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EDITORIAL

Agricultural Research. "The principal function of this Department is scientific research. All its other activities are the practical expression of research results. Research is the primary thing, the key stone of the entire structure of the Departmental functions and services. Were the Department not engaged itself in creative scientific work, it could not use creatively the findings of other institutions. Only science can assimilate science". Thus states the Minister of Agriculture in U. S. A.

Since the ultimate aim of agricultural research is to contribute directly to the welfare of mankind, the agricultural worker, unlike the pure science man, is not at liberty to follow any hare that crosses his path. The applied scientist must pre-define his problem, and should adhere to it most rigidly. The method that he uses for the solution of the problem must be carefully chosen, so as to yield precise results with the least loss of time. The problems are often numerous and when money and time are limited, preference should be given to such problems as are capable of rapid solution and wide application. And it is for this purpose that the agricultural worker must associate himself keenly with the field. When a major crop remains untouched, the improvement and protection of a minor crop are not likely to benefit as large a population as they would in the case of a major crop. Similarly spacing experiments on lands of high fertility have little applicability, and therefore it is desirable to conduct all seed rate experiments on fields of average fertility.

The amount of intricate research that has to be undertaken is probably much more than is realized by the research workers or the administrators. The problems of agriculture are of an omnibus nature, and the full solution of these is seldom within the province of any single department of science. Now it is generally recognized that the improved strains of cereals should possess, in addition to desirable agricultural and commercial characters, high, nutritive properties. The improvement of cereals, therefore requires close collaboration and complete harmony among the plant-breeder, the chemist and the marketing officer. It is only for administrative convenience, that agricultural research is separated into compartments, but the boundary lines do not exist in the practice of agriculture. Separate study enables the analysis of problems, but there must be a synthesis of results, for their application in terms of social welfare.

The gaps in our knowledge are many. In Madras particularly we need more information on the effects of different kinds of tillage and the efficiency of various implements as judged by crop production. Much that is accepted without adequate experimentation may be right, but it is never too late to critically examine the accepted notions.

India as a whole has lagged behind in investigations on the forage grasses. No grass investigation has been carried out on a scale commensurate with its importance. The testing and the breeding of varieties and the species of the grasses is one of the important problems of the day. Practically all of the widely used grasses in U. S. A. have been introduced from foreign countries. The introduction of a hardy type of grass into the Ceded Districts would considerably mitigate the scarcity of fodder during the famine years.

Until very recently agricultural research was largely limited to the study of ways and means to decrease the cost of production and increase of the volume of land output. Now it is being recognized that markets and prices affect the farm as much as the technique of crop production. Research regarding the production, distribution and consumption of agricultural commodities is just taking its rightful place in the activities of the Department. In this Journal, reports of several marketing surveys have already been published. Investigations into the market conditions, practices, and prices will ultimately aid the standardization of farm commodities, develop marketing facilities, and improve crop forecasting. The concept of public responsibility for agricultural welfare has not yet sufficiently widened so as to fully recognize the extent of the farmer's dependence on credit conditions, land values, land tenure, conditions and methods of land settlement, and utilization of non-agricultural land. Until the above mentioned defects are remedied, the fruits of research cannot be gathered in full abundance.

For those who are still sceptical of the usefulness of agricultural research we can do no better than quote an extract from the recent speech of the Minister of Agriculture in Great Britain: "It was no exaggeration to say that no industry of the country has so vitally made use of the products of research as Agriculture. It has been truly said that ignorance could never provide good government, but it did not do much harm in high places as long as it was passive ignorance. The real trouble started when there was active ignorance, and there must be no ignorance now that a different conception was taken of agriculture. There has been a change of attitude on the part of the people and Government towards agriculture, and it was an attitude that would persist. The whole people was conscious of the value of agriculture and would not easily revert to an attitude of complete *laissez faire*. Research work carried on in intimate contact with farmers and those dependent on them was of the greatest benefit, and could become one of the most potent factors in the future of industry".

THE RESPONSE OF RAGI—*ELEUSINE CORACANA* (GAERTN)—THE FINGER MILLET—TO SOWINGS IN THE DIFFERENT SEASONS OF THE YEAR

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Introduction. The Coimbatore farmer sows his main *ragi* crop under irrigation in May or June and the summer crop at the end of December. The main crop needs to be harvested before the last week of September or October if tobacco or wheat as the case may be, follows it. The prudent farmer has therefore to time the sowing so as to secure a maximum yield without at the same time protracting into the proper sowing time for the following crop. The scope for the summer crop is wider ; anytime from December to March, the crop may be sown, there being no time limitations except the availability of water. For these reasons, it was undertaken to investigate the reactions of different seasonal sowings on the crop.

Besides this consideration, there was another problem to be studied. *Ragi* is a crop reputed to grow fairly well, flower and set seed at practically all times of the year. The differential response of the plant to the vicissitudes of weather was a problem awaiting scrutiny. An experiment was accordingly designed to ascertain (1) tha most suitable time for sowing for the main and summer crops, (2) the plant characters which respond to climatic factors in the same manner as grain yield, and (3) the duration of a crop in relation to the time of sowing.

Material and Method. E. C. 1000, a strain usually $3\frac{1}{2}$ months in duration and E. C. 24 later by about a month in duration, both un-purple-pigmented, of the same grain colour and panicle shape, were chosen for the study. On the first of every month, the two strains were sown in nurseries and on the 25th day after sowing, they were transplanted in plots 110×7 square links in a field, the most standardised at the Millets Breeding Station. Planting was done in 5 lines, 110 links long and one link apart with a space of 1 link between plants in a line. This experiment was carried on for 28 months commencing from June 1930. When the main earhead completely emerged and flowered, a fixed number of plants, 50 at first and then increased to 200 was labelled at random in the three central lines of the

plot excluding a region of 5 links at either ends. The following measurements were recorded for each plant : -

1. Number of nodes on the main axis.
2. Number of leaves on the main axis.
3. Length of flag on the main axis.
4. Width of flag on the main axis.
5. Height of the main axis.
6. Length of peduncle on the main axis.
7. Number of thumbs on the main earhead.
8. Number of fingers on the main earhead.
9. Length of fingers on the main earhead.
10. Number of earheads.
11. Weight of first harvest grain.
12. Weight of second harvest grain.
13. Weight of dry straw.
14. Weight of roots.

Unlike other millets, in *ragi*, the earheads ripen unevenly. There is a first flush of ripening of most of the primary earheads, and then follows the ripening of the other earheads. To secure the maximum yield of a crop, it is necessary to harvest all the ears. After a first harvest the general practice is to allow about ten days to elapse for the second harvest which is also the final. As much as 30 per cent of the total yield is sometimes contributed by the second harvest. In the present study, the plants marked were harvested individually when the first flush of earheads ripened and a second harvest was made 10 days later. The plants were then uprooted carefully and the roots washed and dried. The weight of the dry straw and the weight of roots were obtained separately. In Tables I and II are presented the grain yields and the duration of the crop. Table III presents the coefficients of variation. Tables IV and V present the analysis of variance of grain. Table VI gives the correlation coefficients.

Discussion. Though there are some definitely good seasons for raising a *ragi* crop, in no season does it completely fail. For the main crop, E C. 1000, an early strain sown in the first week of June and July ripens about the second week of September and October respectively ; the May and July sowings yield less than the June sowing (Table I), the differences being statistically significant. E. C. 24 when sown in the first week of June and July ripens about the first week of October and November respectively. There is nothing to be gained by delaying the sowing in June, the yield of July sowings equalling that of June (Table II). The May sown crop not only yields less, but takes about a week longer to mature than the June sown crop. In the June crop 1 to 30 per cent of the total yield in the case of E. C. 1000 and 5 to 10 per cent in the case of E. C. 24 are contributed by the second harvest. With a variety like E. C. 24, no great loss will be incurred if only one harvest is made when circumstances press, whereas with a variety like E. C. 1000, the second harvest cannot be ignored and the

duration of the crop must be allowed 10 days more than that mentioned above.

The summer crop can be raised successfully from December onwards. The grain yield during those months is very variable (Tables I and II) and no one period can be taken as better than another. However, December and January sowings are to be preferred for the reason that the duration tends to lengthen in the later sown crops (Tables I and II). The growth of a crop is determined not by the calendar but by the weather conditions. The practice of fixing definite times for sowing depends on the general association between a particular weather cemplex and a calendar month, and this is by no means rigid. For instance, E. C. 24 gave about the lowest yield in the March sowing of one year (Table II) and in the next March sown crop, the yield was the highest for that year. The chief merit of the main season crop, the one sown in June, is that it comes under the generally reliable weather complex of the South-West monsoon and therefore the yield is steady. It is also evident from Tables I and II, that the November sown crop which comes under the winter spell is about the poorest in growth and yields the least.

The next enquiry was directed to the variations in the other plant characters. On the whole, the differential response, of each character as measured by the co-efficient of variation corresponds in the two varieties studied. Climatic factors have the most pronounced effect on straw, root and grain yield (Table III). The coefficient of correlation between the corresponding coefficient of variation in the two varieties is 0·87. There is noticeable in the case of E. C. 1000, a significant excess of variability in the earhead characters (Table III), namely, the number of fingers and the number of thumbs.

Since grain yield is the primary concern, an analysis was made to see whether the variation between months within years was of the same order as the variation within months with due regard to the respective degrees of freedom. The period of two years from June 1930 to May 1932, was considered to examine also the effect of the two cycles of 12 months. It is seen from Tables IV and V that the variation between months is more than can be accounted for by the variation within months ($P < 0.01$), and signifies the reality of the effect of season. The year June 1930 to May 1931 was on the whole more favourable to *ragi* than the following year.

The next step was to determine what plant characters had the variation induced by weather factors corresponding to those of the grain yield. This was done by the method of correlations. The number of leaves on the main axis, the number of nodes on the main axis, the length and breadth of the flag, the height of the plant, the length of peduncle, the weight of root, are all associated with vegetative activity. It is seen in Table VI that all these characters are positively correlated with grain yield through the changing seasons. And straw which is the sum of all vegetative activity is highly correlated with grain yield.

For both the early and late varieties, the grain yield is absolutely independent of the variations in tillering produced by season (Table VI).

In the *ragi* panicle, below the normal whorl, there are usually one or more fingers appearing like the vestiges of a second whorl. These fingers are called thumbs consistent with the nomenclature fingers for the spikes of the first whorl. The manifestation of thumbs varies from season to season; for E. C. 24 the C. of V. is 12·2 and for E. C. 1000, 31·8. It is found that in times of affluence, the early variety puts forth more thumbs ($r = ·7$) these becoming the marks of prosperity. With E. C. 24, the expression of thumbs is erratic (Table VI) ($r = ·08$).

In seasons favourable to high yield, the fingers are long and many in the panicle; the corresponding correlations are above the level of significance (Table VI). These factors secure an extension of the effective region of grain production.

The duration of a crop measured from the sowing date to ripening is the least variable of the factors considered. The C. of V. is 5·7 for E. C. 1000 and 5·6 for E. C. 24. The crop sown in April which comes under the full blaze of the summer sun is the most prolonged; the exception is the behaviour of E. C. 1000 in April 1932. External conditions may retard or hasten ripening, but the performance of a crop is not dependent on the changes in the duration, the corresponding correlations being ·21 and $-·05$ (Table VI).

Summary. The optimum sowing time for the main *ragi* crop is June for E. C. 1000, an early strain. E. C. 24, a long duration strain can be sown in June or July. For the summer crop, December and January sowings are to be preferred to a late sowing for the reason that the duration tends to lengthen in the later sown crops. The plant characters which respond to climatic factors in the same manner as the grain yield are the number of leaves, the number of nodes, height of plant, length of peduncle, length and width of the flag, weight of straw, weight of root, number and length of fingers in the main earhead. The variation in the number of earheads due to season is not reflected in the total grain production.

The alterations in the duration of a crop caused by the seasonal changes in no way affects the final yield.

TABLE I. E. C. 1000. Duration and Average Yield per plant.

Month of Sowing.		Weight of grain First harvest	Second harvest	Duration Days.
		gm.	gm.	
June	1930	13·0	5·5	108
July	,,	10·7	1·6	110
August	,,	9·8	0·4	104
September	,,	8·6	1·3	103
October	,,	16·0	2·1	99
November	,,	6·0	0·7	95
December	,,	11·0	2·5	101
January	1931	13·2	1·7	99
February	,,	9·8	1·4	109
March	,,	12·8	1·6	114
April	,,	12·1	1·2	116
May	,,	11·4	1·3	116
June	,,	11·8	2·3	108
July	,,	10·7	0·8	108
August	,,	10·3	2·9	108
September	,,	5·6	1·1	96
October	,,	5·5	1·3	104
November	,,	4·1	1·4	116
December	,,	5·2	0·4	102
January	1932	8·1	1·1	103
February	,,	11·4	0·0	105
March	,,	14·6	0·1	103
April	,,	11·2	0·3	96
May	,,	8·2	0·5	102
June	,,	15·5	0·2	110
July	,,	11·9	2·1	103
August	,,	8·8	1·3	99
September	,,	7·3	1·2	94

TABLE II. E. C. 24. Duration and Average Yield per plant.

