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EDITORIAL

Indian Farming:— We welcome to the ranks of Agricultural journalism in India the new monthly magazine *Indian Farming* which replaces what is now familiar to our readers as *Agriculture and Live stock in India.* An all-India monthly magazine which can collect, collate and purvey various items of scientific information pertaining to the basic industry of the land in a form which is intelligible to the layman has been a long-felt need. We are glad to note that the journal aims at "transmitting the results of research from the laboratory and the experiment farm to the cultivators". Constituted on an all-India basis and with adequate financial backing, we cannot think of any organisation in the country which is more competent than the Imperial Council of Agricultural Research to undertake this onerous task. The first number of the magazine is a commendable effort in translating the aims of the journal into action and we hasten to congratulate the council on their venture which has materialised not a day too early. The number contains, besides several interesting articles, a plea by the Hon'ble Kunwar Sir Jagadish Prasad, Member for Education, Health and Lands with the Government of India, for paying special attention to the promotion of Agricultural Research during the period of war. The get up of the magazine is all that can be desired in an official publication and we commend the magazine to our readers and trust that they will extend to the new-comer the patronage it so richly deserves.

Dearer Railway freights:— The recent decision of the Government of India to increase the freights on goods by 12½% is disconcerting news to the agricultural and industrial interests in the country. In India where the cultivator's produce has to be hauled over long distances before reaching the ultimate markets, any action which deters the free movement of commodities is bound to react adversely on the population. It may be observed that owing to the exigencies of the war, the competition between the railways on the one hand and coastal shipping and road transport on the other is fast waning and the decision to raise rail freights at a time when the country is slowly yet steadily recovering from a long period of trade depression, is unfortunate. It is the primary producer of the soil who will eventually share the brunt of any set-back and for this reason we trust the Government of India will think over their decision before putting it into execution.

Fodder Crops in the Madras Presidency—A Review.

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(*Continued from the previous number*)

Lucerne (Medicago sativa.) Often termed the queen of forage crops, this is perhaps the most highly esteemed fodder in this province, as elsewhere in India. It has not, however, spread so well in Madras as in Western India ; here it is still confined to the Government Farms and their neighbourhood. Though originally a native of temperate Asia (it is mentioned in the Bible) it seems able to stand the hot Indian climate very well indeed, although of course, the cuttings are heavier during the cold months of November-January than those from May-July. The crop needs a deep, well drained loam rich in lime, with adequate manuring and irrigations. Sullage water also can often be used with advantage, but soil alkalinity is fatal to its success. Being a rich feed, one or two pounds per day per animal is ample, so that in most places it need only be grown in small plots adjacent to wells. Apart from its value as a forage crop, lucerne is also reported as useful in the control of malaria. It is of course well known that malarial mosquitoes live, not only on human blood, but often feed on plant saps also. When they take in the lucerne sap, the organisms causing malaria are destroyed, rendering the mosquitoes harmless. Thus Egypt is believed to be free from malaria chiefly because lucerne is grown so extensively there. In the Argentine also, a similar thing is noted, and is corroborated by Russian workers in the Caucasus region. In Madras, lucerne was first introduced in 1916 on the Central Farm, Coimbatore, where it has ever since been a prominent and regular crop on about 2 acres. The cost of cultivation was rather high in the beginning (149 lb. per rupee in 1917, or Rs. 122 per acre) but dropped down to about 800 lb. per rupee in 1930. The average annual yield works out to 36,000 lb. in about 10 to 12 cuttings, at a cost of 425 lb. per rupee. The sale of lucerne in small bundles is a recent feature of the Coimbatore fodder supply. Attempts to introduce this crop in the Circars have not, on the whole, been very successful. At Samalkota it was tried in 1931 on a small patch and gave a calculated outturn of 25,000 lb. but was not continued in subsequent years. At Guntur the yield was only about 650 lb. per acre, nor was it much better at Chintaladevi where the maximum itself was only 1,040 lb. At Hagari it was grown for two years (1918 and 1919) and then dropped, and resumed in 1922 from which period it has been a regular crop on about one acre. On the East Coast it has figured in a small patch of only 3 cents at Palur, but

has yielded 14,100 lb. at Tindivanam, and has been pronounced a success at Aduturai. At Hosur, lucerne was a prominent crop in the days of the Army Remount Depot for nearly fifty years, and was then popular among the ryots all round, but when this depot was closed down, lucerne cultivation in the neighbourhood also died out. It is strange how such an excellent crop could have failed to catch on with the local ryots, but probably its heavy water requirements and some difficulty in getting good seed might have contributed towards such a fade-out. On the Cattle Farm, its cultivation was naturally resumed from 1924, with an average annual acre yield of 30,220 lb. on about 4 acres each year. Attempts to introduce it on the West Coast were all failures ; the heavy rainfall, coupled with the shallow lime-deficient laterite soils was probably not quite suited to this crop. It has however been a success at Koilpatti with 27,300 lb. in six cuttings for the year, and also on the Hills at Nanjanad, giving 27,400 lb. per acre per annum.

An allied crop berseem (*Trifolium alexandrinum*) was tried at the Central Farm in 1924 and at various other centres (viz., Hosur, 1928, Samalkota 1929, Anakapalle 1933, and Koilpatti 1935), but was found very much inferior in outturn, and was unable to withstand frequent cuttings like lucerne.

Pillipesara (Phaseolus trilobus). This is perhaps the most popular fodder and green manure legume on the deltaic tracts of Kistna and Godavari. It has also subsequently been tried and found good in other parts of the presidency as well. It is a wiry-stemmed, drought resistant plant of sprawling habit that could stand two or three cuttings and then give a fair outturn of seed as well. It is more adaptable to adverse conditions and less susceptible to insect pests than sunnhemp. At Samalkota it was tried in 1929 at different sowing periods, and sowing it in November in the standing paddy was found the best practice. The yields averaged about 15,600 lb. per acre. In the Maruteru tract, pillipesara was well known even before the advent of the Station, the ryots sowing it along with other legumes, from June onwards on field bunds kept specially wide for the purpose, and cutting it two months later. With monthly sowings on different bunds they secure a continuous supply of green forage up to the next February or March. For green manure it was more usual to sow it in November, as at Samalkota, in the standing crop of paddy, utilize the first growth for fodder upto March, and plough in the subsequent flush for the main paddy crop. It is common in this tract to top off overgrown paddy plants in September and utilize them as green fodder. Pillipesara is suggested as very suitable for mixing with these toppings and making silage. At Guntur where it was first introduced in 1927 it has given an average yield of 10,700 lb. as a punasa crop (sown in July and harvested in September), and 11,200 lb. per acre at Nandyal. A proportion of 3 parts of Jonna to 1 of pillipesara was found very suitable at Guntur and Coimbatore, for improving the feeding value of the mixed fodder without causing any appreciable

loss in either grain or fodder yield, but at Nandyal such mixtures were found to pull down the grain yields of jonna.

Curiously enough, pillipesara, although successful at Nandyal, did not fare so well at Hagari, the yields even under irrigation never exceeding 6,700 lb. per acre. On the Ongole tract in the Nellore district, it was a common dryland crop even before the Cattle Breeding Station was opened, and was of course, a regular crop on this station, giving an average outturn of 2,200 lb. green fodder from the drylands. On the East Coast, where it was introduced from the Circars in 1931, it has been reported as being quite a success. Thus, at Aduturai, it gave 16,000 lb. on the average, for the April-sown irrigated crop. Two cuttings are usually taken from this crop by November, and it is then left for seed, the pods being collected in January. The Maruteru practice of sowing in November in the standing paddy crop was tried with success here also; cholam is often mixed with pillipesara, and the first cutting utilized for fodder, the second flush being ploughed in later on for the subsequent crop of paddy. Another practice that was found successful was to grow a mixed crop of maize and pillipesara on the wet lands from June to September and utilize it both as green forage as well as a silage material. In the Mettur project area of Pattukottai, and also at Gudiyattam, pillipesara has been tried and found quite promising. It is one of the standard green manure crops on the Central Farm at Coimbatore, both in wetlands as well as garden lands. The wetland yields work out to an average of 11,000 lb. per acre at a cost of about Rs. 4. At Hosur it has figured regularly since 1929 on the drylands, with an average yield of 6,800 lb. On the West Coast and the Hills, pillipesara was found unsuitable. At Koilpatti it was first tried in 1931 and has proved a success both on the dryland black soils and the irrigated red soil area, with yields of 3,200 lb. and 18,500 lb. respectively.

Sunnhemp (Crotalaria juncea). This is one of the best dual-purpose legumes available in this province, coming in handy both as a fodder as well as green manure. It grows well on a wide variety of soils, but is rather badly susceptible to insect damage. In the Circars it is a common garden land green manure round about Anakapalle, often sown along with other pulses, in May and harvested by August or September. In the Ganjam district however, there is a curious prejudice, that its cultivation could be done only by certain castes, although attempts have been made at the Berhampur Rice Research Station to popularise it in the tract. In the deltaic regions, of Samalkota and Maruteru, it is usually sown in November in the standing paddy crop, along with other pulses like black gram and green gram. The pods from these are gathered in February and the sunnhemp is grazed down or cut for hay, or else sometimes ploughed in for the subsequent crop of sugarcane. It was found however, that this sowing in November did not always give a good crop, as the damage from caterpillars was often very much more severe than when grown in March under irrigation. The yields then were much heavier, averaging about 14,300 lb. per acre at Samalkota

and 15,700 lb. at Maruteru. Although sunnhemp is so popular, the seed supply has always been a problem in both these tracts. Usually the seed had to be obtained from the upland taluks, through middlemen, who often charged as much as Rs. 30 or sometimes even upto Rs. 50 per bag of 160 lb. Consequently attempts were made to produce the seed locally. It was found that by sowing sunnhemp in September on field bunds, and taking care to nip off the top shoots just before the floral buds appeared, buds were induced to form in greater profusion on the axils of leaves and a good seed crop was secured without difficulty. The cost in this case worked out only to about a rupee per 160 lb. of seed, as against Rs. 30 or Rs. 50 often charged by the middlemen. Sunnhemp has been a fair success at Guntur, yielding about 2,000 lb. of dry fodder as a rainfed crop sown in July or August. The optimum time for sowing was found by experiment to be the second week of August. It has not been so good at Hagari. There the average yield, for an irrigated crop sown in July and pitted for silage in October, has been only 6,000 lb green fodder per acre. On the drylands at Nandyal it was a failure, although a very good yield of 26,000 lb. has been recorded one year (1925) from the wetlands of the Station. On the Ongole Cattle Farm at Chintaladevi it was a regular crop each year on about 25—30 acres, both as a pure crop as well as mixed with other cereals like *jonna* and *sajja*, and legumes like *horsegram* and *pillipesara*. The earlier July sown crops were in general better than the September sown, yielding 1900 lb. of dry fodder while the yields from December sowings were even more uncertain than the September crops. At Palur, sunnhemp is a regular green manure crop sown in June, with an average outturn of 5,100 lb. The yields have been even better at Palakuppam with 3,400 lb. dry fodder per acre, while at Aduturai, where it was first introduced in 1931, the June sown crop has yielded 16,300 lb. at a cost of 10 annas per 1000 lb. If sown in December, after the harvest of paddy, the crop was usually ruined by caterpillars, and the outturn never exceeded 1,900 lb. per acre. On the Central Farm, sunnhemp has not been very prominent as a fodder crop, owing probably to the presence of a better feed in lucerne, although it has been one of the standard green manures both in the wetlands as well as the garden and dry lands of the Farm. At Hosur however, it has been a regular fodder for hay and silage on about 10 acres each year. The average yield has been 8,600 lb. per acre. On the West Coast, it could be grown only in September as a rainfed crop on *modan* lands (hilly dry-land areas). The yield in such cases has been about 4,700 lb. per acre. As an irrigated crop in March at Pattambi, an acre yield of 10,000 lb. was recorded in one year (1932), but on the whole, sunnhemp has not been quite suited to West Coast conditions. At Koilpatti it has been regularly grown since 1931 yielding 8,700 lb. on the average as an irrigated crop in the red soil area, and used for making silage.

Cowpea. *(Vigna unguiculata (L.) Walp).* Among all the fodder legumes, cowpea seems better suited to the humid West Coast than any-

where else. In the Circars, it was found at Samalkota, to do better when sown in November amidst the standing paddy, than as an irrigated crop in February. At Maruteru, it figures along with sunnhemp and pillipesara, as one of the bund-sown fodders in paddy lands. Though grown at Guntur from 1933 till 1936, it has been only as a green manure, and never as a fodder. At Hagari, it was a failure, even with irrigations. At Chintaladevi it was a regular fodder crop in the *punasa* season as long as the farm existed, but the yields were uniformly low, averaging only 1,500 lb. green fodder per acre. At Hosur the average was 6,600 lb. Cowpea may be said to have been a success at Palur and Adutural, with a cut of 6,400 lb. and 10,700 lb. per acre respectively, but at both these stations it was grown more for green manure than for fodder. All the same, its success or otherwise, serves as an index to its fodder possibilities as well. On the Central Farm, cowpea has not, on the whole, been very prominent, either as a fodder or as green manure. On the West Coast, however, it has been the most successful among all the legumes tried, both for green manure and as a silage material. The optimum time of sowing was from the end of May till early in June; earlier sowings resulted in the crop getting caught up in heavy rains, just at the flowering stage. On the Southern tract, cowpea was a failure on the dryland black soils of Koilpatti although under irrigation it gave up to 14,500 lb. in the red soil area.

