Madras Agricultural Journal

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

Vol. XX] FEBRUARY 1932 [No. 2

CONTENTS

CHEMISTRY IN THE PRODUCTION AND UTILIZATION OF SORGHUM[1]

BY RAO BAHADUR B. VISWANATH, F. I. C.

Agricultural Chemist, Coimbatore.

In the simplest of terms *agriculture* may be defined as the growing of crops for human beings to live upon. This simple definition is the resultant of the interaction of a number of complex factors in which many natural and physical sciences are concerned. The function of the chemist, depending on the organization and equipment he has, lies in the comprehensive investigation of the chemical, physico-chemical and the bio-chemical factors involved and in defining their optimum conditions for plant growth and also in investigating the possibilities for the utilization of the produce.

The physico-chemical and the micro-biological conditions obtaining in the soil, govern the supply of water and nutrients to the plant. The nature, quality and the proportions between the different classes of nutrients exercise a profound influence on the growth of the crop, its composition, and its nutritive value as well as in its behaviour to external influences including insect and fungus attacks. Thus, crop growth is the integration of the plant's responses to various internal and external factors.

The chemical section of this institute which has the organization and equipment for an all-round attack on problems in soil science, plant and animal nutrition in their independent and mutually related aspects, is engaged in the study of the several factors involved in the production and utilization of sorghum, which, next to paddy, occupies the largest area among cereal crops and forms the staple food of a very large section of the animal and human population of the Presidency. In a contribution of this kind it is impossible to deal in any detail, with the different phases of the work on the crop. I shall, therefore, confine my attention to a discussion of the salient features of

[1] A paper read at the twenty-first College Day and Conference of the Madras Agricultural Students' Union, Coimbatore—December, 1931. The paper was illustrated by charts.

the different lines of investigation in their bearing on practical agriculture. To this end, the many aspects of work may be conveniently considered under four main divisions : (1) The moisture relations between the soil and the plant and the effect of different cultural practices thereon, (2) The manurial requirements of the crop, (3) The nutritive value of straw and grain, and (4) The industrial and commercial possibilities of the crop.

I. The Water relationship between the Soil and the Plant and the Effect of different Cultural practices thereon.—The most important requisite for crop growth is water. Other conditions may be satisfactory but if water is not within the easy reach of the plant, growth stops and moisture supply becomes the limiting factor. Since sorghum is grown to a very large extent as a rain-fed crop and in localities of varying degrees of rainfall the problem of utilizing water to the best advantage is of importance.

Mr. T. Lakshmana Rao has been studying in the laboratory and in the field, the movements of water in the soil and the effect of different cultural treatments on the retention of moisture in the soil and its utilization by the crop.

His Coimbatore results show—

(1) that movements of moisture in the soil vary directly as the mean daily rainfall and inversely with the evaporation from the surface of the soil ;

(2) that the upward movement of water for the benefit of the crop is within a range of two feet from the surface and that the movement is too slow to meet the demands of the crop in hot periods ;

(3) that surface soil mulch does not exercise a protective influence on the evaporation of moisture from the soil ;

and (4) that deep ploughing helps in economising water.

The findings from laboratory and field experiments at Coimbatore agree with the results of field experiments at Hagari where the effects of different cultural practices on the crop are being tested.

RELATIVE YIELDS OF SORGHUM CROP UNDER DIFFERENT CULTURAL TREATMENTS (AVERAGE OF FOUR YEARS' EXPERIMENTS AT HAGARI)

Particulars of treatment.	Grain	Straw
Control (local practice of the ryot)	100	100
Stubble removed soon after harvest	100	102
Plots bunded	129	115
Deep ploughing once in 5 years	142	118
Do. once in 4 years	137	112
Do. once in 3 years	121	99
Do. once in 2 years	134	108
Do. every year	120	100
Sowing at 2½ inches depth	93	99
Sowing at 4 inches depth	73	99

It was suspected that at Hagari the ryot's practice of allowing sorghum stubble to remain in the field might tend to loss of moisture but actual experiment shows that it is not so.

Deep ploughing retains more water and exercises economy in its use as can be seen from the quantity of crop and the proportion of grain to straw but too frequent deep ploughing is detrimental to yield. The statement would give one the impression that frequent deep ploughing is still the best in spite of fall in yields. It is not so. The statement is misleading in this respect. It is so, because the average values for four years are given. The high response to deep ploughing in the first year had contributed to the inflation of the average values. The deleterious effects of frequent deep ploughing will be seen when a single year's data are examined.

	Particulars of treatment.	Average yield of plots in 1930-31
Plot 1.	Control plot	100·0
Plot 4.	Deep ploughed in 1927–28 but not afterwards	117·5
Plot 6.	Do. in 1927–28 and again in 1929–30	99·7
Plot 8.	Do. every year	58·5

It is quite possible that too frequent deep ploughing induces a too rapid oxidation of the scanty supplies of organic matter in the soil. It will be interesting to study the combined effect of frequent deep ploughing and organic matter. Deep ploughing at longer intervals, say, once in five years, appears to be the best. This is what the ryot of the Bellary district actually does. He knows from the accumulated experience of generations that it is not profitable to deep plough frequently.

Consistently satisfactory results are obtained by bunding the plots to prevent run-off of water and from an economical and practical point of view it appears to be the most promising, the simplest and the least expensive of operations for helping the soil to absorb more of the rainfall. The size of the bunded plots will, of course, vary with the slope of the land.

II. The Manuring of Sorghum Crop.—The manuring of sorghum crop will be considered under two different conditions of growth. The one is the condition in which there is adequate supply of water either by irrigation or sufficient rainfall, and the other is the deficiency of moisture supply in localities of precarious rainfall. In the permanent manurial plots which are irrigated, manured and cropped intensively, the increase in the average yield of crop from the farm yard manure plot is 162 per cent more than that from the unmanured plot as against that of 143 per cent from plots receiving complete mineral manure in the form of ammonium sulphate, superphosphate and potassium sulphate. Another interesting observation is that the difference between the cropping capacity of farm yard manure plots and the mineral manured plots goes on increasing in favour of the former as manuring is continued year after year.

YIELD OF SORGHUM CROP

	No manure		Mineral manure		Farm yard manure	
	Grain	Straw	Grain	Straw	Grain	Straw
Average from the 1st to the 36th crop	100	100	292	191	295	192
Average from the 37th to the 56th crop	100	100	336	165	384	202

Considering the requirements of the more important plant food constituents, it may be stated that where adequate water supply exists, nitrogen is the most important factor in contributing to increase in crop yield. It is, however, desirable that wherever practicable, nitrogenous manures should be accompanied by phosphates as otherwise this constituent would form a limiting factor. Applications of potash do not contribute to an increase in crop production. On the other hand they may even exercise a depressing effect. Subject to these conditions sorghum responds to fertilizers like ammonium sulphate, calcium cyanamide, sodium nitrate and superphosphate but usually the increase does not pay the cost of manuring when sorghum alone is considered, but may, when the effects on the succeeding cotton crop are evaluated. In manuring sorghum, both grain and straw are important and therefore, the influence of manuring on the ratio of grain to straw is also an important consideration.

SORGHUM—RATIO OF GRAIN TO STRAW

(Straw = 100)

No manure plots	... 13·7
Non-phosphate plots	... 14·3
Phosphate plots	... 19·6
Cattle manure plots	... 23·7

Here again farm yard manure gives the largest proportion of grain closely followed by phosphate plots. Plots receiving nitrogen and potash either alone or in combination give a very high proportion of straw.

The quality of the seed with respect to its reproductive capacity and of the whole crop in respect of its nutrition is influenced by soil conditions and by the nature of nutrients given to the plant. Here, again, farm yard manure is the best in producing the most virile seed and nutritious crop.

In the case of rain-fed crop the response to manurial treatment varies with the sufficiency or deficiency of rainfall.

STATEMENT SHOWING PER CENT INCREASE OR DECREASE IN YIELDS OVER CONTROL

	Koilpatti Rainfall 30" grain	Nandyal Rainfall 26" grain	Hagari Rainfall 19" grain
Oil cakes	+ 28	+ 3	— 20
Calcium cyanamide	+ 58	...	— 26
Superphosphate	...	...	— 9
Calcium cyanamide + Superphosphate	...	...	— 9
Ammonium sulphate + Superphosphate	+ 71	...	— 31

The effect on yield of concentrated manures, decreases with rainfall. For this reason it is risky to predict the result of manuring in a locality depending on a precarious and erratic rainfall.

Early in the life of the crop there is vigorous growth and as a consequence the moisture supply is so exhausted that it is inadequate at the seed setting stage and this is evidenced by the straw/grain ratios. This condition is accentuated with concentrated and soluble fertilizers. The fertilizer salts dissolve in the soil water and due to increased surface tension of the soil solution the movement of the soil water is accentuated thus helping the plant to grow vigorously. When the moisture supply gets depleted to the critical point, the other effects of the fertilizer salts in solution begin to be felt. These salts increase the hygroscopic co-efficient of the soil and seriously decrease the availability of moisture to the plant. This defect outweighs the gain from decreased evaporation due to the presence of the salts in solution. Once this condition sets in, the supply of water to the root hairs is restricted and in the absence of rainfall or irrigation this depletion goes on till the wilting point is reached. It is obvious that the wilting stage occurs quicker in the case of soils receiving soluble manures than in soils without them. In an experiment with unmanured soil the sorghum plant did not show signs of wilting till the moisture content of the soil fell to 7·5 per cent while in the case of soil containing soluble salts the plants began to wilt even when the moisture content of the soil was as high as 12·7 per cent. This explains the erratic response of sorghum to manuring in areas of precarious rainfall.

From a consideration of the results of investigations on the water relations of the crop and on its response to manurial treatment it would appear that efforts in inducing the soil to retain more moisture and in regulating its supply to the plant, should be more in the direction of building up the organic matter content of the soil than in cultural methods. This is under investigation at Hagari.

III. The Nutritive Value of Sorghum.—Sorghum is used as food for cattle as green fodder and dry straw. As green fodder it is undoubtedly more nutritious than straw, as fodder is cut usually when the crop is at the flowering stage. At this point, the crop is richest in proteins, fat, carbohydrates and minerals and contains low porportion of indigestible fibre.

It is dangerous to feed young fodder to cattle as the sorghum plant, till it is about 60 days old, contains a cyanogenetic glucoside which is very

poisonous to stock. Ensilaging destroys the glucoside and renders the silage harmless. Silage is undoubtedly superior to straw but we have no information as to the relative merits of sorghum silage and sorghum hay. Messrs. F. J. Warth and Kunhi Kutty at Bangalore carried out comparative feeding tests with sorghum silage and fresh guinea grass and found the former possessed better nutritive value than the latter.

Mr. P. V. Ramiah has studied the fermentative changes which silage undergoes and finds that for the first three months after pitting the fermentation of carbohydrates proceeds vigorously and that free acids are produced. At the end of three months this type of fermentation practically stops ; the proteolytic fermentation which commences along with that of carbohydrates, continues even after eighteen months and the amino-acid content goes on increasing. From his experiments he concludes that sorghum silage is fit for feeding three months after pitting and that silage can be kept for 18 months or even more without impairing its quality.

Mr. Ramiah's experiments with *Chitrai cholam* straw (irrigated) as food for cattle, show that sorghum straw by itself is not enough as a ration even if fed *ad libitum* and that it requires supplementing with oil cake. Armsby's standard which has been the guide in fixing the rations has been found to be too high in regard to protein requirements of our animals. Using Ongole and Kangayam bullocks as test animals, and irrigated sorghum straw as the bulky food and groundnut cake as the concentrate, Mr. Ramiah finds that for resting catabolism 125 grams of protein are enough, as against 300 grams found by Armsby, for a mature bullock of 1,000 pound liveweight. For light work the protein requirement is equal to that of Armsby's for maintenance, while for heavy work it is one and a half times that fixed by Armsby for maintenance. These findings when translated into practical feeding standards work out as below for an animal weighing 1,000 pounds.

	Groundnut cake	Sorghum straw
At rest	0·14 lb.	17 lbs.
On light work	1·00 ,,	17 ,,
On medium heavy work ...	1·50 ,,	17 ,,
On heavy work	2·00 ,,	17 ,,

In regard to the nutritive value of the grain, our work here shows that it varies with the kind of nutrition given to the plant and that farm yard manure gives grain with high food value.

Among the different varieties of sorghum grain, the popular belief is that *Manjal cholam* (yellow) possesses better nutritive value than the white one. We do not have direct experimental evidence in regard to this but there appears to be justification for the popular belief in view of the experimental evidence with maize, in which the yellow coloured variety has been found to possess a higher vitamin value than the colourless one.

According to Col. McCarrison the vitamin value of sorghum is higher than that of rice, while the work of T. W. Li on the biological value of proteins assigns to millet an inferior position to that of rice. It must be noted that vitamin efficiency of a food is different from its protein efficiency and it is the latter that determines the efficiency of a food. On

this basis sorghum is inferior to rice. According to European and American investigators the chief sorghum protein prolamin does not contain the important amino-acid tryptophane while that of rice contains as much as 2·7 per cent. Mr. Ramiah is investigating the proteins of sorghum and he finds positive qualitative reactions for tryptophane in *Peria manjal* sorghum. The results of his quantitative work are awaited with interest.

IV. The Industrial and Commercial Possibilities of Sorghum.— The energies of the chemical section have not been solely directed towards increased production. It has realized that the cultivator derives greater benefit if his crop can form the raw material for an industry and to this end efforts are being made to discover new uses for sorghum to widen the market and thus increase its value.

In Southern India sorghum has great possibilities of industrial and commercial development. It is capable of being substituted for barley in malting operations, and the absence of barley crop in South India offers unique advantage to sorghum in this direction. Most of you are aware of sorghum malt process which was developed in our laboratories more than ten years ago. Mr. M. Suryanarayana and myself have demonstrated by experiments in the laboratory and on the semi-industrial scale that sorghum can be successfully put through the process of malting and the resulting malt can be used as the base for a number of malt products of the type of Benger's food, Mellin's food, Horlick's malted milk, Grape nuts, Force, malt extracts and a variety of others which are found on the market. In simple words, malting consists in the controlled germination of sorghum grain. During this process, certain substances called *enzymes* are produced in considerable quantities in the developing germ. Messrs. Suryanarayana and Narasimhachari here and others at Bangalore have made an extensive study of these enzymes. Under the influence of these enzymes the starch in the grain is converted into dextrins and sugars, principally maltose. The proteins and fats also are hydrolyzed into substances of lesser complexity. In other words, the starch, fat and protein in the grain are pre-digested into forms suitable for delicate stomachs. One hundred pounds of sorghum yield 80 to 85 pounds of dry malt of which 60 to 65 per cent is extractable with water.

For domestic purposes, the process of malting sorghum has been simplified so that any person of average intelligence can prepare his own malt from sorghum and have fresh malted foods for the feeding of infants and invalids or for use by healthy persons, with very little expense and possessing all the qualities attributed to the malted foods on the market.