Month of Sowing.		Weight of Grain First harvest	Second harvest	Duration Days.
		gm.	gm.	
June	1930	20·0	2·0	140
July	,,	21·8	1·1	134
August	,,	20·0	0·2	133
September	,,	18·1	3·8	120
October	,,	17·4	3·6	116
November	,,	13·8	4·1	120
December	,,	16·6	3·0	120
January	1931	21·8	1·7	128
February	,,	11·8	0·4	132
March	,,	13·6	0·7	143
April	,,	17·9	1·3	150
May	,,	18·2	0·9	144
June	,,	18·9	1·0	134
July	,,	17·9	1·3	128
August	,,	11·7	2·7	124
September	,,	12·7	4·4	127
October	,,	10·8	1·8	125
November	,,	9·1	2·9	130
December	,,	11·7	3·2	123
January	1932	12·3	1·2	127
February	,,	18·0	0·7	125
March	,,	25·6	0·3	126
April	,,	14·3	0·7	142
May	,,	16·4	0·2	134
June	,,	22·8	2·2	127
July	,,	20·7	4·3	123
August	,,	14·5	1·4	117
September	,,	11·2	1·0	128

TABLE III. Co-efficients of Variation.

Factor.	Coefficient of Variation. E. C. 1000.	E. C. 24.
Grain yield	32 1	26·1
Number of leaves on the main axis	27·3	21·2
Number of nodes on the main axis	16·0	22·0
Height of the main axis	21·4	22·3
Length of flag on the main axis	10·6	12·2
Width of flag on the main axis	8 7	10·2
Length of peduncle on the main axis	9 7	10·5
Weight of straw	47·5	55·4
Weight of root	45·6	51·9
Number of earheads	27·4	30·2
Number of fingers in the main earhead	19 0	6·2
Length of fingers in the main earhead	9.0	10·7
Number of thumbs in the main earhead	31·8	12·2
Duration	5·7	5·6

TABLE IV. E. C 1000. Analysis of Variance of Grain Yield.

Variation.	Degrees of Freedom.	Sum of squares.	Mean square.	$\frac{1}{2}$ Log e (Mean square)
Between years	1	4461	4461	4·20
Between months within years	22	9384	427	3 03
Within months	2416	92312	38	1·82
Total	2439	106157	...	...

TABLE V. E. C. 24. Analysis of Variance of Grain Yield.

Variation.	Degrees of Freedom.	Sum of squares.	Mean square.	$\frac{1}{2}$ Log e (Mean square).
Between years	1	3365	3365	4 06
Between months within years	22	58831	2674	3 95
Within months	2386	214586	90	2·25
Total	2409	276782	...	...

TABLE VI Correlations.

Correlates.	Coefficient of Correlation. E. C. 1000.	E. C. 24.
Grain yield and number of leaves on the main axis *	·55	·44
,, number of nodes on the main axis *	·68	·66
,, height of the main axis * *	·77	·58
,, length of flag on the main axis *	·71	·58
,, width of flag on the main axis *	·71	·60
,, length of peduncle on the main axis *	·73	·50
,, weight of straw * *	·85	·86
,, weight of root *	·74	·76
,, number of earheads * *	– ·05	·06
,, number of fingers in the main earhead *	·68	·63
,, length of fingers in the main earhead *	·70	·37
,, number of thumbs in the main earhead *	·70	·08
,, duration * *	·21	– ·05
,, proportion of first harvest to total grain * *	·28	·29
* * *Level of significance* P = ·05	·37	·37
* ,, ,, ,,	·38	·38

MANUFACTURE OF SYNTHETIC NITROGENOUS FERTILIZERS IN INDIA

Part I. The demand for nitrogenous fertilizers in this country.

By Dr. C. N. ACHARYA, M. Sc., Ph. D., A. I. C., F. A. Sc.

The idea of applying inorganic fertilizers, especially nitrogenous, with a view to increase crop yields, may be said to have originated from India, where potassium nitrate obtained from the nitre-beds of Bihar, Bengal and the Punjab was for a long time used for the purpose. Before the nitre deposits of Chile were discovered and exploited from 1830, India was for centuries the sole source of nitrate both in times of peace for agricultural operations and in times of war, for the preparation of gunpowder. But after the discovery of the huge deposits in Chile, the export of nitrate trom India rapidly decreased and the commercial exploitation of the nitre beds on a large scale has only recently been restarted by a subsidiary company of the Imperial Chemical Industries Ltd.

Though the usefulness of inorganic nitrogenous manures has been realised in India for a long time past, their application on the large scale for intensive cultivation has been undertaken mostly in the Europen countries, where the high density of population has necessitated the adoption of a highly scientific and intensive system of agriculture. Sir John (then Dr.) Russel,[1] writing in 1917, estimated the quantities of fertilizers used in the principal consuming countries to be as follows, and there is no doubt that the amounts have since that period greatly increased in the western countries.

TABLE I.

Country.	Fertilizers used per hectare (2·4711 acres) in cwts. (1917).	Density of population in 1931[2] per sq. K. meter (0·3861 sq. mile).
Belgium	5·38	268
Luxemburg	4·05	...
Germany	3·31	139
Great Britain	1·78	194
Italy	1·19	134
Denmark	1·14	...
France	1·13	76
Cf. India (in 1937)	0·016	75

Such increased use of fertilizers in the more highly developed countries is reflected in the higher yields of crops obtained by them, as shown by the following figures for 1933-34[3]:—

TABLE II.

Rice.		Wheat.	
Country.	lb. per acre.	Country.	lb. per acre.
1. Spain	5,600	1 Netherlands	2,717
2. Italy	4,232	2. Denmark	2,652
3. Japan	3,720	3. Germany	2,154
4 Egypt	2,685	4. United Kingdom	2,144
5. India	825	5. India	632

	Sugarcane. Tons per acre.		Cotton. Ginned cotton lb. per acre.
1. Hawaii	56·42	1. Egypt	452·8
2. Java	50·27	2. Brazil	306·5
3. Egypt	30·97	3. Argentine	220 0
4. Cuba	20 32	4. U. S. A.	217·6
5. India	16 24	5. India	81·0

Even in India, the population is increasing at a rapid rate and the estimated acreage under food crops per head of population is steadily declining[4], as shown by the figures given below :—

TABLE III.

Year.	Population in millions.	Estimated acreage under food crops per head of population.
1871	230	1·01
1891	275	0·88
1901	294	0·81
1921	319	0·72
1931	353	0·60
1941 (estimated)	400	0·53

It is interesting to compare the above figures with the evidence of Burnet and Aykroyd[5], submitted to the League of Nations Health Bureau, on the amount of land required per capita for the production of different types of diet.

TABLE IV.

Diet.		Amount of land required per capita per annum.
1. Restricted diet for emergency use	...	1·2 acres.
2. An adequate diet at minimum cost	...	1·5 ,,
3. An adequate diet at moderate cost	...	1·8 ,,
4. A liberal diet	...	2·1 ,,

That there is not much more land available for cultivation purposes in the older provinces of India is shown by the following data :—

TABLE V.

% of cultivated land to total culturable area. (Wattal)[6].

Province.		% of cultivated to culturable area.
1. Madras	...	77·5
2. Bombay	...	86·4
3. Bengal	...	82 9
4. United Provinces	...	78·1
5. Bihar and Orissa	...	81·7
6. Punjab	...	67·4
7. Central Provinces and Berar	...	66·9

The above data clearly emphasize the urgent need for the State to take suitable measures for increasing the yield per acre of the present area under cultivation. This is possible only by a more extended use of inorganic fertilizers.

India has so far been using mainly organic manures, e. g. farmyard manure, green manures, cakes etc. The supplies of such manures are limited and show a tendency to decrease, due to the extended use of cow-dung cakes as fuel and the heavy exports out of the country of bones, bone-meal, horn-meal, fish manure and guano, amounting to about 88,000 tons per year exclusive of oil cakes.

TABLE VI.

Exports of Manures from India[7].

	1935-36 Tons.	1936-37 Tons.	1937-38 Tons.
1. Bones and bone meal	42,894	57,247	68,830
2. Fish manures	6,165	6,583	6,396
3. Horn-meal	645	2,436	2,563
4. Sulphate of ammonia	7,072	2,626	1,919
5. Other manures	4,561	8,320	8,986
Total Exports	61,337	77,212	88,696

Further, under tropical conditions, the organic matter in the soil is easily oxidized and even heavy additions of organic manures, e.g. farmyard manure, barely serxe to maintain the organic matter content of the soil at the minimum level necessary for successful cultivation. As such, the beneficial effects of such bulky organic manures are more physical in improving the quality of the soil, rather than nutritional in the supply of plant food requirements. It has been the general experience of agriculturists both in this country and elsewhere that the highest yields are obtained by a suitable mixture of bulky organic manures with concentrated inorganic fertilizers.

Of the three important food constituents required by plants, viz. nitrogen, phosphoric acid and potash, Indian soils generally contain enough of potash and do not show any significant response to further additions. Phosphoric acid is no doubt deficient in several areas, but considering the fact that about 70,000 tons of bones and bone-meal are exported from the country, there should be no difficulty in meeting the country's requirements in this regard, by discouraging such export through suitable tariff barriers.

But the case is, however different with nitrogenous fertilizers, which are not manufactured in sufficient amounts within the country, and are moreover required in much larger amounts than either phosphatic or potassic manures. The reason for this greater demand for nitrogenous manures is due to the fact that, for most ordinary crops, the saturation point of the soil is more easily reached in respect of potash and phosphoric acid than for nitrogen In other words, it pays the cultivator to apply larger amounts of nitrogenous manures than phosphatic or potassic fertilizers.

Bueb[8] reports German experience which gives the following crop increases per ton of nitrogen applied as fertilizer :—

18 tons of wheat grain and 40 tons of wheat straw ;
24 tons of barley grain and 30 tons of barley straw ;
24 tons of oat grain and 34 tons of oat straw ;
129 tons of potatoes and 40 tons of potato foliage ;
150 tons of sugar-beet and 199 tons of sugar-beet foliage ;
240 tons of fodder turnip and 79 tons of fodder turnip foliage.

N. Caro[8] came to a similar conclusion that each ton of nitrogen increases the yield of grain by at least 20 tons and that of potatoes by at least 100 tons.

Sir John Russell in his recent Report[9] on the progress of Agricultural Research in this country, also observes :— "Nitrogenous fertilizers usually

give the largest returns" and gives data which show that a maund of nitrogen applied in the form of ammonium sulphate, gives the following increases of crop yield :—

275	maunds of sugarcane ;		5	maunds of tea ;
25	,,	sugar ;	22·5	,,	paddy ;
75	,,	potatoes ;	15	,,	wheat ;
6	,,	leaf tobacco ;	8	,,	seed cotton.

The striking benefit to be derived from the use of nitrogenous fertilizers is reflected in the figures for the imports of manures into India during the last three years.

TABLE VII

Imports of Manures into India.[7]

Nature of manure.	1935—36 Tons	1936—37 Tons	1937—38 Tons
Nitrogenous Manures.			
Ammonium Sulphate	46,385	61,238	53,216
Ammonium phosphate	5,529	4,122	2,167
Sodium Nitrate	2,714	2,470	3,208
Others	488	550	589
Total.	55,116	68,380	59,180
Potassic manures	4,475	2,754	4,532
Phosphatic manures (other than ammonium phosphate)	10,434	9,191	11,184
Other manures	2,185	3,328	3,529
Total imports	72,210	83,653	78,425

The above Table shows that about 75% of our total imports of fertilizers are nitrogenous and about 70% is accounted for by one item, viz. ammonium sulphate. The 50 to 60 thousand tons of ammonium sulphate imported per year are in addition to about 16,000 to 18,000 tons which are produced in India as a by-product in the "coking" industry. The total consumption of ammonium sulphate, therefore, comes to about 75,000 tons per year ; and almost the whole of it is used as fertilizer.

The main sources for the world supply of nitrogenous fertilizers are : (a) Chilean nitrate, (b) by-product ammonia, obtained from coal and (c) synthetic nitrogen obtained by atmospheric nitrogen fixation. Before the War, Chilean nitrate held the predominant position, being almost the only major source for nitrogenous fertilizers. But during the War, Germany which was cut off from the Chilean supplies, perfected the synthetic method for the manufacture of ammonia and also greatly developed her production of by-product ammonia. After the War, the production of synthetic nitrogen compounds has been greatly developed in most of the European and American countries, so much so that, at present this source is supplying about 75—80% of the world demand for nitrogen (vide Table VIII).