Horsegram (*Dolichos biflorus*). This is a hardy, quick-growing pulse, sown usually on the poorest soils. It is probably the best leguminous rainfed fodder crop for light soils, especially on those inclined to be shallow and somewhat stony. Being itself intended as a restorative crop, it is seldom, if ever, manured at all, although as Benson reported from Saidapet in 1879, it is capable of yielding as much as 10 600 lb. within about 70 days, under even moderate applications of manure to the rainfed crop. It makes excellent hay, with a very pleasant smell, although losing about 75% of its green weight on drying. On the Northern Circars, horsegram is sown broadcast in the *Peddapanta* (August—September) season at Anakapalle, following cereal crops like Punasa (June—July) ragi or *Ganti* (Cumbu). In the deltaic regions however, as at Samalkota and Maruteru, it is one of the usual pulses sown in November just before the harvest of paddy. The pods are gathered in February and the *bhusa* (residue of vines and empty pods) used for cattle feed. On the uplands, i.e., the tract between these heavy soils of the deltas and the hilly regions of the interior, horsegram is one of the chief rain-fed crops on light loams, being sown broadcast in October, after an early crop of gingelly or a cereal, and harvested by February. In Guntur also, horsegram is an important recuperative crop following tobacco in October. On the heavy blacksoils of the Ceded districts, as at Hagari, it is not so popular, although it has been grown on the farm, off and on, with an average yield of 4,800 lb. green material per acre, from rainfed crops and 8,100 lb. under irrigation. At Chintaladevi, horsegram was one of the chief November sown crops, after cereals like jonna, and cumbu. It was

grown either pure or mixed with other cereals or pulses like sunnhemp or pillipesara. The yields, however, were low as a rule, averaging only 900 lb. per acre. On the East coast, horsegram has been tried only at Palakkuppam and that too as a green manure on about 50 cents in one year (1931). Sown after the harvest of cumbu in November, it yielded about 5,600 lb. green material. On the Central Farm at Coimbatore, it has been quite a handy crop on the red soil drylands from 1926 onwards, with an average yield of 3,900 lb green material per acre. In the Hosur tract, horsegram, lablab and gingelly are grown on a scale sufficient even for exporting to other districts. On the Cattle Farm, it has been a regular crop every year from the inception of the Station, with an average yield of 2,000 lb. of green fodder per acre. On the West Coast in the vicinity of Taliparamba, it is mainly a grain crop, sown on the drylands after harvesting *modan* paddy, often mixed with *samai (Panicum miliare)* gingelly or sweet potato. The *bhusa* that remains after the grain is threshed out, is an incidental cattle-feed. The yields of grain, however, have usually been very low, often interspersed with failures, both at Taliparamba as well as at the Coconut Stations. At Pattambi, horsegram was tried in 1933, as a green manure but gave only 3,050 lb per acre as against 10,700 lb. from cowpea under similiar conditions. In the southern tracts, as elsewhere, horsegram is a poor-soil crop of the dry lands, chiefly red-soil areas, where it is sown broadcast, either alone or mixed with samai. At Koilpatti it has yielded on the average, 450 lb. of grain per acre from the black soil area, while under irrigation, on the red soil area a phenomenal yield of 12,700 lb. green material per acre was recorded in 1936.

Other Pulses. (Black gram, Bengal gram, Green gram, Theegapesara, Lablab, Soy beans, Lentils and Lupins.)—The first four of the above eight are indigenous catch crops grown on all types of lands, just as it is convenient or necessary. Since these lands are usually poor, the yields too are poor. It is very seldom that any of them figure as a pure fodder crop—the grain is needed for human food and the *bhusa* is an incidental cattle-feed.

In the Northern Circars, green gram (Phaseolus mungo L.) is sown often mixed with other pulses as a second crop in November-December. Thus at Berhampur it has been grown along with kolinji and indigo on ploughed fields after paddy and harvested two months later, in February. At Anakapalle it usually follows ragi and precedes gingelly in the garden land rotation; at Samalkota, it is mixed with black gram, *theega-pesara* (creeping green gram) and sunnhemp and sown broadcast in the standing paddy in November. After the harvest of paddy, these pulses remain in the field till February, when the pods are gathered from the grams and the sunnhemp cut for hay or grazed down. On this Station, *theega-pesara* (Phaseolus mungo L.) has done very well as a green manure crop, the average yields from the March-sown irrigated crop being 14,500 lb. per acre. Black gram (Phaseolus mungo var. radiatus) green gram and

Bengal gram on the other hand, have been primarily grain crops, the fodder value being incidental. Soy bean (Glycine max. Merr.) trials were also conducted from 1932 onwards but here too, all the foreign American types failed, only two Burmese varieties Behrum and Pe Ngypi showing any signs of promise. In the Maruteru tract, black gram and horsegram are sown on dry lands in October, and harvested by February ; in the wet lands, blackgram, cowpea, sunnhemp and pillipesara are sown, as described already, on field bunds from July onwards—for periodical cuttings of fodder.

In the Ceded districts, Bengal gram is the usual cold weather pulse crop. At Chintaladevi, almost all the legumes, Blackgram, Bengal gram, green gram, and lab lab were sown each year, chiefly as mixtures with *Pedda jonna* and *Pairu jonna* to improve the feeding value of the jonna hay and straw. On the East Coast, at Palur black gram and Bengal gram were tried in 1915, as a second crop after early cumbu, but were given up as not sufficiently promising. Soy beans have fared no better, both here and at Palakappam and Aduturai, only green gram being any good at this last place. On the Central Farm at Coimbatore, Bengal gram is the usual cold weather pulse on the black soils, after periamanjal cholam the previous year. The yields depend so much on the extent of dewy nights at the time of pod setting that they fluctuate very widely around a low average of 300 lb. per acre. Black gram too is similar. The *bhusa* from both is esteemed as a cattle-feed. At Hosur, there is no specific reference to these minor pulses. Soy beans have been reported, after a few years of unpromising trials, to have yielded 5,400 lb. green fodder per acre in 1936. This crop has been equally difficult to raise successfully on the West Coast also. and does not on the whole seem to have much scope in the Presidency, either for grain or as fodder.

In the southern tract, at Koilpatti, owing to the high average temperatures prevailing even in December—January, Bengal gram has never been a success. The other pulses too, have been equally poor on the black soils, the yields ranging around only 200—250 lb. per acre ; in fact, as noted by H. C Sampson as early as 1910, there is really no suitable pulse for the black soils of this tract. Under irrigation, however, in the red soil areas, black gram yielded in 1936 as much as 11,300 lb. fodder per acre, thus indicating the possibilities of these pulses under liberal treatment. On the hills, at Nanjanad, where only lupins come up well as a green manure, Bengal gram and soy beans also were tried in 1935, and found to be somewhat promising.

Miscellaneous Fodders. *Sunflower (Helianthus annuus).* This is a quick growing plant capable of heavy yields, but is not very much relished at first by cattle, so that it seems better suited for making silage than for feeding green. It was first tried at various centres in this Presidency in 1924 and was a success at Chintaladevi with an average yield of nearly 10,000 lb and at Hosur it has been a regular crop since 1924 on about 2—4 acres each year with an average of 31,700 lb. per acre. On the

Central Farm, however, it is not mentioned after its first trial in 1924, when it gave an outturn of 7,000 lb. per acre. On the West Coast the laterite soils are presumably too shallow for its success, as the yields were all along very poor. As a rainfed crop on the black soils, at Koilpatti, it was noted as promising in 1929, the only year it was tried there. Sunflower was a failure on the hills.

Sweet potato vines *(Ipomaea batatas).* This bye-product of sweet potato cultivation is not only a palatable green feed but has also been noted to stimulate milk secretion. At Chintaladevi it figured from 1921 to 1924 with an average outturn of 8 000 lb. vines per acre, and at Hosur too, it has been a regular crop since 1932, with an average of 29,900 lb. vines and 6,409 lb. tubers, while on the Central Farm also, it is mentioned (in 1929, 1933, and 1936) as grown and fed to cattle.

Kollaganjeru (*Ipomaea hispida*). This hardy, drought-resistant, trailing plant was tried first at the Millets Breeding Station, Coimbatore, and was found to yield about 2,800 lb. of fodder, of a very high feeding value, being particularly rich in proteins, fats and potash. It has also been grown with success on the black soils of Guntur and Bellary and recognised as a stimulating feed for milch cows. At Pattambi it suffered somewhat from too much rain in the north-east monsoon, but gave, in spite of this, an acre yield of 7,960 lb. and proved an effective smother crop for weeds.

Summary and Conclusions.

It would be useful at this stage to sum up the general position of fodder crops in the Presidency. In the Vizagapatam district, apart from the straw from major food grains, paddy, cumbu and ragi, and to a lesser extent, the straw from cholam, korra and samai, that are utilized for cattle, fodder crops as such are not raised to any appreciable extent. The haulms and *bhusa* from pulse crops like black gram, green gram and horsegram, and groundnut also, are often utilized. Pillipesara is becoming popular in paddy lands both as a green manure as well as fodder. In the deltaic portions of Godavari, Krishna and Guntur also, pillipesara is a popular green fodder, while sunnhemp is another common fodder crop, usually made into hay and stacked along with paddy straw. In the dry lands of these districts, however, since what little grazing was available once is all gone now, cholam either pure or mixed with pillipesara, is grown as a fodder crop in the early season and as a grain crop in the late season. In the Ceded districts, the area cropped per pair of cattle is so large that in normal years the ryot gets all the fodder he needs from the jonna straw on this area. He is, as a rule, fully aware of the fodder value of mixing legumes with his cereal straw, but, with the seasons so uncertain, he is unwilling to risk pulling down his jonna yields by sowing such mixtures. In the black soils of the south, in Madura, Ramnad and Tinnevelly, the ryot usually reserves a portion of land for growing rainfed cholam as a pure fodder crop, using a very high seed rate to get the stalks thin and fine. On the red soils, however, cholam is a grain crop,

Here, it is often mixed with pulses if rainfed and grown pure only when raised under wells. The fodder supply may be said to be adequate in these districts, but the same cannot be said of Tanjore and parts of South Arcot where paddy straw is the mainstay for cattle. Pillipesara has been a success here, so that it is worth while to advocate growing it either pure or mixed with fodder cholam in paddy lands from January till June when there is no paddy crop. Guinea grass and Napier's fodder also can be planted along bunds and sides of water channels. In the garden land districts of Coimbatore, Salem and North Arcot, cholam both as a rainfed as well as an irrigated crop, is the mainstay for fodder. Pulse mixtures too are a common practice. The merits of lucerne are getting to be well known and recognised in Coimbatore. In the town itself, a regular agency has sprung up, supplying lucerne for milch cows and jutka horses. On the humid West Coast (Malabar and South Kanara) green grass is available from July to December, and although the cattle are usually half starved for the rest of the year, from January to June, the raising of fodder crop is hardly ever practised. There seems to be a good scope here, for a wider use of forage crops like green cumbu and cowpea, converting them into silage for use during the dry months from January to June. In the Nilgiris also, the need for raising fodder crops is not yet felt, although here too, suitable crops are avilable, such as samai, teosinte and lucerne.

As regards the future prospect, it is safe to assume that most of the fodder requirements of the Province would continue to be met from an extension of the area under the crops reviewed above, although of course, the possibility of new introductions is not excluded. The Agricultural Department has demonstrated the utility of fodder crops like cholam, maize, guinea grass, Napier's fodder, lucerne and pillipesara. Further lines of useful activity, apart from the continuance of advice regarding the most suitable fodder crops for different localities, under dry as well as irrigated conditions, would be in the evolution of more strains of fodder sorghum, each best suited to particular tracts, and the isolation of better yielding types of other fodder and pasture grasses. In what may be termed sub-urban farming areas, there is a good scope for an intensive commercial cultivation of fodder crops, such as maize and lucerne and supplying their fodder for the town milch stock. Under such intensive cultivation, the question of rotations assumes less importance than in truly rural areas where, with the extensive type of dry land farming, it is vital to conserve the fertility of the land by a judicious rotation of crops.

Grass Flora of North and South Arcot Districts with special reference to fodder grasses.

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The North and South Arcot Districts receive a total annual rainfall of about 30 inches. The heaviest rainfall period is during the north-east monsoon between September and November. During the year (1939) the north-east monsoon was late and only about two inches of rainfall were received towards the end of September. The regular monsoon, however, commenced from about the middle of October. The grass survey was made between the 6th and 23rd of October. The grasses had just started fresh growth and a few were in flower which enabled their identification.

The soils of these districts are generally sandy loam. A large area is under paddy especially in the South Arcot District. There is, therefore, the necessity to maintain a large number of work bullocks and buffaloes. The question of large scale production of good fodder, therefore, is of utmost importance to the ryot in these districts.

The well-known *Kolukkattai* grass *(Cenchrus ciliaris* Linn.*)* of Kangayam tract (Coimbatore District) is absent in these Districts. Attempts have been made in recent years to introduce this species in the panchayat forest near the Arkonam Railway Station but it has not established well. The *Chengali (Iseilema laxum* Hack) of Ongole tract (Guntur District) is also practically absent except for a few stray plants in one or two places. The hill grass *Nendra pul (Sehima nervosum* Stapf.*)* is the best grass of these districts but occurs only in forest regions. It is present abundantly in the plains, forests and completely absent in the open pasture areas. In the former area this species is found to thrive better under trees and shrubs as is seen in the Arkonam panchayat forest. These observations indicate that this grass needs partial shade and does not thrive in open areas. The grasses of these districts may be divided into three groups :— (1) Pasture grasses (2) Forest grasses and (3) Grass weeds in cultivated areas.