The industrial and commercial utilization of the sorghum malting process demands attention. We import annually on an average 1·5 million pounds of malted foods valued at about three million rupees. On the basis of as low a yield as 50 per cent of malt on the grain an acre of sorghum yielding 700 pounds of grain, if converted into malt would fetch a price of Rs. 700. This figure may look fabulous and exaggerated, but is true to calculations on prices as they are. Apart from the enhanced money returns for the ryot, there will be large reductions in the price of malted foods which will then come within the reach of many who cannot now have the benefit of these foods at their present prices.

Another industrial possibility for sorghum is in the manufacture of starch. We import large quantities of starch and this may as well be produced in the country.

IMPORTS OF STARCH AND FARINA INTO INDIA

Year	Quantity in cwts.	Value in rupees
1928	153,950	27,09,928
1929	374,329	37,80,904
1930	435,667	38,06,401

The manufacture of starch from sorghum is relatively much simpler than malting sorghum and does not need technical skill of a high order. Our experiments show that with very simple equipment it is possible to manufacture a fairly pure product with 95 per cent purity.

ENTOMOLOGY OF THE SORGHUM PLANT IN SOUTH INDIA[1]

BY Dr. T. V. RAMAKRISHNA AYYAR, B.A., Ph.D., F.Z.S.,
Entomologist, Madras Agricultural Department.

We have now heard some very interesting papers and the more important aspects of the sorghum plant from my colleagues and I dare say very little remains to be added on this subject. To me has been allotted the duty of adding something about sorghum in its relations to insects. Though this aspect of this subject may not perhaps be so important as the agricultural, botanical or chemical side of it, the prudent cholam cultivator will do well to familiarize himself with the bionomics of some of the more important insect pests of this crop and possible methods of control against them. For, in spite of the best cultural attentions of the agronomists, the finest manuring and nurture by the chemist or the best efforts of the botanists to raise a heavy-yielding variety, it is in the power of insects to undo all such laudable attempts by making one clean sweep of all the growing plants in a single night. To avoid such disappointments and mishaps it is necessary that the farmer should be equipped with some ideas on the insect pests of this crop.

From an entomological point of view the sorghum plant in South India does not occupy such an important status as do some of the other major crops grown in the Province like paddy, cotton or groundnut. Unlike as in the case of some of the latter, the number of insect pests really causing appreciable damage to the crop is comparatively much fewer, and we do not often hear of wholesale damage to this crop by insect pests as in the case of many other cultivated plants. There is no doubt that a number of insects visit the plant and occasionally get some sustenance also from it from its very early stages on to the time of harvest, as may be gathered from the long list of thirty-five different forms recorded by Fletcher in his book;[2] but a careful analysis of that list and a sufficient knowledge of the real extent of damage suffered by the sorghum plant on the whole at the hands of insects will go to show that most of the forms in that list are of rare or chance occurrence, and

[1] A paper read at the twenty-first College Day and Conference of the Madras Agricultural Students' Union, Coimbatore—December, 1931. The paper was illustrated by charts.

[2] Some South Indian Insects (1914), p. 245.

that there are not more than half a dozen insects which might be put down as really important ones. Even out of this half a dozen, only three or four can be considered, in my opinion, as major pests, occurring regularly year after year, having a wide distribution, and doing some noteworthy damage to the crop; the others very rarely attain pest proportions, and even when found as such, are often sporadic and confined to special tracts only. Under the first category may be included the earhead bug (*Calocoris angustatus*), the moth borers (*Chilo zonella*, S. and allied forms) and the red hairy caterpillar (*Amsacta albistriga*). In the latter group we may bring together the grasshoppers of different kinds, including the Deccan grasshopper (*Colemania*), the fly maggot borer (*Atherigona indica*), the shoot caterpillar (*Cirphis unipuncta*), the shoot bug (*Pundaluoya simplicia*) and plant lice (*Aphis maidis*). All the other insects noted on the plant are of minor importance and rarely cause any damage worth noting, though their presence at times may arouse the fears of the farmer. It may be added in this connection that with the exception of one or two specific pests, the insects affecting cholam are also found to attack other millets like maize, ragi, cumbu, etc., and it may be safely put down that the entomology of the sorghum plant in South India is practically an account of the insects affecting all millets in the province.

In the necessarily short time allotted for the consideration of this aspect of cholam, I shall just touch briefly on some of the salient points so far known in the bionomics of the more important insects associated with this plant and try to give you some general ideas on the subject, without worrying you with any technical details.

The Borers.—During the very early stages of the plant when it is just a few inches high, two borer pests affect it in almost all sorghum tracts. One is the fly borer[1] and the other the moth borer.[2] The fly is a minute shining bluish black insect, to all appearance looking like a small house-fly, though really quite different from the latter in structural details and life habits. The female fly lays tiny eggs just under the surface of tender stem of the seedlings and the maggot that hatches out burrows into the stem and there grows by feeding on the internal tissues; at the end of a week the borer is full grown and has a pale yellowish color and is fairly stout and cylindrical. At this stage it changes into the seed-like pupa and remains inside the stem itself and after another week changes into the adult fly. This boring work of the maggot affects the growing central shoot which gradually turns pale and dies: this effect on the plant is what is known as the formation of a '*dead-heart*'. A badly infested field shows numerous dead-hearts of this kind. The fly pest, however, does not attack grown-up plants.

The moth borers (the commonest of these found on sorghum being the pyralid moth *Chilo*), also damage the plants in the same manner as the fly: the caterpillars bore through the stem in the same way and develop inside the stem, pupate there and emerge as moths. The mother moth lays groups of flattish oval overlapping eggs on the leaf surface, and these on hatching into caterpillars bite their way into the stem and feed on the internal tissues and finally emerge as moths after the pupation period. One life cycle from egg to moth generally occupies six to seven weeks (egg one week, pupa one week and caterpillar four to five weeks). The external indication of moth borer attack is, as in the case of the fly, the presence of the dead-hearts in infested fields. Unlike the fly, however, the moth borer attacks the plant at all stages,

[1] *Atherigona indica*, M.

[2] *Chilo* spp.

young, growing and even full-grown plants with earheads. The damage, however, is more serious when young plants are attacked, since the attacked shoots completely die. In the case of infestation during the later stages, when the plants have become stouter and hardy, they are not killed but suffer in vigour and the earheads do not develop into well-formed ones. Two or three different species of moths are sometimes found attacking sorghum. The ragi borer (*Sesamia*) is also found occasionally on it causing the same kind of damage.

In the case of all these borers none but preventive measures of control will be of any avail, since external applications of insecticide, etc., will not in any way affect the internal feeders. For both the fly and moth borers during the younger stages of the plant the most effective and economic method is that of pulling out all young plants showing '*dead-hearts*' when the fields are thinned and dispose those pulled out plants by feeding cattle with them or burying them deep; if thrown on the bunds or in field corners the borers in them may emerge and infest healthy plants again. In tracts where these borers are regular pests season after season, the seed rate may be slightly increased so that the later elimination of dead hearts will not very much affect the number of plants in the field; this is a method followed in Gujerat for the moth borer on young juar (sorghum). Another preventive measure which will go a great way in minimizing borer attacks, especially in the case of the moth borer, is the necessity for giving proper attention to the crop remains left behind in the field after harvest. The stubble in the harvested fields often forms a very fertile harbouring place for the borer to develop and multiply before going into the next crop; these stubbles often give out fresh shoots and the borer finds them very favourable to breed in. Wherever possible the stubble must be pulled out and not allowed to harbour the pest. As stated above the damage to grown-up plants by moth borer is rarely serious and as such it may not demand any real control measures. In such a stage parasites[1] of the borers are often found to do some good work in checking the pest as natural enemies.

The Earhead Bug.—The next important insect or one which is often as serious or even more so than the borers is the earhead bug—the *Naval puchi* (*Calocoris angustatus*). It is an active pale yellowish green bug about a third of an inch in length with well-developed sucking mouth parts with which it sucks up the plant sap from the tender portions of the plant, especially from the tender milky ripening earheads. Unlike the borers the insect is harmful both in its adult and younger stages. In bad infestations each growing plant or tender earhead may be found to be attacked by over a hundred of these bugs in different stages and when such plants are disturbed numerous bugs fly about like gnats. The earheads suffer the most: as a result of bug attack the sap is considerably drained and the earhead becomes chaffy instead of containing ripe and healthy grains. The life-history of this insect is spent on the plant itself; the cigar shaped eggs are thrust into the tender parts of the plant and the active nymphs that come out feed exactly like the adults and in two or three weeks become full-grown winged adults. This insect has a wide distribution in all the dry areas of the province and in certain years causes severe damage to the crop in the Ceded Districts, Guntur area and Coimbatore tract. A good deal of investigation has been carried on in the life-history and habits of the pest for the

[1] The writer has noted some of these in his memoir on the Braconidae, and in his list of Parasites in South India.

past few years on the Central Farm and some data have been collected on the bionomics of the pest and some of the many factors that influence its incidence. Abnormal weather conditions and irregular sowings have been found to help the multiplication of the pest. Catching the bugs by nets or sticky boards and their destruction, though effective and feasible during the younger stages of the crop, become impracticable when the plants are tall and the infestation very widespread. Similarly in valuable experimental plots the pest can be effectively checked by Cyanogas dusting, but the process is both risky and costly in wider areas.

One reason why these borers and earhead bug, which may be put down as the most important pests of cholam and other millets, continue to be perennial pests season after season, is that in dry tracts there is sorghum growing in some fields or other in every area, and though in individual plots alternate crops are grown in rotation there is no wholesale rotation in any one wide area; this evidently gives a good chance for these insects to breed and multiply throughout the year easily and during favourable years assume the status of serious pests. Rotation of crops to have any salutary effect, from an entomological point of view, should be practised not for individual plots alone, as is generally done, but in appreciably extensive areas so that the pest will have no chances of multiplying and infesting the crop when next that crop is sown there.

The Hairy Caterpillar (*Amsacta albistriga*).—In some tracts, especially in the red soil areas, the pest affects the monsoon sorghum and causes some damage; especially is this the case where a previous crop of groundnut in the same area had suffered from this pest. In such tracts the method of picking up the moths during the time of their emergence, which is usually soon after the first monsoon showers, will easily control the pest, and the Pest Act when introduced in some of the areas will also help in this direction. This insect and its life habits and the control measures are so well known that there is no need for any details here. It also attacks other crops like Groundnut, Cumbu, Cotton, etc.

Grasshoppers.—Young sorghum sometimes suffers a little from what are called surface grasshoppers chiefly of the species *Chrotogonus*, small stout-built creatures often having the cryptic color of the soil, and generally attacking many crops when they are in the seedling stages; the damage consists in the creatures cutting off the young plants. In the Ceded Districts, especially in Bellary, during certain years a wingless grasshopper (*Colemania sphenarioides*), popularly known as the Deccan grasshopper, affects sorghum and causes some damage, though 'Tenai' (Korra) suffers much more from this pest. For these grasshoppers mechanical methods of netting, bagging, driving and beating, etc., will be found effective in controlling the pest to a great extent. As a preventive, egg masses in the fields can also be destroyed. In valuable experimental plots spraying or dusting with arsenates will be very effective.

All the other insects found on sorghum are of minor importance and become serious pests very rarely and only under abnormal conditions, and we have very rarely received reports of such pests from farmers in different parts of the Province. The following tabular statement copied from the writer's bulletin on *The Insects affecting cultivated crops in S. India* [1] is however added with the idea that it may give a general idea of these minor insects noted now and then on sorghum.

[1] Bulletin No. 80 of 1923; the revised edition is now in the Press.

Other insects found on Sorghum (Minor pests)

Insect	Distribution	Nature of damage	Scientific name and classification	Control suggestions	Remarks
Sorghum shoot bug.	Coimbatore, Ceded Districts, and Northern Circars.	Colonies of this small insect infest tender leaves and suck the juice.	*Pundaluoya simplicia, D.* (Fulgorid-bug).	No effective remedy known; pull out first attacked plants to check spread; in valuable plots spraying may be done with a contact insecticide.	Badly infested plants appear as though scorched by fire. Ants are found visiting these insects. They are often found in company with plant lice. Fig. 382, *Some South Indian Insects*—Fletcher (1914).
Shoot caterpillar.	Coimbatore ...	Feeding on foliage from inside leaf shoots.	*Cirphis unipuncta, M.* and rarely *C. loreyi, D.* (Noctuid-moths).	Handpicking or dusting shoots with arsenates if necessary.	Not a serious pest, generally a stout smooth caterpillar—one of the army or cutworms. Pl. xviii, *Some South Indian Insects.*
Leaf roller ...	In all dry tracts ...	Rolling leaf and feeding from inside roll.	*Marasmia trapezalis, G.* (Pyralid-moth).	Of minor importance ...	A yellowish brown moth with wavy marks on wings. Pl. xxxiii, *Some South Indian Insects.*
Leaf weevil ...	Coimbatore, Northern Circars, and Ceded Districts.	Feeding on leaves ..	*Myllocerus discolor, B.* (Curculionid-beetle).	Do. do. ...	A greyish brown spp. fairly common everywhere; the grub is often found feeding on roots of cholam, ragi, etc.
Sorghum aphid..	Coimbatore and Northern Circars.	Found in colonies inside tender shoots sucking up juice.	*Aphis maidis, F.* (Aphidae-bug).	Dust tobacco powder if necessary.	Rarely a pest.
Earhead caterpillar.	Tanjore ...	Feeding on the ripening grains.	*Eublemma silicula, S.* (Noctuid-moth).	Very rarely a pest ...	The adult insect is a small pale brown moth.

MINOR INSECTS OF SORGHUM—(*Continued*)

1	2	3	4	5	6
Earhead webber.	Ceded Districts and Coimbatore.	Caterpillars found webbing the grains in the earhead and feeding on the grains.	*Stenachroia elongella, H* (Pyralid-moth).	Rarely a pest and only of local importance.	Fig. 296, S. S. I.
Plant bugs ...	Northern Circars, Tinnevelly and many other parts.	Attacking tender parts especially the ripening earheads and sucking the plant sap.	*Nezara viridula, L*; *Dolycoris indicus, S*; *Agonoscelis nubila, F*; *Piezodorus rubrofasciatus, F*; (Pentatomid-bugs).	Handpicking and netting.	Figs. 352, 347 and 351, S. S. I. Found mostly confined to the earheads.
Earhead chafers.	Ceded Districts and Coimbatore.	Feeding on the ears and pollen.	*Anatona stillata, N*; *Oxycetonia versicolor, F*; *Chiloloba acuta, W*; *Protaetia aurichalcea, F*; (Cetonidae-Chafer beetles).	These beetles are conspicuous and can be easily checked by handpicking and netting; but they are pests very rarely.	Figs. 122, 123 and 124, S. S. I.
Earhead blister beetles.	Do. ...	Do. ...	*Gnathospastoides rouxi, C*; *Lytta tenuicollis, P*; (Cantharid-beetles).	Do. do. ...	Found on paddy also.
Surface grasshopper.	Do. ...	Attacking young plants and often cutting them down.	*Chrotogonus saussurei, B*; (Acridiid-grasshopper).	Netting and poison traps.	Small active creatures often resembling the soil in color.
Sorghum gall-fly.	Coimbatore ...	Breeding inside the tender grains of cholam and making seeds empty.	*Contarinia andropogonis*, Felt (Cecidomyid-fly).	No remedy called for so far.	Sometimes sporadic.
Sorghum mite ...	In most sorghum tracts.	The leaves are turned sickly red by colonies of the mite feeding on the leaf tissue.	*Paratetranychus indicus, H*; (Acari-mite).	Dusting of fine powdered sulphur.	An occasionally serious pest. Not an insect.

