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TO

THE MADRAS AGRICULTURAL JOURNAL

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TO

The Madras Agricultural Journal

Vol. XXIV, 1936.

Original Articles are Shewn in Heavy Types.

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Madras Agricultural Journal

(ORGAN OF THE M. A. S. UNION)

Vol. XXIV] JANUARY 1936 [No. 1.

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Editorial.

New Year Honours. We are extremely glad to note that two of our members are among the recipients of New Year Honours. The title of Rao Bahadur has been conferred on Mr. S. Sundararaman, Government Mycologist, Agricultural Research Institute and on Rao Sahib Y. Ramachandra Rao, Locust Entomologist, Karachi, under the Imperial Council of Agricultural Research.

RAO BAHADUR S. SUNDARARAMAN started service in the Department 30 years ago as assistant to Government Economic Botanist, was later appointed as senior assistant to Dr. McRae, Government Mycologist and he finally succeeded Dr. McRae when the latter left for Pusa. Mycology as a branch of agricultural science had developed but little 30 years ago when Mr. S. Sundararaman started work and he is one of the pioneers in India on the subject. A number of plant diseases of great economic importance have been investigated into, by Mr. S. Sundararaman during his long service. Mr. Sundararaman has been connected with the union ever since its inception and he is now its Vice-President.

RAO BAHADUR Y. RAMACHANDRA RAO like Mr. S. Sundararaman starting service as entomological assistant to Government Botanist worked his way up and was appointed the Madras Entomologist in 1921. During his service in Madras he was for a year put

on special duty as an All-India Officer to investigate the possibilities of finding a biological method of controlling the lantana and we believe this work of his, earned him the title of Rao Sahib. As Entomologist in Coimbatore he was responsible for starting work on biological methods of controlling insect pests. When the locust problem was taken up by the Imperial Council of Agricultural Research, Mr. Ramachandra Rao was selected for the post of Deputy Locust Entomologist and was later appointed as the Locust Entomologist. Mr. Y. Ramachandra Rao is a familiar figure to all members of the Union and during his stay in Coimbatore was one of the active members of the working committee and was for some years Editor of the Journal.

We offer our hearty congratulations to both of them on their well merited distinction. This distinction is a fitting tribute to two branches of science, Mycology and Entomology, the problems of which in their application to agricultural crops, are often complicated and incapable of striking the public imagination like some of the other branches of science.

SIR B. C. BURT. We are glad that knighthood has been conferred on Mr. B. C. Burt, Agricultural Expert and now the Acting Vice-Chairman of the Imperial Council of Agricultural Research. Every one connected with the agricultural departments in India, and who has had a chance of coming in contact with Sir Burt, cannot fail to be impressed with his greatness. He is industry personified and work is a pleasure with him, and there is no activity of the Imperial Council of Agricultural Research where his guiding hand is absent. The success of the Imperial Council of Agricultural Research has been in no small measure due to the ability of Sir Burt who has been its Agricultural Expert from the beginning. While distinguished members of other branches of Science, Botany, Physics, Chemistry, Medicine, Engineering etc. have received this distinction in India already, this is the first time that a member of the Agricultural Service has been chosen for this unique honour. We offer Sir Burt our very hearty congratulations.

Among other recepients of new year honours we are glad to note the names of the following agricultural officers in other provinces.

Khan Bahadur Afzul Hussain, Principal, Agricultural College, Lyallpur, Punjab; Rao Bahadur Tamane, Chief Agricultural Officer, Sindh, and Rai Sahib Lala Harbhajan Lal, Dy. Director of Agriculture, Eastern Circle, Partabgargh.

Ourselves. It is now exactly 25 years since the Madras Agricultural Students' Union was founded, and some of the founders who fortunately are still with us might well feel proud of the developments. The objects of the Union are to encourage an *espirit de crops* among its members and to exchange and record opinions and experiences in matters agricultural. The latter object was sought to be obtained by holding an annual conference and conducting

a journal as an organ of the Union. The journal first published as a year book in 1911, was converted into a quarterly the next year and was made into a monthly in 1915. Apart from the annual conference, the running of the journal is now the one important and sustaining activity of the Union throughout the year. Though in the beginning, the journal was serving a limited purpose, there is no doubt that it has widened its sphere of influence beyond the members of the Union who are all mostly members of the Agricultural Department. The changing of the name of the journal from The Journal of Madras Agricultural Students' Union into The Madras Agricultural Journal has been more than justified.

The main purpose of the Agricultural Department is to impart agricultural knowledge to the public and an agricultural journal like ours naturally supplements the other activities of the Department with regard to the dissemination of such knowledge. It is quite possible that a vernacular journal will be of even greater service because of the very small percentage of people who can read and understand English, but, there is one serious difficulty with regard to the publication of such a journal, namely the existence of four distinct vernaculars, Tamil, Telugu, Malayalam and Canarese in Madras and one cannot easily cater to the needs of the whole province. This is probably one of the reasons why, attempts made to run a vernacular journal in Madras either by private individuals or agencies, have not met with any success. Several of them had to be closed down after a short spell of life. Even agricultural journals in English started by private agencies in India have not succeeded for want of sufficient matter to publish and proper organisations to collect agricultural information. It is therefore a matter for gratification that our journal has run on continuously for the last 24 years.

Our journal is probably the only one of its kind that is run purely by a private organisation of honorary workers, without any financial help from Government or other persons, though of course the editorial board as officers of the Madras Agricultural Department, gets all the facilities and access to the matter that could be published. Since the commencement, each successive board of Editors has been trying to improve the journal by the addition of new features and though there is still scope for further improvements, finance is limiting that scope to a very great extent.

The journal now caters to two sets of people, one the members of the Union who are all officers of the Department, and the other, the enlightened agriculturists of the province. It must be admitted that the requirements of the two sets of people are entirely different. The Union member who is an agricultural officer would like to keep himself in touch with the latest developments of agricultural sciences, and to him, scientific articles appearing in the journal have an appeal. The

practical agriculturists of whom there are a large number of subscribers, desire, on the other hand, popular articles on agricultural matters which might be of some immediate use to them. The attempt to satisfy both the sets of people, has necessarily to be a compromise with the balance perhaps more towards scientific articles. And so far as scientific articles are concerned, we have to pat ourselves on the back, for we believe their standard is appreciated as is seen from the numerous requests we get for copies of special articles from other parts of India and elsewhere. Our articles are also freely quoted in other foreign scientific journals.

The paucity of popular articles has however to be deplored, but we are not without hopes, that this defect will soon be remedied. If only each member of the Union in the district would make up his mind to contribute at least one article a year, about some special crop or some special agricultural practice of the tract he is working in, we should soon have a surfeit of articles which are likely to be understood and appreciated by subscribers who are not officers of the Department. We have on several occasions appealed to our mofussil members and once again at the beginning of the New Year, we appeal for popular contributions from them.

As regards the finances of the journal, it is only recently, that we have just been able to make both ends meet. In the absence of any government grant or private donations the conducting of the journal has to depend upon the number of subscribers on the rolls, and unless the number of subscribers is increased, it would not be possible to make any improvements in the present get up of the journal. Though the strength of the Agricultural Department has been expanding rapidly in recent years, our membership list has unfortunately not gone up to the same extent. There are still a large number of officers who have not enlisted as members. If every member of the Department will enrol, we should have over 1000 subscribers (together with the non-member subscribers), and there should then be no difficulty at all to run the journal. In fact, we should be able to introduce several improvements in its present get up. May we hope that the New Year will bring a greater response to our appeal?

The Union is intending to celebrate in a fitting manner the 25th year of its foundation (Silver Jubilee) this year which also happens to be the 60th year (Diamond Jubilee) of the inauguration of Agricultural Education in the province. There is also a proposal to publish a special number of the journal called the Jubilee Number, and the accomplishment of all these would mean adequate finance. Unfortunately our application to government for financial help has been negatived and we have to depend upon the generosity of the members and well wishers of the Union. An appeal is being sent out by the Secretary of the Union and the amount of response that is obtained will decide the nature of the celebration we are to have this July.

RAINFALL AND YIELD IN THE COCONUT *

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and

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Introduction. The yield is the result of the interaction of genetical and environmental factors. The plant-breeder utilizes the genetic variance in evolving superior types; and the agronomist aids the former in adopting the optimum conditions for the growth of the superior type. One of the important functions of the agronomist is to suggest ways and means to reduce to the minimum the variations in the yields.

The yields of any group of coconuts fluctuate from year to year without any regularity, i. e., there is no periodicity. When the trees receive identical treatment every year, and when the age of the plantation does not influence the yields, the yearly variations in the yield must chiefly be attributed to the weather conditions. A consideration, therefore, of the effect of rainfall on the yield is necessary. In the present communication an attempt is made to show how the yields vary according to the rainfall and how the variations incidental to the rainfall can be reduced to the minimum by suitable changes in the agronomic practices.

Materials and Methods. The data utilized in this paper were collected at the Agricultural Research Station, Kasaragod (District: South Kanara) on the West Coast of India. The soil is red loam. The number of rainy days, and the total rainfall for the different seasons and years, are tabulated in Table I. The yield-data utilized in various correlations was collected from 105 regular bearing palms in Block I. The trees are of the ordinary tall type and they were about twenty-five years old in 1919. The plot has been manured and cultivated more or less in the same manner from year to year. The plot has never been irrigated.

In some of these trees, one or two bunches were damaged by beetles. As this would reduce the yield of the trees, the following correction was applied to the particular year's yield, when any damaged bunch would be ready for harvest. The missing yield is

* Contribution No. 9 of the Oil Seeds Section of the Madras Department of Agriculture.

$y=\frac{x \times a}{a_1}$ were x is equal to the average for the missing month calculated from the rest of the years, a the average yield per month for the remaining months of the same year, and a_1 the average yield per month for the remaining months of the remaining years.

Wishart and Allen's method could not be used as the number of missing bunches was large (300) and would involve laborious calculations. In working out the relationships, ordinary correlation tables have not been prepared. The yearly yields ranged between 10 and 180 nuts per tree per annum. and, therefore, fine grouping makes the number of class intervals unwieldy. Similarly, for the rainfall, the differences are as low as half an inch and this fact causes the inclusion of two or more years' data exclusively into the same row. It was, therefore, thought better to use the simple product-moment method where the correlation coefficient r is given by the formula:

$$\frac{\Sigma d' d''}{\sqrt{\Sigma d'^2 d''^2}}$$

As the correlations are worked out in the same manner for all the combinations of the rainfall, the relationships are comparable among themselves. Since, by this method, the effective number of readings dwindles down to 13, which is too inadequate for an analysis of this kind, the relationship between the rain and the yield is considered to be present in cases where r is not less than 0·6; this is enough to lodge the P between 0·02 and 0·01. Before proceeding with the presentation of the data, it must be admitted that the only justification for the departure from the orthodox procedure of dealing with the data spread over a large number of years, is the importance of drawing the attention of the workers to this problem.

Rainfall.—In point of distribution of the rainfall, the coconut areas in India fare very badly when compared to Ceylon and Malaya. On the West Coast, from the middle of December up to the first of April, only a few showers are received. The number of rainy days and the total rainfall for the different seasons and years are tabulated in Table I.

During the south west monsoon very heavy rainfall is received, and the south west monsoon, if at all late, is late only by a few days. The north east monsoon rains are not uniform, but the variations in the early part of the season have very little effect on the yield. That the changes in the quantity of rain received during the south west monsoon and early part of the north east monsoon bear no relation to the yield, is evident from the correlations in Table II, where the value of r is not significant for any of the comparisons. The total rainfall during the calendar year, previous to the year of harvest, does not appear to affect the yield.

Table I.

The Distribution of Rainfall.

Year.	South west monsoon.	North east monsoon.	Hot weather.	Total.	Calendar year.	South west monsoon rains during 1919 *plus* hot weather rains during 1920 for 1921 yields.	North east monsoon *plus* hot weather rains just preceding the year of harvest.	Two hot weather rains previous to the year of harvest.	Total rains during the calendar year.	No. of rainy days.		
										North east.	Hot weather.	Total.
1919–20	104·14	20·55	10·39	135 08	...	...	...	...	...	...	...	...
1920–21	115·95	10·57	5·43	131·95	...	...	...	...	130·97	35	12	47
1921–22	115·70	12·51	13·79	142 00	1921	109·57	25·98	15 82	141·55	24	22	46
1922–23	104·56	12·17	15·16	131·89	1922	129·74	24·36	19·22	131·89	18	27	45
1923–24	119·75	3·61	4·25	127·61	1923	130·86	27·67	28·95	127·61	24	8	32
1924–25	117·88	3·75	15·28	136·91	1924	108·83	16·42	19·41	136·91	11	23	34
1925–26	101·42	24·56	24·48	150·46	1925	135·03	18·89	19·53	150·33	14	27	41
1926–27	99·64	10·38	1·42	111·44	1926	142 36	28·23	39·76	111·44	32	6	38
1927–28	91·37	16·47	30·78	138·62	1927	102·84	25·98	25 90	138·10	17	22	39
1928–29	86·49	21·85	16·47	124·81	1928	130·42	41·16	32·20	124 81	20	12	32
1929–30	110·53	26·11	23 34	159 98	1929	107·84	32·94	47·25	159 36	25	22	47
1930–31	88·97	23·49	19 41	131 87	1930	109·83	45·19	39 81	131·87	27	21	48
1931–32	117·71	9·38	20·45	147·54	1931	129 94	45·52	42·75	147 54	30	18	48
1932–33	75·18	26·95	25·06	127·19	1932	109·42	43·94	39 86	127·19	30	25	55
1933–34	102·95	20·50	46·80	170·25	1933	142·77	...	...	...	...	...	...

Table II

Coefficient of correlations between the yield and rains of :—	*r*
South west monsoon during the year previous to the year of harvest.	– 0·3004
One north east monsoon rains previous to the year of harvest.	0·1141
South west monsoon in 1919 *plus* hot weather rains, i. e., for 1921 yields.	0 1790
Total rains during the calendar year previous to the year of harvest.	0·5430

The rains received during the south west monsoon are very heavy, and the variations in the rainfall during this period are large enough to mask the effect of other rains when they are combined with the rains received during the south west monsoon. The rainfall during the south west monsoon has, therefore, to be eliminated in determining the relationship between the rainfall and the yield. For the same reasons, the rainfall during the early part of the north east monsoon is also eliminated. The rains which are most likely to affect the trees are those received during the later part of the north east monsoon and during the hot weather. The rains during the hot weather period—January to April—are most irregular (fig. 1). In the following table the important rains are given from 1919 to 1933. In this tabla, x_1 denotes January to May rains of the year of harvest, x_2 January to May rains during the year previous to the harvest, and x_3 January to May rains during the second year previous to harvest.