Pasture grasses. The most important pasture grass, *Arugam pul* (*Cynodon*) is represented by two species, *Cynodon Dactylon* Pers. and *C. Barberi* Rang and Tad. The former has underground stolons and occurs in moist and stiff soils while the latter spreads superficially and occurs in fairly dry and sandy loams. *Amphilophis pertusa* Stapf. is next in importance and makes a matted surface with its creeping and long red stems rooting at the nodes. *Digitaria longiflora* Pers. and *Manisuris Myurus* L. spread all round by their long creeping branches, the former rooting at all the nodes and the latter at the basal nodes. These cover large patches of sandy loams and promise to be very good sand binders in addition to being good pasture grasses. The grasses of the pastures arranged according to their

predominance are :—*Cynodon Dactylon* Pers., *Cynodon Barberi* Rang. and Tad., *Amphilophis pertusa* Stapf., *Urochloa reptans* Stapf., *Dactyloctenium aegyptium* Beauv., *Paspalidium flavidum* A. Camus., *Perotis indica* O. Ktz., *Tragus biflorus* Schult., *Chloris barbata* Sw., *Aristida depressa* Retz., *Panicum psilopodium* Trin., *Eragrostis plumosa* Link., *Digitaria longiflora* Pers., *Digitaria marginata* Link, var. *fimbriata* Stapf., *Alloteropsis cimicina* Stapf., *Echinochloa colona* Link., *Sporobolus tremulus* Kunth., *Aristida Hystrix* Linn., *Chrysopogon aciculatus* Trin., *Manisuris Myurus* Linn., *Oropetium Thomaeum* Trin., *Urochloa panicoides* Beauv., *Iseilema laxum* Hack, *Trachys muricata* Steud., *Brachiaria distachya* Stapf., *Eriochloa procera* C. E. Hubb., and *Eragrostis riparia* Nees.

Forest grasses. The most important forest grasses are *Nendra pul (Sehima nervosum* Stapf.) and *Manjam pul (Cymbopogon coloratus* Stapf.). The latter has to be cut and fed to cattle before flowering as cattle do not relish it after flowering on account of its strong odour. It is necessary, therefore, in any scheme of rotational grazing in such forest regions where this species predominates, provision should be made for issuing grazing permits in such periods as to enable the cattle to graze before the grasses come to flower. This system will have the additional advantage of providing rich nutritious grazing as it is a well known fact that grasses are very rich in proteins in young stages and become less and less nutritious as they flower and set seed.

The forest grasses arranged according to their occurrence. *Cymbopogon coloratus* Stapf., *Heteropogon contortus*, Beauv., *Sehima nervosum* Stapf., *Amphilophis pertusa* Stapf, *Eragrostis bifaria* Wt. et Steud., *Eragrostis brachyphylla*. Stapf., *Aristida depressa* Retz, *Aristida setacea* Retz., *Digitaria marginata* Link., var. *fimbriata* Stapf., *Melanocenchris monoica* C. E. C. Fischer, *Perotis indica* O. Ktz., *Chrysopogon montanus* Trin., *Eremopogon foveolatus* Stapf. *Cymbopogon caesius* Stapf, and *Cymbopogon Martini* Wats.

Grass weeds in cultivated crops. Grasses form the major portion of weeds especially in rainfed crops. These are not systematically removed. When the grasses have grown well they are pulled out and sold as cattle feed. Most of them are annuals and the commonest species is *Maththanga pul* (*Dactyloctenium aegyptium* Beauv).

Grass weeds in cultivated fields arranged according to their occurrence. *Urochloa reptans* Stapf, *Dactyloctenium aegyptium* Beauv., *Cynodon Dactylon* Pers., *Chloris barbata* Sw., *Brachiaria ramosa* Stapf., *Eragrostis pilosa* Beauv, *Setaria pallidifusca* Stapf et Hubb, *Panicum psilopodium* Trin, *Dichanthium annulatum* Stapf, *Panicum repens Linn.*, *Eragrostis cilianensis* Link, (*Imperata cylindrica* Beauv,, var. *Koenigii* Dur., *Saccharum spontaneum* Linn found generally on bunds in rice fields), (*Echinochloa stagnina* Beauv, *Echinochloa crus-galli* Beauv., *Eragrostis japonica* Trin., occur in rice fields along with paddy), *Leptochloa chinensis*

Nees., *Sporobolus Wallichii* Munro., *Sporobolus scabrifolius* Bhide., and *Rottboellia exaltata* Linn. f.

Weeds other than grasses. Even though the weeds are undesirables some of them are readily grazed by cattle when found in pastures or eaten by them when hand fed. *Gisekia pharnaceoides* Linn. (Tamil : *Manal Keerai*) is a very common weed especially in sandy loams. It is a prostrate herb with fleshy leaves covering large patches of ground. It is collected from standing crops and fed to cattle and is much relished by them.

The following weeds are readily eaten and relished by cattle :

1. *Cyperus rotundus* L. (Fam : Cyperaceae) Tam : *Korai.*
2. *Gisekia pharnaceoides* L. (Fam : Aizoaceae) Tam : *Manal-keerai.*
3. *Commelina benghalensis* L. (Fam : Commelinaceae) Tam : Kaana.
4. *Digera arvensis* Forsk. (Fam : Amarantaceae) Tel : *Senchalaakku.*
5. *Borreria hispida* K. Sch. (Fam : Rubiaceae) Tel : *Mathana Akku.*
6. *Physalis minima* L. (Fam : Solanaceae) Tel : *Budama Akku.*

The leaves of the forest tree *Turinje* (*Albizzia amara* Beauv.) and *Agathi* (*Sesbania grandiflora* Pers). which is grown in banana and betel vine gardens afford supplementary forage for cattle.

A list of the grasses of the North and South Arcot districts with short notes and local names for those not mentioned in the Grass Flora of Chittoor District (*Madras Agricultural Journal*, Vol. XXVII, January 1939,) is given.

1. *Imperata cylindrica* Beauv., var. *Koenigii* Dur. & Sch. (*Imperata arundinacea* Cyril.) Eng : Cotton grass Tam : *Tharpai pullu.* Tel. *Dharbha, Modewa gaddi. Kan : Sanna Dabbai Hullu* It is a perennial grass 1′—4′ in height. It thrives in moist situations. It spreads by the underground stems which are often very long. It is a pernicious weed in garden lands. It is a good sand binder. Grazed by cattle only when young and tender.

2. *Saccharum spontaneum* L. Tam : *Viswamitra Darbhai,* Tel : *Rellu gaddi.* A perennial grass thriving in moist situations. It grows from 3′ to 6′ in height. It is a good sand binder often planted along water courses to prevent soil erosion. It is a good fodder for buffaloes.

3. *Sehima nervosum* Stapf. Tam : *Nendra pul.*

4. *Amphilophis pertusa* Stapf. Tam : *Chengaru pul* ; *Kodi savaran pul.*

5. *Vetiveria ziznioides* Nash, (*Andropogon squarrosus* Hack) Eng : The Khus-khus or Cus-cus grass. Tam : *Vilamicham pul,* Mal : *Ramachcham.* It is a coarse perennial grass with stout rhizomes. It grows from 3' to 4' in height. The aromatic roots are used for making screen mats (*thatties*) and fans. An aromatic and medicinal oil is extracted from the roots. It is grazed by cattle when young.

6. *Chrysopogon aciculatus* Trin. (*Andropogon aciculatus* Retz.). Eng: The Love-grass. Tel : *Puthi gaddi.* A perennial grass having creeping root stock. Stems erect, 1′—2′ in height, slender and leafy chiefly at the base. Grazed by cattle before flowering.

7. *Chrysopogon montanus* Trin. Tam : *Moonjan pul.*

8. *Dichanthium annulatum* Stapf. (*Andropogon annulatus* Forsk) Tel : *Molava gaddi.* It is a perennial densely tufted grass ; stems erect or ascending, 1′—2½′ in height. It thrives in moist situations. It is one of the best fodder grasses and is supposed to increase the milk yield in cattle.

9. *Heteropogon contortus* Beauv. Tam : *Panni pul.*

10. *Iseilema prostratum* Anderss.

11. *Iseilema laxum* Hack. Tam : *Thenga Nari pullu.* Tel : *Erra Chengali gaddi.* A perennial grass growing from 1′ to 2′ in height ascending from a shortly creeping root stock Stems, slender, simple or sparingly branched. It stands cutting well. It is considered one of the best fodder grasses and is the mainstay of the famous Ongole Breed of cattle.

12. *Eremopogon foveolatus* Stapf.

13. *Cymbopogon coloratus Stapf.* Tam: *Manjam pul.* It is the commonest grass in all the hilly tracts of these Districts.

14. *Cymbopogon Martini* Wats. Tam : *Kaavaadu pul.*

15. *Cymbopogon caesius* Stapf. (*Andropogon Schoenanthus* L., var. *caesius* Hack.). Tam : *Vella Munjan pul, Kamatchi pul ;* Tel : *Kasi gaddi ;* Kan : *Kasi hullu.* A perennial erect grass growing from 2′ to 3′ in height. It has a strong odour due to the presence of an essential oil. It is used generally for thatching. It is nibbled by cattle when young.

16. *Rottboellia exaltata* L. Tam : *Shona pul* ; Tel : *Konda panuku.* It is an annual, sometimes perennial, growing from 2′ to 10′ in height. Stem tall, erect, branched above, and often with tilt-roots from the lowest nodes. The plant is beset with rough hairs. It is not eaten by cattle but if grazed accidentally the animal suffers by excreting blood.

17. *Manisuris Myurus* L (*Rottboellia Myurus* Benth.) Tam: *Waritsira pul* ; Tel : *Nalla panuku.* It is a spreading grass rooting at the basal nodes of the branches. It is a good fodder grass.

18. *Digitaria marginata* Link., var. *fimbriata* Stapf. Tam : *Kakkai Kal pul.*

19. *Digitaria longiflora* Pers. It is a spreading grass rooting at all the nodes. It thrives in sandy loams. It is a good sand binder. It is grazed readily by cattle.

20. *Alloteropsis cimicina* Stapf. Tam : *Chena pul.*

21. *Eriochloa procera* C. E. Hubb. (*Eriochloa polystachya* H. B. & K.). Tam: *Tandambaran pul, Karungani pul.* It is a perennial grass growing

from 2′ to 5′ in height. It thrives in moist situations often seen on the bunds of rice fields. It is a good fodder grass.

22. *Brachiaria distachya* Stapf.

23. *Brachiaria ramosa* Stapf. Tam : *Pala pul, Kamban pul.*

24. *Paspalidium flavidum* A. Camus. Tam : *Arisi pul.*

25. *Urochloa panicoides* Beauv.

26. *Urochloa reptans* Stapf. Tam : *Gunugu pul, Seela pul.*

27. *Echinochloa colona* Link. Tam : *Saani pul* ; Tel : *Oodara Kasuvu.*

28. *Echinochloa crus-galli* Beauv. (*Panicum Crus-galli* L.) Tam : *Oothu pul* ; Tel : *Pedda-wundu* ; Kan : *Kadu dabhai hullu.* It is a tall grass growing from 3′ to 4′ in height. It thrives in moist places. It is a common weed in rice fields. The grain is eaten by the poor. It is a good fodder.

29. *Echinochloa stagnina* Beauv. Tel : *Bontha Oodu* ; Kan : *Kadu dabhai hullu.* The habit and the uses are similar to *Ehinochloa crus-galli* Beauv.

30. *Panicum psilopodium* Trin. Tam : Chinna samai pul ; Kadai Kanai, Kalam pul. It is an annual growing from 1′ to 2′ in height. This is the wild form of the cultivated Samai, the little millet (*Panicum miliare* Lamk). It is readily eaten by cattle.

31. *Panicum repens* L. Tam : Tandangattai pul.

32. *Setaria pallidifusca* Stapf. et Hubb. Tam : Kulla nari pul.

33. *Cenchrus ciliaris* L (*Pennisetum cenchroides* Rich.) Tam: *Koluk-kattai pul.* It is a perennial grass growing from 1′ to 2½′ in height. It is decumbent and much branched from the base. It thrives in dry localities. It stands cutting well. It is the mainstay of the Kangayam (Coimbatore District) breed of cattle. It has been introduced in one or two places in this district but is not thriving well.

34. *Aristida depressa* Retz. Tam : *Thodappan pul.*

35. *Aristida setacea* Retz. Tam : *Thodappi kuchchi.*

36. *Aristida Hystrix* L. Kan : *Bili, Vunugadi hullu.*

It is a perennial grass growing from ½′ to 2′ in height, from a creeping root stock. Stem diffuse and ascending. It is not eaten by cattle because of the very long awns.

37. *Trachys muricata* Steud.

38. *Tragus biflorus* Schult. Tam : *Ottum Kai pul.*

39. *Perotis indica* O. Ktz.

40. *Sporobolus Wallichii* Munro ex Hook. f.

41. *Sporobolus tremulus* Kunth. Tam : *Upparugu, Uppurutnam pullu.* It is a stoloniferous perennial pasture grass. Stems slender growing from 4″ to 9″ in height. It thrives in alkaline soils and makes excellent lawns. It is grazed readily by cattle.

42. *Sporobolus scabrifolius* Bhide Tam : *Kosu pul.* It is an annual, growing from 1′ to 2′ in height. It thrives in black cotton soils. It is grazed by cattle.

43. *Leptochloa chinensis* Nees. Tam: *Aeri pul*; Kan: *Kadu sanna kari sajjai hullu.* It is an annual, growing in moist situations. Stem erect or geniculately ascending, 2' – 4' in height. It is a good fodder for cattle.

44. *Eragrostis riparia* Nees.

45. *Eragrostis plumosa* Link. Tam: Poo pul.

46. *Eragrostis japonica* Trin. (*Eragrostis interrupta* Beauv. var. *tenuissima* Stapf.). It is an annual thriving in wet places. Stems erect or ascending growing from $1\frac{1}{2}$' to 3' in height. It is a weed in rice fields. It is grazed by cattle.

