0	12·9	1·40	Y=1·40 X — 13·0
8.	1194	4	·995	·072	13·7	,,	0·91	Y= ·91 X — 2·9
9.	1200	5	·919	·228	4·0	*4·6	1·10	Y=1·10 X — 4·6
10.	1202	5	·991	·079	12·5	8·6	1·51	Y=1·51 X — 12·4
11.	1204	5	·979	·119	8·2	,,	1·42	Y=1·42 X — 9·8
12.	1205	5	·989	·086	11·5	,,	1·17	Y=1·17 X — 6·9
13.	1206	5	·998	·033	30·6	,,	1·62	Y=1·62 X — 14·7
14.	1213	3	·996	·086	11·6	*9·9	1·35	Y=1·35 X — 11·6
15.	1214	5	·999	·017	57·7	8·6	1·55	Y=1·55 X — 12·2
16.	1215	5	·999	·022	46·3	,,	1·19	Y=1·19 X — 5·7
17.	1216	5	·997	·041	24·2	,,	1·35	Y=1·35 X — 8·3
18.	1217	5	·997	·046	21·6	,,	1·22	Y=1·22 X — 6·6
19.	1218	4	·994	·076	13·2	12·9	0·87	Y=0·87 X — 4·9
20.	1225	5	·985	·102	9·7	8·6	1·53	Y=1·53 X — 12·5
21.	1228	5	·989	·087	11·3	,,	1·08	Y=1·08 X — 6·3
22.	1230	5	·971	·139	7·0	,,	1·30	Y=1·30 X — 10·3
23.	1231	5	·995	·060	16·5	,,	1·63	Y=1·63 X — 13·9

* For significance at 1 % level.

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Development of *Callosobruchus chinensis* in Certain Vegetable Seeds[1]

by

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Introduction : Unlike other insects associated with stored grains and seeds, the pulse beetle, *Callosobruchus chinensis* is rather specific in its food habits. The natural hosts of this species have been listed by Chittenden (1898), Lefroy (1909), Fletcher (1914), Rao (1917), Fletcher and Ghosh (1919), Black (1922), Ghosh (1937) and Pruthi and Singh (1950). In India it has been found to feed only on a particular group of host seeds belonging to the Natural Order Leguminosae. During surveys of insect pests of vegetable seeds in stores and certification of the vegetable seed samples, this pest has been intercepted from almost every kind of the important leguminous vegetable seeds. It was observed that this beetle laid eggs freely in all such seeds but its further development in these seeds was not uniform, which was also noticed by Ghosh (1937). In some, it developed very fast while in others it could hardly subsist and even died without entering the seed.

These general observations led us to investigate the ability of this beetle to reproduce in and damage the different host seeds. This information will facilitate fixing entomological standards for the seeds which are being sold in the market. Certain seeds may be declared infested on account of the presence of bruchid eggs on them but due to the negative food value or the unfavourable physical make up, the pest may not be able to injure them. This information will further help in understanding the numerical increase of this pest in different hosts in stores. Moreover, not much is known regarding the effect of the various foods on the development of this bruchid which is one of the most serious pests of legumes in stores. Hence, this paper will also serve as a preliminary scientific report on the relative food value of some of the important vegetable legumes to this insect.

1. Paper read at the 45th Indian Science Congress 1958.
2. Now Head of the Department of Agricultural Zoology and Entomology, Rajasthan College of Agriculture, Udaipur.

Material and Method : Experiments were conducted during June to August, 1957, at room temperature using single pair culture of *Callosobruchus chinensis* bred on cowpea (Pusa Barsati), where the average development period from egg to adult stage was about 25 days. The insect was reared on the following recorded hosts and their effect on the development of this beetle was observed.