In speaking of sorghum insects found in our province it is satisfactory to note that all important pests of sorghum are indigenous forms, and, so far we have not yet found any of the serious exotic pests in our midst causing any serious damage, as in the case of the notorious European corn borer (*Pyrausta nubilis*, H) which has entered America from its original home in Europe, and has become the most destructive corn pest of the New world.

As I stated at the beginning this crop suffers from comparatively fewer pests, and let us hope that our endeavours in the future may prevent even these few from levying their heavy toll from a very important food crop like sorghum and I believe, in course of time as our plant breeders evolve out pest resistant strains of the plant, it may be possible to keep away even these few important pests, and in the long run, and, as far as this plant is concerned, dispense with the services of the Entomologist and the Mycologist as a permanent measure of retrenchment.

SORGHUM DISEASES IN SOUTH INDIA[1]

By S. SUNDARARAMA AYYAR, M.A., I.A.S.
Government Mycologist, Coimbatore

Sorghum is subject to a number of fungoid diseases of which the most important in South India are the smuts, the rust and the leaf-shredding disease. Of these, the short smut caused by *Sphacelotheca sorghi* is most destructive and the loss caused by this has been estimated at ten million rupees. But fortunately this disease is easily preventable and thanks to the efforts of the Agricultural department, the loss to the cultivator has been to a considerable extent reduced in recent years. The treatment for this disease is now a recognised practice among cultivators.

The smut appears on the ears of the plants when they are ripening but the fungus which causes it, has been insidiously working its way through the plant from the time the seed was sown in the soil. No difference however between a healthy and a diseased plant can be seen till after the flowers appear. In the diseased plants the individual grains in the ear instead of ripening into normal seed become filled with a black powder. The affected grain grows larger than the normal healthy grain, usually about twice its size. The smutted grain is covered with a light brown skin. The number of diseased grains in a panicle varies considerably. In some cases only a few grains are affected while in others nearly 75 per cent of the grains may be affected. The smutted grains ripen after a time and the skin enveloping them bursts open, liberating the black powder within. This black powder consists of millions of tiny spores of the fungus. These spores are blown by the wind and get lodged on the healthy grain. The harvesting, threshing and winnowing operations considerably help their spread. The spores adhere to the surfaces of healthy grains and if these are sown next season, the crop produced is equally affected with smut.

How the disease is caused. The fungus which causes this smut lives inside the plant, but is too small to be seen by the naked eye, till the black powder is produced within the affected grains. This powder consists of thousands of very small round balls closely packed together. They are called spores and are the seeds of the fungus by which it reproduces itself.

[1] A paper read at the 21st College Day and Conference of the M.A.S. Union, Coimbatore. December 1931. The paper was illustrated by charts.

When sorghum seed with some of these black powdery spores attached is sown in a field, the spores germinate along with the Seed. From the germinating spore, thin colourless mycelium grows out and enters the young sorghum seedlings. Once the mycelium of the fungus has got inside, it goes on growing within the plant but does not hurt it in any way till the time when it is coming into ear. Then the fungus invades the young grain just forming, consumes the nourishment intended for the grain and develops its own colourless mycelium. These gradually produce spores or seeds till the interior of the grain is almost completely filled with a mass of dark coloured spores.

Preventive measures—(*a*) **Bluestone (Copper sulphate) treatment.**—Smut can be prevented from affecting sorghum by steeping the seed for 15 to 30 minutes in a solution of bluestone (copper sulphate) before it is sown. To make the solution, one tola of bluestone should be dissolved in one measuring seer of water. Larger quantities of the solution will be made by dissolving corresponding quantities in the proportion of one tola for every bottle of water required, or of 1½ tolas for every measuring seer of water. The solution should be kept in a wooden, copper or an earthenware vessel, but never in an iron vessel, else the solution will be spoiled and the iron vessel corroded. If powdered bluestone be suspended in a bag just below the surface of the water from a stick laid across the mouth of the vessel, it will dissolve—quickly. If lumps of bluestone be put directly into the water, it requires much stirring to make them dissolve. The seed may be put in a bag and immersed in the solution or may be poured into the solution. In either case, care should be taken that all the grains are thoroughly wetted. The bag should be plunged up and down several times or the seed stirred with a stick. The seeds that are not fully wetted come to the top and are stirred till they sink. Those that will not sink after stirring should be collected and destroyed. After the seed has been in the solution for 15 minutes, it is taken out and spread in a thin layer on a clean gunny sack or on a clean floor to dry in the sun. For broadcasting it may be sown when it is almost dry but for drilling it should be quite dry. Care should be taken that the treated seed does not again become contaminated with living spores. If a floor is used for drying, it should first be washed with the solution. The bag used for holding the seed after treatment or during sowing and the seed-cup can easily be disinfected by plunging them into the bluestone solution. As a rule it will be found most convenient to treat the seed just before it is sown.

The seed-rate for this crop varies greatly. If five tolas of bluestone are dissolved in three measuring seers of water, the solution obtained will be sufficient to treat 16 lb. of seed. If this quantity of solution is made, it is best to do first 8 lb. only, and then after removing this seed to dry, to do the other 8 lb. Bought in small quantities in the bazaar, bluestone now costs about four annas per pound or 40 tolas. Forty tolas of bluestone are sufficient to treat 150 lb. of seed. The cost of treating 3 lb. of seed is therefore about one pie. In other words the seed required to sow an acre can be treated at an expense of about four pies. If the seed is good and if the solution is made of the strength mentioned above, there need be no fear whatever that the treated seed will not germinate.

(*b*) **Sulphur treatment.**—In places where fine sulphur (200 mesh) is available it is cheaper and more advantageous to treat the seeds with this than with copper sulphate. The advantages of this treatment are that the

seeds can be treated dry and if the seeds are not required for immediate use, can be stored without drying. The efficacy of the treatment, however, depends on the thoroughness with which the seeds are mixed with the finely powdered sulphur. Any metal container with a tightly fitting lid and having a holding capacity of about four times the quantity of seed to be dusted can be used to treat the seeds. Four to five ounces (10 to 12½ tolas) are sufficient for treating 60 lb. of seed. The seed should be treated in lots depending upon the size of the container, the required quantity of sulphur added and the container vigorously rolled for about five minutes. The seed is then ready for sowing, or for storing if not required for immediate use. The cost of treating 7 lb. of seed works at one pie and the cost of treating seed required for one acre works at about two pies.

Seed treatment has to be done every year even though the disease is absent in the field, because though some ryots have treated their seed and got no smut in their crops, their neighbours may not have done so and the spores of the smut from the crop grown from untreated seed will get blown on to the earheads grown from treated seed and next year smut may occur again. Also the spores of the smut are to be found on the thrashing-floor, in the carts, on the sowing implements, in the houses wherever grain has been stored, and therefore it is a very easy matter for grain which had no smut in the field to get contaminated again after the crop is cut. It has been shown that the cost of treating 3 lb. of seed is about one pie. Ten average heads of sorghum will give 2 lb. of grain, which is worth about one anna. Therefore, if the seed is not treated, one head wholly smutted, or two or three heads partially smutted, will cause as much loss as the cost of treating 3 lb. of seed. It is therefore wise to treat the seed every year until everybody in the village has adopted the practice and has done it for several years. If any one who grows sorghum loses part of his crop every year on account of smut, he is recommended to try treating his seed either with a solution of bluestone or with fine sulphur. In some villages the ryots are in the habit of making a mixture of asafœtida, cow's urine, bluestone, etc., in which they steep their seed in order to kill the spores of the smut. This practice is useless unless a much larger quantity of bluestone is added than is necessary for a solution in water. When a solution of bluestone is added to cow's urine a solid is produced which is useless for killing smut spores. The bluestone is wasted. It is therefore cheaper to use a solution of bluestone in water as described above or use finely powdered sulphur and get a result that can be depended upon.

Long smut.—(*Tolyposporium filiferum*). As the name indicates the disease is characterised by the grains being transformed into long bags containing smut spores. Only a few grains in the earhead are affected. The life history of this fungus is not fully known. But there is evidence to show that infection takes place through the flower. Seed treatment is of no avail as a remedial measure against long smut.

Whole earhead smut.—The life history of the smut is not fully known. The entire earhead develops into a bag containing the spores of the fungus. Seed treatment is not effective and as a precautionary measure the affected plants should be removed and burnt.

Rust.—Yellow or brown patches are seen on the surface of the leaves and stems. These patches are either linear or oval. If mature patches are examined under a lens they are found to be made of fine yellow powder bursting out and breaking open the epidermis of the outer skin of the leaf.

This powder consists of spores which are one-celled called Uredospores. The mycelium of the rust fungus is hidden inside the tissue of the leaf. It uses up the nourishment in the leaf and after a time spores are formed which break through the leaf. The spores get distributed by wind, insects or man and the neighbouring plants get infected. At the end of the growing season another kind of spores are produced which rest for a while before they can infect the sorghum plant. These tide over a period and infect the crop next season. Spraying is not feasible.

Leaf-shredding disease.—The disease is caused by a fungus *Selerospora graminicola*. This disease is prevalent throughout the presidency. The same parasite or a variety of it attacks several other plants as *cumbu*, (*Pennisetum typhoideum*), *tenai* (*Setaria italica*), maize and sugarcane.

On sorghum three distinct types of attack have been noticed. In the first form the disease appears in the very young seedlings. Affected plants have pale yellow narrow leaves covered with a white down consisting of the conidial stage of the fungus. This occurs on both surfaces but very often on the under surface. The plants continue to grow and when 5 or 6 weeks old white streaks appear on the top leaves. The tissue then tears along these streaks, causing well-marked shredding of the leaf which may result in the separation of all the leaf tissue from the mid rib in long strips. At the same time the white areas turn brown owing to the production of thick-walled resting spores known as oospores which are immersed in the leaf. The affected plants remain stunted and sterile, no ears being formed. Only individual plants are attacked and there is no indication of spread from plant to plant.

In the second form[1] the first symptoms are noticed when the plants are about two months old. The top leaves turn white as also do the bases of the lower leaves. Irregular brown or yellow streaks then appear and oospores develop in quantity in these. On the lower leaves pale yellow patches appear on which the conidial form is found. This may occur at the same time as or even later than the production of oospores. Affected plants rarely produce earheads. Even if they do they are small and with only a few grains; but they are not malformed as in *cumbu*. This is the commonest form and seems to do most damage but there is no indication of spread from plant to plant.

In the third form, the affected plants are in groups and the disease seems to spread from one plant to another. The leaves are marked by long, narrow streaks and patches at first yellow, then orange and finally dark brown. Conidia are found on both surfaces, especially on the under side. The patches appear to spread from the lower to the upper leaves and from the apex to the base of individual leaves. They are limited by the main veins. When the attack is severe the whole leaf dries up and turns dark brown but there is no leaf-shredding. Normal ears are produced.

It has also been noticed that disease is severe in wetter parts of the field. In some forms of attack the internodes are shortened and the leaves arise close together, turn ivory white in colour and stand out prominently from the stem resembling the inflorescence of *Pandanus oderatissimus*, hence called *Tazhai novu* in Tamil. Sometimes the young leaf buds are attacked and become deformed, remaining imprisoned in the sheath of the subtending leaf.

[1] Butler, E. J., *Fungi and Disease in Plants* (1918).

How the disease spreads.—The fungus produces two kinds of spores, conidia and oospores. Conidia spread the disease from plant to plant in the same season and there is evidence to indicate that the disease is carried over from season to season by means of oospores. The oospores remain infective for over nine months.

Season.—Early-sown crop is more susceptible to the disease than late-sown. In 1930 June leaf-shredding appeared in a serious form during the sorghum season. Counts were made in various fields in the Central Farm and outside. The percentage of infection was observed to be between 8 to 10 per cent in the Central Farm, 6 to 8 per cent in the ryots' fields, and 3 to 5 per cent in the Government Entomologist's experimental plots.

It would appear that (1) the incidence of the disease is greater in well-manured crop than incompletely manured crop, (2) early-sown crop is more susceptible than late-sown and (3) irrigated crop is more subject to attack than unirrigated. The results are by no means conclusive; but they indicate the general nature of the disease. In some seasons, the disease is more virulent than others. When the weather is extremely dry or is broken by only short spells of humid weather the disease is not so virulent as when the weather is extremely moist. Since the disease is carried over from one season to another by means of oospores, a long interval between two successive crops of Sorghum is indicated as a means whereby the disease could be controlled. Spraying will not be of any avail for, apart from the impracticability of controlling the operations on a large scale, the disease cannot be checked by means of spraying owing to soil infection.

Sugary disease.—The disease is found occurring in some years during the months of December and January in Coimbatore. On the earhead of Sorghum in some flowers small, yellowish brown drops of sticky juice are produced instead of the grain. These drops gradually solidify and remain on the earhead looking like a big grain. The presence of sugary disease in the sorghum field can be recognized by the presence of bees and other insects hovering over the earhead. The sugary drops examined under the microscope are found to be full of spores. The sugary juice attracts insects which carry the spores on their body and help in the distribution of the fungus.

Leaf-spot disease—(*Cercospora sorghi*). This disease is more common in the months of November-December and appears just before the flowering. Numerous small elongated spots are formed on the leaves. The lower leaves are the first to be attacked and gradually the disease spreads to the upper ones also. The spots vary in colour with different varieties. In some these are of a reddish colour and in others straw yellow. In humid weather the surface of the spot is covered by a greyish white growth consisting of the fructifications of the fungus. It is not possible to estimate the amount of loss caused by this disease but we may expect an appreciable reduction in yield since most of the assimilating tissue is affected. A number of varieties of Sorghum are affected by this. Elsewhere it has been reported that this fungus causes a serious disease of maize also but it has not been noticed here. The only possible method of tackling this disease is by searching for some disease-resistant strains or variety.

Striga lutea.—Another parasite which causes damage is the flowering plant known as *Striga lutea*. It belongs to the family *Scrophulariaceæ*

which includes many other species living in the same manner. The roots of the parasite become intimately attached to those of the sorghum plant, from which it derives some or all of the food material which it requires. The sorghum plant, thus robbed of its food suffers to a great extent and often dies before reaching the seed-bearing stage. The damage is especially great when new land is cultivated, for the condition of equilibrium resulting from a long-continued struggle for existence between striga and sorghum is destroyed and the parasite multiplies rapidly to the detriment of the host plant.