47. *Eragrostis cilianensis Link.* Tel: *Boosi Kasuvu.*

48. *Eragrostis pilosa* Beauv. Tam: *Kuthira val pul.*

49. *Eragrostis bifaria* Wt. et Steudl. Tam: *Oothhu pul.*

50. *Eragrostis brachyphylla* Stapf.

51. *Oropetium Thomaeum* Trin.

52. *Melanocenchris monnica* C. E. C. Fischer. (*Gracilea nutans* Koen.) It is a perennial grass growing from $\frac{1}{2}$' to $1\frac{1}{4}$' in height. Leaves mostly aggregated towards the base. It thrives in dry localities. It is grazed by cattle.

53. *Cynodon Dactylon* Pers.

54. *Cynodon Barberi* Rang & Tad. Tam: *Jellada pul.*

55. *Chloris barbata* Sw. Tam: *Kodai pul,*

56. *Dactyloctenium aegyptium* Beauv. Tam: *Maththangai pul.*

Short notes and local names wherever available of the weeds other than grasses which are grazed by cattle are given below :—

1. *Cyperus rotundus* L. Tam: *Korai*; Kan: *Bhadra Hullu.*

It is a perennial sedge rapidly spreading by its underground stolons. It grows from $\frac{3}{4}$' to $1\frac{1}{2}$' in height. It is a pernicious weed of cultivated fields.

2. *Gisekia pharnaceoides* L. Tam: *Manal Keerai*: Tel: *Isika dunti-koora.* A diffuse prostrate herb with fleshy glaucous leaves thriving in sandy soils. It is a medicinal plant and also employed as pot-herb in time of famine. It is much relished by cattle.

3. *Commelina benghalensis* L. Tam: *Kaana.* Stem 2'—3' long, dichotomously branching from the base upwards From the lower nodes leafless underground branches proceed bearing white flowers which produce perfect seeds.

4. *Digera arvensis* Forsk. Tel: *Senchalaakku.*

An annual herb 1'—2' in height having spreading branches.

5. *Borreria hispida* K. Sch. Tam: *Naththa Choori*; Tel: *Mathana Aakku.* A procumbent herb having quandrangular stems. It is common on the coast sands.

6. *Physalis minima* L. Tel: *Budama Aakku.* It is a herbaceous annual. Stem erect $\frac{1}{2}$' – 1' in height.

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Some Ploughing Experiments

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Every text book on agriculture emphasises the importance of preparatory cultivation for the raising of crops and every farmer will testify to the efficacy of the precultivation methods. In fact, the practice has become so time-worn and well established that any demand for proofs will be deemed as an outrage on truth. Yet it is true that an agronomist wishing to build up the science of cultivation will find little data to help him on while planning improvements. For example, the black soil farmer in the Bellary district uses a grubber for the preparatory cultivation, while his neighbour in the Nandyal valley prefers to plough his fields every year with inversion ploughs. On the other hand, the ryot in Tinnevelly district cultivates his land, only with a country plough. Again, there are variations in the time of doing these operations. In the Ceded districts, all precultivations are mostly done soon after the harvesting of the crop in contrast to the practice in the Southern districts, of waiting for a soaking rain to start ploughing. There are no evidences to indicate whether these methods are followed because of the fact that the fore-fathers were in the habit of doing these and the sons should adopt them as a matter of tradition. Further it is not clearly known which operations are essential for crop production and what frequency in each will prove most remunerative. The lack of knowledge on many of the fundamental points precludes one from getting the maximum benefit from each cultivation operation, from substituting the non-paying one by a better method, and from omitting altogether the superfluities. It can be said that the existence of such lacunae stands in the way of the rapid spread of improvements of cultivation in India.

Recently some of the accepted practices were tested on the black soils of the Agricultural Research Station, Koilpatti in Tinnevelli district in connection with the experiments conducted in the Madras fodder cholam* scheme financed by the Indian Central Cotton Committee. It is proposed to present here some of the results obtained therein, with the object of stimulating other workers to study these aspects in their tracts.

In one group of experiments, the effects of changes in the depth and in the time of ploughing on the yields of succeeding cotton were compared. In the case of studies in depth, one set of plots was ploughed with a monsoon plough to a depth of 4″ – 5″ and another worked with a turn-wrest plough to a depth of 8″ – 9″. In the two seasons of trial, the differences between the two variants were (*vide* table I) within the limits of random error

* Andropogon sorghums.

signifying that the changes in the depth of cultivation did not engender any marked effect on cotton yields under the conditions obtaining at Koilpatti.

TABLE I. Depth of ploughing.

Crop. Rain-grown *karunganni* cotton (G. arboreum).

No.	Nature of treatment	Yield of kapas in lb. per acre. 1933—34 I	1933—34 II	1934—35.
I	Deep ploughing (8 - 9")	308	304	508
II	Shallow ploughing (4 - 5")	340	293	448
	Critical difference.	60	55	77
	Conclusion.	Treatments are not significant.		
	Number of replications.	6	6	8

This conclusion is in agreement with those arrived at by many workers. Allan (1) after reviewing all the results of cultivation experiments conducted in Madras, Bombay and Central Provinces has stated that there is no real evidence to support the belief that deeper cultivation is essential to secure the best economic returns from crops raised on heavy soils during the monsoon, and that it will be sufficient if these soils are periodically ploughed deep. Russell and Keen (11) working at Rothamsted state that there is no virtue in ploughing to a depth of more than 4 inches.

In the experiments relating to the time of ploughing. the effect of ploughing in the stubbles with a monsoon plough soon after the harvest of the crop in February-March was compared during five seasons with that done in May-June soon after the receipt of the rains and also with ploughing late in August—September. The results are set forth in Table II.

TABLE II. Time of ploughing. (Yield in lb. per acre).

No.	Nature of treatments	Years 1933-34 I	1933-34 II	1934-35	1935-36	1936-37	1937-38
1.	Ploughing early (soon after the harvest of the crop)	304	296	479	...	...	...
2.	Ploughing season (soon after receipt of the first rains)	331	305	477	217	381	528
3.	Ploughing late (just before the sowing of the next crop)	338	295	...	226	406	516
	Critical difference	74	68	77	38	27	65
	Conclusions	3,2,1	2,1.3	1,2	3,2	3,2	2,3
	No. of replications	4	4	8	6	12	8

Once again the differences between the treatments were not significant. Such a finding is puzzling in view of the statements made by Russell (9) on the formation of soil crumbs. It is said that if ploughing is done at a critical period necessary for the maintenance of a proper regime for water

and air movements, a larger proportion of water resistant conglomerates is formed. Based on this, one will expect that the treatment—ploughing after the receipt of summer rains—would prove more effective. The data in the present experiments do not, however, support reasonable anticipations. The above results are also not in harmony with there commendations made by Allan (1). He has suggested that ploughing the land soon after the harvest of the crop will be more advantageous than preparing the seed bed late in the season. In the present experiments, variations in the time of ploughing have not caused any differential effects. Possibly his recommendations may hold good in cases of deep ploughing where more time is needed for the weathering of the clods.

In a third set of experiments, the plots prepared with the monsoon plough were compared with those worked with *guntaka* (blade harrow). It is needless to say that in the former, there will be soil inversion, (though only to a small extent), and greater penetration of the implement. It will be evident from the data in table III (a) that very little difference in yield exists between the two methods of preparing the land. The above conclusion is further corroborated by the data secured in another series of experiments, where the same set of plots were precultivated in the same fashion year after year for four consecutive seasons so that the cumulative effects of the treatments were left in them. It will be seen from their data (table III-b) that except in the year when sorghum was grown on the plots, no distinct differences were noticed between the yields of plots prepared either with *guntaka* or with the plough. This is in agreement with the observations made in parts of Bombay presidency (5), but is at variance with those reported in the Central Provinces (2) and at Nandyal Agricultural Research Station in Madras (4) where increased yields are recorded by the use of implements causing soil inversion. Russel (10) however, remarks that no difference will result between ploughing and grubbing, provided that these operations are done at the critical period.

TABLE III-(a). Comparison of ploughing and guntaka working.

(Yield in lb. per acre).

No.	Nature of treatment	1928–29 Cumbu	1928–29 Cotton	1929–30 Fodder cholam	1932–33 Cotton	1933–34 Fodder cholam	1934–35 Cotton
1	Ploughing	473	352	1891	595	5049	450
2	Working with guntaka	475	354	2151	608	5568	493
Critical difference		46	36	Not possible to work.	48	Not possible to work.	81
Conclusions		1=2	1=2		1=2		1=2
No. of replications		6	6	2	8	2	4

TABLE III-(b).

No.	Nature of treatment.	Permanent cultural experiments. 1935–36 Cumbu*	1936–37 Cotton	1937–38 Fodder cholam	1938–39 Cottom
1	Ploughing every year	274	231	2178	328
2	Working with guntaka every year	307	240	1950	351
	Critical difference	30	18	124	44
	Conclusions	2>1	1=2	1>2	1=2
	No. of replications	6	6	6	6

* Pennisetum typhoideum.

In a still another series of experiments ploughing was compared with no ploughing for four seasons (table IV). Much to our surprise, ploughing did not produce any increase in yield in any of these years. On the other hand, the treatment 'no ploughing' gave a significantly higher yield in one year (1935—36).

TABLE IV. Ploughing versus no ploughing. (Yield in lb. per acre).

(a) (b)

No.	Nature of treatment.	Koilpatti Agricultural Research Station. Cotton 34–35	35–36	36–37	37–38	Koilpatti Agrl, Res. Stn. Permanent cultural Fxpts. Cumbu 35–36	Cotton 36–37	Irungu Fodder 37–38	Cotton 38–39
1.	Ploughing	450	261	396	528	274	231	2178	328
2.	No ploughing	433	302	380	505	275	243	1917	347
3.	Working with Guntaka					307	240	1950	351
	Critical difference	81	38	19	65	30	18	124	44
	Conclusions	1=2	2>1	1=2	1=2	1=2 3>2 3>1	1=2 =3	1>2 1>3 2=3	1=2=3
	No. of replications	4	6	24	8	6	6	6	6

(c)

No.	Nature of treatment	District trials Kalukachalapuram Cotton 38—39	Kallupatti Cotton 1938—39
1.	Ploughing	280	512
2.	No ploughing	246	459
	Critical difference	39	37
	Conclusions	1=2	1>2
	No. of replications	8	6

A somewhat similar behaviour was noticed in the permanent cultivation experiments mentioned in the previous paragraph. They contained three treatments, viz., one ploughed every year with monsoon plough, the second not ploughed at all and the third worked with *guntaka* every year. In the 'not ploughed' plots, stubbles and weeds, if any, were handpicked and the

seeds were drilled and covered by *guntaka*, as in the other two treatments. When the data of the 'ploughed' were compared with those of the 'not ploughed' it is seen (table IV-b) that the yield levels of two treatments were similar except in one year when ploughing proved beneficial to the fodder cholam that was raised on them. No difference is also observed except in 1935—36, when the 'guntaka worked' and 'not ploughed' series were compared. It is plain from these that preparing the land either with *guntaka* or with monsoon plough is not an improvement over an undisturbed fallow. It may be stated here that these operations were performed at the normal time by experienced labourers who were actually farming their own lands before they were entertained on the agricultural station and as such the lack of difference could not be ascribed to any ignorance on their part in the art of ploughing.

Apart from these, two other experiments were carried out on farmers' lands in the nieghbouring villages on the advice of the agricultural demonstrators. Their data are set out in table IV-C. It will be seen there that in both cases, ploughed plots gave better results than not ploughed, but when analysed statistically one of them alone proved really more productive.

Now, these data relate to a number of crops for a number of seasons and point out definitely that preparatory cultivation practised on the black soils of Koilpatti farm needs reconsideration with regard to the desirability of discontinuing the superfluous operations with the ultimate aim of cutting down the cost of cultivation. Such a step will run counter to the age-long experience gathered on the effects of ploughing and will make all the farmers proclaim with one voice that there should be something wrong somewhere to get these unbelievable results. It can only be said that all precautions and care were taken in the layout and the conduct of the experiments and the agricultural operations were all done as stated previously by experienced men and at the normal time. It may also be pointed out that similar conclusions were arrived at by other workers. Ducker (6) cited an instance in the third conference of cotton workers held in London last September. He said that in Nyasaland, fields left without any cultivation till the planting time yielded as much as those receiving normal cultivation. Bradfield (3) remarked that we should look upon tillage operations, as we do a surgical operation, indispensable at times, but to be avoided whenever possible. Parbury (8) declared that annual cultivation is not good. Garner (7) stated that in Cambridge the effect of cultivation on yield was interesting since the same result was not obtained in two consecutive years and it would be better to plough in one year and to cultivate in another year. Workers at Rothamsted (11) concluded that cultivations in excess of those needed to produce a seed bed and to keep down the worst of weeds did not confer any further benefit and might even produce a reduction in yield, and that it was only where the soil conditions were very poor, it would be possible to produce a positive effect by cultivations.

An explanation for the strange results may perhaps be found if the purposes served by cultivation are examined. Every student of agriculture knows that preparatory cultivation is done in the tropics with a view to get a good seed bed, to facilitate easy penetration of rainwater and to produce tilth such that optimum conditions for plant growth prevail. Russell and Keen (11) state that according to Von Nitsch the fundamental usefulness of cultivation operation can be measured by the increase in the pore-space brought about during the growing season and that for every increase of one percent in the pore-space in the growing season, an increase of 2·5 to 3 percent in yield would result. One would infer from the negative results obtained at Koilpatti that the necessary requirements for a good seed bed and easy absorption of rain water exist in the heavy black soils and that the good tilth which is expected out of ploughing is not present there.