Seed	% *Moisture*
Canavalia gladita (Sword bean)	10·2
Dolichos lablab (Hyacinth bean)	11·3
Vigna sinensis (Cowpea, K 700)	11·6
,, ,, (Desi)	11·3
,, ,, (K 397)	11·2
,, ,, (Pusa Barsati)	11·5
Cyamopsis tetragonoloba (Cluster bean)	9·8
Vicia faba (Broad bean)	10·3
Phaseolus vulgaris (Kidney bean. red)	10·7
,, ,, (Kidney bean, Desi)	11·1
,, ,, (,, Stringless)	11·2
Cicer arietinum (Chick pea)	10·5
Pisum sativum (Garden pea)	11·4
Glycine max (Soy bean)	11·8

The moisture content of the seed was determined by the usual oven method. Twenty-five grams of seeds from each kind were sorted free from bruchid eggs on them and placed in 6" petri-dishes. Twenty pairs of newly emerged adults (24 hours emergence) were then introduced in each seed lot. The next day (after 24 hours) the number of eggs laid on each kind of seed were counted and the seeds bearing eggs were transferred to 4" petri-dishes. The effect of the different seeds on the development of the pest was judged by the time taken by the eggs to develop into adults. The real growth period is from the hatching of the eggs to the formation of pupae but as the larvae bore directly from the egg-shell to the seed and the pupation also takes place inside the seed, it is ordinarily not possible to fix the exact date either for hatching of the eggs or the pupation of the larvae without injuring them. In order to overcome this difficulty the growth period was calculated from the date of laying of eggs to the date of the emergence of adults. The eggs were kept under observation for two months and the emergence of adults in each seed lot was regularly noted.

Results: The results are tabulated in the accompanying table where the percentage of eggs becoming adults is given together with the average time taken to complete the development. The growth index was calculated as worked out by Singh and Pant (1955) in their nutritional studies of the Khapra beetle. In this experiment this was obtained by dividing the percentage of eggs becoming adults with the average time taken to complete the development. The greater the value of the index figure the better suited was the seed for the growth of the insect.

TABLE 1

Rate of development of *Callosobruchus chinensis* in different vegetable seeds.

Seed	% eggs becoming adults	Range in days	Average	Growth index
Sword bean	0	—	—	All larvae died
Hyacinth bean	0	—	—	do.
Cowpea K 700	93·8	22—30	26·4	3·6
,, Pusa Barsati	95·9	21—30	25·2	3·8
,, K 397	99·0	21—31	25·6	3·9
,, Desi	98·4	21—31	26·3	3·7
Cluster bean	0	—	—	All larvae died before entering seed
Broad bean	2·7	26—28	27·0	0.1
Kidney bean (red kidney)	0	—	—	All larvae died
,, ,, (Stringless)	0	—	—	do.
,, ,, (Desi)	0	—	—	do.
Chick pea	100	21—32	27·4	3·6
Garden pea	33·3	21—42	32·8	1·0
Soy bean	0	—	—	All larvae died

It can be seen that the emergence of adults took place only in cowpea, broad bean, chick pea and garden pea. The newly hatched larvae were unable to penetrate the seed coat in cluster bean and died within the egg - shell. In sword bean, hyacinth bean, kidney bean and soy bean the larvae entered the seed upto a pin - point but all were found dead when seeds were dissected out at the end of the test. Among the susceptible seeds the development was very fast in cowpeas and chick pea where 93·3 - 100% successful emergence took place within an average development period of 25·2 to 27·4 days.

The growth indices were higher which shows that these seeds are ideally suitable hosts for this beetle. The rate of growth was slow in garden pea where the emergence was as low as 33·3% and the development period was also lengthened to bring down the growth index value. Broad bean proved worst as regards its suitability as a host of this insect. The adult emergence was only 2·7% which resulted in a very inferior growth in broad bean.

Summary: Experiments were conducted at room temperature during June - August 1957 using single pair culture of *Callosobruchus chinensis* bred on cowpea (Pusa barsati) to determine the ability of this beetle to reproduce in and damage the different recorded vegetable host seeds. The determination was based on the growth index which was calculated by dividing the percentage of eggs becoming adults with the average time taken to complete this development.