Table III.

Important Rains.

Years.	January.	February.	March.	April.	Up to 15th May.	After 16th May.	x_1	x_2	x_3	F+M* of x_1, x_2 and x_3.	Average yield per tree per year.
1919	...	...	0·14	0·11	...	5·14	...	...	...	...	...
1920	0·07	...	...	2·86	...	1·07	...	...	...	..	...
1921	0·98	...	...	1·72	2·07	5·13	0·57	2 93	0·25	0 14	61·13
1922	0·45	...	...	2·61	1·79	5·89	5·14	2·70	2 93	...	66·58
1923	...	...	0·45	0·12	0·08	3·18	2·45	3·06	2·70	0·45	58·45
1924	...	...	2·44	2·70	0 03	3·21	0·62	5·57	3·06	2·89	57·88
1925	...	...	1·20	1·25	3·12	13·31	...	5·12	0·57	4·09	60·30
1926	0 13	0·40	...	0·09	...	0·31	...	2·45	5·14	4·04	78·44
1927	...	...	0 03	2·34	...	11·24	...	0·62	2·45	1·63	51·77
1928	0·52	4·72	3·15	...	0·13	0·27	...	2·37	0·62	8·30	70·49
1929	...	...	0·20	5·39	5·40	5·99	...	8·39	2·37	8·10	86 26
1930	0·02	...	...	4·77	10·71	13·50	...	5·59	8 39	7·80	85·29
1931	...	...	0·02	8·36	1·60	7·74	...	4·79	5·59	0·40	73·98
1932	...	...	...	0·42	1·20	22·65	...	8·38	4·79	0·20	62·09
1933	...	...	0·21	6·19	...	19·51	...	0·42	8·38	0·41	60·10
										Mean	67·14

* x_1 stands for total rains in January, February, March and April during the year of harvest. x_2 stands for total rains in the same months during the year previous to harvest. x_3 stands for total rains in the same months during the second year previous to harvest. F and M stand for February and March rains respectively.

Table IV

Correlations of yield with important rainfalls.

(*Note*:—J, F and M stand for January, February and March rains respectively.)

		Value of r
1	x_1 = total rains in January, February, March and April during the year of harvest.	0·3400
2	x_2 = total rains in the same months during the year previous to harvest.	0·4598
3	x_3 = total rains in the same months during the second year previous to harvest.	0·3393
4	$(x_1 + x_2)$	0·6428
5	$(x_2 + x_3)$	0·6273
6	$(x_1 + x_2 + x_3)$	0·6767
7	J+F+M of $(x_1 + x_2 + x_3)$	0·7211
8	$(x_2 + x_3)$ + (J+F of x_1)	0·6995
9	J+F+M of x_2 and x_3	0·8104
10	J+F+M of x_2 + (J+F of x_1)	0·5589
11	F+M of (x_1, x_2 and x_3)	0·6656
12	x_2 + (F+M of x_1)	0·4628
13	x_2 + (J+M of x_1)	0·5199
14	J+F+M of x_2 and F+M of x_1	0·4170
15	J+F+M of x_1 and x_2	0·4587
16	J+F+M of x_2 and J+M of x_1	0·3723
17	x_2 + (J+F of x_1)	0·5669
18	April of x_3 + (J+F+M of x_2) (J+F of x_1)	0·3989
19	x up to the 15th May + (J+F of x_1)	0 6409
20	x_2 and x_3 up to the 15th May	0·3391

Note:—All values of r above 0·6000 are clearly significant. P is less than 0·02 The differences between these significants are not significant.

In table IV the coefficients of correlations for twenty different combinations of rainfall are tabulated. The magnitude of the r is the largest for the combination (9) —i. e., January to April rains for two years previous to the harvest. The coefficients for seven other combinations are also significant.

The values of the total correlations, viz., ryx_1, ryx_2 and ryx_3 are utilized in finding out the partial correlations (y = yield). The values of the partial correlations are given below:—

Particulars.	Correlation coefficient. Total.	Partial.
$ryx_1 - x_2x_3$	0·3400	0·2769
$ryx_2 - x_3x_1$	0·4598	0·3466
$ryx_3 - x_1x_2$	0·3393	0·2133

For these data partial regression will be more appropriate and therefore the following relationship has been calculated for the deviations of yield y in terms of the deviations of the respective rainfall totals from their means:—

$$y = 2{\cdot}3427x_1 + 3{\cdot}9907x_2 + 0{\cdot}8538x_3$$

A multiple correlation where $R = 0{\cdot}798$ was also obtained. The multiple correlation value is very close to the coefficient of correlation for the total rains in three years during January to April. The total as well as the partial correlations are not significant, thereby, indicating that the rainfall of one year is not related to the rainfall of another year for the observations made, and that total correlations, wherever significant, are not spurious.

Significance of the partial regression coefficients.

Regression coefficient.	Value of b.	Value of P.
b_1	2·3407±0·84	< 0·02
b_2	3·9907±1·01	< 0·01
b_3	0·8538±0·78	> 0·90

The regression coefficients, given above, show that the rainfall of the year previous to the year of the harvest are significantly correlated to the yield. Though the regression coefficient, for the rainfall of the second year previous to the harvest, is not significant, the importance of this rainfall is derived from the fact that multiple correlation is significant.

Variance due to	Degrees of freedom.	Sum of squares.	Mean square.	Z
Linear regression	3	907·30	302 43	
Deviation from linear regression.	9	542·89	60·32	
Total.	12	1450·19		0·8059

The figures given above show a slightly significant deviation from linear regression, indicating that the curve of the relationship between

the rainfall and the yield does not follow a straight line. The points appear to be distributed along a parabola.

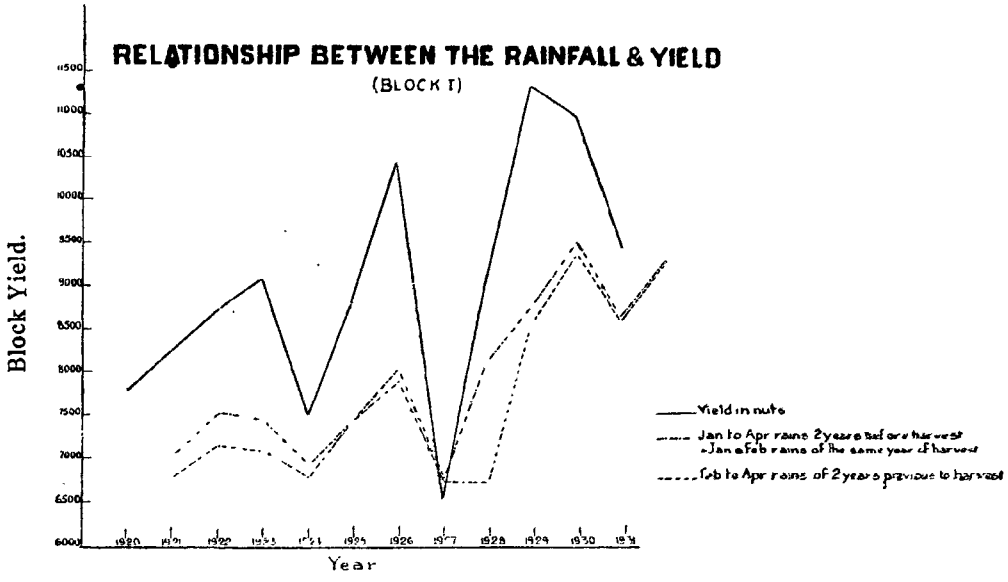
A second degree function of the closest fit of parabola has been calculated by the least square method for the combinations of the rains which give highly significant values of r. The details regarding the equation of the parabola of the closest fit are given below:—

Particulars of rains.	Equation of parabola.
(1) x_2	$y = 54{\cdot}489 + 5{\cdot}227x - 0{\cdot}3x^2$
(2) $x_3 + x_2$ + January and February rains of the year of harvest.	$y = 44{\cdot}795 + 4{\cdot}336x - 0{\cdot}149x^2$
(3) January, February and March rains of (x_2 and x_3)	$y = 57{\cdot}2 + 4{\cdot}521x - 0{\cdot}13x^2$
(4) January, February and March rains of ($x_1 + x_2 + x_3$)	$y = 56{\cdot}556 + 3{\cdot}564x - 0\ 098x^2$
(5) $x_1 + x_2 + x_3$	$y = 44{\cdot}5 + 1{\cdot}734x - 0{\cdot}009x^2$
(6) February and March rains of $x_1 + x_2 + x_3$	$y = 63{\cdot}658 - 1{\cdot}795 + 0{\cdot}48x^2$

In all the above equations, y denotes the yield in nuts per tree and x represents the quantity of rain in inches during the respective periods. All the equations show, as expected, that the yield does not go below a certain minimum even if x becomes zero. The minimum yield that can be expected, per tree, even if January to April rains for the two years prior to harvest and for the year of the harvest are nil, is about 44 nuts per tree.

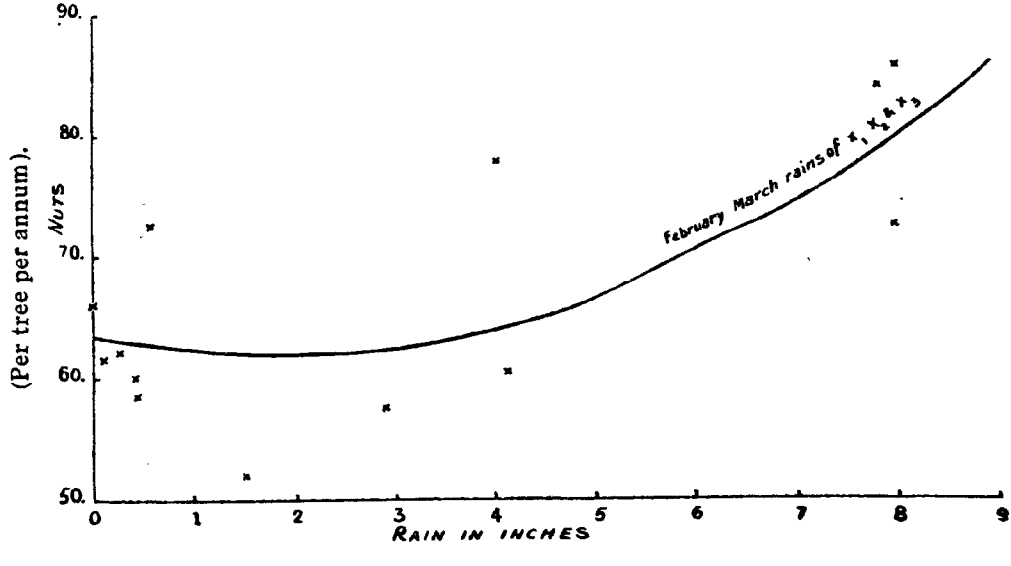
From Table III, it is evident that none of the combinations of rains—the total amount of rainfall—explain the yield during the two years 1926 and 1932. Contrary to expectations, the deviations of the yields from the mean are, for these two years, opposite in sign to the corresponding deviations of the rains for the mean. The rains which relate to 1926 yield, *i. e.*, those of 1925 are below the mean, while the yield is well above the mean. The position during 1932 is just the reverse. These two, out of 13 readings, cannot be attributed to chance, but they may be more appropriately termed abnormal readings.

The year 1925 which is responsible for the yield during 1926, had uniform rainfall during March and April and there had also been continuous light showers from the middle of April to the out-break of the south west monsoon. The year, therefore, experienced the least amount of drought. The poor yield in 1932 is due to the extreme long spell of dry weather, from December 1930 to the end of March 1931. The highest yield is obtained in 1929, on account of heavy rainfall amounting to 7·87 inches during February to March.



GRAPH I

GRAPH II



In all the equations, excepting the last, the coefficient of x^2 is negative (with due regard to the inadequate size of the data) showing that yield cannot go on increasing with the rains. Even though the totals of two or more different rainfalls have been combined in some of the groupings, the mathematical representations obtained therefrom may be taken to show the existence of a relationship, if not the actual extent thereof. The sixth equation, which shows the relation of February-March rains to yields is unique in that the coefficient of x^2 is positive and that of x negative. Since there is no limit to the positive, theoretical value of the ordinate of the curve, it is to be understood that there is a limit to the quantity of rainfall which can be expected during the months of February and March; but a large quantity of rain invariably increases the yield. The high value for c (63·58) of this equation should safely be taken to mean that rains during the other months of the year increase the yield up to a certain period. The negative coefficient of x indicates that the yield is adversely affected by a small amount of rain in February and March; but the value of y rises when x is more than that particular value. Since $y = 0{\cdot}96\,x - 1{\cdot}795$ is the equation of the gradient of the provisional curve of the sixth equation, it means that the yield is minimum when x (the rainfall) is 1·85 inches. It may, therefore, be inferred that a substantial amount of rainfall, *i. e.*, more than 1·85 inches during February to March is important.

The observed and expected value of yield for the sixth equation are shown in graph II.

Rainfall and intercultivation. It is pertinent for a planter to question as to how the variations in the yield consequent to the fluctuations in the rainfall can be avoided or reduced. For the localities where the gardens cannot be irrigated, the intercultivation reduces considerably the annual variations in the yields.

A plot has been left uncultivated since 1916. The weeds are not removed and the palms grow almost in a wild state except that they are not as crowded up as they would be in nature. In another plot intercultivation has been practised since 1916. The land in this plot is ploughed two to three times in the year and occasionally cultivated with Guntaka or the showel cultivator to keep off the weeds. None of the plots were manured. In the following table the annual yields for these two treatments, viz, uncultivated and intercultivated, are recorded.

Table V. *Yield and intercultivation.*

Years.	Average number of nuts per tree per annum.	
	Uncultivated.	Intercultivated.
1917	4·0	14·4
1918	8·3	23·5
1919	6·4	44·4
1920	1 7	46·3
1921	1 6	54·5
1922	13·1	59·3
1923	11·7	56·4
1924	7·4	46·0
1925	2 7	48·4
1926	11·6	65·6
1927	2·4	30·4
1928	2·3	59 1
1929	12·6	58·1
1930	0·3	59·1
1931	1·7	45·3
1932	4·6	47·9
1933	11·0	46·1
1934	3·8	37·1
Average per year—1917 and 1918	6·2	19·0
Average per year—1919 to 1934	5·9	50 3
Percentage increase in the average of 1919 to 1934 over the average of 1917 to 1918	- 4·8	164·7

The yield in the cultivated plot has increased suddenly in 1919 by 134 per cent. of the average of 1917-18. The increase in the yield after 1919 has been gradual. Annual variations in the yields of the cultivated plot are very low when compared with those of the plot left uncultivated. The coefficient of variability for the cultivated plot is 16·6 per cent., but for the uncultivated plot it is as much as 76·2 per cent. The cultivated plot is decidedly less subject to the seasonal conditions than the uncultivated plot. Intercultivation is, therefore, one of the methods to be utilized in regulating the production.