TABLE VIII.

Sources of nitrogen supply for the World. (Metric tons of N).

Source.	1912.	1925.	1935.
1. Chilean Nitrate	411,329	421,000	192,000
2. By-product ammonia	272,007	302,000	365,000
3. Synthetic nitrogen from the atmosphere	32,435	495,000	1,776,000

In the case of India, the distance from Chile is a decisive factor working against the import of sodium nitrate into this country. It can be seen from Table VII that only 3,208 tons of sodium nitrate were imported into this country in 1937-38, as against 53,216 tons of ammonium sulphate.

A local source for nitrate, no doubt, exists in the surface accumulations of saltpeter (potassium nitrate) found in some of the saline areas of Bihar, Bengal and the Punjab. But this source is at present of a limited and uncertain nature; and moreover on account of the tedious processes of dissolving out the nitrate from the soil and recrystallising it, the cost of the nitrate produced in India is higher than that of the imported material. Thus crude 10% saltpeter (local) is selling on the Calcutta market at Rs. 4 to 5 per maund, which works out to about Rs. 120 to Rs. 140 per ton, as against the price of Rs. 100 for sodium nitrate (15·65% N).

As regards the manufacture of ammonium sulphate as a by-product of the coal and coking industry, India is, no doubt, raising about 20 to 25 million tons of coal per year, which at a conservative estimate of a recovery of 0·05 % as ammonia, contains a potential content of 50,000 tons of ammonium sulphate. Further, large amounts of hydrogen are obtained as a by-product during the manufacture of coke, which could be easily converted into ammonia by synthetic methods. The annual production of pig iron in this country during 1937—38 was over 1,620,000 tons, and making a fair allowance for the portion produced with the help of charcoal, the amount of coke used in the iron industry may be estimated at a minimum of 1,000,000 tons. The manufacture of this amount of coke would yield, under conditions of effective recovery of by-products, enough hydrogen to yield 30,000 tons of ammonia or about 150,000 tons of ammonium sulphate.

In the coal industry, therefore, India may be said to possess a potential source for over 200,000 tons of ammonium sulphate per year, which will be more than sufficient to meet her requirements for some years to come at least. But, unfortunately, the coking industry in India is so ill organized that the production of by-product ammonia has been quite unable to cope with the rapidly increasing demands, as will be seen from the following Table.

TABLE IX

Year.	The amount of ammonium sulphate	
	Produced in India. Tons.	Imported from outside. Tons.
1932—33	8,116	37,612
1933—34	9,702	29,800
1934—35	14,034	40,875
1935—36	17,619	46,385
1936—37	16,041	61,238
1937—38	18,100	53,216

There are no indications of any immediate rapid improvement of supply from this source. An annual production of about 20,000 tons of by-product ammonium sulphate is probably what could be expected for some years to come, till the coking industry is better organized.

As such, the balance of our nitrogen requirements, which may be expected to go up to about 100,000 tons within the next few years, will have to be imported from abroad, unless arrangements are made for their manufacture within the country itself.

The most effective means at our disposal for this purpose and the one that has been tried with great success in Europe and America, is the fixation of nitrogen from the air by synthetic chemical processes.

It is not proposed to deal here with the question of fixation of nitrogen by bacterial agency, through leguminous crops, as this is already being followed in the systems of crop rotation adopted in this country. But such a system of rotation, by itself, has not been found sufficient to give the maximum yields of crops. Large quantities of nitrogenous fertilizers are being imported and applied directly to crops such as paddy, sugar-cane, cotton, coffee, tea, rubber etc. Our imports in this respect are nearly 80,000 tons, valued at Rs. 8 crores and promise to increase rapidly in the coming years. There is, therefore, every justification for taking necessary steps for the manufacture of synthetic nitrogenous fertilizers in this country, by starting plants for the fixation of atmospheric nitrogen.

Another reason which has induced European and American countries to greatly develop their atmospheric nitrogen industries has been the great importance of such concerns in times of War, in providing enough supplies of nitric acid for the preparation of munitions. Thus, Germany is at present equipped with plants capable of fixing nearly 1,500,000 tons of nitrogen per year, while America, France and England can fix about 750,000 tons each. Though the world production of fixed nitrogen in 1935-36 was about 2,378,000 tons, the potential capacity is believed to be nearly 10 million tons of fixed nitrogen per year. The ability of Germany to withstand the last War for over 4 years, was mainly due to her capacity to replenish her supplies of munitions by fixation of nitrogen from the air. In these days of modern aerial warfare, survival from annihilation is determined by the ability of a country to produce enough ammunition for its protection against aggression. As such, the importance of starting a number of nitrogen fixing plants in different parts of the country needs no stressing.

In the next Part, we shall briefly consider the relative merits of some of the important methods that have been tried so far in Europe and America, for the fixation of atmospheric nitrogen, with a view to choose one which combines cheapness with suitability to conditions in this country.

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RURAL EXHIBITION *

BY K. UNNIKRISHNA MENON,
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An Exhibition as a means of advertising new methods and wares is considered to be very useful. It really creates a sense of healthy rivalry and has served to produce very valuable results in improving the efficiency of production and the quality of the produce. It is accepted on all hands that Exhibitions are a necessary means to progress. Even the ignorant and illitrate can be educated very effectively through their sense of sight by presenting things in the most attractive manner in an exhibition. Thus an exhibition is fundamentally a means for the education of the masses.

Government Departments and business organisations have conducted or taken part in exhibitions with great success. Such exhibitions were mostly arranged in urban areas or in very important villages where alone they could secure the necessary co-operation from the local public. From them a few of the organisations have without much effort been able to achieve very good results to help them to make progress and expand their business while others have not had such good opportunities in spite of the great pains taken and care bestowed on putting up the show in a very telling manner. Business men who were attempting to secure patronage from a wider circle or to popularise their produce and to find a market for them have succeeded best in them so much as to say that some of the exhibitions have become an array of show rooms or shops wherefrom sales are effected to new customers. Stalls containing curios, fancy goods, toys, carving and inlaid works, furniture, etc. are the most popular places in these exhibitions; Cotton, woollen or silk fabrics take the next place of importance while exhibits on subjects of rural importance such as agriculture, sanitation &c., attracted the least attention. The reason for this state of affairs is not far to seek; since it is due to the simple fact that the visitors to such exhibitions are mostly urban people who can have little taste or interest in rural subjects. Taking into consideration the fact that more than ¾ of the population of India live in rural parts it will be clear that these urban exhibitions can

* Paper read at the Twenty-seventh College Day and Conference, July 1938.

hardly benefit them, from the point of view of practical education which forms the essential purpose of an exhibition.

We had exhibitions in certain places on festive occasions. Though they were in rural areas and attracted very large crowds, the people who used to come there appear to have to transact a particular business and as soon as they finish that, they are found to get away in order to avoid the congestion of the place. Most of the people that often come into the exhibition stalls and spend sometime there, are such as have little by way of occupation. They cannot also be benefited by the show as they lack the incentive to study things or are too lazy to do so. At times it has been found that such persons speak disparagingly about things they saw at the exhibition and conduct, as it were an anti-propaganda.

For instance at the Tiruvannamalai Deepam festival we have one of the biggest gatherings in South India. Those who come to purchase cattle finish the bargain and get away as soon as possible, since it is difficult to keep and look after the animals in a crowded place. The largest gathering is on the most important Kirthika day when devotees coming for the occasion from distant places anxiously await the lighting up ceremony and follow the grand procession of the deities round the hill with all religious fervour. Most of them have little leisure to get into the Exhibition stall and study agricultural matters, since the sight seeing and religious functions in the temple continue throughout the day.

Thus it will be clear from the above facts that in such gatherings also the real ryot is not so fully attracted as one would at first sight expect. The ryots who do gather on such occasions are immersed in the gaities of the fair or festival or are preoccupied with the socioreligious aspects of the function. They are also in too light a mood to think of and bestow attention to their own profession on these occasions and so fail to get benefited by the exhibition to the extent we desire. In cases where conditions were very agreeable some have been really benefited. We are not satisfied with this small achievement which is never commensurate with the efforts made. So also in jamabandi camps wherein the gatherings are more exclusively of village officers and agriculturists, the lectures and exhibitions conducted did not produce the desired effect as the people were pre-occupied with grievances which they were placing before the jamabandi officers. The village officers themselves are most anxious about the trial they have to stand and the final orders they have to receive from the jamabandi officers on their year's work. Another attempt made was to stage our shows in weekly shandies. Here too the progress made has not been very great for the reasons that such shandies are of too short a duration and the ryots attending them have little time for self-education after transacting their more serious business of selling and buying things for which they go to the shandy.

It has become the fashion to arrange in urban areas what are called "All India Exhibitions"; and in these places a large number of sections is

represented under the categories of Fine-arts, Industries, Forest, Health, Agriculture etc. The visitors to such exhibitions are mostly urban. The very few villagers that get into the ground are often attracted to the curio shops or bucket shops where the crowds congregate. Unless it be following a prominent visitor like the Premier the exhibition of rural subjects remains mostly unnoticed. The modern tendency is to conduct a number of "All India Exhibitions" simultaneously in different parts of the same province and as such the All India scope of the exhibition is very much curtailed.

One exhibition in a town for the whole district also appears to attract too little attention of the rural population and much less it is, that they attempt to avail of the occasion for exhibiting their own products and compete for prizes. Experience shows that divisional or Taluk exhibitions are sharing almost the same fate as they have also failed to create a real sense of competition among the farmers of the area. However, it was found that in the two latter types of exhibitions people could be made to take interest and to exhibit some of their products when demonstrators concerned exert much from behind the screen. Proceeding in this strain, the idea of conducting a rural exhibition was thought of and a scheme was prepared. The Director of Agriculture was kind enough to encourage the scheme. The Indian National Congress has probably accepted this view and began to hold its sessions in rural areas.

The scheme is fundamentally different from all other kinds of exhibitions as it is meant to cater directly to the needs of the villagers in the rural areas so as to create a desire to arise from within, to produce better things, to adopt better ways of life and to exhibit them with a healthy sense of rivalry.

We have a number of organisations meant to improve the lot of the villager. They often fail to attain their objects, for the simple reason that they could not stimulate individual effort towards progress. This novel kind of exhibition is meant to create a feeling of competition among the individuals of a locality in excelling one another in adopting improvements in all aspects of village life particularly with reference to farming which is the basic industry of the villager. The villager is encouraged to make his surroundings more and more sanitary by conserving all sorts of refuses as manure in the best way possible. He is forced to put in individual effort to produce best crops by adopting improvements in cultivation, manuring, weeding or by the use of improved seeds and to take up all profitable side-lines of farming.

Since we met here last I have been thus able to make some progress in advertising Agricultural and other items of improvements in village life. From the experience gained by the one exhibition conducted in Malabar I am able to assure you that it has acted as a powerful force to make the villager adopt improved methods in all aspects of rural life more powerful than any other method of propaganda so far adopted.

I venture to place before you the following few details to indicate what was actually done in "this Socio-economic experiment" and the effects produced thereby in the locality.

The scheme was printed in English and vernaculars and distributed liberally in the centre advertising the exhibition nine months in advance in a few villages in and around Tritala, a village on the bank of the Ponnani or Bharata River. The village was selected for the reason that suitable human material was found available there to work up the scheme. There is also a good co-operative organisation working in that centre. The responsibility for arranging and conducting the exhibition was largely entrusted to the co-operative organisation, under the guidance of the local Agricultural Demonstrator.

The society made available to the ryots the necessary materials like seed, manure, pamphlets, etc. to enable them to start the work early enough and to do their part best to compete for prizes. When later on it was found that a large number of people of the locality attempted to compete in adopting agricultural and other improvements to help rural welfare, a committee of judges was formed consisting of the local Agricultural Demonstrator, the Co-operative Inspector and three good ryots of the place. Numerous plots of paddy crops grown with improved strains of seed, properly cultivated plantain, vegetables, fruits and root crops besides fodder and green manure crops, pulses, gingelly and well preserved manure in pits, etc. came up for competition. Their households and cattle sheds with clean surroundings also competed, for prizes. They were all judged in their respective places to the entire satisfaction of the competitors.