Now according to the recent findings obtained chiefly in U. S. S. R, a soil will maintain its tilth in good condition as long as soil aggregates remain without crumbling. The agents that destory the aggregates are cultivation, alternate wetting and drying, presence of injurious salts and also certain cropping systems. But it must be mentioned at the same time that when the land is ploughed at a critical period of moisture content (i. e. at what is called the sticky point), soil crumbs resistant to the action of water and implements are formed to the maximum extent and tilth is built up. It is only ploughing under dry conditions that shatter the aggregates to fine particles which block up the pores. On this basis it looks that ploughing the stubbles soon after harvest of the crop will be prejudicial to the formation of water resistant soil crumbs and that the practice of the farmer of the southern districts of Madras to wait for the rains to start ploughing seems to be sound in principle.

The failure of ploughing and grubbing to produce increased yields has, according to above statements, to be attributed either to the absence of any addition to the existing proportion of water-stable aggregates or to the non-stability of the particles that are actually produced during the process of cultivation. It is not known clearly which of the facts are really operative in the soils at Koilpatti. If it is the former, it will mean that the implements used are not performing the functions expected of them, and the cost of cultivation is being increased without any compensatory improvement in the soil. It may be perhaps worthwhile to test other implements with a view to select those that will lead to an increase of crop yields. If on the other hand the conglomerates formed by these implements are of such a transcient nature as to be easily destroyed by rains or by the sowing operations, it may connote that a state of equilibrium between the agencies in the soil favourable for the production of stable crumbs and the capacity of the implements has been reached possibly by the cumulative effects of the use of mould board ploughs for the past 25 years and that the addition of ameliorants like humus, lime or gypsum alone will bring about further improvement in soil structure. Or it may also mean that the soil condition

chosen at present for the working of the implements does not lie near the critical point, however much the labourers may be experienced in the choice of optimum periods for starting preparatory cultivation. At any rate, one point becomes evident from whatever angle the problem is looked at. That is the fact that we are not in possession of exact knowledge of the cardinal points of tillage, viz., the relationship between soil tilth and crop yield, and the type of implement that will bring about that relationship to the maximum level. If we are to make headway in the improvement of cultural methods accumulation of sufficient data on each aspect of pre-cultivation is a necessary pre-requisite. It is therefore incumbent on the part of all officers in charge of agricultural stations to examine how far the methods of preculti-vation prevalent in each tract are justifiable and remunerative and which operation can be safely omitted with no loss in yield and with an eye to reduce the cost of crop production. In addition, experiments are to be initiated with the object of determining the implements that can perform them in a shorter time with no fall in efficiency.

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SEA WATER FOR IRRIGATION

Sea water is made suitable for irrigation by replacing the cations and (or) anions it contains for cations and (or) anions having a fertilizing action by passing through a suitable ion exchange. A part of the salt may first be removed by other means. The exchange is treated with a mixture of NH_3 and KOH to regenerate the anions and with a mixture of H_3PO_4 and HNO_3 to regenerate the cations :— The *Punjab Agricultural College Magazine* Vol. 7. (January 1940).

SELECTED ARTICLE

Cold Storage and Transport of Tropical Fruits.

By C. W. Wardlaw, Low Temperature Research Station, Imperial College of Tropical Agriculture, Trinidad, B. W. I.

Introduction. Steady and continued success in the important work of transporting tropical fruits to overseas markets calls for information on very diverse subjects, beginning with biological aspects in the plantation and not ceasing until the exotic commodity is finally gratifying the palate of the consumer. I shall indicate those aspects of the problem which appear to be of greatest importance to the worker at the tropical end of, what is, in fact, a very considerable chain of operations.

Of the large number of attractive fruits native to tropical and sub-tropical regions, only a few have yet attained to commercial importance as export crops. Relative to citrus and bananas, all other tropical fruits though their production could be greatly extended, occupy a very minor place on temperate markets and for the most part are only retailed in small quantities and at high prices for the delectation of connoisseurs.

In addition to the tropical fruits occasionally offered on temperate markets there still remains a very considerable number of exotic fruits whose overseas transport has not yet been attempted, or been taken beyond the preliminary experimental stages. For this seeming neglect many reasons can be advanced, including demand (which must first be created by an extensive advertising campaign), competition with other fruits, chiefly temperate, difficulties of consistent production shipping and cold storage facilities and the need for special picking, the high degree of wastage at present inseparable from the handling of these delicate commodities. With a few notable exceptions, in fact, the transport of tropical fruits is still in its infancy. With the improvement of transport facilities it may be anticipated that this situation will to some extent be modified and that an increased variety of properly ripened exotic fruits will regularly be offered on temperate markets. Accordingly, a wide and interesting field of scientific inquiry still awaits appropriate investigation.

It will be evident that by far the greater amount of information at our disposal is based on those fruits such as grape fruit, oranges, and bananas which might now be described as "standard" commodities. Pineapples, limes, mangoes and avocados also find their way to temperate markets, but in comparatively small quantities, leaving a host of others which are seldom or never exported.

Importance of Research on pre-storage aspects. It not infrequently happens that those who are responsible for the inspection of imported tropical plant produce find themselves faced with fruits exhibiting various pathological symptoms of the type described as "physiological" or functional diseases. In the absence of information from the tropical, i. e. producing, end, the correct diagnosis of such diseases may well prove a matter of considerable difficulty. Moreover, as it has been established that certain types of functional disease are a direct result of cold storage, or of improperly regulated conditions in the refrigerated holds, the inspector of imported produce may easily be led off on a false trail, to find in the end that a correct solution is not possible on the information at his disposal, having meanwhile incidentally incurred the enduring enmity of the ship's refrigerating engineer, the accuracy of whose records and depositions he may have had occasion to doubt. Such difficulties can be avoided but only if the effects of

all the pre-storage treatments to which the fruit has been subjected are known and understood. In illustration of this aspect, two instances may be cited. If Trinidad citrus fruits (grape fruit, oranges and limes) are picked while still covered with dew or after rain, the fruits are so turgid that the smallest amount of handling causes mechanical injuries and liberation of oil, which in turn gives rise to the type of superficial blemishing described as "oleocellosis". Again, in Trinidad grape fruit treated with borax solution before crating as a means of controlling blue and green moulds, the effect of the fungicide is to promote the activities of the fungus *Colletotrichum glocosporioides* which is already present within the tissues as a latent infection. In its earlier stages the combination of borax injury and fungal activity yields blemishes whose appearance is suggestive of physiological injury. In both instances, the damage, which might easily be attributed to cold conditions during transport, are in no way caused by refrigeration. Bananas which have been cut too soon and held too long at tropical temperatures may become "stale" and tend to ripen during the overseas voyage. Here again a pre-storage and not a refrigeration factor is involved. Again, banana bunches which have hung too long on the tree because of poor growth conditions may appear suitable for harvesting, but may in fact have reached a maturity considerably beyond that which is desirable in fruit intended for overseas transport.

In general, pre-storage factors, environment, seasonal conditions, and plantation sanitation are important in determining intrinsic quality, keeping quality in storage, and wastage and must be given the same careful attention as those aspects which pertain directly to the subsequent refrigerated storage.

Harvesting Maturity. The question of harvesting maturity is specific to each kind of fruit, and criteria not infrequently of an arbitrary nature, have to be employed. To allow for the progress of ripening during transport and distribution, tropical fruits, as a rule, are picked somewhat immature. Thus the banana is reaped when it is still quite immature and green at stages described as three-quarters full', 'heavy three-quarters full' or 'full' according to the distance of the market for which it is intended. The necessity for harvesting fruits somewhat immature adds to the problems of the physiolgist, for whereas in some fruits the onset of ripening is indicated by well marked colour changes, in many others no colour change is apparent, and other means have to be devised in order that fruit shall be harvested at a constant maturity. With grapefruit and oranges, biochemical tests based on the percentage of total solids, and on the ratio of sugar to acid, have of necessity been adopted, particularly where early season fruit is being handled. The standards which have been found suitable in some countries, however, have not always proved rational or acceptable in others, and different local criteria have had to be devised. In different varieties of mango, it has been found convenient to use a morphological criterion of maturity, the relationship between the stem insertion and the degree of development of the 'shoulders' of the fruit (where growth is localized) being used for this purpose: otherwise in many of the best commercial varieties colour changes associated with ripening afford very little assistance indeed. Again, in green varieties of avocado, no good criterion of commercial harvesting maturity, other than a tentative ratio of fat content to the fresh weight, has so far been ascertained. In fruits such as the papaya, to illustrate another aspect of this problem it has been found that unless fruits show some evidence of yellow (ripening) colour on harvesting, they will not ripen properly later. In tomatoes, it is known that fruits picked when they show some pink coloration ripen to a product of superior quality than do those picked full grown but green. There is the further possibility that fruit harvested at different maturities may require different storage conditions.

Summarising these several points, it may be said that harvesting at the correct stage of maturity bears directly on the success with which subsequent refrigerated storage will be attended.

Rapid Cooling. As a rule, in handling tropical fruits, it is desirable that the time between reaping and placing them in cold storage should be curtailed to the minimum, as it is during the period of exposure to tropical temperatures that fungi make a rapid initial penetration which markedly affects the subsequent progress of rotting. As a rule the ripening of fully-grown fruits at tropical temperatures tends to be very rapid, after which senescence and fungal rotting quickly follow. Undue exposure prior to cold storage may therefore considerably shorten the anticipated storage life. This is particularly true of fruits such as the banana and mango. On the other hand, in grapefruit and oranges where changes take place more slowly the need is considerably less urgent from the point of view of preserving the quality of the fruit but still exists if fungal wastage is to be minimized.

While quick handling is usually desirable there are circumstances in which some delay is advisable. Thus, with citrus fruits which have been picked in a highly turgid condition, it is sometimes advisable as already indicated, that a quailing or curing period of suitable duration should be allowed to minimize the tendency to superficial bruising and the concomitant fungal wastage.

Preservation by Cold Storage. In the tropics, the past forty years have witnessed an increasing utilization of refrigeration for effecting the overseas transport of fruits and vegetables. Nor can it be doubted that there still remains a much wider field of usefulness for refrigeration. The very extensive and valuable industry in bananas from the west Indies, Central and South America has only been rendered possible through the provision of refrigerated shipping. The developing citrus industry, as also minor industries in mangoes, avocados, tomatoes, pineapples, passion fruits, and vegetables of different kinds, which can be produced abundantly and cheaply in the tropics, will in turn be largely, and in some instances, entirely, depend for their continued development and success on the provision of pre-cooling stations and of adequately equipped refrigerated ships. With regard to the latter it may be said that the absence of suitable transport facilities has been, and still is, the chief obstacle to the wider utilization of tropical produce on overseas markets.

It has been, that, if not held at suitably low temperature the ripening of tropical fruits and subsequent onset of wastage take place very rapidly. Accordingly, the problem is primarily one of arresting or retarding the progress of ripening without injuring the fruit. To do this to the best advantage it is essential that the physiological processes involved should be clearly understood. As the vegetable commodities under consideration are still alive, they require cold storage conditions which will permit of approximately normal though retarded maturation, so that the appearance, flavour, texture, aroma, and other qualities for which they are prized, will be preserved. The work of the investigator of fruit transport problems in the tropics, as elsewhere, is therefore principally physiological in nature, so that he may use to the best advantage the practical means which the refrigerating engineer has, or can, put at his disposal. In general, the equipment and design of refrigerated holds or cold stores for tropical fruits should be such as to permit of rapid cooling, the maintenance of steady temperature, humidity, and if necessary, gas concentrations optimal for the fruit in question.

Of recent years there has been a strong tendency to raise the storage temperatures recommended, this having been especially marked in the case of grapefruit where 'pitting' (chil blemishing) has in the past constituted a large proportion of

the wastage. Whereas formerly temperature below 40° F were frequently employed, the present tendency is to use 45° F. or higher. Such higher temperatures are important from the point of view of permitting two forms of wastage to occur at enhanced rates—blemishing due to desiccation and rotting by fungi. Further emphasis is thus put upon rapid cooling and higher humidity.

If an arbitrary and incomplete distinction may be drawn between 'cool storage' and 'cold storage', it will be found that the greater number of tropical fruits require to be carried in 'cool' storage (e. g. avocados, 45° F mangoes and tomatoes, 47·5° F. grapefruit. oranges and limes, 45 to 50° F. Gros Michel bananas, 53° F. Congo and Lacatan bananas, 56 to 58° F. papaws, 60° F., etc) if chilling injuries, are to be avoided. In that too low a temperature may give rise to specific types of physiological injury, to failure to ripen, and to loss of resistance to fungal pathogens already present in the tissues as latent or dormant infections, it will be apparent that the location of thermometers is of considerable importance, and the relationship which exists between the air delivery temperatures and those which are present in the vicinity of the fruit nearest the inlet must be known in order to avoid chilling. The constructional arrangements within holds or storage rooms must permit of uniform distribution of air and consequently of refrigeration. Provided fruit is charged into the holds in good condition, and at the correct stage of maturity its maintainance in good conditions is then the direct responsibility of the refrigerating engineer and indirectly of those responsible for the design and type of equipment installed.

In large fruit industries, with consistent all the year round production, as in the banana industry, whole fleets of ships are employed and refrigeration equipment, with minor variations, has become standardized, i. e., battery equipment permitting of rapid cooling and subsequently of a sufficiently rapid circulation of air at 53°F. in the holds. But with commodities where production is seasonal, adequately equipped shipping is not always available, and instances are known where, for example, grapefruit and oranges have had to be carried as non-refrigerated cargo or in grid-cooled holds, with concomitant danger of enhanced fungal wastage or the production of chilling injury. A major difficulty, where small consignments of fruits, e. g. mangoes, avocados, etc., have to be carried at special temperature, is that small refrigerated holds are seldom provided in the construction of the modern refrigerated ship.