The results showed that in sword bean *(Canavalia gladiata)*, hyacinth bean *(Dolichos lablab)*, cluster bean *(Cyamopsis tetragonoloba)*, kidney bean *(Phaseolus vulgaris)* and soy bean *(Glycine max)* the insect could not live. The newly hatched larvae were unable to penetrate the seed coat in cluster bean and died within the egg - shell and, in the remaining seeds, they penetrated up to a pin - point and died without any further development. Normal life cycle was gone through in cowpea *(Vigna sinensis)*, chick pea *(Cicer arietinum)*, garden pea *(Pisum sativum)* and broad bean *(Vicia faba)*. The growth was very fast in cowpea and chick pea but slow in garden pea. Broad bean proved unsuitable where the rate of growth and the survival of the insect was very unsatisfactory.

Acknowledgment: The work was carried out in the Division of Entomology, Indian Agricultural Research Institute, New Delhi, under the Seed Testing Project. We gratefully acknowledge the help and encouragement given by Dr. E. S. Narayanan, M. A., Ph. D. (Lond.), D. I. C. during the course of the investigations.

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Weather Review — for September, 1958.

RAINFALL DATA (IN INCHES)

Division	Station	Total rainfall for the month	Departure from normal	Total since 1st January 1958
North	Madras (Meenambakkam)	1·8	— 2·9	13·8
	Tirurkuppam*	1·5	— 4·0	16·4
	Vellore	4·6	— 2·3	22·5
	Gudiyatham*	5 8	+ 0·4	22·3
East Coast	Palur*	1·9	— 2.7	13 9
	Tindivanam*	2·8	— 2·4	14·4
	Cuddalore	5·3	+ 0·1	18 6
	Nagapattinam	0·6	— 2·7	6·5
	Aduthurai*	1·8	— 3·2	11·4
	Pattukkottai*	0·6	— 2 8	17·8
Central	Salem	4·5	— 1·6	25·6
	Coimbatore (A. M. O.)* ..	1·2	— 0·1	12·0
	Coimbatore	1·0	— 0·6	12·8
	Tiruchirapalli	2·3	— 1·7	14·0
South	Mathurai	1·2	— 3·5	13·9
	Pamban	Nil	— 1·1	10·6
	Koilpatti*	2·8	+ 1·5	12·7
	Palayamcottai	0·7	— 0·5	13·1
	Ambasamudram*	0·3	— 1·0	19·5
	Nagercoil*	0·8	— 1·3	28·8
Hills	Kodaikanal	3·8	— 3·5	36·1
	Coonoor*	2·8	— 0·6	38 0
	Ootacamund*	3·1	— 0·4	36·5
	Nanjanad*	5·5	— 0·1	49·2

Note:— * Meteorological Stations of the Madras Agricultural Department.

Rain or thundershowers occurred locally at a few places in Madras State during the month of September 1958 except for the ten days when weather was mainly dry throughout the State.

Rainfall occurred locally on 1—9—1958 and 2—9—1958 in interior Madras State. Therafter mainly dry weather prevailed in Tamilnad from 3—9—1958 to 12—9—1958 except for the localised rainfall that occurred on 4th, 7th and 10th of September, 1958. On 13—9—1958 rainfall occurred at a few places in North Madras State. Rain or showers occurred locally for three days from 14—9—1958, while on 17—9—1958 rain or showers had been fairly widespread in Madras State due to the development of an upper air trough off the Kerala coast on the same day. From 18—9—1958 onwards to the end of the month, rain or thundershowers occurred at a few places in Madras State, though mainly dry weather prevailed on 21—9—1958, 25—9—1958 and 26—9—1958.

Rainfall: The noteworthy rainfalls and the zonal rainfalls for the month are furnished below:

Noteworthy rainfalls

S. No.	Date	Name of place	Rainfall in inches
1.	19—9—1958	Salem	2·6
2.	23—9—1958	Vellore	1·6
3.	23—9—1958	Cuddalore	4·4

Zonal rainfall (in inches)

Name of Zone	Rainfall for September, 1958	Departure from normal	Remarks.
North	3·4	— 2 2	Far below normal
East Coast	2·2	— 2·3	,,
Central	2·3	— 1·0	Below normal
South	1·0	— 1·0	Far below normal
Hills	3·8	— 1·2	Below normal

Agricultural Meteorology Section,
Lawley Road Post, Coimbatore-3.
14th October, 1958.