Life history of the Parasite.—[1] The seed of the striga plant is very small in size. It is easily transported from place to place by the wind and irrigation water. When conditions are favourable, the seed begins to germinate, and the root of the young seedling on emerging from the seed-coat grows directly towards the nearest sorghum root even if it has to turn upwards in order to do so, and the root tip of the parasite immediately forms a bell-shaped swelling which applies itself closely to the surface of the sorghum root and gives rise to the first haustorium. In course of time one or more outgrowths quickly arise from the applied surface and penetrate the tissues of the host. The Sorghun plant is now infected and the parasite grows from now on at its expense. The stem of the parasite grows slowly, probably taking some weeks before it reaches the surface, all the while taking its nutrition from the growing sorghum plant. New roots arise from the lower part and from these more haustoria are produced. One can realise therefore the enormous damage which these plants can cause to the sorghum plant. The striga plant grows up, flowers and sets seed, and the life history begins again. A very significant point in the germination of the striga seed is all the seeds do not germinate at the same time even under the most favourable conditions. A small percentage germinates in the first year leaving a greater portion in the soil to germinate later. There is evidence to show that the seeds remain viable for at least 12 years. One can easily imagine therefore the difficulty confronting the cultivator in controlling this noxious weed.

Control measures.—(i) **Rotation.** The practice of rotation helps to a considerable extent in keeping this pest in check, for this plant is partial only to the plants belonging to the grass family.

(ii) Since the weed multiplies itself by seed, the uprooting of the plant before it flowers and sets seed, is indicated as a remedial measure. But as the plant is capable of growing from cut ends, the task is not very easy. However, constant inter-cultivation and removal of weeds will tend to keep down the parasite.

(iii) When the pest has assumed serious proportions the above methods may not suffice and more intensive methods have to be adopted. The most successful and, but for the cost, the best method is the one known as 'trapping'. The field is sown to sorghum and ploughed up a month later and this process is repeated four or five times, till the land is cleared of the weed. By this means not only will the soil be improved but the weed also would have been completely eradicated. If preferred, the sorghum can be cut for making silage and the land ploughed later on.

[1] Pearson, H. H. W., Dept. of Agr. Union of S. Africa, Bull. 40.

DISCUSSION

Mr. T. V. Rajagopalacharya said that all the papers read tended to show how yield of sorghum depended on moisture and moisture alone. Mr. Gopalakrishna Raju's reference to the practice of sowing in lines 2½ feet apart whereby a yield of 1,500 lbs. was obtained, was an instance in point. Such scattering helps the utilization of more moisture and the practice of the Ceded District ryots (some of the most intelligent in the world) aims at the retention of adequate moisture. With reference to Mr. G. N. Rangaswami Iyengar's report about experiments on depth of sowing at Coimbatore, he would inform the conference that the Bellary ryot purposely sows deep. After the rains in October, a heavy three-tyned drill drops the seed just at the moisture layer and a blade *guntaka* passed later produces surface mulch and sub-soil packing—two operations at one stroke! Thus with a low seed-rate, and what looks like a sparse growth, the ryot gets a good yield because there is maximum utilization of moisture. On a rough computation 3 lbs. of grain can be obtained from five ear-heads and 2,000 plants well spread in an acre will yield 1,000 lbs. He would therefore suggest to the breeders to evolve a good type of ear-head. In regard to Mr. G. N. Rangaswami Iyengar's reference to *Tella Jonna* introduced out of the Bellary tract into Nandyal being a failure, he would suggest the procedure to be reversed and that *Pacha Jonna* type be tried outside Nandyal into Bellary, as he believed that *Pacha Jonna* was more adaptable. With reference to natural crossing, he knew that ryots were crudely aware of it, there was in fact a belief among Coimbatore ryots that summer sorghum matured well with a steady wind in April and May probably because winds helped in easy cross fertilization. With regard to Mr. Nath's reference to the fact that deep ploughing once in 4 or 5 years gave more yield of sorghum than when done every year, he wanted to know whether this referred only to sorghum or to other crops as well. His experience was that sorghum did not come up well when deep ploughing was done probably because there was not a firm bed for the seed so that the plants that came up, lodged later on. Another factor necessary in his opinion for good yield of sorghum seems to be adequate moisture during growth and especially at the time of earing. He remembered that in 1918 at Hagari, a crop that grew well suffered for want of rain at the later stages. Fortunately at the time of earing a heavy rain received on two consecutive days revived the crop which gave a bumper yield. In a recent book by Mr. Howard on the improvement of black soil in Central India, a suggestion is made to divide big areas into small parts of 6 to 8 acres by intervening shallow channels and levelling up the whole area into a gradient of 1 in 500 to prevent wash. He would suggest that some such thing might be tried with black cotton soils here. About Mr. Raju's reference to the practice obtaining in certain parts of the Ceded Districts of leaving 1 to 1½ ft. of sorghum stubble after harvest, and to his remarking how this would add to the organic matter contained, he would like to observe, however, that he had come across literature wherein it was stated that stubbles composted and applied had a depressing effect on the crop. To augment the supply of organic manure, Mr. Rajagopalacharya quoted a concrete instance at the Central Farm wherein has been adopted during the past two years, a regular system of growing green manure in the interval between crops in the garden area. This had resulted in the release of cattle manure for application to the fields which in earlier years had not received this in any adequate quantity.

Mr. D. G. Munro remarked that it had been demonstrated by the figures shown that production from rain-fed lands largely depended on the retention of moisture. Retention of all moisture in the soil would also prevent wash. Howard's method mentioned by the previous speaker involved considerable waste of land. Under the light rainfall conditions in the south this waste of land appeared to be unnecessary. At his request the Research Engineer had now evolved an implement for making small bunds and it had worked satisfactorily on the Central Farm. By this implement bunds could be made cheaply, rainfall would be conserved where it fell and the question of wash would be automatically solved.

Mr. Rajagopalacharya replying Mr. Munro, observed that bunds in black cotton soils would not stand well and that was probably why Howard had suggested broad shallow channels.

Mr. N. G. Charley was of opinion that with reference to conservation of moisture, attempts should be directed towards trapping rainfall to augment the sub-soil moisture

content. This has not been done with very great effort in this country before. He ventured to suggest that a fair amount of power was required for this practice. Considering that surprising results had been achieved in other countries by sub-soiling, he saw no reason why it should not produce as good results here if a suitable implement could be had for bullock draft.

Mr. M. Satyanarayana remarked that from consumer's point of view, it would pay, in breeding sorghum types to avoid persistent and coloured glooms as these on account of their dark colour create in the cooked grain an impression of dead insects. Another point to be borne in view should be the production amongst inter-general sorghum-cane hybrids of types with all the qualities of sorghum with only the sweetness of the cane. Evolution of types for the dry-farming tracts, should suit either timely sowing rains followed by the deficiency of rain or delayed sowing rain followed by a proper supply in the growing period. To suit these two different seasonal conditions, ryots of the locality go in for different local varieties and the breeder should also keep this in view when he produces types for these localities.

Mr. K. Krishnamurthi Rao observed that Mr. Nagann Gowda's paper on sorghum economics left one aghast. 3½ *salagais* of grain per acre valued at about Rs. 20 showed a very discouraging state of things. He therefore asked why sorghum was not given up and further efforts directed at improving the hybrid between sugarcane and sorghum so that we could get both sugar and sorghum. With regard to Mr. Charley's suggestion about sub-soiling, he was doubtful if it would be economic when deep ploughing itself was not.

Mr. T. V. Rajagopalacharya answering Mr. Krishnamurthi Rao pointed out that Mr. Gowda's figures should be interpreted differently. What were put down as cultivation expenses were the wages which the ryot receives for his labour and one couldn't expect him to get both wages and increased profits by way of grain. That was why the situation was really economic for him and the ryot had been managing for centuries.

Dr. T. R. Seshadri suggested that the retention of moisture attained by the Ceded Districts practice of soil mulch may not be due to the mulch itself but two other causes, namely the avoiding of deep cracks and the removal of weeds.

Mr. K. Ramiah referring to a recent article in soil science by Dr. Keen, said that it was shown therein that soil mulches lose more water than unmulched plot. As regards Mr. Rangaswami Iyengar's suggestion that a number of suitable types of the grain might be mixed to produce a bulk number he wanted to inform the conference that such a thing had already been done with paddy and that for the past three seasons bulk varieties were being distributed from Maruter. With reference to the remark of Mr. Gopalakrishna Raju and Rao Bahadur Viswanath that artificial fertilizers were not profitable, he was of opinion that the conditions would change and suggested that the time of application of manure to the crop be investigated in detail.

Mr. S. R. Venkatakrishna Mudaliar referring to the sugary disease of cholam on which he had worked for a number of years, observed how the fungus responsible for this had baffled all attempts to isolate it. He suggested that a study of the chemical changes occurring at the various stages of the disease would provide great interest.

Mr. T. Lakshmana Rao referring to the usual conception about surface mulching dwelt on the old and the new ideas about movement of soil water. The point to be noted was that to prevent underground water from escaping, sufficient degree of drying up the surface soil was necessary. A spell of dry weather would anyhow dry up the surface soil. A more efficient method would be to dry it up by a mulching operation.

Mr. K. Gopalakrishna Raju was sorry that Dr. Gowda was not present to answer some points he would like to raise. In his paper Dr. Gowda had compared yields in Hagari and Hospet but conditions were different in those two places. Hospet an oasis in the black cotton tract, was entirely different from Hagari in that the soil was red and being under the Tungabudra valley was silted up and the labour conditions were different. In addition, the rains were received earlier and *Mungari* crops alone were grown.

With reference to Mr. Rajagopalacharya's question whether deep ploughing benefits sorghum 3 years' results at Hagari showed that sorghum yielded well when sown in deep ploughed plots. With reference to the depressing effect of stubbles, he was arranging

to collect and preserve separately a compost of sorghum stubbles this year and was intending to experiment with this material. Answering Mr. Krishnamurthi Rao's question as to why the Ceded Districts ryot should grow such an uneconomic crop as sorghum, Mr. Raju said that he did so to get food for himself and his cattle. If the ryot wanted money he would grow groundnut or cotton.

Rao Bahadur D. Ananda Rao remarked that it was very interesting to read from Dr. Nagann Gowda's paper that in America the Dwarf Milo gives 4,000 to 5,000 lb. of grain. But without knowing what the conditions there, were, and how they compared with ours here, such bald statements were of no use. The Dwarf Milo had in fact been introduced into the Coimbatore Central Farm long ago, but the local taste had not taken to it favourably. Mr. K. Gopalakrishna Raju's reference in his paper to the inadequate supply of cattle manure was in his opinion a very important point. It was up to them departmental officers to raise the manurial supply from one-twentieth to at least one-fifth of the demand. During his recent tour in the Ceded Districts he had seen how the demonstrators were endeavouring to augment the supply. His request to the officers of this department was not to belittle, however small, however dirty, any source of manure that they could lay their hands upon. He would also like to impress on the place of artificials in a manurial scheme. When no manure is available, he would ask why not a start be made by purchasing artificials? In fact the circle should be started with a judicious mixture of artificials and cattle manure and with increased yields of grain and fodder every year, he was of opinion that in course of time our organic manure could be built up.

Rao Bahadur B. Viswa Nath said that with regard to bunding of fields he did not consider that Mr. Howard's method alone was enough as the idea was more to prevent the run-off of water than soil erosion. Bunding would therefore help in the better utilization of rainfall. Of course it will be necessary to use judgment in deciding the area to be bunded taking into consideration the general slope of the land. In answer to Mr. Rajagopalacharya's question, he would say that deep ploughing did increase the yield of sorghum. In fact sorghum appeared to have been benefited more than cotton after deep ploughing. But as he had already pointed out in the paper, deep ploughing lost its significance as yields fell off with the frequency of operation. In regard to the suggestion of increasing moisture contents by sub-soiling, he considered that it was worthy of trial although it was not possible to state anything just now about its financial commitments. In regard to the discussion on soil mulch, he might remind the house that he simply stated that soil mulch did not exercise a protective influence on the evaporation of moisture from the soil, and that he purposely ignored comment on this. It was true that agreeably with modern views on the forces responsible for the upward movement of water in the soil, the failure of the soil mulch to better retain moisture was apparent. But there was the practical aspect of this in which soil mulch was known to enhance crop yields whether it was due to better regulation of temperatures in the mulched zone or to the relatively greater absorption of small quantities of rainfall or dew. It was therefore not desirable to dismiss the subject of soil mulch at this stage. Coming to the question of economics of sorghum growing, his considered opinion was that until its status in society of crops was raised by finding means of utilizing it in industrial processes, its chances of becoming a profitable crop by intensive cultivation or extensive manuring were very remote. He had indicated in his paper some of the directions in which sorghum could be profitably utilized industrially.

Mr G. N Rangaswami Iyengar remarked that Mr. T.V. Rajagopalacharya's suggestion to try *Pacha jonna* in the Bellary *Tella jonna* tracts was not likely to be a practicable proposition as none accustomed to *Tella jonna* and its perfections was likely to go back to the more cosmopolitan *Pacha jonna*. The mixture of 'strains' at Maruter referred to by Mr. K. Ramiah was mere mass selection to meet a pressing demand for seed. But the mixture suggested for sorghum was a mixture of real strains that have passed the tests for strains. While thanking the various speakers for their numerous suggestions, he observed that ideas as to what a sorghum plant might be, should be of a type to spur effort and not to side-track it along impracticable lines.

THE NINETEENTH INDIAN SCIENCE CONGRESS

The nineteenth annual meeting of the Indian Science Congress was held at Bangalore during the first week of January under the presidentship of Rai Bahadur Lala Shivaram Kashyap, B.A., M.SC., of the Punjab Educational Service and the session lasted from the 2nd to the 8th January. This was the second time that Bangalore had this honour, an earlier session of the Congress having been held there in 1924. The arrangements in every way left nothing to be desired and all credit is due to the Mysore Government and especially to the Dewan and the local Secretaries. The opening gathering and the various sectional meetings were held in the spacious premises of the Central College. To add to the interest of the Congress a science exhibition was also arranged in which various Indian and Foreign firms had exhibited a very interesting display of different kinds of scientific instruments and apparatus suited to different branches of scientific investigations.

To the section of Agriculture over which our Millets Specialist, Mr. G. N. Rangaswami Ayyangar, B.A., I.A.S., presided, as many as 56 Papers were contributed on the different aspects of the subject, such as Soil Science, Biochemistry, Economic Botany, Agricultural Zoology, Animal Husbandry, Meteorology and Agricultural Statistics. The following are the titles of the twelve different Papers contributed by different members of the Madras Department to that section:—

1. Inhibitory factor hypothesis and inheritance of quantitative characters in rice (*O. sativa*).—By Mr. K. Ramayya, Coimbatore.