From the purely commercial point of view, the smallness of the initial consignments offered, and the special temperature required by different commodities, present serious obstacles. Yet it is during those preliminary shipments when the fruit must be landed in such a state as to impress brokers and potential purchasers that special refrigeration service is most essential. The provision of some small refrigerated chambers, in addition to the larger refrigerated holds, would provide the ideal solution to this problem. In making this suggestion, it is realized that initial constructional costs would be considerably increased and that supervision of cargoes would also have to be extended.

Both in respect of the normal physiology of the fruit, and the biology of its pathogens, the maintenance of correct humidity relationships within the holds is of very considerable importance. This conclusion is drawn from a number of instances in which the questions of humidity and water-relations have presented themselves for consideration; it must be admitted, however, that no final statements of the exact conditions required in different instances can yet be made. But, in general, it may be said of relative humidity within holds or storage rooms; (a) that it should not be so low as to allow of serious loss in weight or modify the appearance and maturation of the fruit during the storage period; b) that it should not be so high as to promote the superficial growth of fungal hyphae; and (c) that localized condensation within the cargo stack must be

avoided. The question of the need for improved humidity control is now being urged on all sides by biologists ; in its physical and manipulative aspects it is also being closely studied by physicists and engineers, and there seems little doubt that the future will be marked by interesting and valuable innovations.

Special methods of packing may call for modifications in the internal arrangements of holds and in methods of stowage. Thus, whereas the 'naked' stowage of Gros Michel bananas permits of easy access of cold air to the individual fingers a very different situation arises in the case of the Congo (Poyo banana as presently exported in large quantities from French West Indian colonies. This variety, having a more delicate and easily bruised skin than the Gros Michel is carefully padded and packed in a double envelope of paper with an intermediate layer of straw. On being stowed, these packages, particularly when subjected to the weight of the superimposed fruit, tend to form a compact mass of cargo, with the result that the interstices by which air can pass may be greatly diminished. To compensate for this the present tendency is to deliver air to the holds at undesirably low temperatures, with the result that whereas centrally placed bunches may still remain inadequately refrigerated, marginal bunches tend to be chilled. It is open to doubt whether a vertical distribution of air would effect a sufficiently good penetration of each closely packed cargo.

With particular reference to delicate exotic fruits, very considerable possibilities lie in improved overseas transport through the use of (a) small, specially equipped ships plying frequently, and (b) transport by fast ships whereby higher storage temperatures could be employed, with the desirable result that the pristine qualities of the fruit would tend to be less modified than during more prolonged storage at lower temperatures.

Tropical Pre-cooling Stations and Cold Stores. In any agricultural scheme involving the handling of fruits and vegetables in large quantities, the rational application of refrigeration should not be neglected. So far, both as a means of conserving locally produced supplies for home consumption and to facilitate export industries, comparatively little use has been made of refrigeration in the tropics; with some notable exceptions, one cannot escape the impression that the possibilities of refrigeration have to a large extent been overlooked or neglected through lack of knowledge, or, in some instances, fear of the expenditure involved. Still, the ideas are gaining a foothold and the need for local pre-cooling and holding stations is beginning to be appreciated to an increasing extent. The special problems arising in relation to the planning, construction and equipment of cold storage accommodation adapted to different tropical conditions, and to local agricultural and social requirements, will undoubtedly provide great opportunities for refrigerating engineers in the not distant future. Here it should be emphasized that although the basic scientific principles are the same thoughout, the special conditions prevailing in different tropical regions present problems that cannot be satisfactorily solved by experience in temperate countries alone. Indeed, it would appear that there is ample scope for a commission to visit the tropics and to consider the special refrigeration requirements in respect of site, construction, insulation and equipment of the ideal pre-cooling and holding station. In this respect the Union of South Africa is giving a valuable lead which, one would like to see followed elsewhere.

In the humid tropics fruit that has been held in precooling station is liable to 'sweating' (i. e., condensation of moisture) during the period of transference to the ship's hold. In some instance, where ships are unable to come alongside, the commodity may have to be exposed for serveral hours. So far there is no definite evidence that fruit suffers to any marked degree as a result of the changes involved, e. g., sharp rise in temperature and deposition of moisture on the wrappers, provided such moisture is allowed to evaporate fairly rapidly on

shipboard, but it is evident that from the standpoint of the refrigerating engineer such arrangements are very unsatisfactory. These conditions are by no means uncommon in tropical ports. Although there is considerable scope for refrigerating engineers to devise ways and means of solving these special problems, it is probable that the expenditure involved would tend to be disproportionately high.

For the most part, ideas regarding the advantages of local cold stores are only now beginning to be appreciated in the tropics. As a rule the initial capital expenditure and high running costs, and the absence of refrigerating engineers to give the necessary supervision, are the factors which limit schemes whose operation would eventually benefit the whole community to an extent that would be difficult to assess. In this way the value of the short but highly productive cropping period, characteristic of many tropical crops, can be greatly increased, in that "glut" periods and their attendant low prices, can be eliminated, and produce of good quality can be made available over a very considerably extended period. The most economical use of local cold stores, where the harvest period for any one crop is short, is a matter for careful consideration by the authorities involved, departments of agriculture and planters in particular via co-operative marketing.

Post Storage and Ripening. When tropical fruits are removed from cold storage to higher temperatures, ripening takes place rapidly, and serious wastage may soon be sustained. To a considerable extent, the latter undesirable feature could be overcome by holding the fruit at a suitable temperature until required for actual consumption. In countries where refrigeration has been more or less thoroughly domesticated, such special post transport treatment is feasible and is, in fact, an established scheme. In many countries, however, refrigeration whether in warehouses or small stores, is still regarded as an unwarranted and additional expense; until some modification is made in this point of view considerable wastage must be expected during the retailing of delicate tropical fruits In brief, the outlook for exotic fruits on distant markets will be determined among other factors, by the extent to which the use of refrigeration become domesticated. The recent development in the United Kingdom of the retailing of frozen fruit and vegetables also points to the need for investigation of this method on tropical fruits.

Some fruits, in particular the banana, undergo special ripening treatment involving temperature and humidity control on being removed from the ships' holds: the improvements of ripening technique opens up a wide and useful field for physiological investigation.

Concluding Observations. To those who are occupied with questions pertaining to the storage and transpot of tropical fruits it becomes increasingly evident how extensive is the field that awaits the attention of the investigator. Problems such as those of the effect of volatiles, gas storage, transport of mixed consignments, quick freezing, etc., are practically or, in some instances entirely untouched.

Refrigeration applied to agricultural industries in the tropics does not stand alone but should be treated as an integral part of the general business organization of the community. Some words spoken by the President of the British Association of Refrigeration (1938) are apposite to the occasion: "If we are adequately to conserve our supplies, if we are to protect our agricultural heritage and if we desire to secure what has frequently been termed the quantitative regulation of market supplies of perishable foodstuffs, then it would seem to me that the science of refrigeration must be embraced to a much greater degree than it is to-day." *Journal of the Royal Society of Arts.*

ABSTRACTS

Influence of Boron on Flower-bud Development in Cotton—Holley K. T. & T. G. Dublin: *Jour. Agri. Res.* 59: (1939) 541-545. Experiments conducted at the Georgia Experimental Station emphasise the importance of boron in flower-bud development in cotton. The vegetative vitality of plants at different boron levels were not dissimilar till 8-9 weeks. The initiation of flower bud production also seemed independent of the boron levels. The flower buds of plants at lower boran level became chlorotic and were shed. In such plants, the vegetative buds were malformed at advanced stages of growth. (E. R. G.)

A further report on root forming substances used for propagation purposes:—M. A. H. Tinker, & C. H. Unwin: *Journal of the Royal Horticultural Society* XXIV: 554. Systematic experiments were carried out by the authors to test the efficacy of certain synthetic compounds and proprietary substances, reported to be beneficial in accelerating root formation in cuttings used for plant propagation. About seventeen substances were tested, using different concentrations and cuttings usually found refractory root formers. The most satisfactory substances were found to be (a) indolylbutyric acid and (b) napthyl acetic acid. Other factors found influencing root formation are the age of the parent, young tissues responding better; similarly lateral branches have proved superior to terminal cuttings. The presence of traces of vitamin B. (aneurin) in the salts used definitely accelerated root development. (E. R. G.)

Organic and inorganic manures—Their relative effectiveness—Sir John Russell, *The Scottish Journal of Agriculture*, Vol. XXII, page 319.

The oldest and best known method of manuring the land is to give it farmyard manure but the chief trouble is that there is not enough of it. Liebig suggested that the elements of plant food could be supplied by simple inorganic salts, known as artificial fertilisers. Lawes at Rothamsted showed how to do this in practice. The farmyard manure besides supplying the standard plant food, keeps up the supply of the organic matter in the soil, improves the physical properties of the soil, & influences the moisture content of the soil.

Claims are made that crops grown with farmyard manure are sometimes said to be healthier, more resistant to pests and diseases and of better nutritive value for animals and men than those grown with artificial fertilisers, but there is no evidence for these statements. In making comparisons, it is necessary that the artificial fertilisers should be complete, including not only the standard plant foods but also those special minor elements as boron, zinc, manganese, iron &c.

The following organic substances viz. poultry manure, guano, meat and bone manures, fish manures, oil cake manure &c., supply plant food and the nitrogen in some of them is better than in farmyard manure. Waste vegetable matter can be converted into a useful manure by composting. The essential features are that the supply of moisture, of nitrogen and of phosphate should be adequate for the micro-organisms.

Two sources of organic manure are, however, not yet sufficiently used in Great Britain—town refuse and sewage. Town refuse contains nearly as much nitrogen as farmyard manure. Sewage presents a more difficult problem as there is no good method of putting it on to the land—part can be returned as sewage sludge but most is lost. As a maker of manure the human being is almost devoid of agricultural value. (K. K. M.)

EXTRACTS

Care of growing pullets. Any special attention or care given to pullets during their growing stage will be well repaid by greater production when they come into profit. The main points in management which ensure profitable pullets are: Perching early, separation of sexes, small units feeding, and sanitation. Pullets should be taught to perch as soon as possible after they have been removed from the brooder. The earlier they become accustomed to perching, the more they spread at night. This prevents crowding and ensures a good air supply for all. The separation of sexes as soon as the males can be distinguished, gives them a much better change of making good development. Small units also assist in their development and decreases the percentage of stunted pullets, which is the usual result when large numbers are housed together. It is advisable not to house more than 100 pullets in any one unit.

Feeding also is important. The ration should be correctly balanced and the birds given as much food as they will eat. The birds should be given as much mash as they consume in about 20 minutes; if they require more, it should be supplied. It is advisable to give two meals of wet mash, one early in the morning and the other at midday. In no circumstances, should wet mash be left lying about as it sours rapidly and puts the birds off their food. Dry mash hoppers should be kept well filled and always open. The feeding troughs of both systems should be long enough to provide ample feeding space. Lack of sufficient feeding space is a very common error in dry mash feeding. At least one foot of space should be allowed for each ten birds.

Green feed may be supplied with the midday meal, unless the birds have access to a well-grassed run. Wet mash should form the bulk of the midday meal unless the dry mash method is used. In dry mash feeding a small quantity of mash mixed with the greens will tend to increase the consumption of greenstuff. As an evening meal, the pullets should be given as much grains as they will consume.

Clean, cool, fresh water should always be supplied daily, and the drinking vessels should be kept in a shaded position. Coarse sand, shell grit, and charcoal should always be available and kept in suitable containers. Each of these materials has an important influence as an aid to digestion and assimilation of food, and is therefore, invaluable in maintaining health in the flock.

Sanitation also is important and covers the regular cleaning of pullets pens. Wet patches should not be allowed to surround the drinking vessels, and the treatment of perches with creosote to prevent an invasion of blood-sucking parasites should not be overlooked. (*Queensland Agri. Jour.* Vol. 52: October 1939.)

A method of weed Eradication. Under the title, "Biological Eradication of Kans (*Saccharum spontaneum*) in field patches" G. C. Lambe and Y. D. Wad of the Institute of Plant Industry, Indore, Central India, draw attention to what appears to be a simple and efficient method of eradicating troublesome weeds (*Agric. and Livestock in India*, 8, Pt, IV). The method adopted was to cover, by means of thick mulch of green material such as sunn-hemp, green grass or even green weed growth removed from fields, the patches of land overgrown with the particular weed desired to be destroyed, and allow the mulch to remain through the rainy season. At the end of this period it is found that the decomposing green materials had acted on the root system of the weeds under the rotting cover green mantle and had effectively killed it. In addition to such destruction, the treated land is also said to have increased in fertility. Wheat and cotton grown

on such treated plots gave significantly higher yields than the controls and in the case of wheat the quality also greatly improved. The improvement related mainly to the total nitrogen and gluten content which were 2·07 and 11·53 per cent respectively as against 1·65 and 8·04 per cent in the control.

The treated plots showed a higher content of organic matter in the upper zones of their soils than the controls and it is surmised that the better quality of the wheat in the treated plots may be due to this increased organic matter content. The essential feature of the method is the use of green material as such in contradiction with dry material like straw or *bhusa* which are found to be ineffective. The method deserves to be tried in the case of other difficult weeds such as the *Hariali* grass (*Cynodon dactylon*) of the black cotton soils, a weed which greatly reduces cotton yields and involves much cost and labour to eradicate and is seldom permanently removed even then. The touch-me-not. (*Mimosa pudica*) is another such weed against which cultural chemical and other methods are in practice out of the question and a suitable adaptation of this new method deserves a trial. (*The Planters' Gazette and Annual*).

Treatment of Seed Maize. The difficulty often experienced in obtaining satisfactory crop stands more particularly in the early sowings of maize because of crows and currawongs developing an appetite for germinating grain and seedling plants-can be largely overcome by adopting the undermentioned pre-seedling coal tar method of seed treatment.