Discussion:—The study has pointed out that yield in any particular year is influenced by January to April rains for two years previous to the harvest, together with the rains in January to April of the year of harvest. To understand, how the rains during the three years affect the yield, a knowledge of the coconut crown is necessary. The details regarding the crown of a bearing tree as observed in January 1934, are given below:—

Leaf No.	When the inflorescence will be harvested.	The condition of the inflorescence.
10	January 1934	Not ready for harvest
18	September 1934	Tender nuts four months old.
22	January 1935	Spadix just opened.
32	November 1935	The last opened leaf. The spathe will open in about ten months.
34	January 1936	Unopened leaf. The spathe will open in January 1935.
45	December 1936	Unopened leaf. The spathe will open in December 1935.

On the dissection of the crown, it is found that in the axils of leaves, 23 to 45 there are developing spadices, at various stages of the growth. The rains during January 1934, would, therefore, affect these developing spadices, which would come up for harvest during 1935 and 1936. It would also affect the shedding of buttons from the spadix which opened during January 1934. In a similar manner, the rainfall in each of the months during 1934 would affect the setting of the crop to be harvested in 1935. Thus the rainfall during 1934 would affect the yields in 1934, 1935 and 1936.

The development of the inflorescence is a slow process taking about thirty-four months from the time of the differentiation of the flower primordium to the opening of the spathe. The maximum elongation of the spathe occurs during the period of six months prior to the opening of the spathe. The branches of the inflorescence begin to form about sixteen months prior to the opening of the spathe; and severe drought occuring at this period kills the growing points and the spathe aborts. Park (1934) has found that the drought affected the yields for a period of about thirty-two months after the commencement of drought. Thus there is support for the view that the effect of rainfall lasts for about three years after the incidence of the rainfall.

Park (1934) found that severe drought experienced in Puttalam (Ceylon) in 1931, decreased the copra per nut production for a period of one year with the maximum effect approximately six months after the drought. Shepherd's (1926) investigations, in Trinidad, have revealed a positive and significant correlation of $0{\cdot}733 \pm 0{\cdot}072$ between the rainfall over a six month period and the size of the nut one year later. The findings of Shepherd, and Park are in agreement since the size of the nut and copra per nut production are correlated. Patel (1934) has found that the size of the nut and its copra content are correlated. He found the following coefficients of correlations:—

(i) Between the volume of the unhusked nut and its yield of copra $0{\cdot}659 \pm 0{\cdot}013$,

(ii) Between the volume of the husked nut and its yield of copra $0{\cdot}680 \pm 0{\cdot}0127$.

The authors have, however, not attempted the study of the effect of rainfall on the size of the nut or on the yield of copra per nut. From the point of view of the practical agriculturists, the most important finding is the utility in minimizing considerably the effect of rainfall on yield.

Summary and conclusions. The study has pointed out that yield in any particular year is influenced by January to April rains for two years previous to harvest, together with the rains in January to April of the year of harvest. The study of the crown has shown how the rainfall in a particular year affects the yields during that year and the

succeeding two years. On the West Coast of India, the critical rains are those which are received during January to April. Annual variations in the yields of nuts are much more for the uncultivated plot than for the cultivated plot. The vagaries of seasons have less effect on the trees in a cultivated garden, than on those in a plot left uncultivated.

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MULTIPLE SEEDEDNESS IN SORGHUM AND CONSEQUENT REPERCUSSIONS

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The occurrence of double seeds in cereals is frequently reported. The presence of double seedeed varieties in sorghum is on record. In a previous article (G. N. R. Ayyangar and M. A. S. Ayyar, 1929)[1] the stray occurrence of double seeds in a variety of sorghum (*S. Roxb* var *hians.*) has been reported and the possibility of accentuating this double grained condition by continued selection over a period of years indicated. Such selection work was done but resulted in no appreciable increase in doubleness. The range of occurrence proved to be of about the same degree of fluctuation.

While this selection work was in progress further fresh material was obtained from various sources and led to a detailed and careful examination of this doubleness. The material represents varieties from Madras, Central Provinces, and Bihar in India and Nigeria, Rhodesia and Tanganyika in Africa. The incidence of doubleness varied according to the variety. This variation was from head to head in the variety and in the incidence within the earhead. In six varieties (mostly *S. Durra*) all the earheads produced double grains. In the others the incidence was from 1 to 70 per cent of the population. This wide range of material from the various parts of the world representing varying degrees of manifestation of doubleness afforded very good material for the study of this character.

In M. S. 2556, a variety from Nigeria, an analysis of a typical earhead showed that out of the 490 spikelets, 89 were single seeded, 387 double seeded and 14 triple seeded. The double seeded were 79 per cent and the triple seeded 2·8 per cent of the total number of spikelets. In A. S. 3618, a pure line selected from a Bihar variety, the incidence of triple seeded spikelets in an earhead was as much as 36 per cent. This accentuation in tripleness resulted in the production in the same earhead of 81 four-seeded, 14 five-seeded and 3 six-seeded spikelets representing 7·7, 1·3 and 0·3 per cent respectively of the total number of spikelets. This occurrence of 4, 5, and 6 seeded condition in the same spikelet (Fig. 1) is the first on record in sorghum. The incidence of six seeded-ness is 0·3 per cent, a considerable excess over the 0·23 per cent incidence of tripleness recorded by Karper (1931)[2].

This tendency to multiply the seeds finds its commonest expression in doubling. The North Indian name, *Dho-Dhanya*—Two Grains—is connotative of this frequent occurrence. Before the details of this doubling are gone into, the structure of a grain-bearing sorghum spikelet may be given. The two outer glumes of the spikelet are leathery. The two inner glumes are hyaline. The inner-most glume (hyaline) has a palea and between these two are the floral parts producing the seed. It is this fourth grain-bearing glume that bears an awn. The inner glumes, as has already been mentioned, are hyaline and any protection to the growing grain is afforded by the outer leathery glumes that are behind these hyaline ones. When the fourth glume bears a grain between it and its thin palea, the grain develops with the embryo towards the side of its glume, the development of the endosperm being towards the palea and therefore towards the third hyaline glume and the first leathery one behind it.

This free development of the endosperm towards one side leaves the grain asymmetrical with reference to the embryo. Another effect of this glumal equipment is the flat disposition of the growing endosperm which the resistance of the leathery glumes impose on it.

The first type of doubling and the commonest is when the third glume which is hyaline bears a grain in its axil subtended by a new palea which it develops to enclose this second grain. As in the case of the first grain the embryo is towards its glume and the endospermal development towards its palea, with the inevitable result that in this common type of doubling, the two embryos are away from each other, one each towards the outer leathery glumes. This opposite disposition of the embryos is therefore much more simple of explanation than in terms of "inversion" (Karper)[2].

The endosperms of both the grains are flattish and the flatness of disposition is in a plane parallel to the glumes. This abnormal development in an otherwise abortive glume leads to the natural result of

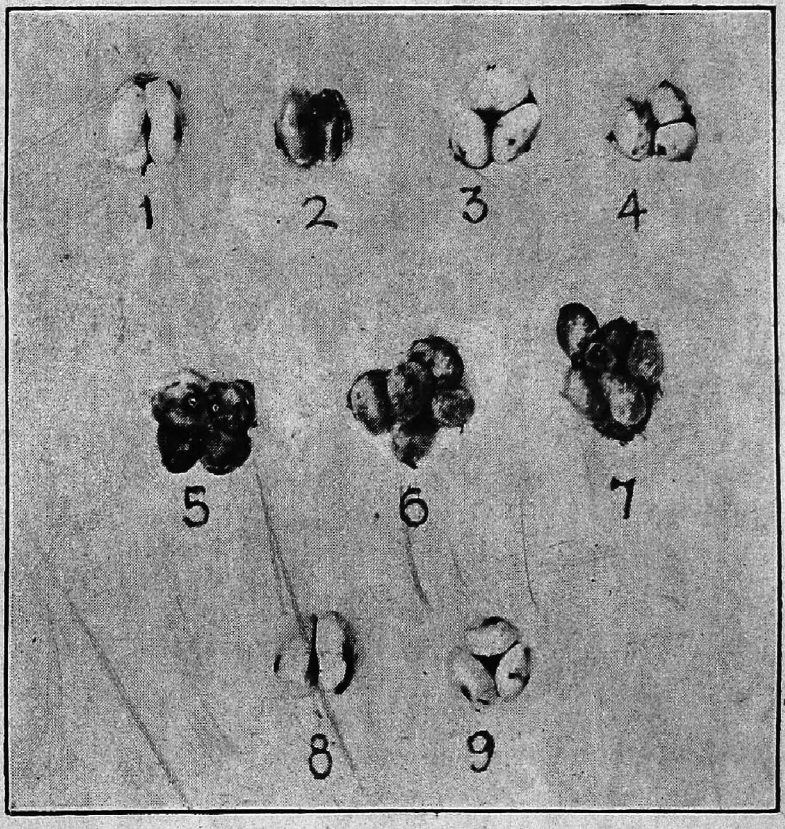

Fig. 1.

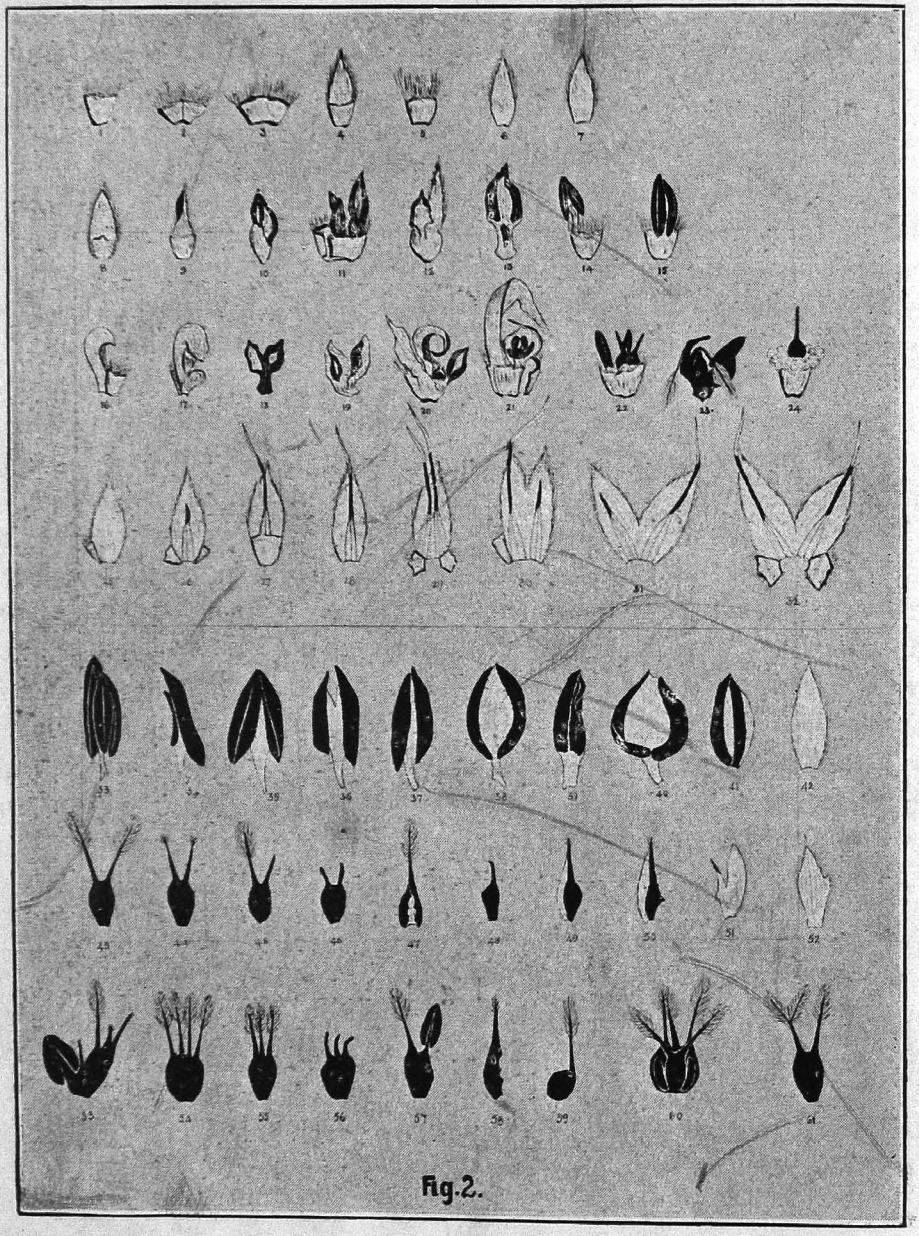

Fig.2.

one of the pair—the new one—being a bit smaller (Fig. I, 2) than the other—the usual one. The two leathery glumes are a protection to the flowers and the growing grain. The two inner glumes could alone bear grains in their axils—so much so that this type of fertility and the double seeds that result therefrom can be double and no more. The "primordia of a third flower" (Karper)[2] have not been met with. From tripling to six-seeded-ness having been met with, the causes for the phenomena are otherwise than this basic fertility of these inner glumes.

A second type of doubleness is the one that results in usually two and occasionally three seeds within a lemma. (Fig. I, 1, 8), The seeds resulting therefrom fall under the group of connate, and Siamese twin group. This doubling occurs within a lemma and involves no excess floral envelopes. There are two embryos. The endosperm developes in support of each of these two. This double development is not easy towards the leathery glumes. The two halves of connate grain therefore grow out and fill the V-shaped interstices formed by the glumes forced apart. This type of doubling and the free development of endospermal growth on two sides instead of one, leaves the double grain, taken as a unit, symmetrical with reference to the two embryos and the two endosperms, each half being as usual, asymmetrical by itself. Such a disposition of the embryo and its endosperm in doubleness will automatically leave the embryos adjacent to each other. The very nature of this doubling is such that no marked inequalities can exist between the two halves. An accentuation of this type of doubling can lead to triplets in the same lemma (Fig. I, 3 & 9). When triplets occur, their embryos are likewise at the centre and near each other.

The above two types of doubling may occur either alone or together in one and the same spikelet. When they occur together it is the normal grain in the fourth glume that turns connate, leaving the newly activated third glume usually single. This leads to triplets, (Fig. I, 4). Occasionally the grain in the third glume may also turn connate. This results in quadruple seeds (Fig. I, 5). Other degrees of intensity in manifolding, representing a combination of these dual lines of doubling result in the extreme cases of six and five grains (Fig. I, 6 & 7).