2. Origin of lint and fuzz hairs.—By Messrs. V. Ramanatha Ayyar and G. Shesadri Ayyangar, Coimbatore.

3. Immaturity of cotton fibres in relation to the position of the seed in a lock and the length of fibres.—By Messrs. V. Ramanatha Ayyar and G. Shesadri Ayyangar, Coimbatore.

4. Variation in the physical properties of fibres situated in the different regions of the seed surface.—By Mr. R. L. N. Ayyangar, Coimbatore.

5. A new variety, and inheritance of certain characters in cotton.—By Mr. R. Balasubramanyan, Coimbatore.

6. Variation in the yields of coconuts and its causes.—By Dr. J. S. Patel and Mr. K. W. Chakrapani Marar, Coimbatore.

7. A study of pastures and meadows at Hosur.—By Mr. T. Murari, Hosur.

8. Bionomics of some thrips injurious to cultivated plants in S. India. —By Dr. T. V. Ramakrishna Ayyar, Coimbatore.

9. A fish pest of fields along the Coromandel Coast.—By Dr. T. V. Ramakrishna Ayyar, Coimbatore.

10. Pests of Ganja (*Cannabis sativa*).—By Mr. M. C. Cherian, Coimbatore.

11. The Cholam Mite (*Paratetranychus indicus*).—By Mr. M. C. Cherian, Coimbatore.

12. Some experiments on the control of the root-gall nematode *Heterodera* (*Caconema*) *radicicola* (Greef) Muller in South India. By Mr. P. N. Krishna Ayyar, Coimbatore.

To the Section of Zoology, Dr. T. V. Ramakrishna Ayyar, our Entomologist, contributed a paper ' A new genus and species of thrips from S. India, (*Veerabāhuthrips bambusæ.*)'

The subject of Mr. Rangaswami Ayyangar's presidential address was *THE INHERITANCE OF CHARACTERS IN RAGI* and this has already appeared in our last month's issue. In our opinion it was one of the best presidential addresses we have had the opportunity of hearing during the session of the Congress including that of the general president, and we offer our congratulations to Mr. Ayyangar. We are, however, sorry that he was not in good health at the time to give us the full benefit of his suggestions and the criticisms on the various papers read.

Though the whole session went off quite successfully, we cannot deny the fact that the attendance was rather poor this year, of course, for obvious reasons. The next session of the Congress meets at Allahabad in January, 1933.

Notes and Comments

Annual Reports of Subordinate Officers.—When last year Government released for publication and sale the consolidated reports of subordinate officers of the Madras Agricultural Department and fixed the price at Rs. 10 per copy we had occasion to point out that the high price would curtail the usefulness of this valuable publication. We were pleased to note that Government heeded our opinion and reduced the price to Re. 1. The report for 1930–31 is just published and though conditions have changed a good deal since the last publication we are sorry to note that the price of the copy has been fixed as high as Rs. 6. We are now obliged to repeat our plea for reducing the price of the volume to a nominal figure and thus bring it within the reach of all those interested in the progress of Madras Agriculture in this province and elsewhere.

A Bureau of Mycology and Entomology for India.—In the course of his presidential address to the Botanical Section of the 19th Indian Science Congress recently held at Bangalore, Dr. Hariprasad Chowdhuri made a timely appeal for the establishment of a Bureau of Mycology for India. Dr. Chowdhuri traced the history of mycological work in India and made a resume of the progress in this branch of applied science during the last quarter of a century. While progress in the past was for the most part due to the labours of Government Agricultural Departments, he expressed satisfaction at the interest displayed in recent years by the Indian Universities in mycological research. ' With the increase in mycological work the establishment of an Indian Bureau of Mycology has become an imperative necessity ' stated Dr. Chowdhuri, and we fully endorse his views. To start with, a combined bureau for Entomology and Mycology would, in our opinion, meet the immediate needs of the day, facilitate the progress of research in these sciences and prevent unnecessary duplication of work in different centres.

Cochin's Retiring Superintendent of Agriculture. Mr. I. Raman Menon, Superintendent of Agriculture and Panchayats, Cochin, has retired from service, having reached the age limit of 55. Mr. Menon is a Chemistry

graduate and took his diploma in Agriculture at Cambridge as a State scholar. He specialised in Animal Husbandry and Dairying before he took over the duties of Superintendent of Agriculture and Panchayats in Cochin which place he held with unique ability for over 15 years. His services to the cause of Agriculture and Rural reconstruction are well known to those who have had the privilege of knowing him. The Central Farm at Trichur will always bear testimony to the useful work he has done for the country of his birth. Many in the College and Research Institute will remember him, as a member of the University Commission, Board of Studies in Agriculture, and Examiner in B.Sc. (Agriculture) degree examinations. Of a kind disposition and gentle manners Mr. Menon made himself the friend of all who came into contact with him. Mr. Menon is in splendid health and still full of energy and we trust that his unique knowledge and rich experience will still be available to his State and to South Indian Agriculture in general.

Railway freight on Rice.—In a letter addressed to the Chief Commercial Superintendent, South Indian Railway, by the Secretary, Tanjore-South Arcot Mill Owners' Association, regarding the reduction of railway freight on rice bags exported from the district to Colombo, the Secretary stated that on account of the fall in price of paddy, mill-owners find it increasingly difficult to pay as much as Rs. 16 to the railway as freight per ton of rice between Kuttalam, an important mill centre of the district, and Colombo. Since the Railway Company was not prepared to reduce the rates, an attempt was made last year to send the rice bags by country carts to Thirumalaivasal, a seaport near Shyali, and then ship them to Colombo by boats, which resulted in a saving of Rs. 5-4-0 per ton to the rice exporters. Although attempts are being made in recent times to improve the condition of roads in this district they are still far from satisfactory. The district has always a large exportable surplus of rice, and if only the road communications to the seaside towns in the district could be improved, practically all the surplus could be exported cheaply. Since the prosperity of the district depends a good deal on the rice trade, it is up to the local bodies to see that the road communications particularly to Thirumalaivasal, a flourishing seaport in olden days, is improved. If this is done we are sure the cost of transporting rice bags first by motor vans to the port and thence by boats would work out much cheaper than the rate of Rs. 12 per ton which the Association is urging upon the Railway Company to accept instead of the existing rate of Rs. 16.

The Sukkur Barrage.—What is regarded as the largest single irrigation scheme undertaken in any part of the world—THE LLOYD BARRAGE—was opened by H. E. the Viceroy on the 13th January at Sukkur. The proposals which led up to it were under consideration and discussion for over twenty years prior to its sanction finally in April, 1923. The construction was put in hand in the month of July, 1923. The Project is the latest development in the process of improvement and extension of the primitive inundation canals which have been going on ever since the British occupation of Sind in 1843. The cost, as estimated by the Government of India, amounted to 18·35 crores of rupees, exclusive of 8·14 lakhs incurred on surveys and investigations, while returns on the sum (thirty years after completion) were computed at 10½ per cent. It was further estimated that the scheme would become productive in 9 years after completion. The objects of the scheme, among other things, were to keep out silt from canal mouths,

to maintain in the canals a steady supply of water at a fairly constant level, to enable higher duties to be realised and to secure a better outturn of crops than under the old canals, and to provide agricultural employment to the population all the year round. The barrage is nearly a mile long and has been built of a creamy white limestone. The magnitude of the scheme may be gauged from the following figures:—Total estimate of scheme, Rs. 20,03,00,000; cost of barrage and head-works, Rs. 5,58,97,000; total length of canals of all sizes to be excavated, 6,400 miles; total cost of machinery employed Rs. 4,53,33,000; total number of bridges and regulators to be constructed, 1,970; gross area commanded by the scheme, 7·4 million acres.

Protection for Indian Sugar.—It is gratifying to note that the Government of India have decided to introduce a bill in the Legislative Assembly proposing a protective duty at the rate of Rs. 7-4-0 per cwt. on all classes of sugar until March 31,1938, and making provision in the statute for a further enquiry before the end of that period into the question of continuing the protection to the Indian Sugar Industry. The Government have done this by accepting the suggestions of the Imperial Council of Agricultural Research and as a result of enquiries made by the Tariff Board. Though the Government have not accepted all the recommendations of the Tariff Board they have accepted some of the more important suggestions. The Board's recommendation that an annual grant of not less than Rs. 10 lakhs should be made for sugar research was not sanctioned due to financial circumstances.

Cashew Industry in South India.—The cultivation of the Cashew tree (*Anacardium occidentale*) has been given an impetus within recent years by the great demand for the kernels in the New World. The tree grows wild, quickly and luxuriantly all over the West Coast tract. The demand for the produce of the tree is likely to increase very rapidly as in addition to the kernels some by-products are also produced such as an oil from the shell and alcohol from the fruit juice. The industry has begun to increase in magnitude in Mangalore where there are a few firms doing large business in this line. Exports are chiefly to American markets. The Government of Madras have encouraged this industry by planting a small area of this crop in the Coconut farm at Nileshwar. A good deal has to be studied with regard to the tree in its various aspects and it is hoped that further detailed particulars may be had in this direction after the experiments have produced results.

ABSTRACTS

(With this Number we begin a new feature entitled 'Abstracts' which is intended to give a brief summary of Agricultural literature appearing in current periodicals, particularly those of interest to India. Contributions to these pages are invited.—ED. *M.A.J.)*

Tobacco Growing V. Seed selection, Harvesting and Curing.—MCDONALD, W. J. B. and COGHLAN (*Jour. Agr. Victoria*, vol. 30, pp. 578-585). The first article of this series, which appeared in the August issue of the Journal, dealt with the soil and climatic conditions most suitable for tobacco growing and the preparation of seed-beds. Subsequent articles in the September, October, and November issues, describe the methods of transplanting the seedlings, the work involved in the care of crops and the construction of flue-curing barns. In the present article, the writers deal with seed-selection, harvesting and priming, and also compare the relative advantages of different methods of 'curing'. Working details are given for a satisfactory method of barn-curing. (C. N.)

Studies in Indian Tobaccos. No. 6. The improvement of Indian Cigarette Tobacco by Hybridization. KASHI RAM (*Ind. Jour. of Agr. Sci.*, 1931, vol. 1, pp. 455-472). This is a continuation of previous work (*Agr. Res. Inst., Pusa, Bull. No.* 187) where it

was shown that a bright leaf of a suitable colour and texture can be produced in India by flue-curing. But the varieties tried previously were exotic American ones grown from imported seed, and an attempt is described in the present paper to develop indigenous varieties by hybridization. The local Pusa Type 28 was crossed against the American Adcock, and ten hybrids were obtained in a homozygous condition, breeding true. The preliminary test with one hybrid has given encouraging results. (C. N.)

Curing Tobacco by the Leaf Method V. Curing on the Stalk.—COLLINGWOOD, E. W. (*Rhodesian Agr. Jour.*, 1931, vol. 28, pp. 1112-1119). Leaf-curing gives more uniform yellowing and occupies less space in the barn, but requires careful handling and attention especially towards the later stages, on account of too rapid drying. The writer's experiments confirm those of Garner in America and Mohr in Germany, that leaf cured on the stalk, loses approximately 11-14% more dry matter than the picked leaf. In the 'priming' method, the total loss of organic matter in curing is, for the whole leaf, from 13 to 14 per cent., while for leaves cured on the stalk, it is 25 to 26 per cent. The writer concludes that the increased loss in weight when cured on the stalk, is due not so much to intense respiration, but rather to a translocation of nutrients from the leaf into the stalk. (C. N.)

Preparation of Manure from Plantain Stems.—GOKHALE, V. N. (*Poona Agr. Coll. Mag.* 1931, vol. 23, pp. 184-187). As the rating of plantain stems for fibre or their conversion into paper were not found economical propositions, an attempt was made to find out the optimum conditions for the conversion of the stems into manure. The stems were cut into nine-inch pieces and laid (1) in a heap with free access to air but without addition of more water, (2) put into a pit, without the addition of water, and (3) laid in the trenches in the plantain field with frequent additions of water. It was found that methods (1) and (2) converted the stem into good manure in about 4 to 5 months. Addition of powdered limestone or kunkar at the rate of 5 per cent and Calcium Cyanamide at the rate of 0·1 per cent of Nitrogen, both calculated on the dry matter of the stem, yielded a manure containing about 1 to 1·2 per cent of total nitrogen. (C. N.)

A Mathematical Study of the Decrease of Crop Yields.—GREAVES, J. D. (*Soil Science*, 1931, vol. 31, pp. 115-122). An attempt was made to test further the equation for crop yield developed by Greaves and Gardner (*Soil Science*, 1929, vol. 27, pp. 445-457). Their exponential integral was assumed to be a linear function of the time. The formula was then tested on all available Rothamstead data with good confirmation. This would tend to establish the two assumptions on which the formula is based, viz. (1) The rate of increase of crop yield with increase of the deficient element is proportional to the magnitude of the deficiency of the limiting nutrient from an optimum concentration. (2) The time rate of depletion of a deficient element, provided none is added from outside sources, is proportional to the product of the soil's content of the deficient element and the crop yield. (Author's Summary).

Manuring of the Mango in the Konkan.—WAGLE, P. V. (*Poona Agr. Coll. Mag.* 1931, vol. 23, pp. 188-192). The results of experiments on the manuring of the Mango at Ratnagiri Farm, during the last three years are described. Recommends that the pits dug for planting grafts should be filled with a layer of Nivadung (*Opuntia decumana*) at the bottom, and over it with soil mixed with 5 to 6 lbs. bonemeal and 3 to 4 baskets of well-rotted farmyard manure. After the plants are well established, top dressings of small quantities of sulphate of ammonia are applied at intervals of 4 to 6 months during the first 3 or 4 years when the plants are irrigated during the hot weather. After this period, hot weather irrigations are stopped, and manuring is done only once a year about June with 2 lbs. each of bonemeal and sulphate of ammonia and 2 baskets of farmyard manure. This brings the plants into bearing at the age of 5 or 6 years. (C.N.)

Silage Investigations at Bangalore. II. Quality and Yield of Silage in relation to filling conditions.—KRISHNAN, T.S. (*Indian Jour. of Vet. Sci. and Animal Husb.* 1931, vol. 1, pp. 259-282). An attempt was made to determine the effect of (*a*) rate of filling, and (*b*) addition of water on the resulting silage of *Jowar* (*Sorghum vulgare*). There was little difference in the quality of silage produced, though conditions of filling varied considerably ; in each case 'acid brown' silage of good quality was obtained. The maximum temperature recorded varied from 36°C to 47·8°C. Rapid filling caused greater loss of dry matter, while watering gives a better aroma and consistency to the resulting product. The average loss of dry matter was 7·67 per cent. A continuation of the study of the chemical changes in silaging already reported (*Memoirs, Dept. Agr. India*, 1930, vol. 10, No. 10) showed that extensive decomposition of true protein takes place with a large increase of 'amides,' owing to the production of considerable quantities of volatile bases and amino-acids. The ratio of the volatile bases to the amino-acids was less than unity. Increase in volatile bases accompanied the production

of good silage. A large amount of organic acids, both volatile and non-volatile were developed on ensilage; the ratio of the volatile to non-volatile acids was less than unity. Ether extract increased by about 100 per cent, mainly on account of the organic acids soluble in ether. In watered pits, there is a larger increase of volatile acids. On the whole, about 10 to 15 per cent of the carbohydrates were lost, and 5 to 10 per cent of crude fibre was broken down. Rapid filling caused increased loss of carbohydrates. (C.N.)