The final meeting was held on 13th February in a spacious pandal specially erected for the occasion and decorated with evergreens, flags, etc. The neighbouring ryots gathered in large numbers and accorded a warm and fitting reception to the visitors. There was also a regular exhibition arranged in the pandal and the school building nearby. The exhibition thus put up was quite an interesting display of big roots of Tapioca, large plantain bunches, fine specimens of pineapples and a variety of vegetables and selected seeds all specially grown for competing for the prizes. Jams and jellies made from different fruits, good bunches of coconuts and arecanuts, etc., live bee colonies, improved poultry, choice cattle including good cows, work bullocks and breeding bulls were the additional features. There was a separate health section with a baby show. Some of the schools exhibited their products—labours of their children in such items as embroidery, basket making, drawing and clay models competed for prizes. Competitions were held in spinning, both by boys and girls, in public speaking, wrestling and music. A health show exhibiting control measures against infectious diseases and sanitary aspects of village life was put up by the Health Department. A small departmental show of improved agricultural products, specimens of pests and diseases and charts was also put up in the school building. The Health and Veterinary departments co-operated whole

heartedly with the Co-operative and Agricultural Departments in making the show a success. There was a number of instructive lectures delivered by the Departmental officers particularly with regard to Health, Sanitation, Co-operation, Veterinary science including Cattle rearing, and Agricultural improvements all bearing on village uplift. Manure conservation with a view to utilise all waste materials as such by making them harmless to the household in order to provide necessary sanitation was given great emphasis as the basic work on which advance in the farming must depend. It is interesting to note here that a ryot who won the first prize in manure conservation had more prizes to his credit namely the first prize for the best paddy and best plantain crop besides others for the sanitary condition of the cattle shed and clean household. Thus 76 prizes were awarded for various items for which there was keen competition. In most of the items three prizes were awarded.

The Boy scouts from a neighbouring High School added to the grandeur of the occasion by the display of scout drill ; so too Kolattam by school girls. The scouts were very helpful in making arrangements for the exhibition and maintaining order in the big gathering. The ryots who mustered strong evinced keen interest in the exhibition and great enthusiasm prevailed.

The visitors from distant places were eager to see what a rural exhibition meant. The Co-operative Union came forward with a request that the Government Departments may help them to make this exhibition an annual event and offered to conduct the exhibition in December. The workers of the place extended invitations to a few more villages round about Tritala to join the exhibition and compete for prizes.

At the very outset by way of providing necessary materials to the ryots to introduce Agricultural improvements, the Co-operative Union undertook to stock and sell improved seeds, manures and implements etc., thus the union began to serve the locality as a useful depot. There was a ready response from the ryots to adopt Agricultural Improvement advocated by the Department and the Union agreed to increase the scope of the Co-operative depot to meet the demands for competition next year. A sub depot has thus been practically opened there. In short it may be said that Agricultural reconstruction is set on foot in this centre on a firm basis, thereby paving the way for a demand for such knowledge and keener incentive for their adoption was made to arise from within.

The Judges and competitors walking from field to field for judging crops was an impressive show in itself. This roused a sort of enthusiasm and spirit of healthy competition which was given free expression by ryots by way of challenging one another for prizes in the next exhibition.

The exhibition centre is gradually becoming a centre for the dissemination of knowledge on rural welfare. The depot gets sufficiently advertised. Rural Development would become easy if the Development Departments heartily co-operate. This one show has attracted the attention of people

in different places, and more centres are seeking help for the conduct of such exhibitions.

If an exhibition of this kind becomes an annual event in several centres in the same taluk there may possibly arise a sense of competition among different centres and the progress may become more rapid.

Health week, Baby show, Educational, Industrial (Rural) and Agricultural Exhibitions can all be held in the same place at the same time. This should certainly add to the utility and grandeur of the occasion attracting more people. I would even go to the extent of suggesting that such a show may last for two or three days with instructive lectures and useful programmes for demonstration and competition, besides a few items of varietal entertainments to break the monotony of its business aspect. Radio sets can come handy for a part of such entertainments.

The last but not the least is the question of finance. It often happens that the enthusiastic worker in a village is a poor man and the villagers are themselves poor. It was therefore necessary at the outset to admit exhibits free of charge into the stall and the amount collected as local subscription was necessarily small. It is however gratifying to say that they contributed their utmost in cash, thereby providing funds for awarding prizes. The kind support given to it by the President and Secretary, Palghat Agricultural Association, was a substantial help.

I would suggest that this may be accepted as one of the lines of work for which financial grant may be made by the Government on the recommendation of the Departmental Officers. Such help may be required in the initial stages until the organisations build up their own finances. I commend these results of this exhibition to the workers assembled here and invite their valuable criticisms and remarks indicating how further improvements can be effected in the programme.

GREEN GRASS*

By T. MURARI, B. Sc., (Oxon), F. L. S., F. R. S. A.,
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Grass is the most important item in this world on which civilisation depends. Without grass there will be no cattle and sheep and no humus for the soil to enable crops to grow; even among crops, it is the grass family that yields the most important food materials for man-kind.

In spite of the fact that this country has seen many civilisations and had comparative peace for well over a century, it is remarkable that very little work has been done on grasses. There has been one continuous war with the Forest Department for facilities for grazing and of late, certain forests were handed over to the Panchayats and the grazing fees have been halved.

* Paper read at the Twentyseventh College Day and Conference, July 1938.

But, do these solve the grass problem of this country ? The only answer to it is in the negative.

Despite the fact that this civilisation depends on the cattle and grass of the country, one does not find much work being done on the grass on which the cattle depend. There are of course stray cases of individual effort, but there is, as yet, no band of workers devoting their undivided attention to grasses alone. There is an urgent necessity for a bold outlook on this problem and there is work for a considerable number of scientists for tackling various problems that await solution.

The most important requirement of our grasslands is that they should provide keep throughout the year. There should be certain types of herbage which should not only withstand the drought periods, but must also be able to withstand much of the gross misuse of pastures such as grazing them continuously throughout the year or grazing the same area precisely at the same time each year. By such misuse the composition of the herbage must necessarily be adversely affected. Examples of such misuse could be seen by a visit to any of the so-called grazing areas round about the villages. In order to minimise this profligate usage, there should be mixed farming and control over the animals with regard to the kind of species and the numbers. This can only be done when there is a change of outlook in the method of farming, by which, there will be conservation of fodder and introduction of short leys in the rotation. There is evidence of this in Coimbatore district with regard to *Kolukkattai* grass *(Pennisetum cenchroides)* and in the Telugu districts the *Pillipesara (Phaseolus trilobus)* but this is not enough.

By conservation of fodder, I mean not only straw, hay and silage, but also dried young grass. We not only misuse pastures by continuous grazing, but also waste considerable quantities of grass which can be converted into silage and artificial dried grass. Though Dr. N. C. Wright has passed this subject lightly, I am very anxious as to the future of this aspect of the question. My personal experiments, with artificial dried grass, show that it is possible to manufacture young dried grass, of a very high quality, which nearly approaches the quality of linseed cake. The method of drying adopted by me was no doubt very simple and capable of much improvement, but I maintain that in the monsoon periods when there is heavy rainfall and the growth of grass is quick large quantities of dried grass cakes can be manufactured. These can be conserved for many years and transported to areas where there is scarcity.

The next important factor in the pasture is the composition of herbage. For the grazing animal and for the soil, legumes are essential. It is frequently mentioned that our grazing areas do not contain legumes. This is not quite true. For instance, there are several indigofera. (*Indigofera enneaphylla*, Linn ; *Indigofera viscosa* Lamk) which can be tried to meet our requirements. When the pasture problem is tackled systematically, there is

no doubt, there will be other legumes in addition to the useful grasses which will be discovered in this country.

The next important point is the management of grasslands. Unless grasslands are cultivated periodically, at least once in 20 years, so that the land gets a chance to recover, we are misusing the grasslands. In addition to cultivation, there is the problem of manuring.

The last, but not the least important problem regarding pastures, is the seed. All other things being under control, if the quality of the seed is not taken into account, there will be no good pasture. This stage, in this country. can be reached when all our grasslands are classified according to regions, the botanical composition and the various other factors are studied from the point of view of the grazing animal.

There is just another important point I should like to mention. One of the important problems is erosion in the tropical countries particularly where torrential rains wash away large quantities of the agriculturist's capital in the form of loose soil. If it were possible to have green grass as an important part of the rotation, in addition to proper fencing and planting of trees, more of this national capital can be conserved.

I now hope that I have said enough to create that bold outlook in our agricultural practice and that we shall be able to do some useful work along the lines I have so inadequately discussed.

EXTRACTS

Plant Physiology and Agriculture.* by H. R. Barnell. (Low Temperature Research Station).

The problems of satisfying increased demands for plant products, or of raising the returns on a particular crop to a profitable level, resolve themselves into the question of "Yield". The yield of a plant may be the whole mass of plant produced, its fruit, its seed, its stem or its roots or some part of any of these, or appendages. Yield is determined by hereditary constitution and by the conditions under which the plant has been grown; it can be regarded as the integration of the metabolic processes concerned in growth and development until the harvesting period is reached. It follows that before the factors determining yield can be analysed with any exactitude it is necessary that our knowledge of the fundamental problems of plant metabolism should be greatly increased; only then may the effect of variation in any one enviromental factor on the life of the plant be forecast with assurance. The only way, in fact, in which the ideal of providing a plant with the most favourable environment for producing its maximum yield can be attained, is by the study of metabolic processes and their reactions to varying external factors. Until this information is available we cannot even suggest a value for the maximum yield of a particular crop and hence we have no fixed standard by which to assess the "efficiency" of present day systems of cultivation. Of new systems introduced today it can only be said that they are improvements or otherwise on past systems.

* Extracts reprinted from *Tropical Agriculture* 15 p. 123, 1938.

The maximum yield of a plant will be obtained when its environment is so arranged that its many metabolic processes are collectively functioning under optimal conditions throughout the life of the organism. Any plant of the same genetical type which is not producing this maximum yield may then be considered to be 'pathological', i. e., suffering from an excess or deficiency of some environmental factor or from the attack of a parasitic organism. It is safe to say that, judged by this physiological ideal of maximum yield, very few crop plants today would be regarded as 'non-pathological.'

In the agricultural industry the application of plant physiology has so far been of limited extent, and has largely consisted in "explaining" the various current modes of cultivation. For example, modern study has shown that major operations such as ploughing, liming, supplying humus, etc., all tend to increase yield by increasing the available supply of nutrients to the plant—a direct consequence of keeping the soil "open" whereby more efficient aeration and rapid oxidation of the weathered rock become possible. This preliminary elucidatory phase of the application of plant physiology to agriculture represents the essential "catching up" of a new science to an ancient industry; in brief, it has been necessary for the science as a first aim to understand as far as possible, the fundamental nature of practices at present in operation.

The basis of agriculture is the green plant grown in the soil. The plant requires from the soil; anchorage, nutrients and water, the last two in suitably balanced quantities. For physiological studies, however, sand or water cultures are preferred, as, in general, better and more uniform plants can be produced than in soil which rarely contains the right balance of nutrients or possesses the best physical state for the encouragement of growth; moreover, soils vary considerably in physical and chemical composition even when obtained from a limited area of land. Intensive agriculture (particularly glasshouse culture of fruit and vegetables) is tending more and more to apply sand or water instead of soil culture to its crops because of the more standardised growing conditions obtained and the consistent better yields produced. Agriculture in general, however, must of necessity remain content with the soil The aim of applied physiological research will be to attempt to ascertain the best use to which the soil and prevailing climate can be put. As knowledge of the interaction of plant metabolism with external factors increases, the selection of plants to suit particular environments should become a matter of less uncertainty than at present. Cultivation methods will also be modified to provide the nearest approximation to the environment most favourable for the plant.

The extension of a single crop to large scale production usually brings numerous problems in its train, among others liability to disease in epidemic form. e. g., the onset of Panama and Leaf-Spot diseases of the banana plantations in Central America and the Caribbean. It is cogent to enquire what assistance the physiologist is likely to be able to render in the future to the pathologist in his efforts to reduce such diseases. Since some aspects of every disease are referable to derangements of the normal metabolism, it follows that for the full understanding of the pathological condition physiological investigations will also be required. The difficulties in the way of general advance along these lines at present lie in the relatively slow rate of advance of physiological knowledge due, in part, to the few workers engaged in that science. It is not possible to carry out more than a superficial investigation into the disordered metabolism of a diseased plant while the metabolism of the "healthy" plant is not understood (for practical purposes a "healthy" plant is here understood to be one showing no apparent symptoms of disease, and if a crop plant, providing a satisfactory yield). Thus, one of the results of an attack of "leaf-spot" (*Cercospora musae*) disease of bananas is premature ripening associated with

abnormal colour, flavour and odour of the pulp; while the causes underlying the initiation of ripening in the healthy banana remain unknown, only provisional hypotheses can be made concerning the manner in which the fungal attack diverts the normal metabolism of the fruit. All too frequently in the early days of plant pathology, a disease was considered adequately investigated and the problem, so far as the agriculture was concerned, closed, once a causal organism had been found, named, and some control measure suggested: whereas the discovery of a causal organism (or of the absence of such an organism in so-called "physiological diseases"), should, in fact, be regarded as a starting point for specialised physiological study both of the pathogen and its host.