This prolificness is also reflected in the pedicelled spikelets which are occasionally antheriferous. An examination of a number of spikelets in *Dho-Dhanya* showed that even in these pedicelled spikelets the third glume bore anthers, only these tended to be a bit smallish in size. The pollen in these anthers was normal. There were two lodicules and a palea. In most cases there were only two anthers, the third one proliferating.

This proliferation in grains led to a close examination of the incidental floral accompaniments. Several abnormalities have been met with and most of these have been connected with the newly activated flower in the third glume. The normal equipment per flower are the usual single ovary, three stamens, two lodicules and two stigmas. The intense proliferation, firstly by the activation of the third glume into fertility and secondly by each of these centres of fertility proliferating into connateness sometimes of a triple degree, created conditions so chronically different to the usual, that the normal ratio between the number of grains and the attendant floral accompaniments got seriously upset. This led to metamorphoses of types tending to throw intense light on the fundamental trimerousness of the grass flower. Three lodicules and 3 to 5 stigmas have been met with. Six stamens in entirety did not occur. This trimery is and could never be met with in perfection but all the rudimentary stages indicative of this have been experienced. Most of the aspects are naturally abnormal. The stages by which the metamorphosis of floral parts have occurred are in Fig. II.

A series by which the ciliate, fleshy lodicule turns into a parchment-like ciliate lemma is pictured in Fig. II, 1-7. The stages through which a lodicule gets metamorphosed into a stamen are presented in sketches 8-15. A lodicule turning through various incipient stages into an additional flower is pictured in sketches 16-24. The lodicule turning into a lemma with an awn, (the sole vestige of a glume that could be fertile) is portrayed in 25-32. The transitions between an anther and a lemma are figured in 33-42. Similarly, between an ovary and a lemma in 43-52. The abnormalities in stigmatic doubling are given in 53-61.

These multifloral tendencies leading to an elaboration of the floral parts in a unifloral type are of intense evolutionary interest. They amply bear out the hexamerous condition of the Grass Flower and lend weight to Saunders' (1925)[3] interpretation thereof.

This double seeded-ness having been met with in a constancy of manifestation, crosses have been made with single seeded varieties. The first generation plants were double seeded and further generations are keenly looked forward to.

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FRUIT MARKETING IN MADRAS PRESIDENCY WITH SPECIAL REFERENCE TO ORANGES

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The total area under fruits and vegetables including root crops in the Presidency is about ·7 million acres. Roughly a little over a third of this area, is under mangoes and about 20% under plantains; only about 15,000 acres are under citrus fruits.

Most of the plantains produced in our Presidency find a sale in the local shandies. The quantity that moves by rail to markets in cities and large towns, is of the order of about $8\frac{1}{2}$ lakhs of railway maunds for the southern districts, of which, Madras City alone consumes more than a third. During the past few years, we are faced with the difficulty of finding proper markets for plantains, and, the possibilities of finding markets outside the province have had to be examined. In this connection, the Agricultural Department has been considering the development of export trade to North India, and with the co-operation of the railways has been able to obtain special rates for through wagons to certain cities in the north. Questions like quick transport, the provision of special wagons suitable for fruit traffic etc., are engaging attention. With the grant made by the Imperial Council of Agricultural Research intensive research work on plantain has been proposed to be taken up in Coimbatore and other plantain growing areas.

Although our position in respect of production of plantains is satisfactory, it is hardly so with other fruits. With regard to grapes, for example, we are importing heavily from Northern India to the tune of four thousand maunds, while our consumption of apples, which also runs to about the same quantity, is practically met from supplies from outside the province, as also from outside India like Japan, Africa and America. We have also no production worthy of the name in the case of plums, peaches and similar classes of choice fruits. Madras imports annually, plums to the extent of 800 maunds mainly from Mirzapore, and also from South Africa. All these facts are enough to show that in the matter of fruits there is a wide market, even in our own province, for expansion.

Let us now consider about oranges with which we are more concerned today. Although the area under citrus fruits is of the order of 15,000 acres, the acreage under oranges is limited to certain districts as follows :—

Sathugudi Oranges	...	Ceded Districts, Chittoor and North Arcot.

* A lecture delivered on the occasion of the opening of the Fruit Research Station at Anantarajpet on the 12th December 1935 by the Hon'ble Mr. P. T. Rajan.

Coorg Oranges or Kamala (Loose Jacket)	...	Nilgiris, Salem, Madura, Vizagapatam and Godavari.
Salem (Tight Jacket)	...	Salem and Nilgiris in parts.
Batavin ...	...	West Godavari and Kistna.
Sour Oranges ...	...	Guntur, Kistna and Godavari.
Mozambique ...	...	Parts of Ceded Districts.

Besides these home-grown varieties, Madras imports largely from Nagpur, and smaller shipments from South Africa, Australia and America. Taking the case of Madras City, which is the largest consuming centre in the Presidency for oranges, the supplies during 1934–35 have been as follows:—

Nagpur Oranges	...	37,360	Railway maunds.	
Sathgudi Oranges	...	35,000	,,	,,
Batavian (mainly)	...	7,000	,,	,,
Salem Oranges	...	4.000	,,	,,
South African Oranges	...	400	,,	,,

We have not yet received full figures from certain places, but from the figures already quoted, the supply of Madras is of the order of 90,000 maunds of which Nagpur oranges alone contribute about 45%. These oranges have also found good markets in the south of the Presidency in places like Trichinopoly, Madura and Coimbatore. The last mentioned place alone is reported to consume 50,000 rupees worth of Nagpur oranges every year. Besides Nagpur oranges, the above three districts receive supplies from Coorg through the assembling market at Tellicherry. Even four to five lorry loads of 15,000 fruits each per day are consumed in the season from December to March. I have taken the imports first, as they are broadly indicative of our deficiencies, and therefore of our market avenues.

Let us next take the case of our home production. The *Sathgudi* oranges find a market largely in Madras City. They are very popular in Madras and fetch better prices than any other variety. Oranges from the Nilgiris are consumed largely in Coimbatore, Salem and Trichinopoly districts and to a small extent in Madras. The Salem orange finds a market in Madras and Coimbatore, but what is known as '*Cheeni*' in that variety is of the tight jacket type and very sour. It is a cheap orange and arrives early in the season, at a time when other oranges are scarce, and therefore finds a ready market. The loose jacket or *kamala* of the Circars finds a sale in the districts of production. It also moves to Madras, but the quantity is small as compared to Nagpur or *Sathgudi* oranges. The Batavians however are most popular in their own tract, and have not found extensive markets outside. They move in small quantities to Madras, Nizam's State, Karagpur and Vizianagram. Lastly, we have the sour oranges of Guntur which, on account of the dietetic value ascribed, have established a strong local reputation and are mostly consumed in the producing area.

I have so far given a broad indication of the movements of the trade in oranges in our presidency, but what we are more really concerned with is the direction of quality and movements in order to best make use of the supplies, to meet the demand. In considering this problem, we have to consider several points like the competition between different fruits, varieties of the same fruits, seasons of glut and scarcity, fluctuation in prices and lastly variations in the quality as well as quantity of demand. I am not going to enter into minute details here which will form the subject of a comprehensive survey we are now making of the fruit trade. But as a general indication of the tendencies involved and of the line of action to be adopted, I shall cite as an example the case of the Madras City, which as I have told you consumes annually about a lakh maunds of oranges from all sources. Taking the year 1934—35, it is found that the supply of oranges is limited in the months of June—July, being only about one thousand maunds in each case. This supply increases to 6,000 maunds in August, and 9,000 maunds in September. Up to this point, the contribution is almost entirely from the Sathgudi oranges, with very little competition from other sources. It is on this account that this variety fetches very good prices at that time, the prices being so high as Rs. 2—8—0 per dozen for the best grades, and about a rupee for the smaller sorts.

But in the months of October—November the loose jacket or *kamala* from the Circars reaches the Madras Market. The first stage of competition begins now and wholesale prices fall from Rs. 10 to Rs. 5 per hundred, for the top grade of *Sathgudi*. This fall in prices continues until January, and supplies amount from eight to ten thousand maunds per month. From January onwards competition of a different kind is introduced with the onset of Nagpur oranges. In December they arrive in small consignments, but from January onwards they are consigned in special wagons attached to passenger trains from Nagpur or Katol, each wagon carrying 1,200 to 1,500 baskets of fruits. Altogether 80 such wagons arrived during last season, the period of peak being in February—March. From March onwards, the supply of Nagpur oranges goes down, the quantity in May being only 5,000 maunds, and still less in June—July.

I have given you a broad idea of the supply and demand of Madras City, which is the largest market for oranges in the province, as an indication of the market conditions during the year. The practical consideration that should guide us in laying down any policy of future programme, consists essentially in making the best use of the supplies to meet the demand. As already indicated in my figures, there is a deficit supply of oranges in the city in the months of May, June and July and a glut in December to March. It is this variation that is responsible for the large fluctuation in prices that occurs in the same season in the fruit market. But with proper marketing such variations

should be reduced to a minimum. The chief aim is to ensure a stability of supply and fair prices in the trade, to benefit the consumer as well as the general trade. In order to ensure this, two things can be done; the first is the exploitation of new markets during glut and the second the prolongation of the marketing period by methods such as cold storage, to get a more evenly distributed supply.

I shall deal with the problem of gluts first. In the season, the Madras market gets over-full, the commission agents dispose of their stock to their customers at Trichinopoly, Madura, Tanjore and Salem districts. Direct marketing to these centres is done in the case of Nagpur oranges by agents who settle there in the season. For the home produce a first improvement can be effected by greater direct booking to the centres, avoiding by that means a glut in Madras. This will also ensure a greater uniformity of supply to the consuming areas. At present, Salem oranges move to towns in the south like Tanjore and Mayavaram, but the demand for other varieties also exists. From our studies, we find that a demand for superior varieties and better quality exists in the centres at Coimbatore, Trichinopoly, Madura and Tanjore. Similarly the West Coast can take in better varieties like the Sathgudi in place of the commoner quality largely used now. The " Eat more fruit " campaign in England has contributed largely to increase consumption, and there is no reason why similar results should not be achieved elsewhere. Already thanks to the high value attached to fruits by the medical profession and by nutrition experts people are taking more and more to fruit diet especially oranges.

This leads us as a next step to the improvement in varieties which is a natural essential for market expansion. There is much scope for work in this connection. Many of the gardens in certain districts are not properly cared for, and in these are grown sour oranges instead of the better varieties. Trees are grown in shade, no attempt at pruning or cultivation is made, and the plantation lives a hand to mouth existence. It is in this aspect of the problem that the fruit research station, which is being established under such good auspices, will open out possibilities. Our province has also yet to develop greater experiences in the use of citrus graft through adaptability to different conditions and also the bearing of stock on scion. In this direction also will this fruit research station contribute to our future. Introduction of finer varieties like the Washington-Navel orange, to suit the demand from special consumers, and research in the methods of pruning, manuring and cultivation will also go side by side. At Coonoor, inarching has met with greater success than budding, but in the Batavian tract greater success at budding has been reported to have been achieved by some growers.

Let us now consider the methods of organisation necessary to develop marketing. A common feature of our existing conditions is

the wide gap between the prices paid to the grower and that paid by the consumer. In America and Africa this spread between the growers' and consumers' prices has been sought to be remedied by the creation of marketing organizations which have developed enormously in these days. The assembling and grading of fruit, packing, provision of cold storage, inspection at ports of consignment and delivery are all done by these associations. Fruits travel several thousand miles on land and sea, and have found markets all over the world. The Co-operative Organisation of the Californian Fruit Growers handles more than ten million dollars worth of fruit every year. The local associations do business up-to a lakh of dollars each. The work is carried on by a central exchange with district branches. So far as *Kodur* oranges are concerned it is a well known fact that there are more than two or three intermediaries before the fruits reach the consumer viz., the contractor or the lessee of the garden, commission agents and godown owners in Madras, the wholesaler, retailer etc. If an Association of fruit growers of this area be formed and arrangements made for the establishment of sale agencies in Madras and other principal centres in the Presidency, it should be possible to realise better returns than now. The aims and objects of such an Association will be:—

1. To organise the marketing of fruit on a co-operative basis by adopting the improved methods in grading, packing etc., and by establishing sale agencies wherever found necessary in order that the growers may secure better value for their produce.
2. To finance the growers, so that, if necessary, they may pledge their crop to the Association and not to contractors who now lease out their gardens at a low rate in the early stages of growth of the fruit.
3. To obtain necessary requisites such as seeds, plants, manures, implements etc., on a wholesale basis and to supply these to the garden owners as cheaply as possible.
4. To arrange for careful handling and rapid transport of the fruit on Railways and to secure reasonable and concession rates.
5. To supply the services of specially selected *maistries* to assist growers to lay out or extend their gardens and renovate old ones, to bud, prune etc.
6. To organize fruit shows so as to stimulate better production, grading, packing and marketing.
7. To issue to members free of charge, posters, leaflets etc. containing information about seasonal operations, prices and other marketing news.

8. Generally to take such steps as would encourage fruit growing within the district by obtaining all possible assistance and support from Government and public bodies.

In a work of this kind, however, our country has much to learn. The first point to remember is that of grading and standardisation of fruits. The existence of standard grades is a common medium of understanding between grower and consumer and between buyer and seller, even when separated by long distance. It also makes for a steady market and an assured supply of what is wanted. If we look at any package of the South African or American fruit for example, what we find is that all the fruits are of one size, of guaranteed variety and free from blemishes. The consumer, and specially the better class of consumer, is prepared to pay for this. Gradually the existence of grades will also fix the nature of demand and result in less delay in transport in reaching suitable destinations. At present, sorting of fruits is done in a small way by the wholesale commission agents at Madras and again at the retail market. It is on this question that growers have to improve themselves most. The marketing survey now in progress is engaged in the fixing of standard grades on an all-India basis suitable for more efficient trade, and with the growth of healthy organisation this part of the work is bound to expand considerably.

The ultimate aim of marketing organisations will be to reduce costs at all stages of marketing while providing for large increases in the trade. The pooling of produce is at present largely done by contractors at the wholesalers' godowns in Madras but we have often had reports that full amounts have not been paid. A healthy system of marketing finance from growers' organisations, has been a very useful remedy in this connection, but in a perishable commodity like fruit, a certain amount of care is indicated. A necessary condition for such organisation is that they should represent a large body of the growers. Otherwise success cannot be achieved. It is only in recent years that we are seeing attempts at such organisation, but greater effort is needed to make them serviceable. I need hardly add that the marketing section will render all possible help to foster the growth of such associations. It is by no means to be inferred from this that the services of middlemen will be entirely dispensed with, but costs can be reduced considerably, while periods of gluts and depression can be more adequately dealt with.