Chemical Study of the Effect of frost on Cane crop and Gur-making from frost-affected Canes in the District of Ahmednagar in 1929.—PATWARDHAN, V. G., and APUE, N. G. (*Agr. and Livestock in India*, 1931, vol. 1, pp. 177–88). Intense frost (minimum 34–35°F) caused (1) drying up of the leaves, (2) burning of the top shoots, (3) rotting of the growing points (being an after-effect), with spread of rot from top downwards, and (4) sprouting of eyebuds at several joints. The percentage of glucose was increased by 20 to 66 per cent (normal crop 1·0 to 1·5 per cent). Sucrose showed marked decrease (normal 17–18 per cent decreased to 8–15 per cent). There was no regular fall in Brix, but the co-efficient of purity was greatly decreased. Frosting had an adverse effect on the quality and quantity of *gur*; it was found difficult to obtain crystalline *gur*. Acidity of juice was not appreciably affected. (C.N.)

Effects on the yield of Grain and Straw of Rice if weeds are left to decay in the Soil.—PERALTA, F.DE. (*Philippine Agriculturist*, 1931, vol. 20, pp. 423–429). An examination is reported of the effect on the soil of ploughing in the large mass of weeds which grow up in the Philippine rice fields, between harvest time and planting time. The following conclusions are arrived at :—(1) Weeds, both tops and roots, turned under and allowed to rot in the soil before planting rice plants were found to be beneficial to grain and straw production of low-land rice. Of the four kinds of weeds tried, the sedge (*Cyperus spp.*) and waterlily (*Monochoria hastata*) were found to be most beneficial, and Zacate (*Leersia hexandra*) the least. (2) Allowing only the roots to rot in the soil resulted in a large reduction in the yield of grain and straw. (3) Complete removal of weeds, both tops and roots was found to be detrimental to rice production. (C.N.)

Mineral Composition of the Fodders of Central Provinces and Berar and its bearing on Animal Nutrition. PADMANABHA AYER, A. R., and KAYASTH, R. N. (*Agr. and Livestock in India*, 1931, vol. 1, pp. 526–532) (1).—The mineral composition of the grasses and fodders (growing in the provinces and used as cattle food) is given. (2) The grasses grown on heavy black soils are found to be richer in mineral content than those grown on light soils. (3) C. P. grasses are very poor in Phosphoric acid (0·2 to 0·5 per cent) and Calcium, compared with good pasture of England and also poor in Nitrogen. The following are J. B. Orr's figures for English pastures :—

Constituents.	Good English pasture (cultivated.)	Poor pasture (not eaten).
Silica free ash	6·97%	3·13%
CaO	1·10	0·30
Phosphoric anhydride ...	0·765	0·370
Potash	2·97	1·61
Chlorine	0·90	0·33
Nitrogen	2·93	1·82

(4) The authors observe that phosphate deficiency in C.P. grasses is more serious than that in lime, and recommend the addition of oil-cake to the ration to make up for phosphate deficiency, and the growing of leguminous fodders to make up for Nitrogen and Calcium. (C.N.)

Food requirements of Crops with reference to South Indian Soils. VISWANATH, B. (*Indian Jour. Agr. Sci.*, 1931, vol. 1, pp. 495–502). Compares the relative advantages of cattle manure and complete mineral manure from the point of view of (1) the growth and yield of crop, (2) the composition of the crop, (3) the vegetative and reproductive capacity of the seed, and (4) the nutritive value of the crop, as judged by the experiments carried out at Coimbatore. (1) In the Permanent Manurial Plots, complete mineral fertilizer, gave maximum yield of grain and straw from the 1st to the 36th crop, but from the 37th crop onward (to the 56th crop) cattle manure gave higher yields; the proportion of grain to straw was greatest with cattle manure. (2) The composition of the grain is not appreciably affected by the kind of manuring, except in the case of phosphorus, where grain containing the highest content was obtained from phosphate plots. (3) Manuring affects the vegetative and reproductive capacity of the seed. Experiments with sorghum, cotton and sugarcane showed that seed obtained

from the cattle-manured plot gave a very much better crop than that manured with mineral manures. (4) Feeding experiments with rabbits showed that grain from the crop manured with cattle manure possessed better nutritive value than grain from the crop manured with mineral manures or the no-manure crop. (C.N.)

Cow and Buffalo Ghee. BHATTACHARYA and HILDITCH. (*Analyst*, 1931, vol. 56, pp. 161–170). Reports the results of a comparative study of samples of *ghee* made from cow and buffalo milks. The general analytical characteristics found were :—

	Buffalo		*Cow*	
	Sample I	Sample II	Sample I	Sample II
Saponification value ...	252·3	251·0	252·0	249·2
Iodine value	32·5	33·0	35·2	36·0
Rechert-Meissl value ...	28·0	30·9	25·2	26·0
Polenske value ...	1·4	2·2	1·4	1·9
Kirschner value ...	24·6	25·6	20·9	20·6
Refractive Index D/60 ...	1·4467	1·4462	1·4475	1·4470

The authors conclude that buffalo ghee corresponds closely to cow's ghee in its chemical composition, though certain features seem to be distinctive. There is definitely more butyric acid present in buffalo butter fat than in the average cow butter fat, and this is reflected in the somewhat higher Reichert-Meissl and Kirschner values. The proportion of linoleic to oleic acid is higher in the cow butter fat than in the other. The most apparent difference in the milk fats of the two types of animals seems to lie in the increased amount of stearic acid, and the presence of small but definite amounts of arachidic acid in buffalo's as compared with cow's butter. It is probable that the proportion of palmitic acid is more variable in buffalo than in cow butters. (P.V.R.)

A new water-lift. 'Simple in design and durable in construction, made of angle iron mounted on a girder frame forming one unit and fitted on or removed from any well within a couple of hours' is the description given of a new and improved water-lift designed by Mr. C. Mayadas, I.A.S., and Sardar Hansraj Singh of Cawnpore Agricultural College. We are told that full consideration has been given to the condition of the farmer's draft cattle and the type of wells which generally exist in the rural areas. The draft power required is extremely low and when lifting water 35 ft. is less than that required to draw the country plough. The discharge for such a lift is reported to be about 3,500 gals. per hour. The machine was under severe test on the College Farm, Cawnpore, where in May and June, 45 acres of dry ploughed land was irrigated in 9 hours. One of these machines for a 30 to 35 ft. lift can control about 15 acres of garden land and 8 acres of intensely cultivated farm land while for vegetable market gardening one such lift would be ample for 5 acres. An ordinary pair of bullocks and even one strong bullock at a time can operate the lift. The designers claim for their machine a discharge of 1,500 gals. per hour for 60 ft. lift and 8,000 gals. per hour for a ten ft. lift. The price varies with the depth but ranges round Rs. 150. (K.M.T.)

The Earth-worm as a pest. (*Science* No. 1930, December 25, 1931). Though believed to be the friend of the farmer as a valuable adjunct to the fertility of the soil, a case has come to the notice of Mr. C. T. Hurst of Colorado, where the earth-worm is a distinct menace to the farmer. It was found that the soil bordering irrigation water-channels was so riddled with the burrows of earth worms that it was impossible to get water through the channel to irrigate the fields, because the greater part of the water was lost by seepage through the borrows!. The best remedy against earth-worms was found to be poisoning them with copper sulphate, a poison which is comparatively harmless to vertebrates. (K.M.T.)

Gleanings

Making Hay without Sunshine.—'Another of the sun's steady jobs has been taken away, and another agricultural proverb has been proved out of date, at E. A. Ashton's Ashgrove Farms, near Saratoga, New York. Making hay whether the sun shines or not, is something that the Ashgrove Farms have been doing profitably since last June, with the aid of an artificial dryer and electric motors . . . The artificially dried hay is highly nutritious, because the leaves, which become wet with rain and are easily lost in sun-curing, are saved. The crop as a whole is higher in protein and fat values and lower in fibre content. After drying, the hay can be stored indefinitely without heating, sweating, fermenting or discoloring. The dried hay retains its

natural green colour . . . Mr. Ashton has estimated 'that the cost of his summer crop of hay was no greater because of the artificial drying process; the crop itself was of higher quality and feed value, and all the losses usually following a rainy season were eliminated.' (*Scientific American*, November 1931).

The value of Tomato Juice.—' Orange juice having been given its full share of publicity with regard to its possession of a good all-round average of vitamins, bids fair however to be out-stepped by tomato juice, a food which is one of the richest sources of the three first-discovered vitamins A, B, C. According to Henry C. Sherman, Professor of Chemistry at Columbia University, who has classified these foods with respect to their Vitamin contents—in *Chemistry of Food and Nutrition* :—

Vitamin A ...	Orange juice, about	350	Tomato juice (raw or canned)	2,700.
Vitamin B ...	do.	150	do.	130–250.
Vitamin C ...	do.	150-300	do.	150–300.'

' Dr. William Weston in the *Journal of the American Medical Association* (vol. 95, p. 834) quotes Dr. Alfres Hess from his book on *Scurvy*, as making the statement that infants can take twice as much tomato juice as orange juice, without causing digestive disturbances.'—*Jour. of the Jamaican Agricultural Society*, October, 1931.

Marine Algae as Fertilizer.—' The Governor of Tripolitania has had a chemical investigation made of algæ which form large deposits at many parts of the coast of Tripoli, to find out whether they have fertilizer possibilities after having been first used as bedding for cattle. The analysis shows: water 19·44 per cent, nitrogen-bearing materials 2·4 per cent, carbohydrates 51·86 per cent, chlorine as sodium chloride 14·81 per cent; lime, silica, soda, magnesia, alumina, iron, potassium, iodine, phosphate and sulphate 11·45 per cent. The organic matter contains 3·85 gm. of Nitrogen per kilogram of algæ. It would therefore seem to be possible to utilize the algæ as fertilizer.'—*Scientific American*, Nov. 1931.

Is inheritance of Milk sex linked?—' The evidence of the statistical analysis of data given by Gowen in his book *Milk Secretion*, and of Dr. R. Graves, is to the effect that the sires transmit milk yield to their sons in the same ratio as to their daughters. Further cross-breeding experiments carried out at the Agricultural Institute, Allahabad, between breeds of high milk yield and low percentage of fat, and breeds of relatively low milk yields and high percentage of fat, show quite clearly that the first generation offspring from these crosses are intermediate in milk yield and percentage of fat, indicating that both parents are contributing equally. The evidence is against the old axiom that " sons take from their mothers; daughters from their fathers." One of the main objects in breeding is to produce great transmitting sires. Too often we condemn a cow for its low milk-yielding capacity when we should condemn the sire.'—*Allahabad Farmer*, October, 1931.

Ayrshire Milk Yields.—' Ayrshire cattle have lately won much popularity in the South as milk producers. It is an interesting reflection of this development that the honour of developing the highest milk recorded Ayrshire cow in Great Britain, now comes to an English farmer Mr. C. G. Vyner of Studleigh Royal, Ripon. The record-breaking cow is Cowden's Gem 2nd, bred at Lockerbie, which has given 22,073½ lb. of milk in the last milk recording year, with a butter fat percentage of 3·65.'—*The Veterinary Record*, December 12, 1931.

PROVINCIAL RESEARCH COMMITTEE, MADRAS

[*We have received for publication the following from the Director of Agriculture, Madras.*—ED. *M. A. J.*]

In pursuance of the recommendations of the Royal Commission on Agriculture contained in paragraph 57 of their report, the Government are pleased to constitute a Provincial Research Committee with headquarters at Madras consisting of the following members to examine and advise on schemes of research framed by departments of Government which it may be proposed to refer to the Imperial Council of Agricultural Research and on applications from quasi-official or non-official bodies and private individuals for grants from the Research Council :—

(1) His Excellency the Governor, President; (2) The Hon'ble the Minister in charge of Agriculture; (3) Secretary to Government, Development Department; (4) Director of Agriculture; (5) Director of Veterinary Services; (6) Registrar of Co-operative Societies; (7) Director of Industries; (8) Professor B. B. Day, Professor of Chemistry, Presidency College, Madras; (9) Dr. T. Ekambaram, Professor of Botany, Presidency College, Madras; (10) Dr. F. H. Gravely, Superintendent, Government Museum, Madras; (11) Dr. H. Parameswaran, Professor of Physics, Presidency College, Madras; and (12) Professor P. J. Thomas, University Professor of Economics, Madras.

In the absence of His Excellency the Governor the Hon'ble the Minister in charge of Agriculture will preside over the meeting of the Committee.

The Advisory Committee constituted by G. O. No. 416, dated 8th March 1929, will now be abolished.

Review

The use of fertilizers in tropical and sub-tropical Agriculture.—A JACOB, PH.D., and V. COYLE, M. SC., 10*s*. 6*d*. net. 267 pages. Ernest Benn Ltd., London.

The publication is a compilation of the results of manurial experiments with artificial fertilizers in different parts of the world, chiefly Europe and America. It is neatly printed on good smooth paper and contains 102 photographs illustrating the results of experiments with different crops. The subject-matter of the book is divided into two parts. The first part consists of six chapters and deals with the relation of fertilizers to crop growth and soil conditions, function of fertilizer constituents, composition of tropical soils, different classes of fertilizers, method and time of application of fertilizers and the conduct of manurial experiments.

The chapter on method and time of application is disappointing. One would expect it to contain the results of experiments on fertilizer dressings at different stages of the growth of a crop, but there is nothing beyond the usual precautions on the application of the different soluble fertilizer salts. The second part of the book describes the results of manurial experiments on a variety of grain, root, fibre, pulse, fruit, vegetables and industrial and commerical crops with all the principal nitrogenous, phosphatic and potassic manures. Except, perhaps in the case of tea and coffee, the increases recorded do not pay the cost of manuring in South India. Taking rice for instance, at Tokyo using 445 lb. of ammonium sulphate, 460 lb. of super and 260 lb. of potassium sulphate an increase of only 1,800 lb. was obtained as against 1,200 lb. without manure. These are, of course, very high quantities. The ordinary dosages varied from 150 to 250 lb. per acre of each of the three classes of manures and even here the increase does not pay the cost of manuring. One point of general interest to us is that some of the experiments confirm in some respects the results of our experiments. In the case of rice and wheat, potash has not been found as essential as nitrogen and phosphates and that the latter form the limiting factor. In the case of cotton and sugarcane, potash has been beneficial in many instances. Based on the experience gained in a number of experiments, the authors recommend for cotton a mixture of fertilizers with cotton seed meal or dried blood in adequate quantities.