Except in those instances where a plant is genetically weak all morbid metabolic states are attributable to external factors. These may include: a deficiency of water supply; deficiency of some essential element in available form; deficient oxygen supply due to over-crowding or to water logging of root systems; excess of some element or elements or carbon dioxide; or, the external factor may be an alien organism which competes for the synthesised food materials of the plant and perhaps, simultaneously secretes a toxin having an additional deleterious effect on the metabolism of the plant. Any combination of one or more of the above factors may be responsible for disease: in all cases the disease is a diversion of the normal metabolism of the plant as grown under ideal conditions.

A single factor, the excess or deficiency of which, in conjunction with the inroads of parasites, is responsible for more pathological conditions than any other, is that of water supply. Water in excess of a plant's requirements or, presented unequally so that periods of excess occur, though the rainfall over the whole season may barely provide an adequate supply, results in waterlogging of the roots, decreasing the respiratory activity of their tissues by reducing the rate of diffusion of oxygen to their surfaces, causing stunted root development with consequent poor growth of the whole plant and inability to cope with temporary drought periods. Water deficiency in the soil results in many pathological symptoms including wilting, little-leaf, defoliation, and stunted growth generally.

These examples represent part of the toll of disease due to variations in the intensity of a single factor of the plant's environment. Each of the other environmental factors (nutritional and other elements in the soil, oxygen, light, etc.) may be present in excess or deficiency and each add its quota of possible pathological states. Combinations of various deficiencies and excesses will produce complex abnormal plant growth. The optimum intensity for each factor can only be elucidated by research, which is made particularly difficult by the interdependence of the factors in their effects on the plant (e. g light intensity and temperature, temperature and water supply). Fortunately each variety of plant can tolerate a more or less wide range about the optimum intensity of each factor without any serious pathological condition being induced.

Plants growing under conditions near the limit of their range with respect to a particular factor may be subnormal and therefore less resistant to attack by those parasites for which the conditions are nearly optimal. Thus fungal parasites in general grow and spread most rapidly under conditions of abundant water supply and high humidity, hence crop plants already partially crippled by conditions of water-logging are liable to more virulent infection by fungal pests than those grown under more satisfactory conditions of water supply.

Restoring conditions to a closer approximation to the optimum for a crop's growth will assist in the combating of alien organisms producing specific diseases. Thus, draining modifies conditions in the right direction for crops suffering from excess of water while the application of fertilisers, to supply deficient essential elements in the soil, also modifies the plant's environment but in a complex manner.

The influence of environmental factors on the incidence of disease has been much discussed by pathologists and numerous investigations have been carried out both in the field and under controlled conditions. As a result the conditions favouring disease incidence or otherwise are now at least partly known for many diseases of major importance. Nevertheless, to obtain the desired measure of control it will be necessary to carry the analysis of disease problems far beyond the present state.

Fertilisers, as mentioned in the preceding section, act on the soil and on the plant in numerous ways, the understanding of which is not easy. Addition, in available form, of an element definitely demonstrated as deficient in the soil is almost invariably beneficial but in exceptional cases it may so disturb the balance of the chemical-physical-biotic soil complex as to produce deleterious effects on plant growth. The modes of action of a fertiliser on the soil and on the plant are too numerous to discuss at length, so are briefly summarised :

(1) The physical properties of the soil are altered.
(2) Availability of other soil constituents may be affected.
(3) Concentration of the soil solution is changed.
(4) Reaction (pH) may be altered.
(5) Balance between certain soil constituents, e. g magnesium-calcium antagonism, may be corrected or disturbed.
(6) Biotic balance (bacteria, nematodes, etc.) is modified.
(7) May act as toxin towards plant or may protect against toxins already present.
(8) May serve directly as a plant nutrient.
(9) Decreases " water requirement " of plant, increasing efficiency in utilisation of scanty water supply.
(10) When absorbed by the plant increases its resistance towards specific diseases, e. g. salts of lithium increase resistance of wheat to mildew (*Erysiphe graminis*), Spinks (1913). Wortley W. R. S. (1936).
(11) May render plants poisonous to pests, e. g., selenium salts and thrips on cotton, Mason, T. G. and Phillis, E. (1938).

It is clear that with so many diverse actions of a fertiliser on the soil and on the plant many important changes may escape detection in empirical experiments and much possible information be neglected. Even when the yield is not increased, in a trial with a particular fertiliser biochemical and physiological study may reveal differences of fundamental importance. Once comprehensive knowledge is available concerning the metabolical and morphological reactions of a plant to variations in its environment much greater use than is possible at present could be made of the plant as an indicator of the soil and climate in which it is grown, pointing the way to success or failure of other crop plants grown under similar conditions.

Agricultural Jottings.

MARKETING OF LINSEED IN THE MADRAS PRESIDENCY

(From the Director of Agriculture, Madras.)

The area under linseed in this presidency including Ganjam represents only one-thousandth of the total area under linseed in India including the states. The chief centres of production in India are the Central Provinces, the United Provinces, Bihar and Orissa. The acreage under linseed in this Presidency has gone down from 12,279 acres in 1925--26 to 2,480 acres in 1934--35 and 1,539 acres during 1936—37. The reduction is mainly due to its replacement by more paying crops like ground-nut and cotton. In the Ceded Districts, the main centre of

linseed cultivation, there is often scarcity of fodder and in such seasons the ryots prefer to have more of *cholam* which will yield both grain and fodder. The low prices since 1930 reduced the margins of profit and there was a further fall in the area under linseed. There are also wide fluctuations in the area under linseed from year to year depending on the season. Linseed is generally sown in poor soils towards the middle of November and harvested in January. The average yield per acre of linseed is about 300 lbs. and the annual yield for the Presidency is estimated at about 400 tons only, against all-India production of about 450,000 tons annually. The crop is sown invariably mixed with *cholam* and very rarely pure. There does not seem to be much scope for increasing the area in this Presidency.

There are no imports of linseed by sea. Linseed is taken to Madras ports especially Vizagapatam and Masulipatam by rail from other provinces like Central Provinces, Bihar, Orissa and the Nizam's States for exports to foreign countries as the United Kingdom, Australia, France, Germany and Egypt. The total foreign exports during 1935—36, 1936—37 and 1937—38 amounted to 7,026, 7,747 and 10,979 tons respectively. There were no foreign exports of linseed through this province before 1933—34. Nearly 65 per cent of these imports are from the Central Provinces Besides the above movements by rail, about 100 tons of linseed used to come annually by road to Kurnool market from the Nizam's State. The exports by rail are mostly to Bombay, the average annual export being less than 200 tons. The local consumption of linseed is negligible. Small quantities of seed are occasionally fed to poultry and calves. Out of about 400 tons of seed produced annually in this Presidency, about 20 tons are reserved for seed and other purposes, and the rest is available for export.

There is no manufacture of linseed oil in this presidency. The requirements of oil are entirely met by imports from Bengal, Bombay and from foreign countries, mainly the United Kingdom.

Imports of Linseed Oil into Madras Presidency (Quantity in gallons).

	From Bengal.	Bombay.	United Kingdom.	Other countries.	Total.	Total value Rs.
1932–33	65,431	5,076	16,995	26	87,528	179,609
1933–34	67,926	13,321	10,880	58	92,185	174,141
1934–35	89,969	13,696	13,394	350	117,409	217,129

Of the total imports of linseed oil from the Indian provinces and abroad, the share of Bengal is about 75%, that of Bombay is about 9%, and that of the United Kingdom about 12%.

Linseed oil marketed in Madras is of three main classes—raw, double-boiled and pale-boiled. Raw oil is absolutely pure and made from pure linseed without admixture of other deleterious ingredients and used generally for veterinary purposes. It is not used for edible purposes as in other parts of India. It is also used for painting work pure or unmixed with double boiled oil, to impart elasticity to the paint. Raw oil is considered more durable than refined or boiled oil, but takes a longer time to dry up than double boiled or pale boiled oils. Double boiled oil being of dark brown colour is used for colour paints while pale boiled oil is preferred for white paints. There are various brands of Indian linseed oil in the market. Among the foreign oils, Blundel Spence and David Storer Bell Brand hold the market.

Linseed cake is not used in this presidency. Cake is imported into Vizagapatam from the Central Provinces and Bihar for export to foreign countries. In 1934–35 the export of linseed cake amounted to 3,529 tons valued at Rs. 2·41 lakhs or about 9% of all-India exports. The shipments of cake commenced only from

1933-34 and are mostly to the United Kingdom, the Netherlands, Germany and Belgium.

Prices variations. There is no difference in price between double boiled or pale boiled oil of the same brand. Raw oil sells about 8 annas cheaper than double boiled oil per 5 gallon drum of the same mark. Blundel Spence oil (imported from England) is always more costly than any of the Indian brands. Early in 1932 Blundel Spence oil was selling at Rs. 12 to Rs. 12–8–0 when Shalimar oil was selling at Rs. 9/8 per 5 gallon drum. The price of the former gradually dropped, and during July—September 1932 it was selling at Rs. 10/14 per drum of 5 gallons. There was a slight revival in 1933 and during June to September 1934, Blundel Spence oil was selling at Rs. 14 per drum to drop again to Rs. 13 by December 1934 and thereafter remained more or less steady. The price of Blundel Spence oil falls or rises after a fall or rise in the price of linseed at Bombay. The prices of Indian brands of oil do not vary very much with the prices of linseed and have no relation with the prices of foreign imported oils. The use of linseed oil is on the increase in this presidency. The demand is met by heavier imports from Bengal and Bombay. In 1934--35 the presidency imported to the extent of 117,409 gallons against 87,528 gallons in 1932--33.

As linseed is a very minor crop in this presidency and as there is little scope for increasing the area, methods of improvement can be effective only in the major centres of production outside our province. The impurities found with linseed are particles of earth, stones, straw and other grains which find their way by defective threshing and cleaning. If the cleaning is done by the producer himself there will be considerable saving in transport and cleaning charges besides affording better price for the producer. It is estimated that annually about 3 lakhs of rupees are lost to the linseed producers in India by way of freight on excess dirt and cleaning charges alone. A special problem connected with linseed oil is the question of adulteration with edible oils notably rape and mustard oil. The export trade of India is dependent on the Argentine crop and is declining, although the quality of Indian linseed is superior. In spite of large production, India imports more linseed oil than it exports. As in other crops, much can be done in the improvement of marketing linseed by regulating market charges, standardisation of weights and measures, improved communications, better conditions of harvesting and proper dissemination of market intelligence. The Agricultural Marketing Adviser is supplying radio information about the linseed crop in all important markets for the use of the trade.

MARKETING SURVEY OF COFFEE IN THE MADRAS PRESIDENCY

(From the Director of Agriculture, Madras)

The average area under coffee plantations in India was about 200,000 acres of which Mysore represented 52%, Madras 26%, Coorg 20%, Cochin and Travancore 2%. Brazil is undeniably the most important producer of coffee in the world producing nearly 60% of the world output India's share of production is only about 1% of the total world production.

The cultivation of coffee in Madras is mainly confined to the hills, the main centres of production being the hill slopes of the Nilgiris, the Shevaroys in Salem, the western and the eastern slopes of the western ghats in Malabar, Coimbatore and Madura districts. The most suitable elevation for the proper growth of coffee bushes and the development of the beans have been found to be between 2,500 to 4,500 feet above sea level, although coffee grows even in the plains and at elevations above 6,000 feet. Places above 5,000 feet are considered unsuited for coffee as they are liable to frost. The quality of coffee is not only influenced by elevation but also by many other factors as variety, rainfall, soil,

manuring etc. Shade also affects the quality. The general saying is "good shade, good prices". Coffee from the Nilgiris and the Shevaroys is considered better than that grown on the Pulneys, Mysore and Coorg.

The coffee area in the Presidency has increased from 50,892 acres in 1909-10 to 56,987 acres in 1936-37. During the same period the area under tea increased from 14,625 acres to 75,349 acres.

The bulk of the coffee grown in this Presidency is *Coffee Arbicaa*; Robusta variety which is grown in Wynaad (Malabar) and to a small extent on the Pulneys (Madura) is considered inferior and sells for almost less than half the price of *Arabica*.

Coffee bushes flower in the second or third year of planting, but are not allowed to bear a heavy crop till they are 5 or 6 years old. The bushes come to full bearing when they are 10 to 12 years of age. The crop is said to be a gamble on the weather. The yields fluctuate considerably from year to year. A heavy crop is generally followed by a poor one. The annual average yield of a series of years works out to 191 pounds of clean coffee per acre. The estimated average annual production of coffee in the Presidency is about 4,400 tons as against 21,800 tons for the whole of India. On the Pulneys the coffee picking season is from August to December while in the other centres—the Shevaroys, the Nilgiris and the Anamalais the crop is about a month later. The ripe berries are pulped on the estates in pulping machines and the coffee in parchment is dried in the sun and sent to curing houses in the plains.