As a necessary accompaniment to work of development must be mentioned the development of technique in the methods of grading, packing and storage. I have already indicated the advantages of standardised grades, but the question of next importance is that of storage. Countries like Africa and America that have established a

wide export trade have arranged for a systematic erection of cold storage plants to fit in with assembling centres. In our own country, the Bombay department have conducted trials on the cold storage of mangoes. The findings are that while Alphonso and Salem varieties respond well to treatment, the Circars variety '*Swarnareka*' does not. It is said that the storage life of fruits can be extended by even about 60 days by proper cold storage methods. The economic advantages of this are obvious. For instance, I have already pointed out that there is a deficiency of supply in June–July. If the glut of April could be preserved in cold storage up to May–June, there will not only be a more even supply but better prices could be got. Also fruits imported from abroad, which are transported under cold storage, require cold temperature during keeping at ports, and the erection of cold plants will therefore be advantageous.

In considering the necessity for cold storage plants it is well to remember that the methods for pre-cooled plants on the field are different from those adopted for fruits which have already been handled in transport. Internal breakdown is more difficult to avoid in the latter case. The special conditions necessary for such work in India are to be fully studied, but it is a necessary condition for long distance transport and for export trade. There are wide markets for citrus fruits as in England which imports annually from two and a half to three lakhs of tons of oranges every year, but such considerations though not immediately indicated, should be borne in mind in our developmental work for the future.

There is also another method by which gluts in the market can be avoided, and that is by the fruit preserving and transforming industry. The Bangalore Institute reports favourably on the vitamin content of some of our citrus fruits, and results obtained in North India point to considerable success in this direction. Fruits can be preserved with and without sugar, under particular conditions, but the need for such work is indicated only in case of gluts or over-production as for instance in the case of pears in the Nilgiris or limes in certain parts of the Presidency. As for oranges there appears sufficient demand at present for fresh fruits although some centres as in the Nilgiris and Salem are not finding the full market. I daresay this fruit research station which is started under expert control will open out avenues for further expansion. As in all cases of special preparations a market for such products is really created, and not necessarily existing. In the expanding use of such products as fruito, vimto and the ice frute, and in our many classes of aerated drinks, we see conditions for development which will be fruitful of results for the future of the fruit industry.

I have in this short discourse given you some broad lines of improvement in the marketing of fruits, necessary for future expansion.

I have given you indications of our supply, the nature of imports and the movements of home produce. I have also indicated to you the lines on which future research work on varieties, cultural methods, storage and the transforming and preserving of fruit, will help us. I have stressed the need for standardisation in our marketing methods and the growth of healthy organisation towards such ends. I am sure that the fruit research station on which devolves some of the technical problems of our future will give ample scope for the expansion of the activities which the marketing staff are now engaged in.

AGRICULTURE IN BURMA

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[Under the auspices of the Madras Agricultural Students' Union, a meeting was held on Monday the 16th December, when Mr. K. Ramiah, who had recently been on a tour to Burma, spoke on 'Agriculture in Burma'. Mr. R. C. Broadfoot, President of the Union, who presided on the occasion, referred in the course of his introductory remarks, to the impending separation of Burma from India and observed that apart from its importance as a producer of rice, timber, oils and minerals, this separation would result in Burma having a commendable say in the future trade of the East.

Below is an abstract of Mr. K. Ramiah's speech. —Ed. M. A. J.]

Rice and Agriculture. The title I have chosen, sounds ambitious, but, actually a talk on Burman agriculture will essentially be a talk on rice cultivation in Burma; because, rice is the most important and wealth-producing crop of the province. This can be gauged from the fact that the total value of rice and rice products exported annually from Burma, is to the tune of 30 to 40 crores of rupees, while the total value of exports of other products in which Burma is rich, namely, minerals, timber and oil, all put together amount to only 20 crores. In fact, the whole population in Burma is directly or indirectly dependent on rice.

The Agricultural Zones. Agriculturally Burma can be divided into three zones:—a wet zone on the north, a dry tract in the middle, and another wet zone in the south. The northern zone is a hilly tract most of the areas being unfit and still unexplored for cultivation. A number of mountain ranges start from this part of the country, the most important being the Arakham, the Shan and the Pegu ranges. The total rainfall in this zone amounts to about 80 inches annually. The middle zone is dry and crops are raised here only with artificial irrigation. Most crops including rice, are grown only in this area, which receives only about 20 to 30 inches of rainfall. Lower Burma, the third and the most important zone receives the full benefit of the south west monsoon with about 100 inches of rain while a narrow strip of country between the coast and the mountain ranges both on the west and eastern ends of this zone receives even as much as 200 inches. In

addition to these three there is the Shan States, a big plateau of 3 to 5 thousand feet above sea level, practically undeveloped. It is stated that it may prove a valuable tract for sheep farming.

The importance of rice. As mentioned already, rice is the most important crop, occupying 75 % of the cultivated area or about 13 million acres, of which nearly 11½ million acres are in Lower Burma, about a million being in the middle zone. The only difference between these two zones is that in Lower Burma, rice is cultivated entirely as a rainfed crop, while in the dry middle zone it is grown with artificial irrigation as in Madras. The immensity of rice cultivation in Lower Burma is prominently brought to one's notice, as one travels through this tract. One sees on all sides vast sketches of paddy fields, with green and luxuriant crop and with trees almost absent in the landscape except on the borders of creeks. The only relieving feature is the short palm, *Nipa fruitescens*, which looks like a big fern, with leaves like those of the coconut. These leaves are used for roofing houses and occasionally toddy also is tapped from this palm.

The History of Rice Cultivation. Until the middle of the 19th century, Burma rice was not known outside that country the production being just sufficient to meet the internal consumption. The lower Burma was all a swamp and undeveloped. There were no settlers and no roads, and rice cultivation was only done in patches here and there, like the hill cultivation in Malabar and Agency tracts. After the British occupation however, (about the years 1870—1880), development took rapid strides. Government opened up roads, put up embankments and bunds to prevent flood water getting in, and dug channels to drain off water, and serve as water ways. Thus land which was previously subject to floods and was precarious for rice cultivation, now became eminently suitable for the rice crop. Settlers from North Burma moved over, as also emigrants from Madras, to occupy the reclaimed swamps on which lands were given on favourable leases.

The Madras emmigrants were chiefly *Nattukotai Chetties*, who financed the cultivators and it is the enterprise of these Chettiars, that has been responsible, in no small measure, for the development of the Burma rice industry. The venture of these people was something like a speculation in financing a new and promising business, and although it has been alleged that in their financial dealings they have not been overscrupulous in their methods, it must be remembered that these people far away from their homes were taking a great risk. It is now estimated that the total amount invested by these *Chetties* in lower Burma amount to nearly 60 crores of rupees.

The Cultivation. The cultivation of the crop starts with the south west monsoon. The soils of lower Burma are like those of our deltas, only they contain more silt than clay, as different from

Madras soils which contain a bigger fraction of clay than silt. The cultivation details are not very different from those obtaining here, but one interesting thing is that the lands are ploughed only once, after which two implements unknown to us, one the Burmese Harrow, and the other the Burmese settoon—which has a number of rotating blades which cut weeds and curdle the soil—are passed a number of times. Considering that with a single pair, a tenant is able to finish 2 acres a day with these implements, they are worthy of trial in our country, as their adoption would result in considerable saving of expenses towards preliminary cultivation; and there is room to think, that these implements may be effective on our soils also to provide the required tilth, because, the soils of the dry middle zone, unlike those of lower Burma, are clayey like those of our deltas, and even in this zone, these implements are in vogue.

There is practically no manuring given to the crop, although recently the Agricultural Department have been experimenting with fertilisers and have found Ammonium Phosphate 20 : 20 to give increased yields; this however has not been found to be paying enough in the present depressed state of the rice market.

The harvest is peculiar in that the whole plant is not cut, but only the earhead with about a foot of the straw. Actually the plants grow very tall, 5½ to 6 feet, and some times even 7 feet, and the straw is stiff and coarse; after harvest, the straw is either left in the field and grazed by cattle, or some times burnt away; some times it is also cut off and used for roofing houses in towns and villages.

Holdings. The main difference between Madras and Burma in the size of the holdings; in our deltas it is probably less than 4 to 5 acres, but in lower Burma it is somewhere between 22 to 25 acres and in upper Burma 10 to 15 acres. A tenant usually manages 25 acres, with a single pair, hiring out an extra pair for the season only and the animals are after all small sized, just like our small *Kangayams*. This of course is due to the thinner population with less pressure on the land unlike our deltas, and thus the bigger size of the holding is a definite factor that goes towards decreasing the cost of production of rice in Burma.

Land tenure etc. More than 50% of the holdings are managed by tenant cultivators. In recent times, a new phase has come over the old state of things. The old Burmese settlers, have gradually become more and more indebted to the *chettiars* who have been financing them and with no prospect of the loans being returned, the land has gradually passed over into the hands of absentee landlords. This can be seen from the fact that while in the earlier years only 6% of the holdings was owned by chettiars, in 1935 it is estimated that nearly 22% of the area in lower Burma is owned by them. This state of affairs has been mainly brought about by the Burmese trait, which is a national characteristic almost, namely a pleasure-loving disposition with never a

tendency to save or to repay loans. In spite of his big holdings, the Burmese ryot is always involved in debt.

Rice varieties. There are three classes of varieties agriculturally, the early, the medium and the late; the last two of 5½ to 7 months' duration are the most important and comprise about 70% of the total. There is no variety less than 4½ months in duration.

Out of a total production of 7 million tons nearly 3½ million tons are exported as milled rice, and thus, trade requisites have resulted in a number of classifications amongst the rice exported from the country.

There is an impression here that Burma rice is not good; this is hardly the case. What actually happens is, that Burma rice is sent to two markets, the eastern and the western. In the former in which is included South India, the chief consideration is cheapness and in the latter, those of European countries, the criterion is quality. Thus price outside decides quality, and therefore, South India which imports only the cheap rices gets the poorer quality. There are several fine varieties of rice and it will not pay to import them into Madras.

The Agricultural Department and Rice. In Madras our chief aim is the increase of yield; in Burma, however, while reasonable yield is desired, the attention of the department is directed more towards the evolution of strains with better milling qualities. The milling industry has thus a large voice in directing the policy of the Agricultural Department. There is always a close co-operation between the department and the millers and no variety or strain is passed out by the department which has not been approved by millers.

Seed farms run by the Department are more highly developed than in India. A large amount of *poromboke* unassessed lands classed as grazing areas which are leased out to tenants on definite conditions, have been handed over to the Agricultural Department for use as seed farms, and agricultural officers corresponding to our Demonstrators, are put in charge of these areas. Each demonstrator has about 10 or 12 seed farms under him. There are two kinds of seed farms; the major seed farms are those at the headquarters of the demonstrator, and provided with threshing floor and storing fecilities. The minor seed farms are with the tenants themselves with a supervision by the demonstrator. In 1935, there were 23 major farms with a total area of 2800 acres and 153 minor farms with an area of 9000 acres, the total produce distributed as seed being nearly 8 thousand tons of paddy. The Agricultural Department works in close co-operation with the millers and often act as the buying agents of the mills.

Milling and Trade. Milling in Burma is different from our conception of what it is in our country, their mills being very much bigger, some with a turn-over of even 200 tons of rice per day.

The trade is mostly in the hands of Europeans, and is a highly organised industry with headquarters in England and with a large amount of English capital. These English companies are mostly in charge of the big mills and, creating a demand in the United Kingdom carry on a flourishing trade. The trade with India and Ceylon is not done by these companies but by Gujeratis from Bombay; there are neither cultivators nor millers, but only brokers; they get telegraphic communications of market fluctuation and buy and sell rice. Moghul street, Rangoon, where the rice brokers all reside, strongly remind one of the Wall street of New York or the Stock Exchange of London in a smaller degree.

The trade is keenly alive to tastes and demands. Twenty years ago, only white rice was being exported; now, since there is a demand for parboiled rice in South India, it is being prepared and exported. The millers who are doing business on a large scale are out to improve the processes of preparing parboiled rice and are keenly alive to the problems arising in it. Whenever necessary, they engage chemists specially to attack special problems. In the preparation of whole rice for the western markets some of the finer kinds give only about 25 to 30 % head grain the rest being classed into different grades of broken rice. This broken rice, a by product, is usully sent to south India where there is a ready sale. There is a complaint that they have lost some of this trade since the coming in of Siam in the picture.

Other Crops. The other crops grown, besides rice, in order of area and importance are beans, gingelly, groundnut, sorghum, maize, chillies, rubber and sugarcane. Most of these are grown in the dry middle zone, and also on a narrow strip of tract on either side of the Iravady, the latter known as the riverine corresponding to our *Padugai*, cultivation on river banks.

Conclusion. The rice cultivator in Burma has a number of advantages; he spends comparatively less on preliminary cultivation, his implements are more efficient than the plough; he uses no manure, the Iravady brings him plenty of silt, his yields compare well with ours about 1700—2000 lb; his assessment is low, only about 3 to 5 rupees; his holdings are large; and his mode of transport is cheap and efficient.

[In his concluding remarks, the Chairman congratulated Mr. K. Ramiah on his extremely practical and interesting paper and observed that Burma's example, in a number of instances, was worth being followed. There was no reason, why with a number of Irrigation Projects launched in our Presidency, Madras should not be self-sufficient in the very near future, as regards her rice production.

At the instance of the Chairman, a number of questions were put to the lecturer who in the course of his replies, gave the following further information about Burma.

1. The grazing problem is not serious; the villages scattered, the cattle are few and there is enough straw left on the fields after the harvest.

2. Green manuring is not done and in fact, when tried, was a failure; this is because, no rains are received at all during summer, when cracks develop in the soil, making it unfit for crop growth; the soil again gets soaked only with the receipt of rains in May.

3. He was inclined to think that if not the *settoon*, at least the Burmese harrow could be used with advantage on our soils.

4. The size of fields varied from 20 cents to 5 acres depending on distance from channels.

5. The labour population, not only for agricultural but for other purposes, is mostly supplied by emmigrants from Vizagapatam, who regularly sail over to Burma in batches, during the season; this is because Burmese labour is poor.

6. The cost of production of rice per acre, which 3 years ago was about Rs. 15 now ranges from Rs. 20 to 22]

POPULATION AND PRODUCTION IN INDIA, 1920–32.[1]

By P. J. THOMAS, *Professor, Madras University.*

The increase of 10·5 per cent. in the population of India between 1920 and 1930 has created considerable uneasiness in many quarters. The author of the Census Report, 1931, views it with alarm and this is shared by a large number of publicists. Mr. R. W. Brock, formerly the Editor of *Capital*, made the following statement at a meeting of the East India Association in 1932:—'So far as the official figures indicate there has certainly not been any increase in India's agricultural and industrial production, in any way proportionate to the increase of her population, and the only possible inference appears to be that there has been a fall in the average income and therefore the average standard of living.'[2] This startling statement challenges a statistical examination of the problem.