The publication is a compilation of only *successful* experiments, with a number of fertilizers and crops, in which varying degrees of responses from various crops to different types of manures are recorded. As experiments they are far below the mark. The information given is too inadequate for the agricultural scientist and too expensive for the practical agriculturist.

B.V.N.

College News and Notes

Association of Economic Biologists.—The second annual meeting of the Association was held on Wednesday, 27th January. The function began with a group photograph of members followed by a tea, and later by the business meeting. The annual report of the Association for the year 1931 read by the Secretary, showed all-round progress in that the strength of the Association had risen during the year from 54 to 67, and there was a closing balance of nearly Rs. 200 to the credit of the Association. The report mentioned that the Association had come to stay and was serving a very useful purpose in bringing together research workers in different branches of agricultural science and stimulating their interest in further work by a frank and free exchange of ideas. An important change in the by-law of the Association was adopted, reducing the annual membership subscription from Rs. 3 to Rs. 1-8-0. The publication of the proceedings by the Association was also considered by the general body but postponed for more favourable times. The following office-bearers were then elected for the year 1932:—President, Mr. S. Sundararaman; Vice-President, Mr. N. L. Dutt; Secretary, Mr. K. Ramiah; Other members of the Committee, M.R.Ry. Rao Bahadur B. Viswanath and Mr. V. Gomathynayagam Pillai.

Later in the evening the retiring president, M.R.Ry. Rao Bahadur T. S. Venkatraman, gave a lecture on 'The Indian Sugar Problem.' The lecture was open to the public, and several gentlemen from Coimbatore had come to hear the lecture. The lecturer gave a very comprehensive survey of the past and present sugar position of India as compared to other sugar-producing countries of the world, and pointed out how the work at Coimbatore was slowly but surely increasing the sugar output of the country. He also referred in his lecture to the intergeneric hybrid between sugarcane and sorghum which had been successfully done at the Coimbatore station two years back and the great economic possibilities of the same, mentioning the very promising results he had obtained with some small-scale trials he had conducted with the progenies of this hybrid. The lecture was throughout illustrated with interesting slides and there was no doubt that the lecture was a real treat to all those who attended it.

Epidemics.—Coimbatore district suffered a good deal from cholera during the months of December and January, and the prevalence of the disease in the villages outlying the College estate was a cause for anxiety both to the residents as well as to the College authorities. There was one case among the residents which fortunately did not prove fatal, and two fatal cases among the village domestic servants working on the estate. Thanks to the prompt measures taken by the District Health Officer, over 300 residents and a large number of 'contacts' were inoculated in good time to prevent the spread of the epidemic.

Officers' Club.—At the general body meeting of the Club held on Monday the 25th January following were elected office-bearers for the year 1932:—President, Mr. C. Tadulingam; Vice-President, Mr. N. L. Dutt; Secretary, Mr. V. T. Subbiah Mudaliar; Assistant Secretary and Treasurer, Mr. T. Narayana Rao. The Officers' Mess attached to the Club had to be closed in January for want of boarders and the working of the Mess has now been given to a local contractor who supplies meals and tiffins at specified rates.

Boy Scouts.—There was a very successful show on 6th February put up by the Estate Boy Scouts' Association when its new building just completed was opened by Rao Bahadur T. A. Ramalingam Chettiar.

Visitors.—We had several visitors recently, prominent among them being Dr. Bannier of Java, Dr. W. McRae, Director of the Imperial Agricultural Research Institute, Pusa, Dr. M. B. Soparkar of the Tuberculosis Institute, Bombay, Mr. Kanti Singh of Ajmere, Mr. V. Ramakrishna, I. C. S., Director of Industries, and the Raja of Kangundy, an honorary visitor. Mr. S. H. Slater, I. C. S. until recently the Collector of Coimbatore, prior to his joining his new post as the Secretary to Government, Development Department, visited the Millets, Paddy and Cotton breeding stations on a number of days and went over the various lines of work in great detail, evincing a keen interest in everything.

Games.—The inter-tutorial hockey tournament for the Krishnamoorthy Rao Memorial Cup was played during the month, and it provided some surprises. The last year's winners, Mr. V. Muthusamy Ayyar's wards, who were considered the strongest of the teams, got defeated by Mr. K. Ramiah's wards in the first round itself. The semi-finals between Mr. K. Ramiah's wards and Mr. C. Narasimha Ayyangar's wards proved exciting. The match was a draw on the first day and in the second day also nobody

had scored until the time was up. When, however, the play was resumed for an extra time Mr. Narasimha Ayyangar's team was able to score two goals. This team met Mr. P. V. Ramiah's wards in the finals and won the tournament by scoring three goals to nil.

The inter-class hockey tournament for the Parnell Cup was also finished during the month, class III being the winners obtaining the largest number of points.

The Tennis Singles and the Handicap Doubles tournament are still in progress and are not expected to finish before the end of the month. The increasing popularity of this tournament may be judged from the fact that as many as 36 teams have entered for the doubles event. We are glad to note that a long-desired improvement to the tennis courts has been effected during the year in that they have been provided with curtains to prevent the glare and the shade in the courts.

The tournament connected with the Victory Cup is still to be finished. The award of this cup is to be decided on the results of games in Hockey, Cricket and Football. So far the first two are finished and football is yet to be played. The III-year class won over the II-year in cricket in the finals but lost to the I-year in hockey finals so that the results of the football match would decide the winners.

Athletic Sports.—The College was represented at the Y. M. C. A. district sports on 5th and 6th February and we are glad that student Bennett of class I won the first prize in Pole Vault.

Our Director.—Mr. S. V. Ramamurty, I.C.S. our new Director of Agriculture, paid his first visit to the College and the Institute between the 5th and 10th of February. He had a full programme for all the days of his stay in Coimbatore. On the 5th morning immediately after his arrival, he in company with Mr. V. Ramakrishna, I.C.S., the Director of Industries, went round the new workshops of the Agricultural Research Engineer, and the Cotton Breeding Station. In the afternoon they visited the Y.M.C.A. rural reconstruction centre at Ramanathapuram. On the 6th morning they first visited the Paddy Breeding Station and later the Sugarcane Breeding Stations. The same afternoon they went to Peelamedu and saw the Industrial Institute of P.S.G. & Sons. They were entertained at tea by P.S.G. & Sons to which a number of gentlemen from the Coimbatore town as well as from the Agricultural Department had been invited. The same evening Mr. Ramakrishna gave an interesting lecture on 'Eri silk' under the auspices of the Agricultural College Students' Club at which Mr. Ramamurty presided. On Sunday the two Directors were away at Ooty for the whole day. On Monday the Director of Agriculture went round the Central Farm, College dairy and the new orchard. The afternoon he spent his time with the Government Agricultural Chemist going round all the subsections, Bacteriology, Soil Physics and Animal Nutrition. He later attended a tea at the Sugarcane station, Rao Bahadur T. S. Venkatraman playing the host. Later in the evening he presided over the annual meeting of the Andhra Students' Union, acted as the Chairman of judges for the elocution contests in Telugu among the students and distributed the prizes. On the 9th morning he inspected the activated sludge plant in the wetlands and also went over the Mycologist's experimental plots in O block. Between 2 and 4-30 in the afternoon he went over the different sections in the Research Institute, and was entertained at tea by the Upper Subordinate's Association. At 5 in the evening he delivered a public lecture in the town under the auspices of the Coimbatore Students' Literary Association on 'Our needs in Agriculture'. The same night at 8-30 he was entertained at a dinner by the students of the College. After the dinner the students presented him with an informal address of welcome in which they drew his attention to some of the disabilities the past students of the College were labouring under with regard to appointments in the department. Rao Bahadur Ramasami Sivan, ex-Principal of the College, who was present at the dinner and who presided over the function, in proposing the toast of the chief guest, made a special appeal to the Director regarding some of the points raised in the address presented to him. Mr. Ramamurty, in his reply to the address, thanked the students for their address of welcome and kindly promised to do what he can in redressing all the reasonable grievances of the past students of the College. On Wednesday the 10th he visited in the morning the Insectary, Millets Breeding Station, Botanical Garden and the Herbaceum section of the Cotton Specialist. In the afternoon the different sections of the Teaching College were gone over and he was later entertained by Mr. C. Tadulingam at tea at which all the Gazetted Officers of the College, Research Institute and the Sugarcane Station were present. Mr. Ramamurty left Coimbatore the same day, by the Blue Mountain Express.

Tuition fee.—It is learnt that Government have passed orders levying a fee of Rs. 120 per year from future entrants into the Agricultural College.

Retrenchment.—Government have passed orders abolishing the post of Assistant Warden in the College hostel and reducing the emoluments of the Warden by Rs. 5. Other retrenchments already effected are the abolition of the special pays drawn by the lecturer in Animal hygiene and the Chemistry Assistant recording Meteorological observations. The telephone connection to the College is the latest item which has come under the axe.

AN ADDENDUM TO THE REPORT OF THE GENERAL BODY MEETING

[*We regret, that by an oversight, the following resolutions passed at the General Body Meeting on the 20th December, 1931, were left out from the proceedings of the meeting published in the January issue.*—Ed., *M.A.J.*]

Resolutions.—1. This meeting of the General Body of the Madras Agricultural Students' Union requests the Director of Agriculture to take steps to so amend the G. O. No. 314, Public Service, dated 30th March 1931, as to make Bachelors of Science in Agriculture of the Madras Agricultural College, eligible for appointments in the Science Sections, including Gazetted posts. No. 2. This meeting of the General Body of the Madras Agricultural Students' Union requests the Director of Agriculture to move Government to raise the age of entry into services into the Agricultural Department from 25 to 27, as the Agricultural course is a technical course, and to keep it on a par with other professional courses.

Weather Review (JANUARY 1932)

RAINFALL DATA

Division	Station	Actual for month	Departure from normal	Total since January 1st	Division	Station	Actual for month	Departure from normal	Total since January 1st
Circars ...	Gopalpore ...	0	— 0·2	0	South ...	Madura ...	0	— 0·6	0
	Vizagapatam.	0	— 0·5	0		Negapatam..	0·1	— 1·5	0·1
	Cocanada ...	0	— 0·1	0		Pamban ...	0·2	— 1·8	0·2
	Masulipatam.	0	— 0·3	0		Palamcottah.	0	— 1·4	0
Ceded Districts.	Kurnool ...	0	— 0·2	0					
	Bellary ...	0	— 0·2	0	West Coast	Trivandrum.	0	— 0·8	0
	Cuddapah ...	0	— 0·4	0		Cochin ...	0	— 0·7	0
						Calicut ...	0	— 0·6	0
Carnatic...	Nellore ...	0	— 1·5	0		Mangalore ...	0	— 0·1	0
	Madras ...	0	— 1·4	...					
	Cuddalore ...	0·6	— 0·8	0·6					
					Mysore and				
Central ...	Vellore ...	0	— 1·3	0	Coorg ...	Bangalore ...	0	— 0·3	0
	Salem ...	0	— 0·3	0		Mercara ...	0	— 0·1	0
	Coimbatore Town ...	0	— 0·6	0					
	Coimbatore Res. Inst. ...	0	— 0·8	0	Hills ...	Kodaikanal..	0	— 2·6	0
	Trichinopoly.	0·1	— 0·6	0·1		Coonoor ...	0	— 3·3	0

General summary of weather conditions.—Weather was dry over the whole area throughout the month with the exception of two days—12th and 13th—when a few scattered light falls of rain occurred on the South Coromandel coast. Pressure was in

excess all through the month and the fine weather was due to the ridge of high pressure lying over the area.

Night temperatures were low during the last week of the month in the south.

Weather Report for the Research Institute Observatory.—

Absolute Maximum in shade	88·5
Absolute Minimum in shade	52·5
Mean Maximum in shade	84·5
Mean Minimum in shade	61·3
Total rainfall	nil
Departure from normal	– 0·84 inches
Mean daily wind velocity	2·2 m.p.h.
Mean 8 hours' wind velocity	3·3 ,,
Mean humidity at 8 hours	71·2%
Total hours of bright sunshine	302·7
Mean daily hours of bright sunshine	9·8

Summary of weather conditions.—Weather was dry and fine throughout the month with lower night temperatures than usual. The mean minimum for the month was 61·3° as compared with 64·5° in 1931 and 65·4° in 1930. A cold spell set in on the 26th and the temperature fell to 52·5° on the 28th which makes a new record for low temperatures for this observatory.—P.V.R., and B.S.N.

Departmental Notifications

I Circle.—B. Madhava Rao, A.A.D., Aska, l.a.p. for 10 days from 25-1-'32. T. V. Krishnaswami Rao, A.D., Berhampur, extension of l.a.p. for 7 days from 25-1-'32 in continuation of 3 weeks leave already granted. B. P. Pappiah, A.A.D., l.a.p. for 15 days from 17-1-'32. D. Bapiah, A.D. on Entomology work, Vizianagaram, l.a.p. for one month from 27-1-'32; on return from the leave he will join duty at Vizagapatam as A.D. for the Vizagapatam taluk. **III Circle.**—C. Rangaswamy Iyangar, A.A.D. in Mycology, Tadpatri, l.a.p. on M.C. for 4 months from 4-1-'32, with permission to prefix the Xmas and the New Year holidays. K. Ramanatha Iyer, A.D., extension of l.a p. on M.C. for 3 months from 23-12-'32. **IV Circle.**—P. S. Venkaswami Iyer, A.D., Madurantakam, l.a.p. for 30 days from 15-1-'32. **VII Circle.**—The unavailed portion of the l.a.p. for 15 days granted to K. Soopi Haji, A.A.D., Kasargod, from 7-1-'32 cancelled from 7-1-'32 to 14-1-'32. l.a.p. for 15 days from 4-1-'32 granted to K. S. Ramanna Rai, A.D., Mangalore, cancelled. **VIII Circle.**—N. Srinivasa Rao, A.D., Tiruppur, l.a.p. for two months from date of relief. M. Subramania Pillai, A.D., Erode to be A.D., Tiruppur. D. S. Subrahmania Iyer, on the expiry of leave, to be A.D., Annur. P. A. Narayana Nambiar, A.A.D., Annur, on relief to be A.A.D., Palladam. S. Ramaswami Iyer, A.D., Palladam, to be A.D., Udamalpet. K. Sivasankara Menon, A.D., Dharmapuri, extension of l.a.p. for 15 days from 4-2-'32. G. K. Subrahmania Iyer, A A.D., Krishnagiri, will be in additional charge of the Dharmapuri Taluk. **Transfers.**—K. Achutan Nair, Upper Subordinate on probation to be A.D., Salem. T. S. Sundaram on probation, to be A.D., Hosur. S. Veeravaratha Raju, A.D., Hosur, on relief to the deputed to the Co-operative department in place of V. S. Ramaswami Iyer. **D. A's Office Orders.**—T. Paramanandam, A.D., Rajahmundry, to II circle as A.D., Guntur. M. Satyanarayanamurti, A.D., Gannavaram, to I circle to report to D.A.O., Rajahmundry. K. Achyutan Nair, A.D., Tinnevelly (Probation), transferred to VIII circle, Coimbatore, to report for duty to the D.A.O., Salem. S. V. Kuppuswami, B.A., re-appointed as Offg. Assistant, V grade, in the Chemistry section on Rs. 85 in the scale of Rs. 85-5-120. K. Kumaraswami Chetty, B.Sc. (Edin.) appointed as Offg. Assistant in the Cotton Section in the V grade in the scale of Rs. 85-5-120. **Oil Seeds Specialist's Section.**—A. P. Balakrishnan Nair, F.M., A.R.S., Pilicode, l.a.p. for 12 days from 5-2-32. **Paddy Section.**—Samuel Jobitharaj, Assistant, extension of l.a.p. for 10 days from 25-1-'32. **G. M's Section.**—P. Vishnusomayajulu, Assistant, l.a p, for one month from 25-1-'32. **G. E's Section.**—T. V. Subramania Iyer, Assistant Entomologist, relieved on the afternoon of the 5th February, to avail of the leave from 6-2-32. N. Krishna Menon, Sub-Assistant, l.a.p. for 6 weeks from 4-2-'32.