Parchment coffee or coffee in husk is shelled by machines. The process consists in stripping off both the parchment and the silvery skin from the beans. The coffee is then sized into different grades. It is sorted into two main grades: Peaberry (round) and flat. The ripe coffee fruit or cherry consists of usually two seeds. But in some there will be only one bean which on account of the shape is known as 'peaberry'. Flats are again graded into A, B, C, 'triage,' 'blacks' and 'bits,' 'A' being the biggest and best of the flats. All abnormal, defective and damaged beans are classed as 'triage'. At Coimbatore, coffee is graded into peaberry, Royal extra-bold, zero, A, B, C and triage.

The variety, size of beans, weight, colour and aroma, are the main factors which determine the quality of coffee Of the two varieties cultivated in this Presidency, *Arabica* is preferred to *Robusta*. The weight of the beans is considered as a reliable index of the quality of coffee. The higher the specific gravity the better is the quality. There are coffees of various shades of colour ranging from very pale to dull green and blue black. The weather conditions at the time of drying and storage greatly affect the colour. Once coffee is cured, i. e., after the parchment and silvery skin are removed, the beans lose colour steadily and finally turn white. A high humid climate hastens this process. For this reason, coffee after curing or husking is not stored in the West Coast. Nilgiri coffee has a more bluish colour and is preferred to Mangalore coffee. As colour is a test of quality, old and discoloured coffee beans are artificially coloured to be passed as superior grades.

Cherry dried coffee. The strippings, gleanings and ground pickings which contain a high proportion of immature berries are not fit to be pulped and cured as ripe berries. They are, therefore, dried in the sun with the fruit coat or pulp and made into cherry dried coffee. In small estates where there are no facilities for pulping, the whole crop will be dried as cherry coffee. Such coffee is husked in peeling machines or by means of mortar and pestle.

The prohibition of the imports of raw coffee and coffee plants from places outside India, as a measure against *Stephenodores* and other pests came into effect

in April 1931. Since then, there is practically no import of raw coffee from foreign countries. The imports are only from other provinces and States in India. The average annual imports by sea amount to about 320 tons. The main supplies are from the Portuguese ports which are only the produce of North Mysore. Small quantities are being received from Bombay, Burma and Bengal. Due to the increased lorry transport direct from Mysore to Mangalore the imports via Portuguese ports are diminishing. The rail borne imports also amount to about 300 tons annually and are mostly from Mysore. Almost the whole of the Coorg crop and a major share of the production of Mysore are taken either to Mangalore or Tellicherry for curing and export. The estimated annual receipt of coffee by road from Mysore and Coorg is about 9,700 tons. The exports by sea to foreign countries are only of raw beans. The total exports of coffee to foreign countries in 1935-36 amounted to 10,688 tons valued at 101·4 lakhs of rupees, but declined to 6,658 tons of value 53 9 lakhs of rupees during 1937-38. France is the main buyer and exports to France represent nearly 30 per cent. of the total exports. The shipments to the United Kingdom rose from 2,100 tons in 1931-32 to 3,551 tons in 1935-36 and declined to 1,449 tons during 1937-38. Exports to France incresed from 2,154 tons to 4,128 tons in 1935-36 and declined to 2,075 tons during 1937-38.

The other countries importing coffee from this Presidency are Germany, the Netherlands, Norway, Belgium, Australia, New Zealand, Denmark, Algeria, Ceylon, Canada and Sweden. Generally high grown coffee of Mysore goes for consumption in England. Average quality of Mysore or Coorg coffee is exported to Germany, Czechoslovakia, Belgium. Holland and Italy. Plantations 'B', 'C' and Triage have good demand in France and Australia. Peaberry is mostly in demand locally but small quantities are going to the United Kingdom. Cherry dried coffee known by the trade as Native coffee and small quantities of 'monsooned' coffee are exported to France. As a rule monsooned coffee is shipped to Scandinavia.

Shipments of coffee to foreign countries during the period 1931—32 to 1937—38 were as follows :—

	Quantity in cwts.	Value in lakhs of Rs.
1931—32	153,180	92.92
1932—33	171,811	108 83
1933—34	184,688	101 61
1934—35	140,577	72.50
1935—36	213,750	101.36
1936—37	205,842	82.02
1937—38	133,163	53 86

The share of Madras is more than 90% of the total Indian exports. The shippings start in January with the commencement of the new crop and continue upto the end of June. Nearly 86 per cent. of the total exports is over in this period. During the monsoon months July—August, the shipments are negligible. In October—November, exports are only of monsooned coffee. Nearly 75% of the total exports are from Mangalore.

Besides the shipments to foreign countries, supplies are being made to other provinces in India. The exports to Indian Provinces have definitely been on the increase. The average annual export amounted to about 635 tons valued at 7.33 lakhs of rupees. Bombay gets the major share of over 50 per cent. of the total. The average annual export to Burma is about 200 tons. The intake of Bengal averages about 50 tons. The exports are high during January to June and the trade is slack during the rest of the period. The average annual rail-borne export is about 400 tons of which nearly two-thirds are to Mysore.

The estimated average consumption of coffee in the Presidency in terms of raw beans is about 5,070 tons as shown below.

1. Production in the Presidency (average of 10 years).		4,410 tons.
2. Imports by road from Mysore and Coorg.		9,700 ,,
3. Imports by sea from other provinces.		318 ,,
4. Imports by rail.		314 ,,
	Total.	14,742 tons.
Deduct.		
Exports and re-exports to foreign countries (average of 5 years).		8,640 tons.
Coastal exports.		635 ,,
Exports by rail.		398 ,,
	Total.	9,673 tons.
Net available for consumption in the province.		5,069 tons.

The *per capita* consumption on the basis of the last census is about 0.24 of a pound of raw beans per year.

Peaberry coffee always gets a premium in price. The difference between the price of peaberry and that of 'A' is about Rs. 8 to Rs. 12 per cwt. in favour of the former at Mangalore market. If the price is taken as an index of quality, all grades of Nilgiris coffee are superior to similar grades from other sources. The normal difference in prices between those of 'A' and 'B' or 'B' and 'C' is about Rs. 4 per cwt. Triage sells about Rs. 4 per cwt. less than the prices of 'C'.

Towards the end of 1926 peaberry coffee was selling at Rs. 27—8—0 per maund (1,000 tolas) at Salem. Prices were low in 1927 and the first half of 1928, the average being Rs. 21—8—0 per maund (1,000 tolas). Prices improved in the following year and peaberry was selling at Rs. 26—8—0 per maund in October 1929 at Salem. Prices receded heavily in the next two years and in May 1931 peaberry was selling at Rs. 14—4—0 a maund. There was some improvement in 1932 and the quotations ranged from Rs. 17 to Rs. 20. Prices remained fairly steady in 1933 and 1934 and ranged between Rs. 15 to Rs. 17. Prices consistently declined and the quotation for peaberry was lowest in September 1936 being Rs. 10 or a drop of Rs. 17 compared to the price in September 1926. The current wholesale price of peaberry at Salem is Rs. 11 to Rs. 11—8—0 per maund (1,000 tolas).

At Mangalore, the coffee season commences in December—January and weekly auctions are held by the Curers' Association till the end of May. In January 1936 fair average quality plantation assortment coffee was selling at Rs. 33—11—0 per cwt. while peaberry was quoted at Rs. 45(There was a gradual fall in prices since then and by the middle of May 1936, the price of *fair average quality* plantation assortment dropped to Rs. 26-12-0 and peaberry to Rs. 39-12-0 per cwt. Prices improved slightly since then and in December 1936 plantation assortment was selling at Rs. 35—2—0 and peaberry at Rs. 49 per cwt., and in March 1937 the corresponding prices were Rs. 41—8—0 and Rs. 61—8—0. Since then there was a gradual fall in prices. On 7th May 1938 the auction sales fetched Rs 33—12—0 for plantation assortment and Rs. 50 for peaberry.

There are a number of factories, large and small, engaged in roasting, grinding and blending coffee and they are distributed mainly in the southern districts of the Presidency. Raw coffee is polished by machines by removing the silvery skin covering the beans. At Madura, the consumers mostly go in for polished coffee. But polished coffee loses its flavour sooner than unpolished stuff. As bluish green colour is an indication of good quality, old and discoloured coffee is artificially coloured by machines at Mangalore, Virudunagar and Tuticorin, by first polishing, moistening, adding small quantities of white and green colouring materials and working in a machine for 20 to 30 minutes. Annually 1,000 to 1,200 tons of coffee are artificially coloured at Virudunagar alone. The charge

for colour polishing is only 10 annas to 12 annas per cwt. The colour is maintained for about two months. When artificial colouring was first introduced, coloured coffee fetched a premium of about Rs. 6 per cwt. Now coloured stuff is looked on with suspicion by the buyers and the process of colouring is gradually going down.

Most of the South Indian consumers of coffee prefer to purchase raw beans and do their roasting at home in iron pans. When the beans turn into light dark colour, the stuff is taken out and spread on the floor for immediate cooling. By such sudden cooling, the loss of volatile oils is minimised. Among the several grades, peaberry is considered the best, more especially because it gives an even roasting. The roasted beans are ground for immediate use only, as ground coffee loses its flavour very quickly. To give body to the beverage, a small quantity of sugar is also added while roasting the beans in coffee hotels In the cities and towns, electric roasters are becoming very common and many consumers have taken to this method of roasting as it gives a better and even roasting. The loss in roasting is estimated at 18 to 20% by weight. Roasted coffee is ground in mortar, small hand machines or in grinders driven by power. The grinding in machine can be adjusted to fine, medium or coarse as desired by the consumer.

With the fall in the prices of coffee adulterants other than chicory are not very much used. Annually about 300 to 400 tons of chicory valued at about a lakh of rupees are imported into this presidency for adulterating coffee. The quantity of chicory annually imported represents nearly 6 to 7 per cent. of the coffee consumed. Chicory is imported in powder form packed in iron drums, mostly from the ports of Rotterdam, Amsterdam, Antwerp and London. Chicory being cheaper than coffee, some of the coffee hotels mix a fair proportion (10 to 15%) of chicory to coffee powder. Poor people use even husk of the coffee cherry as a substitute for coffee.

The two chief blends of coffee in the market are 'pure' and 'French coffee.' The latter is labelled to contain varying proportion of chicory from 25 to 45%. Inferior grades of coffee like triage, blacks and bits are used by many of the coffee blenders. Even cherry husk is utilised by retailers selling coffee powder. Triage coffee is roasted, powdered and mixed with chicory in varying proportions and sold as powder or tablets coffee. In some of the coffee tablets in the market, the proportion of chicory is as much as 90 to 95%.

There is great scope for increasing coffee consumption in India as well as Madras. The *per capita* annual consumption of coffee is only 0.24 pound in terms of raw beans for Madras province and for India 0.07 lb. The consumption is more in Madras city and in the districts south of Madras. In the Ceded Districts the consumption is negligible. In the West Coast, tea is more largely used than coffee. In many parts of North India coffee is almost unknown, and tea is the common beverage. At present, the major share of Indian production is exported to the European countries and the prices depend entirely on foreign demand. If a steady demand is created in India itself, the prices will increase especially as the import of raw coffee from outside India is prohibited. Intensive propaganda is necessary to bring home to the village the usefulness of coffee as beverage. The work is rendered easier in districts where prohibition has been introduced. Among foreign countries, the United States of America and Canada appear suitable markets for exploring the export trade of India. At Bombay the opening up of "an Indian Coffee House' has greatly stimulated coffee consumption.

The quality of coffee varies generally with the centres of production. Mangalore or Mysore coffee often sells at Rs. 5 to Rs. 6 less per cwt. than Nilgiris coffee. Retailers often sell Mysore or Mangalore coffee as Nilgiris coffee, the latter being considered superior. It will be to the advantage of the consumers to stop such sales. Coffee may be sold in sealed bags or packages with the district

of origin and the grade noted on the package. Tinning in small quantities of roasted or ground coffee would greatly stimulate sales in non-consuming districts of the Presidency and in Central and Northern India where proper method of roasting is not known. Prohibition of the import of chicory is likely to increase coffee consumption.

Grade specifications in coffee marketing also require improvements. What is styled as 'A' in one curing centre may approximate to 'B' of another. Also mixing and adulteration are freely practised, some samples of so-called pure coffee containing even 10% chicory. Standardisation of coffee grades is therefore very useful and such a step will also serve usefully in direct trade with England, as a basis of proper quotations.

Correspondence.

To The Editor, The Madras Agricultural Journal.

"Future of the Indian Mango Industry."