There is one serious difficulty in accurately estimating production in India. Not less than 70 per cent. of the people are dependent on agriculture, but the available statistics of agricultural production are hardly reliable, as they are based on a very imperfect system of crop forecasts. The forecasts of crop outturn in India are based on (1) area under cultivation; (2) the standard of normal outturn per acre; and (3) the condition factor or the annavari estimate. The figures of area are supplied by the Revenue Department, and are fairly reliable except in the permanently settled tracts of Bengal, Bihar and Orissa, and parts of the United Provinces. The standard outturn is 'the average yield on average soil in a year of average character'. The outturn figures are deduced from crop-cutting experiments, but in most provinces such experiments have not been systematically carried out, and in some they have not been undertaken since 1919; and although in the meantime considerable increase in the area under improved varieties of crops has taken place, the figures adopted in 1919 are still used for estimating crop yields. The worst link in the chain is the annavari estimate which is submitted by the village patwari. The annavari represents the relation of the crop reported on to the normal crop per acre, but it is based on guess-work.

The result is that year after year, the crop forecasts made have proved either an under-estimate or an over-estimate, generally the former. In the case of two crops—cotton and jute—it is possible to test the forecasts by a post-mortem examination. Such a test showed that in both cases the forecasts had been under-estimated. In the case of cotton, the difference is 17 per cent. and in the

1. I am grateful to Dr. A. L. Bowley and Mr. Sundararama Sastri for help in regard to the method and the tables.

2. *Asiatic Quarterly*, 1932, p. 440.

case of jute, 18·6 per cent. The annual average production of cotton for ten years, was 5,380,000 bales, but the post-mortem examination showed that it was 838,000 bales less than the actual crop of those years. In the case of jute, the divergence has been even wider. In a single year (1922) the difference came to 52 per cent. (The forecast was 47·37 million bales; but the actuals came to 64·36 million bales). The area under improved crops has been increasing at a rapid pace during the decade 1920–30; from 2,507 acres in 1920–21, it rose to 12,016 acres in 1930–31. It is true that such under-estimation has made the statistics rather defective as commercial information, but the error is 'systematic', and as we are here dealing with only 'relatives', it does not affect the result tangibly.

The position in respect of industrial production is slightly better, because although there are no recorded statistics of production in unorganized industries, the statistics of production in the organized industries are fairly accurate, within certain limits. In the case of textiles (cotton and jute), we have statistics for a fairly long period, and for iron and steel, sugar, coal, paper, etc., we have complete statistics for the last decade. The publication, from September 1933, of the *Monthly Survey of Business Conditions* has greatly improved our knowledge of production in the chief organized industries, but we have still only a hazy knowledge of unorganized industries, which employ the great majority of our industrial population. Hence the need for a comprehensive economic survey, as recommended by Dr. Bowley and Mr. Robertson.

The progress of industrial production has been rapid since the War. The advance has been phenomenal in sugar and large in cement and in iron and steel. The value of organized industrial production today may be between one-third and one-half of that of primary products. The progress has been even more rapid since 1929.

Four statements are given below to illustrate them. The first two deal with agricultural production (chief crops) and the next two deal with industrial production (chief industries). The period taken for the analysis is the 12 years from 1920–21 to 1931–32. The average of the estimated production (both agricultural and industrial) during the years 1920–21 and 1921–22 is taken as the base. On this basis the relatives of the several commodities for the successive biennial periods are calculated. The general or composite index number of production for each biennial period is a weighted average of the relatives, the weights being proportional to the values of the several commodities. Throughout, the price per unit of the commodity is taken as constant. For all agricultural commodities the average wholesale prices in the years 1920–21 and 1921–22 (base period) are taken as the prices per unit. As prices for all the industrial products for the base period are not available, those of the prices which are given in the *Indian Trade Journal* (cotton yarn, piecegoods, jute bags and gunny cloth, and sugar) are taken for that period, and the rest are standard prices recommended by the Tariff Board. These prices are only a means to get the weights, and slight variations in weights do not alter the composite index number to any material extent.

In Tables I and III average estimated production and value of each commodity are given; and in Tables II and IV, the relatives with the respective weights assigned to each commodity are given. The formulae used in calculating the composite index number are:—

1. Weighted arithmetic mean.

$$100 \times \frac{\Sigma p_0 q_1 \times \frac{q_1}{q_0}}{\Sigma p_0 q_1}$$

p_0 price per unit of the commodity in the base year.
q_0 production of the commodity in the base year.
q_1 production of the commodity in the given year.

TABLE I

Agricultural Production (Quantity and Values)

(Average of two years).

Commodity.	Average Price per Unit in 1920–21 and 1921–22 (base period).	1922–23 and 1923–24		1924–25 and 1925–26		1926 27 and 1927–28		1928–29 and 1929–30		1930–31 and 1931–32	
		Quantity.	Value (Crores of Rs.)	Quantity.	Value (Crores of Rs.)	Quantity.	Value (Crores of Rs.)	Quantity.	Value (Crores of Rs.)	Quantity.	Value (Crores of Rs.)
Rice (millions of tons) ...	Rs. 9 per cwt.	31	558	30·9	556	29	504	31·5	567	32·6	587
Wheat (millions of tons) ...	Rs. 9—1—0 per cwt.	9·9	179	8·8	159	8·4	152	9·5	172	9·2	167
Sugar cane (millions of tons)	Rs. 55 per 500 lbs.	3·2	79	2·8	69	3·3	81	2·7	67	3·6	89
Tea (million lbs.)	Rs. 0—9—3 per lb.	343	20	369	21	392	23	418	25	392·6	23
Cotton (million bales) ...	Rs. 50—9—0 per cwt.	5·2	94	6·2	112	5·5	100	5·5	100	4·6	83
Jute (million bales)	Rs. 300—6—0 per ton	8·3	45	10·5	57	10·1	55	10·7	58	5·7	31
Linseed (thousand tons) ...	Rs. 12—6—0 per cwt.	568	14	551	14	377	9	351	8	394	10
Rapeseed (thousand tons) ...	Rs. 11—6—0 per cwt.	1179	28	1065	26	922	22	1002	23	1014	24
Sesam (thousand tons) ...	Rs. 15—4—0 per cwt.	463	14	467	14	479	14	430	13	495	15
Groundnuts: nuts in shell (millions of tons)	Rs. 13—4—0 per cwt.	1·2	24	1·8	36	2·4	48	2·9	58	2·9	58
Indigo (thousand cwt.) ...	Rs. 41 -9-0 per cwt.	·44	2	25	1	15	1	14·5	1	12	1
Coffee (million lbs)	Rs. 59—3—0 per cwt.	·22	2	26	3	35	4	33·5	4	33	4
Rubber (million lbs.)	Rs. 78—0—0 per cwt.	13	1	18	2	25	3	27·5	3	22	2
Jowar (millions of tons) ...	Rs. 6 per md.	5·8	95	5·6	91	5·9	96	6·3	103	6·6	108
Bajra (millions of tons) ...	Rs 6—5—0 per md.	2·3	41	2·1	37	2·5	44	2·0	36	2·7	48
Maize (millions of tons) ...	Rs. 5 per md.	2·1	29	1·8	25	2·1	29	2·2	30	2·35	33
Gram (millions of tons) ...	Rs. 7 per md.	4·9	94	4·1	78	3·6	69	2·9	58	3·6	69
Barley (millions of tons) ...	Rs. 10—4—0 per cwt.	3·0	62	2·6	54	2·4	50	2·4	48	2·4	48

TABLE II

Agricultural Production—(Index Numbers)

Base: Average of 1920–21 and 1921–22 = 100.

Commodity.	Average of 1922–23 and 1923–24		Average of 1924–25 and 1925–26		Average of 1926–27 and 1927–28		Average of 1928–29 and 1929–30		Average of 1930–31 and 1931–32	
	Index.	Weight.	Index.	Weight.	Index.	Weight.	Index.	Weight.	Index.	Weight.
Rice	102	40	101	41	95	37	103	42	107	42
Wheat	121	13	107	12	102	12	116	13	112	12
Sugar-cane	128	6	112	5	132	6	108	5	142	6
Tea	111	1	119	1	127	2	135	2	127	2
Cotton	130	7	155	8	138	8	137	7	115	6
Jute	177	3	223	4	215	4	228	4	121	2
Linseed	161	1	153	1	107	1	99	1	115	1
Rapeseed	117	2	105	2	91	2	99	2	100	2
Sesam	103	1	104	1	106	1	96	1	110	1
Groundnuts	120	2	180	3	240	4	290	4	290	4
Indigo	80	...	45	...	28	...	26	...	22	...
Coffee	105	...	124	...	167	...	160	...	157	...
Rubber	118	...	164	...	228	...	250	...	200	...
Jowar	89	7	86	7	91	7	97	8	102	8
Bajra	100	3	91	3	109	3	87	3	117	3·5
Maize	91	2	78	2	91	2	96	2	102	2·5
Gram	111	7	93	6	82	5	66	3	82	5
Barley	107	5	92	4	86	4	86	3	86	3
Composite Index Numbers										
Weighted Arithmetic Mean ...	**111**		**112**		**113**		**111**		**116**	
Aggregative type	**109**		**107·4**		**106**		**102**		**112**	
Median	**100**		**106**		**108**		**101**		**115**	

TABLE III

Industrial Production (*Average of two years*).

Commodity.	Average price in base period.	1920–21 and 1921–22	1922–23 and 1923–24		1924–25 and 1925–26		1926–27 and 1927–28		1928–29 and 1929–30		1930–31 and 1931–32	
		Quantity.	Quantity.	Value (Crores of Rs.)	Quantity.	Value (Crores of Rs.)	Quantity.	Value (Crores of Rs.)	Quantity.	Value (Crores of Rs.)	Quantity.	Value (Crores of Rs)
*Cotton yarn (millions of lbs.)	Re. 1—8—0 per lb.	677	661·5	74·55	790·3	88·91	808	90·9	741	83·36	916·5	103·11
Cotton cloth (millions of yds.)	Rs. 0·4 per yard	165·6	1713·5	68·54	1962·0	78·48	2324	92·96	2116·5	84·66	2651·5	106·06
Jute bags (millions)	Rs. 0·46 per bag	438·3	365·5	16·81	419·4	19 29	437	20·06	480·4	22·10	478·2	22·00
Jute cloth (millions of yds)...	Rs. 0·2 per yard	1314	1187·5	23·75	1402·5	28·05	1482	29·64	1560·5	31·21	1461	29·22
Sugar (thousands of tons) ...	Rs. 470 per ton	74·3	84·4	3·97	79·4	3·74	120·4	5·62	105·0	4·94	189·9	8·93
Coal (millions of tons) ...	Rs. 9 per ton	186·5	19·4	17·46	21·1	18·99	21·7	19·53	23·0	20·70	22·8	20·52
Cement (thousands of tons).	Rs. 53 per ton	112	193·0	1 03	321·0	1·71	512	2·71	555	2·95	555	2·95
Paper (Do.).	Rs. 464 per ton	29	25·0	1·16	27·1	1·26	33·0	1·53	39·1	1·82	39·1	1·82
Pig Iron (Do.).	Rs. 34·5 per ton	339·6	454·0	1·57	876·3	3·02	1021·3	3·52	1116·5	3·85	1085·5	3·75
Steel (Do.).	Rs. 180 per ton	119·2	131·3	2·36	284·0	5·11	394·5	7·11	344·0	6·19	442·0	7·96

* As we are here comparing the growth of industrial activity at different periods, the question of double counting does not arise.

TABLE IV

Industrial Production: Index Numbers

Base: Average of 1920-21 and 1921-22 = 100.

Commodity.	1922-23 and 1923-24		1924-25 and 1925-26		1926-27 and 1927-28		1928-29 and 1929-30		1930-31 and 1931-32	
	Index. No.	Weight.	Index. No.	Weight.	Index. No.	Weight.	Index. No.	Weight.	Index. No.	Weight.
Cotton yarn	97·5	35	103·5	36	119·5	33	109·5	32	136	34
,, cloth	103·5	32	118·5	31	140·5	34	128·0	32·5	161	35
Jute bags	83	8	96	8	100	7	110·0	8	109	7
,, cloth	89	11	107	11	112·5	11	118·5	12	112	9
Coal	104	8	113	8	116	7	126	8	122	7
Sugar	114	2	107	1·5	162	2	141	2	256	3
Steel	110·5	1	238	2·0	331·5	3	289	2	320	1
Pig Iron	129·5	1	258	1·0	301	1	329	1·5	371	2·5
Cement	172·5	1	286·5	1·0	457·5	1	495·5	1	504	1
Paper	86	1	93·5	0·5	114·0	1	134·5	1	138	0·5
Composite Index Numbers										
Weighted Arithmetic Mean ...	**99**		**115**		**137**		**130**		**151**	
Aggregative type	**98**		**111**		**128**		**122**		**144**	
Median	**104**		**110**		**130**		**131**		**149**	

2. Aggregative type.

$$100 \times \frac{\Sigma p_0 q_1}{\Sigma p_0 q_1 \times \frac{q_0}{q_1}}$$

3. *The Median.*

The weighted arithmetic mean is the biased II type of Fisher (refer Fisher's *Making of Index Numbers*). In Appendix II, Art. 8 of the same book it is pointed out that for the arithmetic mean this is the best system of weighting, because the upward bias possessed by the average has to be counteracted by a downward bias in weighting. As for the aggregative type, it is pointed out by Fisher that the two types differ very little and hence, for the sake of convenience in calculations the given formula is chosen.

In result, we obtain the following indices of population and production during the period :—

	1920–21 to 1921–22	1922–23 to 1923–24	1924–25 to 1925–26	1926 27 to 1927–28	1928–29 to 1929–30	1939–31 to 1931–32
Population[1]	100	102	104	106	108	110·4
Production[2]						
(1) Agricultural	100	111	112	113	111	116
(2) Industrial	100	99	115	137	130	151

It may be clear from the above that agricultural production has kept pace with population, and that industrial production has increased much faster than population. In the decade 1920–30, population increased by 10·5 per cent., but this is abnormal for India, seeing that in the three previous decades, population increased only by 2·5, 7·1 and 1·2 per cent., respectively. The increase of population between the biennial periods 1920–21 to 1921–22 and 1930–31 to 1931–32 had been 10·4 per cent. but agricultural production increased by about 16 per cent. and industrial production by 51 per cent. during the same period. The slow growth of agricultural production is due largely to the declining demand for cereals, especially dry grains, which are being supplanted by rice and wheat. India formerly exported large quantities of wheat, but today most of it is consumed at home. Thus some classes at any rate have raised their standard of living. Considering the limited scope for the expansion of rice cultivation, it is likely that India will have to depend increasingly on imported rice in future.[3] However, there is a large compensating factor in the steady growth of industrial production.