Gazette Notification.—John A. Muliyil, Offg. Assistant Entomologist, l.a.p. for 8 months without M.C., and leave on half average salary for 16 months, out of India, from 10th March 1932, or date of relief.

APPENDIX

ADDITIONS TO THE LIBRARY DURING NOVEMBER 1931

A. BOOKS

1.	*The Study of Rocks*	S. J. Shand	1931
2	*The Soil (Revised and Enlarged)* ...	A. D. Hall	,,
3.	*A Practical Handbook of Water Supply.*	F. Dixey	,,
4.	*Handbook of Viticulture for Victoria.*	.....	1891
5.	*Agricultural Education and Agricultural Development in America.*	A. E. V. Richardson ...	1918
6.	*Bailliere's Encyclopædia of Scientific Agriculture, 2 vols.*	H. Hunter	1931
7.	*Bibliography of Books and Papers relating to Agriculture and Botany of Ceylon up to 1915.*	T. Petch	1925
8.	*Report of the Proceedings of the 4th World's Poultry Congress, 1930.*	.....	1931
9.	*Tropical Forests of the Caribbean* ...	T. Gill	,,
10.	*Locusts and Grasshoppers* ...	B. P. Uvarov	1928
11.	*Index IV to the Literature of American Economic Entomology.*	M. Colcord	1930
12.	*Social Behaviour of Insects* ...	A. D. Imms	1931
13.	*The Year Book of the Universities of the Empire, 1931.*	.....	,,
14.	*Calendars of Madras, Annamalai and Andhra Universities.*	.....	for 1931-32

B. REPORTS

(1) Annual Reports of the Imperial Council of Agricultural Research, 1929-30 and 1930-31. (2) Scientific Reports of the Imperial Institute, Pusa, 1930-31. (3) Report of the Operations of the Madras Agricultural Department for 1930-31. (4) Report on the Work of the Agricultural Research Institutes in the United Kingdom, 1929-30. (5) Rothamstead Experimental Station Report for 1929. (6) Rothamstead Experimental Station Report for 1930. (7) Report of the 3rd Imperial Entomological Conference, 1930. (8) Annual Administration of the Agricultural Department of the Gambia Colony for 1930-1931. (9) Annual Administration of the Uganda Protectorate, Part II, Station Reports for 1929-30. (10) Annual Administration of St. Kitts Nevis (West Indies), 1930-31. (11) Annual Administration of Antigua (West Indies), 1930-31. (12) Proceedings of the West Indian Conference of Agricultural Officers, 1930. (13) Annual Report of the Agricultural Experimental Station, Florida, for the year 1928-29 (with Bulletins). (14) Annual Administration Report of the Madras Civil Veterinary Department for 1930-31. (15) Statistical Tables relating to Banks in India 1929.

C. Special Reports

(a) *Imperial Economic Committee Reports.*

No. 3. Marketing and Preparing for marketing of Foodstuffs produced in the British Empire. No. 8. Functions and Work of the Imperial Economic Committee. No. 9. Report on Tobacco. No. 10. Report on Timber. No. 11. A Survey of the Trade in the Agricultural Machinery. No. 13. A Memorandum on the Trade of the British Empire 1913 and 1925-1928. No. 17 Report on Hides and Skin. No. 18. Report on Tea.

England. H.M.S. Publication.

Guide to Current Official Statistics of the United Kingdom. Vol. IX, 1930.

D. Bulletins

Imperial Bureau of Plant Genetics.

No. 4. Abstract—Review of Lucerne Literature during 1925-30. No. 5. Research in Progress on Herbage Plants, Forage Crops and General Grassland problems in the British Empire.

Ministry of Agriculture and Fisheries.

No. 9. Bee-keeping. No. 11. Oil Cakes and Extracted Meals. No. 20. Some Beneficial Insects. No. 21. Domestic Preservation of Fruits and Vegetables. No. 22. Practical Soil Sterilization. No. 24. Cereal Smuts and their Control.

Scientific and Industrial Research Special Report.

No. 16. Construction joints in concrete (Binding new concrete to old).

Empire Marketing Board.

Bulletins—No. 30. Canadian Fruit Shipments. No. 42. A Preliminary Report on Investigation into the Biological Control of West Indian Insect Pests.

Imperial Bureau of Agricultural Parasitology—Notes and Memoirs.

No. 1. On the Eelworm Heterodera Schactitu as a Potential Danger to the Sugar-Beet Industry in Britain. No. 2. Hand List of Helminth Parasites of the Rabbit. No. 3. The Helminth Parasites of Common Rats. No. 4. The Root infesting Eelworms of the Genus Heterodera—A Bibliography and Host List. No. 5. Eelworms of the Genus Heterodera. No. 6. The Kidney Worm of Swine.

Ontario Agricultural Department Bulletins.

No. 344. The more important Fruit tree Disease of Ontario. No. 345. Fungus and Bacterial Diseases of Vegetables. No. 358. The European Corn Borer.

Alberta Agricultural College Bulletin.

No. 6. Plows and Plowing.

South Australian Agricultural Department Bulletins.

No. 250. Present and Future Economic Position of Farmers. No. 251. The Production of fat lambs. No. 252. Some Problems and Experiments in Livestock Feeding.

Victoria Agricultural Department Bulletins.

No. 15. The Broom Fibre Industry. No. 16. The Pig Industry. No. 26. Tomato Culture—in Victoria. No. 32. Citrus Culture. No. 39. Potato Culture—The Composition of the Potato plant at various stages of development. No. 43. Bottling and Drying of Fruit. No. 45. Silo construction and Making of Silage. No. 46. Onion Production in Victoria. No. 47. Standardized packing of fruit for Export. No. 52. Dairy Farming in Victoria. No. 53. Tobacco Culture, Production and Flue-curing Tobacco. No. 54. Poultry Farming. No. 58. Planting Fruit Trees for Inter-Pollination. No. 60. The Farm Garden. No. 63. Budding, Grafting, and inarching of Fruit trees.

Union of South Africa Agricultural Department Pamphlet.

No. 102. Pineapple Culture in Cape Province.

Kansas Agricultural Experimental Station Bulletin.

No. 242. Alfalfa Production in Kansas.

Cornell Agricultural Department Extension Bulletin.

No. 209. Plans for a simple milk house.

Wisconsin Agricultural Department Research Bulletins.

No. 103. The Foreign Type Cheese Industry in Wisconsin. No. 104. The Germination of Tobacco seed. No. 418. Green House and Tomatoes. No. 419. Self-Feeder for Hogs.

Illinois Agricultural Experimental Station Bulletins.

No. 359. New Protection against Stored Grain pests. No. 360. A Non-acid Babcock Method for determining fat in Ice-cream. No. 361. Breeding two new varieties of Greenhouse tomatoes resistant to Fusarium Wilts. No. 362. Response of Illinois soils to systems of soil treatment. No. 363. The Prices of Illinois Farm Products from 1921–1929.

Michigan Agricultural Experimental Station Bulletins.

(Technical) No. 110. Contribution to the Bacteriology and Pathology of the Bovine udder. Special No. 207. Public Health and Educational Services in Michigan. No. 208. Services of Institutions and Organizations in Town-Country Communities. No. 209. Consume demand for apples in Michigan. No. 210. Corn Growing in Michigan. No. 212. School Financing in Michigan. No. 213. Investigations with Oat varieties and Diseases in the Upper Peninsula. Circular Bulletin No. 135. Chestnut Blight in Michigan.

U. S. A. Agricultural Department Technical Bulletins.

No. 242. Biology of the Indian Meal moth on dried fruits in California. No. 253. Petroleum oils and oil Emulsions as Insecticides and their use against San-Jose scale on peach trees.

U. S. A. Agricultural Department—Farmers' Bulletins.

No. 834. Hog Cholera. No. 1372. Plum and Prune growing in the Pacific States. No. 1655. The control of moths in upholstered furniture. No. 1668. The Red Harvester Ant and How to Subdue it. No. 1669. Farm Terracing. No. 1671. Short leaf pine. No. 1675. Care of milk utensils on the Farm. No. 1684. Game Laws for the Season 1931–32.

E. Leaflets, Miscellaneous Publications etc.

Madras Agricultural Department Leaflet No. 2.

Conditions to be fulfilled for the grant of premium for breeding bulls maintained by private bodies.

Madras Agricultural Department Leaflet No. 43.

Smut Diseases of Cholam and Tenai.

Gujaret Vidyapith, Ahmedabad.

The Peasant's Account Book.

Imperial Bureau of Entomology Publication.

A summary of Data relating to Economic Entomology in the British Empire.

Imperial Agricultural Bureau Publication.

List of Agricultural Research Workers in the British Empire. 1930.

Imperial Bureau of Plant Genetics.

The Meeting of the International Association of Plant Breeders, Berlin. 1931. Abstracts.

Imperial Bureau of Animal Genetics No. 6.

Bibliography on Animal Genetics.

Empire Marketing Board Publications.

Technical Bulletins Nos. 1–18. Production and Trade of the Various parts of the British Empire—' New Zealand, Ceylon, Canada, Newfoundland, India, Union of South Africa, Kenya and Uganda, Zanzibar-Nyasaland, Northern Rhodesia, Southern Rhodesia, Australia, Irish Free State, Sierra Leone, Gold Coast, Nigeria, Mauritius, and Cyprus.

Leaflets.

(1) The Empire Marketing Board and the Home Producer. (2) Why should we Buy from the Empire. (3) The Empire Marketing Board Organizations.

General Propaganda Leaflets—(Empire Marketing Board.)

Fruits and Vegetables of Empire:—(1) Apples from New Zealand. (2) East African Coffee. (3) Australian Dried Fruits. (4) South African Oranges. (5) British deep sea fish. (6) St. Vincent Arrow root. (7) Empire Recipes for Economical Meals. (8) Indian Rice from Bengal and Burma. (9) Canadian Apples. (10) Home-Grown Potatoes. (11) Canadian Canned Salmon. (12) Canned and Bottled Fruits from the Empire at Home and Overseas. (13) Newfoundland Frozen Salmon. (14) Home Apples. (15) Home Plums. (16) Empire Tea.

Ottawa Agricultural Department.

Seasonable Hints from the Dominions Experimental Farms:—(*a*) A successful Brood Mare. (*b*) Fish meals and their nutritive value. (*c*) The value of cull potatoes for feeding steers. (*d*) The Renovation of Pastures. (*e*) Mulching for winter protection. (*f*) Recent Developments in certification of Raspberry stock. (*g*) The effect of Temperature on Rust development. (*h*) Feeding for Egg production. (*i*) Making the Apiary pay. (*j*) Cider making.

Seaonable Hints from the Dominions Experimental Farms (Prairie Edn.)

(*a*) Supplementary feeds for fall pigs. (*b*) Crippling of swine in winter. (*c*) Commercial fertilizer for farm crops. (*d*) Is the burning of stubble wasteful. (*e*) Hold the snow. (*f*) Winter preparations in the Garden. (*g*) Feeding for egg production.

Cyprus Gazette Agricultural Supplement.

No. 40. Report of the Agricultural Adviser to the Secretary of State for Colonies on his visit to Cyprus.

Victorian Agricultural Department Publications.

(1) Feeding cows for Milk production. (2) Why cream Test varies. (3) Poultry Housing. (4) Swine Fever. (5) Seeded pastures under Irrigation. (6) Sweet Wines of moderate alcholic strength. (7) Orchard pests—Control Measures. (8) Household Insect Pests.

U.S.A. Agricultural Department Publications

No. 102. Foreign Plant Materials Introduced. Miscellaneous publications. No. 122. Officials and Organizations concerned with wild life protection. 1931. Circular No. 168. Insects injurious to Agriculture in Japan. No. 185. New Fertilizer Materials. Leaflet No. 79.

Phillippine Agricultural Department Circulars.

No. 1. Hog raising for beginners. No. 4. Curing Ham and Bacon for Home use. No. 5. Poultry Raising made easy. (Revised) No. 8. Horse Breeding in the Philippines. No. 9. Fences for Farm Animals. No. 10. Practical Directions for Coffee Planting. 11. The New College Copra Drier. (Revised) No. 15. Cattle Raising under Philippine Conditions. No. 17. The College Trap nest for Poultry. No. 18. Surveying with a cross staff.

Victoria Agricultural Department Publications.

(1) Twenty years of reconstitution—Phylloxera Resistant stock in vine. (2) Spring Frosts. (3) The Cultivation of Maize. (4) Millet. (5) Summer Fallowing for wheat. (6) Fallowing for wheat. (7) Vineyard Tillage. (8) Manuring of Vines. (9) Asparagus. (10) Sub-terranean Clover. (11) Sudan Grass. (12) Pasture top Dressing. (13) Cultivation of flax. (14) Wheat pickling methods. (15) *Mealy bug—a potential* vine pest. (16) Cut Worms. (17) Control of Wooly Aphis. (18) Control of Codling Moth. (19) Spraying costs in codling moth control. (20) Calf rearing. (21) The care of cream. (22) Home Butter making. (23) Mastitis of Dairy cattle. (24) Milk Fever. (25) Infectious eye disease of stock. (26) Contagious abortion of Cattle. (27) Actinomycosis. (28) Lamb Marking. (29) Worms in Sheep. (30) Lip and Leg ulceration of Sheep. (31) Foot rot of Sheep. (32) The sheep Blow fly. (33) Sheep Nasal Bot. (34) Liverfluke Disease. (35) Black Disease in sheep in Australia. (36) Chicken Rearing. (37) Rearing chickens on the colony system. (38) Poultry-keeping on Dairy Farms. (39) Poultry Feeding. (40) Homemade *Brooders.* (41) The Caponizing of Cockerels. (42) Poultry Parasites. (43) Poultry Tick. (44) Avian Tuberculosis. (45) Common Colics of the Horse. (46) A Neglected market for our Wines. (47) Sulphiting—a recent French wine making Development. (49) Home Wine-making.