The procedure is as follows:— Warm a small quantity of coal tar slowly until it tests to a string like horse hair consistency. Place the seed maize in a large shallow vessel and wet it with warm water for a few minutes and then drain. Spread over the warm moistened grain 1½ to 2 tablespoonfuls of prepared tar per bushel and stir immediately and continuously until each kernel comes in contact with the tar and assumes a sooty appearance. Spread the grain out and expose it to dry. The addition of a handful of sulphur to each bushel of grain will assist in a smooth run through the planter. (*Queensland Agri. Jour.* 52: October 1939.)

Wanted a Dictator ? "India needs a dictator". This has been repeated in our hearing again and again that we have been forced at least to consider whether such a statement has any truth in it. The more we consider it however, the more we feel inclined to agree with it. For, as we look around us, we see that the progress is too slow. In Agriculture, and we believe, in most other matters, India seems to need a strong hand. Crops in Government farms or in farms connected with agricultural institutions seem definitely to be superior to the crops of the villagers just across the road. But many of these villagers do not seem to want to change either their seeds or their methods of cultivation both of which having been handed to them by their fathers and their grand-fathers. A cow in an agricultural institution may be giving 40 to 50 lbs. of milk a day, but that of the villagers is only giving 4 to 5 lbs. per day; yet how many of such villagers are seriously considering the improvement of their cows by careful breeding and selection. A man using modern implements can now easily take care of 20 to 50 acres of land, whereas one using a *desi* (country made) plough can take care of 5 to 10 acres only. Can any one, therefore, deny the fact that if a strong hand is used the progress in our rural areas would be much more rapid than it is now? The above, however, do not seem to us to be so pressing as some other problems in agriculture.

One of the things we would like to see the Government authorities adopt as part of their immediate programme is the control of erosion. It has been pointed

out again and again that erosion is robbing our nation of our very life blood as this process impoverishes the soil to such an extent that a field once considered to be rich is sooner or later depleted of its fertility. In order, therefore, that the Nation be no longer robbed of its heritage given to us by God, we plead that this waste in the form of soil carried down to the ocean be stopped at once. A country-wide survey of agricultural lands in the province in order to find out where immediate steps should be taken to prevent this loss is, to our minds very necessary for not only keeping up the fertility of our lands, but also for reclaiming those that are almost beyond hope of any possibility for reclamation. Such steps, we have no doubt, will help to increase the productive power of the agricultural lands in this country, a thing sorely needed when a good part of our agricultural population go from one day to another without sufficient food. For it is indeed painful to see, as one goes around in these provinces, the dreadful loss that is caused to the country by man's attitude of indifferecne to one of the most important factors of production, namely, land. Lands that should be capable of producing the best kind of wheat that there is anywhere in the world is now only capable of producing *Bajra*, a millet, so poor that it does not even pay the cost of producing it. Some lands have been rendered almost completely useless by erosion that only grasses of the very poorest kind would now grow on them. It is high time, therefore, that something more be done about it sooner or later, besides the very feeble attempts made by the Forest departments for attacking this very serious problem. (*The Allahabad Farmer* Vol. XIII No. 2 March 1939 pages 53 to 55).

Gleanings.

Paradichlorobenzene. News of a really effective insecticide is always welcome to those plagued with *poochies*,* as most of us are in South India. In spite of its formidable name,—Paradichlorobenzene is a simple white crystal substance easy to handle. It is much stronger than napthalene and smaller quantities are required. Not only does it keep away insects, but we learn it actually destroys their eggs and larvae. To prevent too rapid evaporation it may be placed in small cloth bags, or else in wide neck bottles or cigarette tins with holes punched in their lids, and then kept in cupboards, almirahs, etc. We understand that paradichlorobenzene is put up in 1 lb. and 5 lbs. by the Imperial Chemical Industries. (*The Planters' Chronicle*, Vol, XXXI, No. 24).

Use of Blood as a Fertiliser. Blood is fairly rich in nitrogen, but requires to be decomposed before being added to the soil. If in a liquid condition, the blood should be absorbed in sand, soil or litter, and made into a compost with soil and manure or any waste vegetable material, such as leaves, lawn clippings, etc., which may be available.

If the blood is clotted it should be broken up and made into a compost in the same way. The compost should be protected from rain and forked over from time to time. At the end of a couple of months, it should be well dug into the soil where it will supply nitrogen in a readily available form. *Agri. Gaz.* Vol. 50: (November 1939).

Mange in Pigs. Caused by a minute, worm-like mite which lives in the hair follicles and sweat glands of the skin, the condition described as demodectic mange in pigs is one which the pig raiser ought to know all about because its presence sometimes results in the degrading of carcases, especially of those submitted for export. The mites are microscopic in size, measuring only one hundredth of an inch in length. The lesions of demodectic mange first appear,

* Tamil word for insects. Ed. M. A. J.

as a rule on the snout, eyelids, elbows, and knees. In the initial stage the areas attacked have a reddened, scurfy appearance with numerous small, hard nodules scattered over them. These become infected with bacteria and begin to ooze pus and serum. The disease gradually spreads over the throat, breast, abdomen, and elsewhere where the skin is soft and thin. In its early stages, demodectic mange may be checked by frequent applications of crude oil. The disease, however, is very difficult to cope with, and once it appears, it is best to get rid of infected animals and to isolate all other animals which have been in contact with them for at least a fortnight. In addition, the sites should be cleaned out thoroughly with boiling water and soda and then disinfected. *Queensland Agri. Jour.* October 1939.

Crop & Trade Reports.

Subject:—Statistics—Crop--Sugarcane—1939—Third or Final Report. The average of the areas under sugarcane in the Madras Province during the five years ending 1937-38 has represented 2·8 per cent of the total area under sugarcane in India.

The area planted with sugarcane up to 25th December 1939 is estimated at 132,010 acres. When compared with the corresponding estimate of 96,930 acres for the previous year and the actual area of 98,262 acres according to the Season and Crop Report, the present estimate reveals an increase of 36 2 per cent and 34·3 per cent respectively. The estimate of the previous year fell short of the actual area by 1·4 per cent.

The present estimate of area exceeds the second forecast by 9,270 acres. The excess occurs mainly in Vizagapatam, Kistna, Salem, Coimbatore and Trichinopoly.

The increase in area in comparison with the actual area of 1938 as per Season and Crop Report occurs in all districts outside Tinnevelly and Malabar and is attributed to favourable prices prevailing for jaggery. The increase is marked in Vizagapatam (plus 4180 acres), Bellary (plus 5,050 acres), South Arcot (plus 3,780 acres) and the Central districts (plus 16,450 acres). The area estimated for Bellary, Cuddapah, South Arcot, Coimbatore, Trichinopoly, Tanjore and South Kanara is the highest reported in recent years The present estimate includes an area of 6,700 acres under ratoon sugarcane in the districts of Vizagapatam (800 acres), East Godavari (3,000 acres), West Godavari (700 acres), Bellary (700 acres), Chingleput (80 acres), South Arcot (400 acres), Chittoor (1,000 acres), Coimbatore (100 acres), Trichinopoly (590 acres). Tanjore (200 acres) and Malabar (20 acres).

5. The harvest has just commenced and yields below normal are expected in all districts outside Anantapur, Cuddapah, Nellore, Salem, Madura and Ramnad where the yield is expected to be normal. The seasonal factor for the Province is estimated at 95 per cent of the average as against 97 per cent in the previous year according to the Season and Crop Report. On this basis, the yield is estimated at 358,140 tons of jaggery as against 261,130 tons estimated in January 1939, an increase of 37·2 per cent and as against 273,860 tons, estimated in the Season and Crop Report of the previous year, the increase in this case amounting to 30·8 per cent.

The wholesale price of jaggery per imperial maund of 82 2/7 lb. (equivalent to 3,200 tolas) as reported from important markets on 22nd January 1940 was Rs. 9—14—0 in Adoni, Rs. 7—2—0 in Vizianagaram, Rs. 7—1—0 in Erode, Rs. 6-14-0 in Chittoor, Rs. 6—6—0 in Mangalore, Rs. 6—1—0 in Cuddalore, Rs. 5—15—0 in

Vizagapatam, Rs. 5—14—0 in Coimbatore, Rs. 5—12—0 in Cocanada, Rs. 5—9—0 in Rajahmundry, Rs. 5—2—0 in Bellary and Vellore, Rs. 4—15—0 in Salem, and Rs. 4—7—0 in Trichinopoly. When compared with the prices published in the last report, i. e., those which prevailed on 4th December 1939 these prices reveal a rise of approximately 12 per cent. in Coimbatore and Mangalore, two per cent. in Erode and one per cent. in Vizianagaram and a fall of approximately 35 per cent in Vizagapatam, 34 per cent. in Salem, 31 per cent. in Trichinopoly, 29 per cent. in Vellore, 27 per cent. in Bellary, 23 per cent. in Rajahmundry, 19 per cent. in Cuddalore and 12 per cent. in Cocanada, the prices remaining stationary in Adoni and Chittoor.

Subject :—Statistics—Paddy 1939—40.—Final forecast Report. The average of the areas under paddy in the Madras Province during thefive years ending 1937—38, has represented 13 4 percent of the total area under paddy in India.

The area sown with paddy in 1939—40 is estimated at 9,614 000 acres as against 9,943,000 acres for the corresponding period of the previous year and the finally recorded area of 9,844, 388 acres in 1938-39. The present estimate falls short of the final area of the previous year by 2·3 per cent and of the area of 10,200,160 acres in a normal year by 5·7 per cent.

1,128,000 acres have been reported as sown since the last December forecast was issued. The extent so sown was large in the South (320,000 acres), the Circars (244,000 acres), the Central districts (235,000 acres) and South Arcot (133,000 acres). The area sown in December and January was greater than that sown in the corresponding period of the previous year by 165,000 acres or by 17·1 per cent.

The area under second crop paddy is expected to be below normal, though slightly greater than last year, owing to the failure of rains in December and January.

The harvest of the main crop of paddy is in progress.

The crop was affected to some extent by the heavy rains and floods in November 1939 in parts of the districts of East Godavari, West Godavari, Kistna and Tanjore. The crop was also affected to some extent by drought in the other important paddy growing districts outside the West Coast. Attacks by insects have been reported from parts of the districts of North Arcot and Tanjore. The yield is expected to be normal in Kurnool, Bellary, Cuddapah, Salem, Madura, Malabar and the Nilgiris and below normal in the other districts. The seasonal factor for the Province works out to 93 per cent of the average as against 83 per cent in the Season and Crop Report of the previous year. On this basis, the yield works out to 89,258,000 cwt. of cleaned rice. This represents an increase of 7,253,000 cwt., of cleaned rice or 8·8 per cent when compared with the estimate of 82,005,000 cwt., of cleaned rice in the Season and Crop Report of the previous year. The yield in an average year is estimated at 102,007,000 cwt. of cleaned rice.

The wholesale price of paddy, second sort, per imperial maund of 82 2/7 lb. (equivalent to 3,200 tolas) as reported from important markets on 12th February 1940 was Rs. 2—14—0 in Tinnevelly, Rs. 2—13—0 in Rajamundry, Rs. 2—12—0 in Vizianagaram and Chittoor, Rs. 2—11—0 in Virudhunagar, Rs. 2—9—0 in Ellore Guntur, and Madura, Rs. 2—8—0 in Bezwada, Vellore and Hindupur, Rs. 2—7—0 in Cocanada, Rs. 2—5—0 in Cuddalore and Trichinopoly, Rs. 2—4—0 in Anantapur and Conjeevaram Rs. 2—0—0 in Kumbakonam and Rs. 1—15—0 in Nagapatam When compared with the prices published in the last report, i. e., those which prevailed on 8th January 1940, the prices reveal a rise of approximately 13 per cent in Conjeeveram, eight per cent in Guntur, five per cent in Vizianagaram, Rajahmundry, Ellore, Hindupur and Tinnevelly and three per cent in Bezwada

and a fall of aproximately 23 per cent in Anantapur, 20 per cent in Kumbakonam, 15 per cent in Madura, 10 per cent in Chittoor, five per cent in Vellore, three per cent in Cocanada, Trichinopoly and Nagapatam and two per cent in Virudhunagar, the prices remaining stationary in Cuddalore.

Sub:—Statistics—Crop—Gingelly—1939-'40—Intermediate condition report. Sowings of late gingelly are in progress in most districts and the germination is fairly good.

The wholesale price of gingelly per imperial maund of 82 2/7 lb. (equivalent to 3,200 tolas) as reported from important markets on 5th February 1940 was Rs. 7—8—0 in Cocanada, Rs. 7 in Vizagapatam, Rs. 6—14—0 in Tinnevelly, Rs. 6—9—0 in Trichinopoly, Rs. 6—8—0 in Vizianagaram, Rs. 6—6—0 in Salem, Rs. 6—3—0 in Tuticorin, Rs. 6—1—0 in Ellore, Rs. 5—15—0 in Rajahmundry and Cuddalore. When compared with the prices published in the last report, i. e., those which prevailed on 8th January 1940, these prices reveal a rise of approximately 17 per cent in Salem, 15 per cent in Tinnevelly, and 11 per cent in Trichinopoly and a fall of approximately 6 per cent in Ellore and 5 per cent in Vizagapatam and Rajahmundry, the prices remaining stationary in Vizianagaram, Cocanada, Cuddalore and Tuticorin.

Cotton Raw, in the Madras Presidency. The receipts of loose cotton at presses and spinning mills in the Madras Presidency from 1st to 9th February 1940 amounted to 2,847 bales of 400 lb. lint as against an estimate of 366,800 bales of the total crop of 1939--40. The receipts in the corresponding period of the previous year were 4,785 bales. 4,689 bales mainly of pressed cotton were received at spinning mills and 431 bales were exported by sea while 324 bales were imported by sea from Karachi.