C. B. M., M. V. J. & A. K. V.

Smut in Cholam (Jowar)

Easy Method of Seed-Treatment

This *rabi* season, more farmers will be treating their *cholam* seed with sulphur before sowing as a measure against the control of the smut disease.

State Governments have taken necessary steps to popularize this method of seed-treatment among farmers as a step towards grater *cholam* yields.

The smut disease, when it appears on the crop, causes a reduction in *cholam* yield. Since the disease is carried by seed, treating the seed with sulphur powder is a sure away of getting over it.

An ounce of finely ground sulphur is sufficient to treat 15 pounds of seed *cholam* needed for sowing an acre. Treating this quantity of seed will cost but four Naye Paise.

The seed can be put in a *chattie* or *ghara* or a metalic drum with a tight-fitting lid, the sulphur added and the container shaken for three to four minutes.

I. C. A. R. Farm News Release.

Departmental Notifications

Gazetted Officers—Madras Agricultural Department.
Postings and Transfers during the month of October 1958.

Name and designation	Transferred or posted to
Sri K. Lingannan	Posted as Asst. Agrl. Engineer, (Head quarters) Madras
,, T. S. Fransis, Joint Director of Agriculture (Extension) Office of the Director of Agriculture, Madras	Extension of earned leave for 8 days from 20—9—'58 to 27—9—'58 with permission to suffix the holiday on 28—9—'58 subject to eligibility
,, K. M. Sundaram, D. A. O., Chinglepet	Transferred as Seed Development Officer, Tanjore
,, V. Venkatasubramaniam, Seed Dev. Officer, Tanjore	Transferred as Dt. Agrl. Officer, Chinglepet
,, D. John Durairaj, Asst. Agrl. Chemist, Sugarcane Research Station, Cuddalore	Appointed temporarily as Reader in Soil Science, in the Regional Post-Graduate Research Institute, Coimbatore
,, C. S. Sridaran	Posted as Deputy Director (Drilling)
,, V. K. Appaji, Sugarcane Specialist, Sugarcane Research Station, Cuddalore.	Leave on average pay for 2 months from 9—10—'58
,, N. Sankaranarayana Reddy, A. A. E.	Extension of earned leave for 4 days from 28—9—'58
,, N. Srinivasalu, Asst. in Oilseeds	Reappointed temporarily as Assistant Oilseeds Specialist, Pollachi
,, R. Krishnamurthi, D. A. O., Madurai	Leave on average pay for 4 months
,, K. Sriraman, Seed Dev. Officer, Madras	Leave on average pay for 24 days from 23—10—'58
,, V. D. Guruswami Raja, Asst. in Cotton	Appointed temporarily as Assistant Cotton Specialist, (K. 2 and Co. 4 combined Scheme) Koilpatti
,, T. S. Sivasubramaniam, Seed Dev. Officer, Coimbatore	Transferred as District Agricultural Officer, Villupuram
,, T. S. Dakshinamurthi, D. A. O., Villupuram	Transferred as Seed Development Officer, Coimbatore
,, T. V. Swaminathan, Administrative Officer, Central Office, Agricultural College and Research Institute, Coimbatore	Leave on average pay on medical certificate for 4 months from date of relief

Upper Subordinate -- Agricultural Department
Postings and Transfers during the month of October 1958.