Dear Sir,

I read with considerable interest the article contributed by Mr. Naik, Superintendent of the Fruit Research Station, Kodur on the above topic published in the June issue of your valuable journal. He suggests that "Suitable state measures such as imposition of a higher tax on the illplanned new plantations appear to be called for". I am afraid that if at this stage of the industry, a legislation of the above kind is introduced, it might drive away altogether prospective fruit-growers from the industry. Already the fruit-growers are suffering under numerous handicaps, and Government can and should come to their rescue by adopting measures similar to those introduced by the Italian and Egyptian Governments. Prospective fruit growers should be educated and guided by means of bulletins, and leaflets through the Agricultural Department, as to the proper and scientific methods of Fruit Culture, just as is being done in the Punjab. The importance of this industry has just been recognized and work has been started in Kodur Fruit Research Station under the able guidance of Mr. Naik. Full facilities should be afforded to intending planters to enable them to raise plantations on improved lines. The Government should supply plants to such fruit-growers, if not free of cost, atleast at reasonable prices from their nurseries. Legislation should be passed to control and supervise private nurseries, which should be made to supply only genuine and reliable plants.

"Remission of land revenue to those planting trees on approved lines, free supply of nursery plants, erection of cold storage plants, reducing transportation charges, organising fruit-growers, and subsidies to fruit product factories" are said to be some of the facilities, that Governments are offering to fruit-growers in Egypt and Italy. We should have all these facilities here too.

Fruit Farms should be opened in different centres of the province, where varieties of plants suitable to that zone should be raised, so that fruit-growers in and around that locality can practically see scientific methods of propogation, planting, pruning, manuring, irrigation, etc, and adopt those methods.

A list should be prepared of the insectivorous birds of the province. It should be made a penal offence to destroy those insectivorous birds. This list should be revised and added to, from time to time, as new species of birds are found or introduced into the province to keep down insect pests of fruit trees.

In these and other ways, encouragement should be given to fruit-growers, and they should not be driven out of this field of industry by deterrant measures of a penal kind.

Ilanji, Tenkasi S. I. Ry.
July 19, 1938.

I. S. Akilandam Pillai.

Gleanings.

Mango Graft on Citron Tree. At the recent mango show in Allahabad, held under the auspices of the Fruit-growers' Association, at which more than 90 kinds of mangoes were exhibited, a new kind of fruit was shown. It was the result of a mango graft on a citron tree. It was produced in the Government Garden at Saharanpur, U. P., under the supervision of the Assistant Director of Agriculture. The fruit looks like a mango, but with a rough and thick rind. The stone within is small. The pulp is sour, tasting and smelling neither like a mango nor like a citrus fruit. If the sourness of the pulp can be improved which is not impossible, there will be an additional fruit for frugivorous persons. (*The Modern Review*, August 1938.)

College News & Notes.

Students' Corner—Students' Club. Under the auspices of the Students' Club a debate was held on Wednesday, the 17th instant, at the Freeman Hall when Mr. K. Sanjeeva Shetty, B.Sc., (Ag.) moved "That in the opinion of the House, introduction of Legislation into Hindu marriage and social customs is necessary." This was opposed by Mr. S. N. Chandrasekhara Ayyar, M. A. The proposition, on the discussion of which several speakers took part, was finally thrown out by the House.

Cricket. The college cricket team played a friendly cricket match with the Scout Recreation Club on 11—8—38 which ended in a draw. The college team took 185 runs for 4 wickets and declared, the chief scorers being K. K. R. Menon 65, C. N. Babu 51 (not out) and C. Ramaswami 31 and Dinker Rao 20.

The first match in connection with the Rhondy Shield was played on Saturday, the 13th instant, against the Government Arts college. Our college had an easy win. The college team scored 227 runs for 5 wickets and declared. C. Ramaswami retired after his century, S. M. Shetty scored 38 (not out) and H. Shiva Rao 20. The Government college were all out for 82 (Shetty 2 for 1 run, K. S. Ramaswami 5 for 16, Dinker Rao and Nagaraja Rao 1 each for 12 and 11 runs respectively).

The Second match was played on Saturday, the 20th instant, against the Scout Recreation Club, Coimbatore. The college team scored 214 runs for the loss of 3 wickets. H. Shiva Rao 67, C. N. Babu 51, (not out) K. K. R. Menon 28, C. Ramaswami 25, and Dinker Rao 21 (not out). The S. R. C. Eleven were all out for 108—Subbaraman 45, and Ramakrishnan 37. (C. Ramaswami 5 for 24, Dinker Rao 4 for 27, and K. M. Shetty 1 for 7).

A friendly match between Agricultural College 'B' team and Government College 'B' team was played on Sunday the 21st instant. The Government College eleven were all out for 104, Venkatraman 37 and Padan 36. (Sreenivasan and Bhaskara Reddy 4 and 3 wickets respectively) The college scored 94 for the loss of two wickets—Sreenivasan 50 (not out).

Hockey:— The first hockey match of the season was played on 28-7-'38 against the Coimbatore Recruits School and the college lost by 3 goals to 1.

The Students played against the Officers on 7-8-'38 and drew-three all. Mr. H. Shiva Rao and P. K. Menon played well for the defence. The scoring honours were shared by Mr. Maria Kulandai and Ramachandran for the Officers.

The Students again met the Officers' Eleven on Sunday the 14th instant. Though the Officers team was considerably strengthened by the inclusion of C. Ramaswami, the students won by 3 goals to 2.

Foot-ball:— The first match of the season was played against the Government College team on 18—8—38 which ended in a draw.

College Estate: — His Holiness Sri. Vidyamanya Thirtha Sripadangalavaru of the Bhanderkeri Mutt, Udipi, visited the Estate on Friday 12th August 1938 for a *Biksha* given by Mr. C. V. Nagaraja Rao. His Holiness went round the several sections at the Research Institute, Freeman Building, Central Farm, Dairy, Botanical Gardens and the orchard in the afternoon, and performed *Puja* in the night which was largely attended by the Estate Residents.

Visitors :— Mr. S. N. Muzumdar, I. C. S., Director of Development, Orissa, arrived here on the 5th instant. He proceeded to Ooty on the 6th and returned on the 7th. He left for Madras on the 7th night. During his stay here, in addition to seeing the various sections of the Institute, he met the two students of the 1st year class who have been deputed for study here by the Orissa Government.

Mr. F. Ware, C. I. E., F. R. C. V. S., I. V. S., Animal Husbandry Expert to the Imperial Council of Agricultural Research, came here on the 16th instant and inspected the Dairy and the Herd.

Mr. H. R. Stewart, Agricultural Expert to the Imperial Council of Agricultural Research, was here on the 10th instant. During his stay here, he visited the various sections in the Agricultural Research Institute.

Mr. Ronald. C. Mundell, Senior Research Entomologist of Australia was camping in the Estate from the 16th till the 20th.

Address. Under the auspices of the Madras Agricultural Students' Union Rao Bahadur B. Viswanath Garu, Director of Agricultural Research Institute, New Delhi, delivered an interesting and illuminating address on "New Pusa" at the Freeman Hall on the 1st instant under the presidency of Mr R. C. Broadfoot, Principal, and President of the Union.

In the course of his address he traced the history of Old Pusa, the activities of which were cut short by the great earthquake of the 15th January 1934; and referred to the reorganizations of this institute at New Delhi.

The lecturer then dwelt at length on the research work done at New Pusa (New Delhi) in the different sections. Mentioning the fact that over 200 workers have already been sent outside through the Institute, he drew attention to the various facilities offered for post-graduate training.

After a lively discussion, Mr. R. C. Broadfoot, on behalf of the Union, proposed a vote of thanks to the lecturer.

ANNOUNCEMENT

The following letter from the Vice-Chairman of the Imperial Council of Agricultural Research is published for the information of the students proceeding to England for higher studies :--

During the last few years it has come to the knowledge of the Imperial Council of Agricultural Research that a number of Indian graduates proceeding abroad, especially to the United Kingdom, for post-graduate instruction in the sciences pertaining to agriculture (often in the hope of subsequently obtaining employment in agricultural departments and research institutes on their return) frequently fail to take the best opportunities available, and many are disappointed on return.

In the first place, it may be emphasised that far too much importance is attached by Indian graduates to the Ph. D. Degree of English universities. There is an impression that a Ph. D. is an essential qualification for research and similar higher appointments in Indian agricultural departments. Enquiries have shown

that this is not the case, and that much more importance is attached to a candidate's knowledge of his subject and practical research experience than to any post-graduate degree. In many cases the decision to work for the Ph. D. degree prevents a student from obtaining the best training which the Institute selected could give him in research technique. Most agricultural investigations extend over a number of years and it is impossible to complete a major research in a period of 2 or 3 years. In consequence, candidates for the Ph. D. degree have to take up some minor and very specialised investigation on an academic piece of work and do not obtain that broad training in research technique which is so valuable in after-life.

2. Several instances have occurred, as a result of the concessions given by British Universities to Indian graduates, where post-graduate students have taken research degree without having the necessary scientific foundation in the subject chosen. For example, a student who has taken a good degree in Botany in India, with comparatively little chemistry, might specialise in fungi, then take up soil fungi and pass on to certain aspects of soil bacteriology. Under experienced guidance he might do a piece of quite good work, initiated by some one else, in a specialised line. On return to India such a graduate would have no chance of obtaining an employment as a soil bacteriologist or a soil microbiologist, although he might have actually done research on the border line of this subject.

Students who desire to take up the study of plant breeding and plant genetics as a career frequently do not appreciate the fact that a sound knowledge of agriculture, and especially of crop production is an essential part of the investigator's make-up. Students from science colleges who have not studied in an agricultural institute or worked in an agricultural department could not take full advantage of any advanced course in plant breeding or genetics in the United Kingdom, much less could they do successful independent research until they had acquired a reasonable knowledge of agriculture and plant breeding.

3. This note deals solely with the training of agricultural research workers, and those who desire to become such and it is strongly recommended that students from science colleges in India who desire to take up agricultural research should *first* take full advantage of the facilities which are offered at the Imperial Agricultural Research Institute, New Delhi, which has properly organised post-graduate courses including systematic instruction designed for men who have taken a good Honours or M. Sc. degree in India in pure science. Such men can subsequently obtain employment as a rule without difficulty or if they proceed abroad, can take full advantage of the facilities obtainable. It is usually a waste of time for a student to learn the general agriculture abroad under unfamiliar conditions. Speaking generally, the result of several years' experience has shown that the men who have done best and gained most advantage from advanced study in the United Kingdom are those who have worked in an agricultural department or a research institute in India before going abroad.

4. It has already been pointed out that Ph. D. course is very frequently not the most suitable for those graduates who desire to undertake agricultural research on their return to India. Several British universities offer particularly good post-graduate advanced courses in agriculture, and special branches of it, where students are in close contact with the research work in progress and with modern developments. Here they have every opportunity of acquiring a broad knowledge of their subject, as well as of advanced technique. A typical example is the post-graduate agriculture course at Cambridge which is usually taken by the British students who have already taken honours in science.

5. The Imperial Council of Agricultural Research has established informal contacts with a number of research institutes and universities in the United Kingdom and will always be glad to advise graduates intending to proceed abroad who intend to studying agricultural science.

Crop and Trade Reports.

Sugarcane—1938—First report. The average of the areas under sugarcane in the Madras Province during the five years ending 1936-1937 has represented 3·2 per cent of the total area under sugarcane in India.

The area under sugarcane up to 25th July 1938 is estimated at 75,720 acres. When compared with the area of 81,620 acres estimated for the corresponding period of last year, it reveals a decrease of 7·2 per cent. The decrease in area is general except in Kistna, South Arcot, Coimbatore, Trichinopoly, the South (except Tinnevelly) and the West Coast.

The condition of the crop is generally satisfactory except in Salem where the growth was arrested to some extent owing to the insufficient water supply in wells.

The wholesale price of jaggery per imperial maund of 82⅔ lb. (equivalent to 3,200 tolas) as reported from important markets on 8th August 1938 was Rs. 7--6 -0 in Mangalore, Rs. 6—14—0 in Chittoor, Rs. 6—7—0 in Vellore, Rs. 6—5—0 in Adoni, Rs. 6—0—0 in Rajahmundry, Rs. 5—7—0 in Cocanada, Rs. 5—5—0 in Trichinopoly, Rs. 5—3—0 in Erode, Rs. 4—15—0 in Vizagapatam and Salem, Rs. 4—13—0 in Vizianagaram, Rs. 3—15—0 in Bellary and Rs. 3—11—0 in Cuddalore. When compared with the prices published in the forecast report at this time last year, these prices reveal a rise of 108 per cent in Vizagapatam, 94 per cent in Vellore, 85 per cent in Cocanada, 75 per cent in Vizianagaram, 66 per cent in Rajahmundry, 62 per cent in Bellary, 55 per cent in Mangalore, 22 per cent in Adoni, 21 per cent in Trichinopoly, 20 per cent in Salem and 11 per cent in Erode and a fall of 3 per cent in Cuddalore.