A decade, even twelve years, is far too short a period for correlating population and production. The thirty years between 1900 and 1930 may provide better scope for such a correlation. Full statistics of industrial production for the period are not available, and therefore only cotton yarn, piecegoods, jute cloth and gunny bags, and coal are taken, but the figures for agricultural production are fairly complete. The following table gives quinquennial indices of population and agricultural production, worked out by Fisher's weighted aggregate index method.

Period.	Population	Agricultural production.	Industrial production.
1900–01—1904–05	100	100·0	100
1905–06—1909–10	104	103·0	142
1910–11—1914–15	107	123·5	187
1915–16—1919–20	103	124·5	255
1920–21—1924–25	109	120·0	251
1925–26—1929–30	113·5	129·0	289

1. It is assumed that population increased uniformly from year to year.
2. Indices worked on the Weighted Arithmetical Mean.
3. See *Madras Census Report* (1931) I, p. 47.

Population increased by 19 per cent. between the two censal years 1901 and 1931, but if we compare the first and last quinquennia, as in the case of production, the increase is only 13 5 per cent. Thus, when population increased by 13·5 per cent. production increased by 29 per cent. The index would be much higher if we take the arithmetic mean; for the production of several commodities increased enormously during the period. Groundnuts, for example, increased from 93,000 tons to 2,466,000 tons, i. e. 2,500 per cent. Industrial production has also increased rapidly; the annual production of cotton textiles increased from 500 million yards in 1900 to 2,654 million yards in 1931-32. Hardly any pig iron was made in 1900; but 1.085,000 tons of it was made in 1931-32.

Thus, whatever period we may take, there is no indication that population has outstripped production. It does not mean that India is not overpopulated. It may, or may not be; that is a different question, and I do not propose to deal with it here. All I can see from the statistical study carried out is that if India was not overpopulated in 1900—and that is the view of some—it is not overpopulated now. Production has been keeping pace with population; and in some lines—e.g., industry, commercial crops—it has increased at a much more rapid pace than population. And this progress has been kept up during the world depression—and that is a significant fact. [From the *Madras Univ. Journal* Vol. VII, No. 2, pp. 93—102 by courtesy of the Author].

ABSTRACTS

A simple apparatus for measuring the compactness of soil in the field, and some results obtained in a cultivation experiment. By O. V. S. Heath (*The Empire Jour. of Experi. Agri.* vol. ii. No. 7 pp. 205—212). The article describes a simple and easily-made apparatus, for measuring compactness in a soil, the method of working it, and the results obtained with it. Based on the principle of the stratometer, the apparatus consists of a tripod, supporting an iron rod which bears at its lower end a steel cone. A length of steel pipe surrounding the rod, serves to carry the force of impact direct to the cone, the rod only serving as a guide. The weight is lifted to a mark on a graduated scale behind and allowed to fall freely, thus driving the point into the soil. A "soil plate" placed flush with the soil, and provided with a projecting tube which prevents loose soil falling into the hole made by the steel cone, completes the apparatus.

The apparatus was used on a cultivation experiment with three treatments, which were designed to give different degrees of soil compactness, namely:—normal, grubbed and compressed soil,—and results obtained by the apparatus are very comparable and satisfactory. More than any thing else, cheapness of its construction, should appeal, to all who desire a fairly satisfactory method of comparing soil compactness in different treatments. M. R. B.

Activation of cambial growth by pure Hormones. By R. Snow (*The New Phytologist*, Vol. 34, No. 5, p. 23). An extremely interesting paper which throws light on the possible nature of the hormone present in leaves, which is responsible for cambial growth. Urine being a good and abundant source of auxin and other hormones, the ether-soluble extract of urine was tried on young sunflower seedlings, which were decapitated before applying the solution to the cut surface. The experiment was also done in the hypocotyl-region and the results show that cambial growth is activated by solutions in gelatine of synthetically prepared hetro-auxin and auxin-£—in minute concentrations. From the results, it is concluded that the normal cambial growth is promoted in plants by the same growth—hormone (perhaps auxin-£) in young leaves. M. R. B.

The non-protein nature of a fraction of soil organic Nitrogen. By A. W. J. Dyek and R. R. Mckibbin (*Can. Jour. of Res.* Vol. 13, No. 5, pp. 264—269). In the case a number of samples of organic soils, drawn from widely different locations in the

province of Quebec, the authors found that there were considerable differences in the percentages of nitrogen, as determined by the Kjeldahl and the Dumas methods. The latter always gave a higher figure, the difference between the two methods varying from 6·4 to 29·6% of the total nitrogen. The results therefore lend support to the belief, that not all the nitrogen in the soil is of a protein nature and that the non-protein nitrogen which may be an appreciable fraction, is not estimated by the Kjeldahl method. M. R. B.

Some factors affecting the influence of soy beans, oats, and other crops on the succeeding crop. By D. R. Dodd and G. G. Pohlman. (*Bull. 265 Agri. Expt. Stn. West Virginia Univ.*) Different investigators having reported different results as regards the effect of soy beans (grown for hay and for seed) on the succeeding crops, the authors attempted to study this effect in a three fold direction.

1. to determine the effect of a crop of soybean hay as compared with oats on the yield of corn, wheat, buckwheat, potatoes and oats, following. 2. to determine the effect of respective crops of oats, buck wheat, potatoes, wheat and corn or the yield of following crops of soy beans and oats. and 3. to determine the effect of these various crops and cultural treatments on the nitrate and moisture content of the soil, and the relationships of these contents to the yields of crops.

Results obtained showed that as regards (1), the yields of oats (both grain and straw), wheat *grain* and corn grain were significantly higher when following soybeans than when following oats, but as regards potatoes, clover and wheat straw, the difference was not significant. As regards the 2nd point, wheat was found to be the best crop, to precede oats or soy beans. During the growth of soy beans, the nitrate content of the soil diminishes reaching a minimum at the time of removal of the crop; the soil recoups gradually after the removal of the crop and therefore sufficient time (about 3 weeks) should be allowed after the removal of the soy beans, for the store of available Nitrogen to be replenished, before the next crop is planted; as an alternative an addition of 50 pounds of Sodium Nitrate per acre, may be applied. M R. B.

Gleanings.

Bees in Court. Near Amity, N. Y. lived two brothers, surnamed Utter. One was a peach grower by general occupation while the other added beekeeping to his various other rural pursuits. For some time a bad feeling existed between the two, and then Peach Utter conceived the idea that the bees of his brother, the beekeeper, were injuring his peaches and even killing the trees. Upon these allegations he based a complaint and brought a suit for damages against Beekeeper Utter. The judge gave a judgment of 25 dollars and costs against Beekeeper Utter. On this, the National Beekeeper's Association, America whose attention was called to the matter, employed competent counsel and took the matter up to the country court. The final trial which came off on 17th, 18th and 19th December 1931, before the country court was stubbornly contested by both sides, about 30 witnesses were examined and the jury after 10 minutes' deliberation brought in verdict for the defendent, Beekeeper Utter.

There were in attendance, witnesses ready to render expert testimony to the fact that, bees do not and cannot puncture sound fruit; some laughable testimony was given by the witnesses for the prosecution, like the statements ' that the bees used their horns (antennae) to make holes in the fruit,"—which only illustrated the prevailing ignorance in regard to bees. Professor Benton one of the defence witnesses showed by live and dead specimens of bees, and also by charts

which he brought for the occasion, that in his opinion it was a physical impossibility for the bees to puncture fruits with their jaws or mandibles; that the jaws of bees were very different from those of wasps and other insects having cutting edges or teeth × × × × (*American Bee Journal*—Dec. 1935. P. 571.)

Where Spores score over Human Beings. Surviving conditions under which man would die, tiny spores of important plant diseases are growing in a laboratory of the Department of Agriculture, Washington, after journeying nearly 13¾ miles into the stratosphere, with the balloon *Explorer II*. Discovery that spores can live after being sent to an altitude of 72, 395 feet, is the first scientific conclusion from the recent ascension. × × × × The spores carried aloft had to withstand (1) temperatures lower than 65 degrees below Zero Fahrenheit (2) such a low atmospheric pressure that man could not live in it (3) ultra-violet rays from the sun which never reach the earth and which are capable of killing some forms of life (4) ozone & (5) extreme dryness. (*Science-Suppt.* vol. 82, No. 2136, p. 12).

Sugar Windows! Slapstick comedies are now few and far between these days but even then a movie villain is now and then tossed through a window. When you see this, don't cringe for fear that the glass will cut the actor, for, this glass-like pane has been prepared from sugar. (*Sc. Amer.* Jan. 1936, p. 50).

Improvement of memory by sleep. If a person memorises certain kinds of material perfectly and goes to sleep immediately afterwards, he will recall most of it, and also relearn the whole thing more economically after a lapse of 24 hours, than if he waits even a few hours before going to sleep, according to Dr. H. M. Johnson, Professor of Psychology, Washington. Experiments based on different methods, made by Dr. Rosa Heine Katy and Joseph O' Brien at the University of Gettingen, showed that all the subjects who were studied, were better able to recall and also relearn material that they had learned by rote and partially forgotten, if they slept for 8 hours and then worked for *16* hours, than if they distributed their rest and activity in any other way during the 24 hour period. × × × × (*Sc. Suppt.* vol. 82 No. 2137, p. 15.)

The Composition of some Common Foods :—

Food.	Percentage of				Calorie (energy value) per lb.
	Protein.	Fat.	Carbo-hydrates.	Salts.	
Wheat.	12·0	1·7	73·7	1·5	1750
Cambu.	10·0	5·0	74·2	2·0	1750
Cholam.	8·9	3·1	71·0	2·5	1750
Rice.	7 5	1·8	82 0	0 8	1584
Grams.	19 0	4·3	54·0	2·8	1530
Lentils.	25·0	1·5	60'0	6·0	1600
Peas & Beans.	24·0	1·5	60 0	3 0	488
Soya Beans.	40·0	20·3	24 6	4·8	2100
Linseed.	24·0	40·0	26 0	2·0	2270
Groundnut.	24·0	45·0	22 0	2·0	2450
Meat.	24·0	2·5	...	1 5	576
Eggs.	14·8	10·5	...	1 0	720
Milk (Buffalo's)	4·0	7 to 9	4·0	0·8	480
Potatoes.	3·0	0·12	14·2	1·0	556

(From Pamphlet No. 7—Bombay Presy. Baby and Health Week Association).

Correspondence.

Growing Sugarcane in the Tanjore Delta.

Rao Bahadur C. S. Subramanyam writes from Mayavaram :— Some years ago it was the common opinion among farmers and agricultural officers that sugarcane cannot be grown in the wet lands of this delta. The imposition of the protective duties against the import of sugar was not taken advantage of by the Tanjore farmer, though it has been utilised very profitably by the farmers and industrialists in Northern India. About three years ago different varieties of cane were planted in the wet fields of the Government Aduthurai Farm, where the land is a flat level block that does not drain quickly after a heavy rain. As the results were encouraging, here and there some farmers grew sugarcane with varying success. The failures were due, as I have since ascertained, to their not adopting the correct method of cultivation as also to the unsuitable choice of land.

Early last year, I tried growing sugarcane on my farm and chose a wetland field somewhat higher in level which would drain off quickly after a heavy rain. The local method of raising the crop is to plough the land 3 or 4 times and plant the setts in dry land beds of 4 or 5 feet square. Irrigation water is obtained either by diverting the adjoining channels or raising it from a well by means of a *picotah*. The local Agricultural Demonstrator advised me to dig trenches one yard apart, put in farmyard manure and channel silt and plant the setts a foot apart, after a preliminary watering. 1500 setts of Fiji. B. and about 800 setts of Co. 281 and Co 285 were thus planted in about 12 cents of land between the 10th and 15th of May. The Fiji B. seed was obtained from a friend, and the other varieties from the Aduthurai Farm. For the first two months, the crop was watered once a week by raising water *(picotah)* from a well previously sunk for the purpose. After the freshes arrived in the river, the channel water supply was utilised, and irrigation became easy. About two months after planting, I applied about 5 maunds of groundnut cake and earthed up the ridges. A second earthing up was done in August, and thereafter, not much attention was required until the cane came to harvest in March. The cane was exhibited at the Srirangam Exhibition early this year and also at Aduthurai at which places it earned a silver medal and an iron plough respectively.

The reported failures are due to choosing a plot which would not drain off, planting a large area without trying the suitability of the land in the first instance, and not seeking the advice and guidance of the Demonstrator—in brief, attempting to do the job without knowing the ropes. I do not think that all the villages in this delta are suitable for sugarcane cultivation, because, the fields therein get water-logged after some continuous or considerable rain. But a very large number—nearly half—of the villages have some higher-level lands in them, and on these, cane could be grown successfully. Wetlands of this type score over dry lands as the cost of lift irrigation, except for a few weeks in the beginning, is saved. The requisites for a successful planting are (a) a high-level wetland that drains easily, (b) a well in its centre, and a *mhote* or *picotah* arrangement to lift the water and (c) acting under the advice of a Demonstrator, instead of playing off one's bat. The initial outlay consists in digging and constructing a well for every 6 or 7 acres. The *mhote* arrangement is better, for it does away with human labour to a great extent, and the bullocks can be worked for ploughing other lands, carting manure and produce etc.

I have not kept a costing account. The labour employed was of men engaged in paddy cultivation on the same farm. The cost of seed, manure and labour

came up to Rs. 20. As the effort was the first of its kind, the cost might be 25% more than was necessary. About 3000 canes were the outturn. The cultivation was not intensive. Almost every farmer, big or small, could easily attempt this venture on a small scale in the first instance, and observing the results, expand the cultivation.

The growing of paddy and paddy alone is monotonous work and drab, and this accounts for the indifferent cultivation one sees everywhere. There is a friend of mine, who, with an oil engine installation, grows sugarcane and plantains, and it is paying him.

Crop & Trade Reports.