Name and designation	Transferred or posted to
Sri A. Narayanan, Asst. in Cotton, Tiruchengode	Transferred as Asst. in cotton, Karuganni scheme, Koilpatti
,, N. Tulasi Rao, Asst. in Cotton, Avanashi	Transferred as Asst. in Cotton, Agricultural Research Station, Bhavanisagar.
,, V. Krishnamoorthy, Cane Asst., Vadapathimangalam	Transferred as Agronomy Asst. Sugarcane Sub-station, Kulithalai
,, K. V. Danial, Special Agricultural Demonstrator, (Sugarcane) Kallakuruchi	do. do. (2nd post)
,, K. N. Srikanta Iyer	do. do. (3rd post)
,, C. Ranganathan, Extension Officer for Agriculture, Radhapuram	Extension Officer for Agrl. Karungulam Block at Seithunganallur, Tinnevelly Dt.
,, V. Subbiah Thevar	Extension Officer for Agri., Radhapuram
,, S. Madhava Rao, Asst. in Botany, Botanical Gardens, Coimbatore	Assistant Lecturer in Botany, Agricultural College, Coimbatore
,, M. Dinakaran, Special Agricultural Demonstrator, (Sugrcane) Kulitalai	Asst. Lecturer in Botany, Agril. College, Coimbatore
,, A. Mahaboob Alikhan, Farm Manager, Central Farm, Coimbatore	Assistant in Botany, Botanical Gardens, Coimbatore
,, C. K. Rajagopal	Asst. in Chemistry, Agricultural College, Coimbatore
,, S. Venkatachalam	do. do. do.
,, V. Subramaniam	Posted as Asst. in Chemistry, Ghee Grading Laboratory, Coimbatore
,, J. Clement Moses	Posted as Asst. in Chemistry, Agricultural College, Coimbatore
,, V. Sadagopan, Special Agricultural Demonstrator, (Sugarcane) Cuddalore	Resigned from 7—8—'58 forenoon
,, P. N. Sundar Rao	Posted as Asst. in Chemistry, Agricultural College, Coimbatore
,, Kumari Mary Clara, Asst. in Paddy, Agricultural College, Coimbatore	Transferred as Asst. in Cotton, Agricultural College, Coimbatore
,, J. K. Mathew	Posted as Asst. in Fruits, Fruit Research Station, Periakulam
,, K. Kuppuswamy, Extension Officer for Agriculture, Tiruppathur, N. A. Dt.	Posted as Extension Officer, for Agriculture, Moolanur
,, K N. Padmanabha Nambisan, Fruit Asst., Banana Research Station, Aduthurai	Transferred as Assistant in Fruits, Fruit Research Station, Periakulam
,, N. V. Raman	Posted as Assistant in Fruits, Model Orchard cum Nursery, Madurai, on the expiry of his leave on 18—10—58. A. N.
,, S. V. Madhavan Nayar	Appointed as Special Agricultural Demonstrator, (Sugarcane) Kallakurichy

Crop and Trade Reports

Mesta - First and Preliminary Report - 1958 — '59 : The area sown with mesta with Madras State upto 25—6 –1958 is estimated at 750 acres. Compared with the area of 610 acres estimated for the corresponding period of the previous year this is an increase by 23·0 per cent. Compared with the average area of 690 acres calculated for the five years ending with 1957—'58, it shows an increase by 87 per cent. The area estimated is the same as that for the last year in North Arcot, Coimbatore, Tiruchirapalli and Tanjore District. A decrease in area is estimated in the Madurai District while in Tirunelveli district, the area is estimated at 150 acres. The yield per acre is expected to be normal in Tanjore district and slightly below normal in North Arcot, Coimbatore, Tiruchirapalli, Madurai and Tirunelveli districts. The seasonal factor for the State as a whole works out to 98 per cent as against 99 per cent estimated for the corresponding report of the previous year. The total yield works out to 1390 bales of 400 lbs. of dried fibre. Compared with the yield of 1130 bales of 400 lbs. estimated for the corresponding period of the previous year, it shows an increase of 23·0 per cent. Compared with the average yield of 1270 bales of 400 lbs. calculated for the preceding five years, it shows an increase of 9·4 per cent.

Pepper First Forecast - Report — 1958—'59 : The area under the pepper crop upto 25—8—'58 in the districts of the Nilgiris and Kanyakumari is estimated at 525 acres (175 acres in the Nilgiris district and 350 in Kanyakumari district). The area estimated for the corresponding period of the previous year was 410 acres (150 acres in the Nilgiris district and 260 acres in Kanyakumari district) and the present estimate is an increase by 28·0 over last years estimate.

The condition of the crop is reported to be satisfactory in both of the districts.