Groundnut—1938—Second report. *Summer crop—Area and yield:* The area under the summer or irrigated crop of groundnut in parts of the Madras Province during the five months—January to May 1938—is estimated at 82,500 acres. When compared with the area of 67 800 acres estimated for the corresponding period of last year, it reveals an increase of 21·7 per cent. The crop has been harvested in most places. The yield is expected to be normal in all districts except in Chingleput where it is expected to be below normal on account of insufficient rains. The total yield is estimated at 72,500 tons of unshelled nuts as against 60,100 tons estimated for the corresponding period of last year.

Early crop—Area and yield. The area under the early crop of groundnut (mostly unirrigated) up to 25th July 1938 in the districts of Salem and Coimbatore, is estimated at 146,000 acres. When compared with the area of 181,000 acres estimated for the corresponding period of last year, it reveals a decrease of 19·3 per cent. A normal crop is reported from Salem. The crop in Coimbatore has been affected by drought to some extent. The total yield is estimated at 67,700 tons of unshelled nuts as against 90,500 tons estimated for the corresponding period of last year.

The wholesale price of groundnut (shelled) per imperial maund of 82⅔ lbs. (equivalent to 3,200 tolas) as reported from important markets on 8th August 1938 was Rs 4—7—0 in Cuddalore, Rs. 4-5—0 in Vizagapatam, Rs. 4—2—0 in Guntur, Rs. 4—1--0 in Vizianagaram, Rs. 3 -12—0 in Anantapur, Rs. 3—10—0 in Vellore, Rs. 3—9—0 in Cuddapah, Rs. 3--7—0 in Hindupur and Tadpatri, Rs. 3—5--0 in Nandyal and Adoni and Rs. 3--4--0 in Bellary. When compared with the prices published in the last report, i. e.. those which prevailed on 11th July 1938, these prices reveal a fall of 5 per cent. in Nandyal and Cuddapah, 4 per cent. in Cuddalore and Tadpatri, 3 per cent. in Vellore, 2 per cent. in Vizianagaram, Adoni and

Bellary and 1 per cent. in Guntur, the prices remaining stationary in Vizagapatam, Anantapur and Hindupur.

Gingelly—1938-39—First forecast report. The average of the areas under gingelly in the Madras Presidency during the five years ending 1936-37 has represented 15·4 per cent of the total area under gingelly in India.

The area under gingelly up to 25th July 1938 is estimated at 336,900 acres. When compared with the area of 356,800 acres estimated for the corresponding period of last year, it reveals a decrease of 5 per cent. There has been a large decrease in area in Vizagapatam, Chingleput, North Arcot and Coimbatore which has been partly counterbalanced by a large increase in area in East Godavari, West Godavari and Bellary.

Yield. The yield is expected to be below normal in Vizagapatam, Salem, Coimbatore, Tanjore, Ramnad and South Kanara and normal in the other districts.

The wholesale price of gingelly per imperial maund of 82⅔ lbs. (equivalent to 3,200 tolas) as reported from important markets on 8th August 1938 was Rs. 6—7—0 in Trichinopoly, Rs. 6—6—0 in Salem, Rs. 5—12—0 in Cocanada, Rs. 5—11—0 in Rajahmundry, Cuddalore and Tuticorin, Rs. 5—6—0 in Tinnevelly, Rs 5—3—0 in Ellore, Rs. 5—2—0 in Vizianagaram and Rs. 4—14—0 in Vizagapatam. When compared with the prices published in the report for the corresponding period of the previous year, i. e., those which prevailed on 9th August 1937, these prices reveal a rise of 11 per cent in Salem and 3 per cent in Trichinopoly and a fall of 19 per cent in Ellore, 15 per cent in Cuddalore, 14 per cent in Tinnevelly, 10 per cent in Viziangaram, 8 per cent in Tuticorin, 7 per cent in Vizagapatam, 4 per cent in Cocanada and 3 per cent in Rajahmundry. (*Director of Industries, Madras.*)

Cotton Raw, in the Madras Presidency. The receipts of loose cotton at presses and spinning mills in the Madras Presidency from 1st February 1938 to 19th August 1938 amounted to 391,336 bales of 400 lb. lint as against an estimate of 488,600 bales of the total crop of 1937-38. The receipts in the corresponding period of the previous year were 415,885 bales. 319,025 bales mainly of pressed cotton were received at spinning mills and 56,000 bales were exported by sea while 62,720 bales were imported by sea mainly from Karachi and Bombay.

(Director of Agriculture, Madras.)

Weather Review—JULY 1938.

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	3·90	−3·4	17·2	South	Negapatam	0·9	−1·0	17·6
	Calingapatam	1·30	−4·0	13·8		Aduthurai *	1·0	−0·4	10·2
	Vizagapatam	3·90	−0·6	15·2		Madura	5·5	+3·6	14·3
	Anakapalli*	3·5	−1·6	15·1		Pamban	1·5	+0·9	12·6
	Samalkota*	0·0	0·0	0·0		Koilpatti*	1·0	+0·4	16·3
	Maruteru*	12·3	+4·8	22·4		Palamkottah	0·3	−0·8	13·7
	Cocanada	9·7	+3·9	18·6					
	Masulipatam	3·6	−2·8	14·9					
	Guntur*	3·3	−2·7	10·7	West Coast	Trivandrum	9·5	+2·1	34·1
						Cochin	21·0	−1·8	59·2
Ceded Dists.	Kurnool	2·9	−1·9	9·4		Calicut	34·4	+4·2	90·9
	Nandyal*	7·0	+1·6	11·6		Pattambi *	26·7	+1·2	67·7
	Hagari *	1·3	−1·1	5·8		Taliparamba *	38·5	−6·5	99·5
	Siruguppa*	2·0	−1·2	9·3		Kasargode *	47·6	−18·1	104·3
	Bellary	1·1	−0·7	4·0		Nileshwar*	43·6	+1·0	113·2
	Anantapur	1·3	−2·1	4·1		Mangalore	44·5	+7·4	108·6
	Rentachintala	6·7	0·0	12·7					
	Cuddapah	3·4	−0·5	11·1					
	Anantharaju-pet*	6·0	+1·6	8·9	Mysore and Coorg	Chitaldrug	1·4	−3·3	5·9
						Bangalore	5·4	+1·0	11·3
Carnatic	Nellore	1·5	−1·3	4·9		Mysore	1·7	−2·4	5·9
	Madras	1·9	−2·0	5·9		Mercara	47·3	+6·4	91·7
	Palur*	3·6	+0·68	17·6					
	Tindivanam *	3·5	+1·8	13·4					
	Cuddalore	1·9	−1·2	10·0	Hills	Kodaikanal	5·0	0·0	20·3
						Coonoor	0·0	...	...
Central	Vellore	2·7	−2·6	12·5		Ootacamund *	6·1	+0·2	19·4
	Salem	8·9	+5·1	15·1		Nanjanad *	5·5	−5·4	15·7
	Coimbatore	1·8	+0·3	5·1					
	Coimbatore A. C. & R. I.*	1·6	+0·3	4·5					
	Trichinopoly	3·2	+1·6	9·1					

* Meteorological Stations of the Madras Agricultural Department.

@ From average rainfall for the month calculated upto 1935 published in the Fort St. George Gazette.

General. Both the Bay of Bengal and the Arabian Sea branches of the monsoon were generally active throughout the month. The monsoon was vigorous in Malabar, strong in the North and West of the Peninsula and active in Mysore, Konkan, Deccan and the East Central Province.

Depressions. Three depressions of the Bay of Bengal and one depression of the Arabian Sea were responsible for the widespread rainfall.

Rainfall. The rainfall was in slight excess in parts of Circars, Ceded and Central Districts and the West Coast.

Humidity Skies were moderately to heavily clouded and the humidity was in slight excess in the Bombay Deccan, South Hyderabad, and North Madras Coast while it was in defect in South-East Madras.

Temperature. The maximum temperature in shade was below normal in Malabar, Mysore and Madras Deccan; markedly below normal in the extreme

north and normal in other places. The highest maximum temperature recorded was 101°F at Madura and Nellore.

Chief amounts of rainfall recorded.

Mercara	9·3″	on the 1st.
Calicut	7·8″	do.
Mangalore	5·5″	do.
Cochin	5 1″	do.
Nileshwar	7 1″	
Anantharajupet	3·1″	on the 27th.
Trichinopoly	2·1″	do.
Vellore	2 1″	on the 29th.
Nandyal	2·4″	

Rainfall report for the Research Institute A. C. R. I.

Report No. 7/38.

Absolute maximum in shade	91·2°F.
Absolute minimum in shade	65·5°F.
Mean maximum in shade	86·5°F.
Departure from normal	−0·6°F.
Mean minimum in shade	68·9°F.
Departure from normal	−3·1°F.
Total rainfall for the month... ...	1·57″
Departure from normal	+0·30
Heaviest fall in 24 hours	0·36″ on 27th.
Total No. of rainy days	9
Mean daily wind velocity	5·2 M. P. H.
Mean Humidity at 8 hours	68·5%.
Departure from normal	−2·9%.

Summary. The monsoon was generally active throughout the month, and rainfall was in slight excess. The heaviest fall of 0·36″ was recorded on the 27th. Skies were moderately to heavily clouded. The mean humidity, the mean maximum temperature in shade and the mean minimum temperature in shade, were all below normal.

P. V. R. & P. G.

Departmental Notifications.

Transfers.

Name of officers	From	To
R. Balasubramaniam	Gazetted Assistant, Adoni.	Asstt. in Cotton, A. R. S. Guntur.
A. K. Ganesha Ayyar	A. D. on leave	A. D, Tiruvadanai.
S. Muthuswami	A. D. Bellary	A. D. Tirukoilur.
L. Narasimhachari	A. D. Ponneri	A. D. Chittoor.
K. V. Natesa Ayyar	A. D. Tiruvellore	A. D. Ponneri,
S. Veeravarada Raju	A. D. (on leave)	A. D. Tiruvellore.
S. Sithapathy Rao	Asst. A. D. Nellore	A. D. Amalapuram.
S. V. Parthasarathy	A. D. Nandigama	A. D. II Circle.
S. Bhimaraju	A. D. Sankarankoil	A. D. Bellary.
P. Gopalakrishnan	Offg Asst. in Chemistry, Coimbatore	Millets Section, Coimbatore.
G. Konda Reddi	F. M. A. R. S. Nandyal	A. D. Nandyal.

M. Subramaniya Chetty	A. D. Nandyal	F. M. A. R. S. Nandyal.
R. Krishnamoorty	Asst. in Cotton, Coimbatore	Agricultural Section, Coimbatore.
P. Lakshminarayana	Asst. A. D. Rajamundry	Asst. A. D. Cocanada.
V. Atchyutam	Asst. A. D. Amalapuram	Asst. A. D. Rajamundry.
V. Butchiraju	A. D. Ramachandrapuram	A. D. Chintalpudi.
D. Panakala Rao	A. D. Guntur	A. D. Ramachandrapuram.
D. Satyanarayana	A. D. Tekkali	A. R. S. Anakapalli.
G. Kameswara Rao	A. D. Cocanada	A. R. S. Samalkota.

Leave.

Name of officers	Period of leave.
K. M. Krishna Menon, Offg. Chemistry Asst., I. C. A. R. Coimbatore.	L. a. p. for 23 days from 9—8—38.
K. Ramanatha Rao, Asst. in Paddy, Coimbatore.	L. a. p for 27 days from 4—8—38.
T. S. Lakshmanan, Asst. in Chemistry Section.	L. a. p. for 1 month from the date of relief.
K. M. Bhakta, A. D., Cheepurapalle.	L. a. p. for 1 month from the date of relief.
P. N. Muthuswami, F. M., A. R. S., Siruguppa.	L. a. p. on m. c. for 3 months from 15-7-38.
K. Krishnamoorthy, A. D., Parvatipur.	L. a. p. for 24 days from 10-8-38.
K. Kuppamuthu, A. D., Warehouse.	L. a. p. for 1 month from 17-8-38.
N. Annaswami Ayyar, A. D. (on leave).	L. a. p. for 1 month from 9-7-38.
M. V. Kondal Rao, A. D. (on leave).	Extension of l. a. p. for 6 weeks from 1-7-38.
P. P. Syed Muhammad, A. D., Palladam.	L. a. p. for 29 days from 3-7-38.
C. Ekambaram, F. M., Gudiyatam.	L. a. p. for 1 month from the date of relief.
A. Ramadoss, A. D. (on leave).	L. a. p. on m. c. for 2 months from 1-7-38.
M. Vaidyanathan, A. D., Guntakal.	L. a. p. for 1 month from 1-9-38.