Castor—First or Final Report—Madras—1935. The average of the areas under castor in the Madras Presidency during the five years ending 1933—'34, has represented 20 per cent of the total area under castor in India. The area under castor in the Madras Presidency up to the 25th November 1935 is estimated at 261,700 acres. When compared with the area of 289.200 acres estimated for the corresponding period of last year, it reveals a decrease of 9 5 per cent. The estimate for last year was above the actual area of 278,131 acres by about 4 per cent. The decrease is general outside Ganjam, Vizagapatam, East Godavari, Bellary, Chingleput, North Arcot, Trichinopoly, Tanjore, Ramnad, Tinnevelly and the West Coast. The yield is expected to be 99 per cent of the normal as against 79 per cent in the previous year according to the season and crop report. On this basis, the yield is estimated at 25,800 tons as against 26,100 tons estimated for the corresponding period of last year and 22,780 tons estimated in the season and crop report of last year. The wholesale price of Castor seed per imperial maund of 82-2/7 lbs. as reported from important markets towards the close of November 1935, was Rs 6 in Berhampore, Rs. 5—5—0 in Vizianagaram, Rs. 5—4—0 in Madura, Rs. 5—1—0 in Cocanada and Rs. 5 in Vizagapatam, Ellore, Bezwada and Guntur and ranged from Rs. 4—2—0 to Rs. 4—15—0 in the other markets. When compared with the prices reported at the corresponding date of last year, these prices reveal a rise of 33 per cent in Vizagapatam, Vizianagaram and Ellore, 31 per cent in Guntur, 30 per cent in Vellore, 16 per cent in Salem, and 7 to 10 per cent in the other markets.

Paddy—Intermediate report—Madras—1935—36. The main crop of paddy has been harvested in parts of the Circars, the Deccan and the West Coast. The yield is reported to be slightly above normal in South Canara, normal in Kistna, the Deccan and Malabar and below normal in the other districts. The main crop of paddy under rainfed tanks in parts of the Nellore district has been affected by drought to some extent. In Tanjore, the early samba varieties have been adversely affected by the high winds in November and rains in December and in parts of the districts of Trichinopoly, Ramnad and Tinnevelly, the crop has been affected a little by insects. The condition of the crop is fairly satisfactory in the other districts. The wholesale price of paddy per imperial maund of 82-2/7 lbs. as reported from important markets towards the close of December 1935 was Rs. 3—2—0 in Cuddapah, Rs. 3—1—0 in Salem, Rs. 2—13—0 in Nellore, Rs. 2—12—0 in Vellore, Erode, Trichinopoly and Madura, Rs. 2—11—0 in Vizianagaram, Rs. 2—10—0 in Nandyal Rs. 2—8—0 in Berhampore, Rs 2—6—0 in Tinnevelly and ranged from Rs. 2—1—0 to Rs 2—5—0 in the other markets. When compared with the prices reported in the previous month, these prices are stationary in Vizagapatam, Vizianagaram, Nandyal, Cuddapah, Vellore, Erode, Trichinopoly, Kumbakonam and Tinnevelly; they have risen by eight per cent in Cuddalore, two per cent in Cocanada and Guntur and by one per cent in Ellore and are lower by 8 per cent in Madura, 7 per cent in Negapatam, 5 per cent in Rajahmundry, 4 per cent in Masulipatam and by one to 2 per cent in the other markets.

Cotton—Intermediate Report—Madras—1935-36. The Cocanadas cotton in parts of Guntur and Nellore and the dry cotton in the Vizagapatam district have been affected by drought to some extent. The crop has been affected with fungus disease in Cuddapah owing to cloudy weather and flowers are falling. The condition of the crop is fairly satisfactory in the other districts. The wholesale price of cotton lint per imperial maund of 82-2/7 lb. as reported from important markets towards the close of December 1935 was Rs. 20—7—0 for Cocanadas, Rs. 24—14—0 for Northerns, Rs. 19—8—0 for (early crop) Westerns, Rs. 28—2—0 for Cambodia, Rs. 26—11—0 for Coimbatore-Karunganni, Rs. 24—7—0 for Tinnevelley-Karunganni, Rs 23—12—0 for Tinnevellies and Rs. 24—2—0 for Nadam. When compared with the prices in the previous month, these prices reveal a rise of six per cent in the case of Northerns and one per cent in the case of Westerns; they have fallen by two per cent in the case of Cambodia, Coimbatore-Karunganni and Nadam, five per cent in the case of Tinnevellies and six per cent in the case of Tinnevelly-Karunganni. The price of Cocanadas is stationary.

Pepper—Final Report—Madras—1935 The area under pepper in 1935 in the districts of Malabar and South Canara is estimated at 90,500 acres in Malabar 8,500 acres in South Kanara as against the final area of 85,164 acres in Malabar and 7,581 acres in South Kanara in the previous year. The condition of the crop is fair. The crop is getting ready for harvest. The seasonal factor is estimated to be 90 per cent in each district as against 100 per cent in the previous year. On this basis, the yield is estimated at 12,200 tons for Malabar and 1,150 tons for South Kanara as against 13,300 tons for Malabar and 1,280 tons for South Kanara estimated in the previous year. The wholesale price of pepper per imperial maund of 82-2/7 lb. as reported from important markets towards the close of December 1935 was Rs. 15—12—0 in Calicut, Rs. 14—1—0 in Cochin, Rs. 13—1—0 in Tellicherry and Rs 14—8—0 in Mangalore. When compared with the prices reported in August 1935, these prices have fallen by about 14 per cent in Calicut, 13 per cent in Tellicherry and Mangalore and 12 per cent in Cochin.

Gingelly—Third Report Madras—1935—36. The average of the areas under gingelly in the Madras Presidency during the five years ending 1933—34 has represented 12 per cent of the total area under gingelly in India. The area sown with gingelly up to the 25th December 1935 is estimated at 500,600 acres. When compared with the area of 462,600 acres estimated for the corresponding period of last year, it reveals an increase of 8·2 per cent. The increase in area is general outside Vizagapatam, East Godavari, South Arcot, North Arcot, Salem and South Kanara. The increase is marked in Trichinopoly (18,500 acres). There has been a marked decrease in Salem (16,700 acres). The main crop has been harvested except in the south where the harvest is in progress. The crop suffered from drought to some extent and the yield is reported to be below normal except in East Godavari, West Godavari, Kistna, the Deccan, Salem, Ramnad and South Kanara. The seasonal factor for the Presidency works out to 92 per cent of the aver ge as against 84 per cent for the corresponding period of last year. On this basis, the yield is estimated at 61,700 tons as against 53,300 tons for the corresponding period of last year, an increase of about 16 per cent.

Ginger—Final Report—Madras—1935. The area under ginger in 1935 is estimated at 11,800 acres in Malabar as against the actual area of 11,733 acres in the previous year. The seasonal factor is estimated at 80 per cent of the normal as against 70 per cent in the previous year. On this basis, the crop is expected to yield 3,370 tons of dry ginger as against 2,750 tons in the previous year. The wholesale price of dry ginger at Calicut towards the close of December 1935 was Rs. 27—10—0 per imperial maund of 82-2/7 lb. When compared with the price reported towards the close of August 1935, there has been a rise of 4·4 per cent.

College News & Notes.

Students' Corner. The College reopened after the christmas vacation on 6th January. The second year students assembled at Anakapalle for an agricultural tour in the Circars, under the charge of Messrs. K. Raghavachari, Lecturer in Agriculture, V. Suryanaraya, Assistant Lecturer in Agriculture, and B. Suryanârayana Rao, Assistant Lecturer in Entomology. They returned to head quarters on the 20th.

With one class away, there was not much of athletics, only cricket being played. The first and third year students played 2 matches on the 13th and the 18th the third years winning on both occasions, although with both the teams putting forth their best, the issue was kept in suspense till almost the very last over bowled. Another exciting match was the holiday match on Pongal day between students and officers, which the former with 126 runs, won by a narrow margin of 3 runs.

Weather. Rather unhealthy weather with marked fluctuations—hot during the day and very chill at nights—prevails during the month, and chicken-pox, measles etc. are prevalent on the estate.

A Royal visit. H. H. The Maharajah of Cochin, accompanied by the Dewan and the Collector of Coimbatore, visited the Research Institute on the afternoon of the 17th. Mr. R. C. Broadfoot and Mr. M. C. Cherian, took the Royal visitor round the various sections, where His Highness was much impressed with all that he was shown.

Other visitors. Mr. C. Ramalinga Reddy, M. L. C., who had been to Coimbatore in connection with the Golden Jubilee Celebrations at the Students' Literary Association, visited the College on the afternoon of the 7th and was taken round the various sections by the Principal.

Pongal celebrations. As usual, *Mattu Pongal* was celebrated with great enthusiasm at the Central Farm and the several Breeding Stations. The Animal Nutrition section, where the number of animals under experiment has been growing was another of the units that celebrated the festival this year.

Obituary. We regret to record with great sorrow the death due to heart failure of Mr. K. D. Dharmarajan student of the second year at Anakapalle. The fact that the death occurred during the tour of the students and suddenly, adds much to the poignancy and we offer our heart-felt condolences to the members of the bereaved family.

The King's death. The melancholy news of the King's death was received, by the Estate residents, with great sorrow. The Officers' Club and the Government Servants' Co-operative Society remained closed for 2 days. A resolution of condolence was passed at a meeting held under the joint auspices of the Madras Agricultural Students' Union, the Association of Upper Subordinates, the Indian Officers' Association, the Officers' club, the Ladies' club, the Association of Economic Biologists and the Fieldmans' Association, on the 24th inst., Principal, Mr. R. C. Broadfoot presiding. The Union sent a message of condolence to the members of the Royal family through His Excellency the Viceroy.

Weather Review (DECEMBER 1935).

RAINFALL DATA

Division	Station	Actual for month	Departure from normal	Total since January 1st	Division	Station	Actual for month	Departure from normal	Total since January 1st
Circars	Gopalpore	0	-0·8	42·7	South	Negapatam	18·7	+7·3	73·5
	Berhampore*	0	0	34·1		Aduthurai*	16·8	+8·3	49·9
	Calingapatam	0	-0·6	29·3		Madura	1·2	-0·6	26·2
	Vizagapatam	0	-0·7	18·6		Pamban	4·4	-3·1	37·8
	Anakapalli*	0	-0·2	22·2		Koilpatti*	1·8	-0·9	20·4
	Samalkota*	0	-0·3	36·3		Palamkottah	2·9	-1·2	30·1
	Maruteru*	0	-0·6	33·6					
	Cocanada	0	-0·9	24·9					
	Masulipatam	0	-0·9	32·7	West	Trivandrum	3·0	+0·3	59·6
	Guntur*	0	-0·1	29·8	Coast	Cochin	0·6	-1·1	83·3
						Calicut	0·3	-0·8	102·8
Ceded	Kurnool	0	-0·3	26·1		Pattambi*	0	-1·2	78·8
Dists.	Nandyal*	0·1	-0·3	31·5		Taliparamba*	0·2	-0·8	129·0
	Hagari*	0	-0·2	22·0		Kasargode*	0	-1·2	145·6
	Bellary	0	-0·1	20·0		Nileshwar*	0·1	-0·8	127·5
	Anantapur	0	—	21·0		Mangalore	0·6	-0·1	122·8
	Cuddapah	0·2	-0·7	33·0					
Carnatic	Nellore	0·5	-2·7	24·9	Mysore	Chitaldrug	0	-0·3	25·8
	Madras	2·3	-3·4	40·3	and	Mysore	0·2	-0·2	39·6
	Palur*	8·7	+0·2	46·2	Coorg	Mercara	0·2	-0·5	121·2
	Palakuppam*	4·8	-0·4	34·4					
	Cuddalore	12·9	+5·7	46·5					
						Kodaikanal	6·1	+2·5	79·1
Central	Vellore	2·1	-0·6	40·3	Hills.	Coonoor	4·4	—	53·6
	Hosur cattle farm*					Ootacamund*	2·4	-2·4	38·1
						Nanjanad*	1·8	-0·2	45·2
	Salem	0·4	-0·6	31·0					
	Coimbatore	0·6	-0·5	15·2					
	Coimbatore Res. Inst.*	0·8	-1·5	—					
	Trichinopoly	4·5	+2·0	38·0					

* Meteorological Stations of the Madras Agricultural Department.

Summary of Weather Conditions, December 1935.

Dry weather prevailed over the Peninsula in the first week. A depression formed in the Andaman Sea on the 5th instant but weakened the next day to a trough of low pressure, which persisted till the 9th. This did not affect the weather in the Peninsula, but caused widespread rain in Tenasserim. The north-east monsoon strengthened in south Madras on the 18th and there was widespread rain there from the 18th onwards. A low pressure wave passed westwards across Ceylon on the 20th causing general rain in the south-east Madras. Associated with a strengthening of the north-east monsoon in the South-West Bay of Bengal there was generally heavy rainfall in south Madras on the 23rd, 24th, 25th and 26th instants.

Rainfall was locally in excess at a few stations in the south and in defect elsewhere.

Chief falls reported were :—

Negapatam	6·0″ on the 18th.
Cuddalore	4·3″ „ „

Negapatam	5·7'' on the 20th.
Cuddalore	2·9" „ 27th.
and Aduturai	5·6"

Weather Report for the Research Institute Observatory.

Report No. 12/35,

Absolute Maximum in shade	88·8°F
Absolute Minimum in shade	58 3°F
Mean maximum in shade	84 9°F
Departure from normal	0
Mean Minimum in shade	65·8°F
Departure from normal	0
Total Rainfall	0·84"
Departure from normal	1·49"
Heaviest fall in 24 hours	0 32 (Recorded on 25–12–35.)
Total number of rainy days	4
Mean daily wind velocity	2·6 M. P. H.
Mean humidity at 8 hours	7·51 %
Departure from normal	4·6 %
Total hour of Bright Sunshine.	213 5 hours.
Mean daily Hours of Bright sunshine	6·9 hours.

Summary. Rainfall was in large defect. Most of the rainfall was received between the 24th and 28th instants in small showers. Temperatures were normal Lowest minimum recorded was 58·3°F on the 1st December 1935.

A. S. R. & D. V. K.

Departmental Notifications.

Leave. Mr. S. Ramachandran, A. D. VIII Circle. extension of l. a. p. for 2 months. Mr. M. Eggiaswami Ayyar, A. D. IV Circle extension of l. a. p. on M. C. for 10 days in continuation of 8 months' l. a. p. already granted.

Transfer. Mr. V. Chidambaram Pillai, A. D. Nanguneri as F. M. A. R. S. Koilpatti, Mr. J. S. C. Antony, F. M. A. R. S. Koilpatti, as A. D., Nanguneri. Mr. E. T. Verghese, Asst. to G. A. C. transferred to officiate as Asst. Lecturer in Chemistry Vice Dr. C. Narasimhacharya deputed for foreign service. Mr. K. H. Subrahmania Ayyar, A. D. Annur to be on van duty in Salem Dist. till 16—2—36, after which to be A. D., Erode. Mr. P. K. Nambiar, A. D., Erode to be A. D. Pollachi.

Manager's Notice.

Subscribers and Members whose subscription expires by December 1935, are kindly requested to remit their subscription before the first week of February at the latest.