Ginger First Report - 1958 — '59 : The area under ginger crop upto 25–8–'58 in the districts of Madurai, the Nilgiris and Kanyakumari is estimated at 900 acres. Compared with the area of 850 acres estimated for the corresponding period of the previous year, it shows an increase of 5·9 per cent.

An increase in area is estimated in the districts of Madurai and the Nilgiris and a decrease in the district of Kanyakumari. The condition of the crop is stated to be satisfactory.

Madras Agric. J., 45 : (10) 401—405, 1958

Review of Market Conditions of Commercial Crops in the Notified Areas for the Month of September, 1958.

Cotton : In this section lint : Candy of 784 lbs.
Kapas : Pothi of 280 lbs.

Tirupur : Coimbatore District : Season : There was a rainfall of 3·50 cm. during the month. Sowings of Cambodia is in progress in Avanashi and Palladam areas and sowing of Karunganni would take place in the coming week.

Arrivals and transactions : During the month the harvest started with an opening balance of 10473 candies of Cambodia and 2304 candies of Karunganni limt. The main arrivals, continued to be received from South Arcot, Salem and Pondichery into the Tirupur market during the month, were 16980 candies of Cambodia and 3762 candies of Karunganni lint to which were added 1972 candies of Cambodia and 316 candies of Karunganni locally ginned. Despatches from Tirupur accounted for 7931 candies of Cambodia and 1487 candies of Karunganni lint which were sent to Madras, Tanjore, Salem, and Dindigul and to places in Bombay, Kerala and Andhra Pradesh States. At the end of the month there was a closing stock of 9049 candies of Cambodia and 2275 candies of Karunganni lint.

Kapas : During the month the kapas market started with an opening balance of 29449 pothis of Cambodia and 5026 pothis of Karunganni kapas. The total arrivals into the Tiruppur Market during the month were 47242 pothis of Cambodia and 8849 pothis of Karunganni kapas. The disposals during the period were 30901 pothis of Cambodia and 6596 pothis of Karunganni kapas, in the market area of Tirupur. At the end of the month there was a closing stock of 16341 pothis of Cambodia and 2253 pothis of Karunganni kapas.

Prices: There was a moderate demand for all types of cotton. The price ranges were as follows :

	Lint (per candy of 784 lbs).	*Kapas* (per pothi of 280 lbs).
Cambodia superior quality	Rs. 900—981	Rs. 145—150
,, average ,,	Rs. 810—870	Rs. 120—130
Karunganni superior ,,	Rs. 850	Rs. 127

Ramanathapuram District: Season: Good rains were reported during the month and the same were beneficial for the sowings of Karunganni cotton.

Arrivals and transactions: The following were opening stocks, the arrivals, disposals and closing stocks of kapas and lint in important markets in the district during the month.

Name of market	Opening stock	Arrivals	Total	Disposals	Closing balance
Kapas in pothis of 280 lbs:					
Virudhunagar ...	1,000	3,200	4,200	3,700	500
Sattur ...	...	4,150	41,50	4,150	...
Rajapalayam ...	5,000	14,500	19,500	18,000	1,500
Total ...	6,000	21,850	27,850	25,850	2,000
Lint in candies of 784 lbs:					
Virudhunagar ...	315	650	965	665	300
Sattur ...	50	495	545	505	40
Rajapalayam ...	730	1,400	2,130	1,200	930
Total ...	1,095	2,545	3,640	2,370	1,270

Prices: The following were the prices of cotton kapas, lint and seeds in the district during the month.

Kapas in pothi of 280 lbs.	
Karunganni ...	Rs. 89— 98
Tinny Karunganni ...	Rs. 72— 88
Tinny ...	Rs. 60— 73
Uganda 1st quality ...	Rs. 133—158
,, 2nd ,, ...	Rs. 100—125
,, 3rd ,, ...	Rs. 58— 80
Lint in candy of 784 lbs.	
Karunganni ...	Rs. 706— 746
Tinny Karunganni ...	Rs. 650— 680
Tinny ...	Rs. 580— 636
Uganda Certified ...	Rs. 1296—1390
,, uncertified ...	Rs. 1126.00

Groundnut : (In this section kernels are in candy of 531 lbs and pods in tons).

South Arcot District: The arrivals of kernels in regulated Market Yards were 5587 tons during the month. A quantity of 3075 tons were disposed by Millers and 589 tons by Traders 257 tons were consumed by chekers. A quantity of 1484 tons were despatched to other districts like Tanjore, Madras, Tiruchy, Coimbatore, Salem and Pondichery.

Prices: The average prices that prevailed at the several markets varied from Rs. 176·43 to Rs. 187.41 per candy of 531 lbs. according to quality.

North Arcot District: Season: Rains during the month, were scattered and fairly large almost throughout the district and the same were helpful to standing crops.

Arrivals and Transactions: During the month the arrivals increased. The following were the stocks, arrivals, disposals and prices in the district.

	Opening balance	Arrivals	Disposals	Closing balance
Groundnut kernels (candy of 531 lbs.) ...	136	6475	4352	2259
Groundnut pods (Tons) ...	1970	1275	1730	1515

Prices: The prices of groundnut and its product were on the decrease except groundnut oil cake when compared with the last month's prices.

The following were the prices of groundnut and its products during September, 1958 compared to August, 1958.

		September, 1958.	August, 1958.
Groundnut kernels	(Cdy. of 531 lbs.)	Rs. 150—167	Rs. 165—185
Groundnut pods	(Bag. of 80 lb.)	Rs. 15—17	Rs. 13— 19
Groundnut oil	(Cdy. of 500 lbs.)	Rs. 328—340	Rs. 300—342
Groundnut cake	(Md. of 82 2/7 lb.)	Rs. 8—9·25	Rs. 9— 11

Ramanathapuram District: Arrivals and Transactions: The arrivals of groundnut kernels were on the increase. The groundnut market was active and brisk during the month.

The following were the arrivals and disposals of the groundnut kernels in Virudhunagar Market during September, 1958.

	Opening stock	Receipt	Disposals	Closing stock
Kernels (in cdy. of 531 lbs.)	Nil.	4600	4600	600

Prices: The following were the price range that prevailed for pods, kernels and oil during Septembor, 1958 compared to that of August, 1958.

	September, 1958.	August, 1958
Groundnut pods (Bag. of 80 lbs).	Rs. ...	Rs. 18—20
,, kernels (cdy. of 531 lbs).	Rs. 175—195	Rs. 172—185
,, oil (cdy. of 500 lbs).	Rs. 325—350	Rs. 300—330
,, oil cake (Mds. of 82 2/7 lbs).	Rs. 10·33–12·32	Rs. 9.80—12.00

Gingelly: (In this section bag is 168 lbs).

South Arcot District: Arrivals of gingelly seeds amounted to 2831 bags. Disposals were mainly to chekkus and they consumed about 625 bags. Despatches to other districts accounted for 1378 bages.

The average prices per bag of 168 lbs. varied from Rs. 62.00 to 68.00 according to quality.

Tobacco: (In this section tobacco is in candies of 500 lbs),

Coimbatore District: Arrivals and Transactions: At the end of the month under reports there was a stock of 16305 candies of chewing and 780 candies of cheroot tobacco. About 4935 candies of chewing and 400 candies of cheroot tobacco were exported to South Arcot, Madurai, Salem, Tirunelveli and North Arcot districts of Madras State and to places in Mysore, Bombay, Kerala and Andhra Pradesh.

Prices: There was some improvement in the off take of tobacco in exporting centres in Kerala State.

The price ranges were as follows:

Prices in Rs. per candy of 500 lbs.

Variety	I Grade	II Grade	III Grade
1. *Chewing tobacco (Sun-cured):*			
(a) Meenampalayam	400—480	275—350	150—250
(b) Other varieties	260—320	190—250	100—180
2. *Cheroot varieties:*			
Sun-cured grown in Erode and Bhavani taluks	250—320	200—250	150—190
3. *Chewing tobacco:*			
Pit cured grown in Palladam and Sulur areas.	240—330	180—230	80—140

Cardamom: *Arrivals and transactions:* During the month the arrivals of Cardamom in all the assembling markets were heavy. Exports to other States like Bombay were in large quantities. The arrivals of Cardamom at Bodinaickanoor and other centres in Periakulam taluk were mainly from the crop in Kerala State. The arrivals at Pattiveerampatti were mainly from the crop in the lower Palani hills (Thandikudi Hills) of Madurai district.

The estimated arrivals and stock positions of cardamom during September, 1958 were as hereunder:

Quantity in lbs.

Name of centres.	Estimated Arrivals.	Despatches.	Closing balance.
1. Bodinaickanur ...	3,95,000	3,75,000	39,000
2. Thevaram ...	30,000	28,000	3,000
3. Pannaipuram ...	30,000	21,000	10,000
4. Kombai ...	15,000	10,000	6,000
5. Uthamapalayam ...	10,000	8,500	2,000
6. Cumbum ...	75,000	58,000	25,000
7. Gudaloor ...	15,000	12,500	3,000
8. Pattiveeranpatti ...	54,000	52,500	7,000
9. Virudhunagar ...	45,000	48	18,000
	6,69,000	5,65,548	1,13,000

Prices: The minimum and maximum prices of Cardamom that ruled during September, 1958 for different trade qualities were as detailed below:

Prices in Rs. nP. per lb.

Bodinaickanoor, Thevaram etc.

Trade Varieties:

(1) Green (bulk)	Rs. ...	8.60 to 9.98
(2) Green (extra bulk)	,, ...	9.12 to 10.63
(3) Splits	,, ...	6.20 to 8.47
(4) Lights	,, ...	6.80 to 8.55
(5) Seeds	,, ...	9.14 to 10.90

Pattiveeranpatti:

I *Sundried:*

(1) Superior and bold	,, ...	9.90 to 10.66
(2) Medium and bulk	,, ...	9.27 to 9.87
(3) Inferior	,, ...	8.63 to 9.02

II *Store Green:*

(1) Superior and bold	,, ...	10.16 to 10.93
(2) Medium and bulk	,, ...	9.39 to 10.18
(3) Inferior	,, ...	8.96 to 9.35
(4) Splits	,, ...	7.99 to 9.02
(5) Lights	,, ...	3.60 to 8.19
(6) Seeds	,, ...	11.00 to 12.02

Virudhunagar:

(1) Green bulk	,, ...	9.75 to 10.00
(2) Green (extra bulk)	,, ...	10.50 to 10.75
(3) Bold qualities	,, ...	9.00 to 9.25
(4) Shipment	,, ...	12.00 to 12.25
(5) Seeds		

Madras Agric. J., **45** (10) : 406, 1958

Review of Administrative Activities of Market Committees during September, 1958.

General: The Market Committees of South Arcot, Market Committee, North Arcot Market Committee and Coimbatore Market Committee, Tiruchirapalli Market Committee continued to function during the month. The Market Committees of Ramanathapuram and Tirunelveli could not function due to the appeal pending with Supreme Court.

Enforcement: The progress of licensing by the Market Committees during the month were as follows:

Name of the Market Committees	Section 5 (1)		Section 5 (3)		Weighmen	
	A	B	A	B	A	B
South Arcot Market Committee	126	2027	89	1459	82	1354
North Arcot Market Committee	161	1284	140	1055	53	553
Coimbatore Market Committee	119	1234	84	983	2	561

A = Licences issued during the month.
B = Licences issued up to the end of this month.

Meetings: A special Committee of the South Arcot Market Committee was held on 17—9—1958. Eight members attended the meeting, 19 subjects were disposed of at the meeting. There were no meetings in other Market Committees during the month under report.

Quality Analysis: Nil.

Quality Competition: Nil.

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தவணைத்தாள்.

செ. எண் : ப. எண் :

வழங்கிய நாள். (1)	திரும்பிய நாள். (2)	வழங்கிய நாள். (1)	திரும்பிய நாள். (2)

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