Market Reports

TIRUVOTTIUR MILCH CATTLE MARKET

Market Report No. 3 of 1940.

Madras, Friday the 19th January 1940.

Due to Pongal festival, the arrivals of milch cattle were very poor at the market and consequently there was no brisk trade in either cows or buffaloes. Prices remain stationary.

The stock movements were as follows;—

	Stock at Commencement.	Arrivals during the week.	Sale during the week.	Balance at end.
Cows-Ongole	150	49	81	118
Buffaloes-country	109	55	58	106

Prices,

Age.	Milk yield.		Prices ranging From	To
			Rs.	Rs.
Cows-Ongole				
1st and 2nd calving	2—3	Madras Measures	80	90
	3—4	,, ,,	90	120
3rd and 4th calving	2—3	,, ,,	70	80
	3—4	,, ,,	80	100
Buffaloes-country				
1st and 2nd calving	2—3	,, ,,	55	70
	3—4	,, ,,	70	100
3rd and 4th calving	2—3	,, ,,	50	60
	3—4	,, ,,	60	80
Others				
Cows-cross-bred			130	180

Market Report No. 4 of 1940.

Madras, Friday the 26th January 1940.

The Pongal festival being over, the market has regained its activity with increased arrivals and sales of stock. Cows are in better demand due to slight improvement in fodder supply. Prices especially of cows have an upward tendency.

	Stock at Commencement.	Arrivals during the week.	Sales during the week.	Balance at end.
Cows-Ongole	118	150	100	163
Buffaloes-Country	106	196	111	191

Prices.

Age.	Yield of milk.	Prices ranging. From	To
		Rs.	Rs.
Cows—Ongole			
1st and 2nd calving	2—3 Madras Measures	85	95
	3—4 ,, ,,	95	125
3rd and 4th calving	2—3 ,, ,,	70	80
	3—4 ,, ,,	80	100
Buffaloes—Country			
1st and 2nd calving	2—3 ,, ,,	55	70
	3—4 ,, ,,	70	100
3rd and 4th calving	2—3 ,, ,,	50	60
	3—4 ,, ,,	60	80
Others.			
Cows-cross-bred		No stock.	

Market Report No. 5/40.

Madras, Friday the 2nd February 1940.

Country buffaloes continued to arrive in large numbers and the stocks of both cows and buffaloes at the market have increased. Due to heavy arrivals, the prices of buffaloes have slightly decreased.

The following gives the stock movements during the week ending 2nd February 1940.

	Stock at commencement	Arrivals during the week	Sales during the week	Balance at end
Cows...Ongole	168	146	137	177
Buffaloes...Country	191	208	169	230

Prices.

Age	Yield of milk	Prices ranging From	To
		Rs.	Rs.
Cows-Ongole.			
1st and 2nd calving	2—3 Madras Measures	85	95
	3—4 ,, ,,	95	125
3rd and 4th calving	2—3 ,, ,,	70	80
	3—4 ,, ,,	80	100
Buffaloes-Country			
1st and 2nd calving	2—3 ,, ,,	50	65
	3—4 ,, ,,	60	95
3rd and 4th calving	2—3 ,, ,,	45	55
	3—4 ,, ,,	55	75
Others.			
Cows-cross-bred		130	180

Market Report No. 6/40.

Madras, Friday the 9th February 1940.

The arrivals of cows and buffaloes continued to be good during the week and better type of cattle are now available at the market than in the previous weeks. Prices are stationary.

The following gives the stock movements during the week ending 9th February 1940.

	Stock at Commencement.	Arrivals during the week.	Sales during the week.	Balance at end.
Cows-Ongole	177	167	144	200
Buffaloes-Country	230	179	179	230

Prices

Age		Milk yield.	Prices ranging. From	To
			Rs.	Rs.
Cows-Ongole				
1st and 2nd calving	2—3	Madras Measures.	85	95
	3—4	,, ,,	95	125
3rd and 4th calving	2—3	,, ,,	70	80
	3—4	,, ,,	80	100
Buffaloes-Country				
1st and 2nd Calving	2—3	,, ,,	50	65
	3—4	,, ,,	65	95
3rd and 4th calving	2—3	,, ,,	45	55
	3—4	,, ,,	55	75
Others				
Cows-cross-bred			130	180

Market Report No. 7/40.

Madras, Friday the 16th February 1940.

The arrivals of cows from the Ongole tract have slightly declined while buffaloes have arrived in more numbers. Better type of cattle are still available at the market and prices are stationary.

The following gives the stock movements during the week ending 16th February 1940.

	Stock at Commencement.	Arrivals during the week.	Sales during the week.	Balance at end.
Cows-Ongole	200	105	110	195
Buffaloes-Country	230	147	130	147

Prices.

Age		Milk yield	Prices ranging From	To
			Rs.	Rs.
Cows-Ongole.				
1st and 2nd calving	2—3	Madras Measures.	85	95
	3—4	,, ,,	95	120
3rd and 4th calving	2—3	,, ,,	70	80
	3—4	,, ,,	80	100
Buffaloes-Country.				
1st and 2nd calving	2—3	,, ,,	50	65
	3—4	,, ,,	65	95
3rd and 4th calving	2—3	,, ,,	45	55
	3—4	,, ,,	55	75
Others.				
Cows-cross bred			130	180

(1 Madras Measure of Milk = 4 lb.)

College and Estate News.

Students' Corner;— *Students' Club activities:--Games:*— The following inter-tutorial cricket matches were played:— C. R. Srinivasa Ayyangar's wards won against P. V. Ramiah's wards. C. R. Srinivasa Ayyangar's wards put up a total of 155 runs, Krishnan 53, M. R. M. Punja 44, S. V. Srinivasan 5 for 74. P. V. Ramiah's wards gathered 83 runs, M. Ali-khan 54, K. S. Ramaswami 14, M. R. M. Punja 5 for 21.

K. M. Thomas' wards won against C. Narasimha Ayyangar's wards. K. M Thomas' wards—70 for 4, Shankara Rao 31 and T. Chellappa 14. C. Narasimha Ayyangar's wards were all out for 60, Narasimhamurthi alone reaching double digits—13,—K. M. Somanna 6 for 14.

C. R. Srinivasa Ayyangar's wards won against K. M. Thomas' wards by 11 runs. C. R. Srinivasa Ayyangar's wards 142, Krishnan 84, Bhaskara Reddy 23 and Maduram 17, Somanna 6 for 57, Kamath 3 for 37. K. M. Thomas' wards—131. Nageshwara Rao 20, T. Chellappa 24. Somanna 62, M. R. M. Punja 4 for 24, Bhaskara Reddy 2 for 11.

Club Day Victory Cup Tournament. *Foot-Ball*:—In this series, the first match was played between B. Sc. III and B. Sc. II in which the former won by 2 goals to 1.

The third years were subsequently defeated by 1st years by 1 goal to nil.

Hockey. Class III lost to class II in their first encounter by 1 goal to 3. The 1st years were defeated by IInd years by 1 goal to 2.

Cricket, B. Sc. III was defeated by B. Sc. II:— IIIrd years were all out for 76, Ayyappa 15, Srinivasan S. V. 4 for 43, and Bhaskara Reddy 3 for 3.

IInd years—107 for 8, S. V. Srinivasan 46, Kamath 27 not out.) The second years then met the 1st years and won by a margin of 32 runs. IInd years—123, Koulatlayya 31 not out, S. V. Srinivasan 19, Somanna 16, Radhakrishnan 6 for 56, 1st years—91, Krishnan 33, Shankera Rao 21, S. V. Srinivasan 17 for 33, Somanna 3 for 23. The Second years thus won the Victory cup for the year.

Other cricket matches. A friendly cricket match was played on 28—1—40 between C. Ramaswami's Eleven and Palghat Eleven at the Agricultural college grounds. Batting first, C. Ramaswami's Eleven scored 234 for 7 and declared their innings. C. Ramaswami 48, S. V. Srinivasan 108 retired. Padmanabhan 38. Rammohan 3 for 11, Narayanan 2 for 59.

The Palghat Eleven were all out for 158. Raghavan, P. M. 42, Ramamohan 21, Madhavan 21, Mukunda Rao 23, S. V. Srinivasa 4 for 41, Mukundan 2 for 8, C. Ramaswami 2 for 25.

The Agricultural college cricket team from Coimbatore captained by C. Ramaswami met and defeated the Salem Gymkhana by 35 runs on 11—2—40. The match was played on Manor House compound. Salem Gymkhana 142, MacHatton 37, K. N. Venkatachari, 28, T. Spittler 23, Kothandaraman 6 for 42, Somanna 2 for 29, Srinivasan S. V. 2 for 24.

Agricultural College 177, Babu, C. N. 53, C. Ramaswami, 46, R. Natesan 3 for 29, R. Spittler 3 for 64, R. Manickkam 2 for 24.

University Extension lectures. These lectures are arranged by the University of Madras for the benefit of rural workers engaged in social amelioration. A course of three lectures was delivered by Dr. J. J. De Valois, B. Sc., Principal, A. A. M. Agricultural Institute, Katpadi, at the Freeman Hall, Agricultural College, Coimbatore on the 26th and 27th of January 1940 Mr. R. C. Broadfoot presided

over the lectures. The subjects of the discourse were (1) Rural youth organisation (2) Rural Education and (3) The University and Rural life. The Lectures were illustrated with cinema films depicting the activities of 4 H—clubs and other social organizations in the United States of America.

M. Sc Degree:— We are glad to note that the University of Madras has conferred the degree of M. Sc., on Mr. S. Sundaram B. A., B. Sc., Ag. Cotton Assistant, Koilpatti for his thesis on "The harmful effects of fodder cholam on the succeeding cotton crop". We offer our congratulations to Mr. Sundaram.

Agricultural College Officers' Club. *In the General body meeting held on* 20—2—40, the following office bearers were elected for the year 1940.

Sri. T. S. Ramasubramaniam,	President.
„ P. D. Karunakar	Vice-President,
„ P. Krishna Rao,	Secretary.
„ Balasubramania Mudaliar,	Treasurer.
Messrs. M. A. Sankara Ayyar, C. S. Krishnaswami and C. V. Nagarajan,	Committee Members.

Obituary.

The late Mr. S. Subramania Ayyar, We are sorry to record the sad demise at Kumbakonam of Mr. S. Subramania Ayyar, a retired member of our Department, Born in September 1873, he entered Government service on 9th October 1894 and served the department till 1927 for a periof of 33 years. He served for sometime (1919—1921) as an Assistant Director of Agriculture at Bellary.

We express our heartfelt condolences to the members of the bereaved family.

Mofussil News and Notes.

Anakapalle. Honey Week Celebration at the Agricultural Research Station, was celebrated with great enthusiasm and *eclat* on Sunday the 21st January 1940. An instructive show of all available bee-keeping appliances was put up, and Sri M. Lakshmikantam, B. Sc. (Ag.) staged a bee-keeping demonstration, followed by a lucid talk on "Apiculture as a successful cottage industry" The assembled agriculturists and 'elite' of the town appreciated the show, and evinced great interest in it. The meeting terminated with a discourse by the Superintendent Sri. K. Venkataraman, M. A.

K V

Bezwada. At the invitation of Mr. P. Govinda Rao, B. Sc. Ag., Mycology Assistant in charge of the citrus disease control work at Bezwada, a meeting of citrus growers in the Bezwada taluk was held at the Pattamata library on Monday, the 29th January 1940. Over thirty growers were prensent. Mr. K. M. Thomas, Government Mycologist, Coimbatore addressed the gathering on the nature of the Citrus root disease occuring in the Kistna and Guntur districts, the pre-disposing causes and the methods of prevention and Control. This was followed up by a speech by Mr. Govinda Rao who explained to the audience the object of the new scheme of work started at Bezwada and the extent to which Government are prepared to help the growers. Mr. P. L. Narasimham, Agricultural Demonstrator, Bezwada also spoke and explained to the growers the advantages to be accrued from a general adoption of the control measures advocated. A discussion followed as a result of which most of the garden

owners signified their willingness to adopt the measures and a dozen, offered to give their gardens for purposes of demonstration. The method of treatment now followed consists in the following :—

(1) Adoption of ring irrigation in place of flood irrigation.
(2) Cutting of drainage channels across the gardens.
(3) Examining the crown of roots and excision of diseased roots;
(4) Application of Copper sulphate incorporated around the trunk.
(5) Scraping of cankers on the roots and trunks and application of creosote oil.

and (6) Covering wounds on roots stem and branches with shelmac P G. R.

Cocanada. An Agricultural Exhibition was held at Cocanada on a large scale from 20th to 22nd January 1940 by the Horticultural Exhibition Society. Various exhibits from the Agricultural Research Station at Samalkot and Maruteru and from the Agricultural Demonstrators in the division were obtained and exhibited. Entomological and Mycological specimens bee hives and honey were also exhibited by the Assistant to the Government Entomologist, of Samalkot. Lectures on various aspects of gardening and methods of propagation of fruit, and flower and vegetables were also delivered. D. H. R.

Kodur. The Kodur Chinese Grader which was recently devised at this Station with the help of a grant from the Marketing Section was demonstrated to the growers in a number of gardens by the Kodur Fruit Growers' Association. The usefulness of this cheap machine (costing less than Rs. 50) in grading sweet oranges has now been established, and the Association has already placed an order for the supply of two new machines. K. C. N.

Vadalur. An Agricultural Exhibition was held at Vadalur (Cuddalore Taluk) the resting place of Ramalinga Swamigal, during Thaipusam festival which attracted large crowd from South Arcot and the neighbouring districts. Lectures with the aid of magic lantern were delivered by Agricultural and Health Departments on this occasion. K. S. K.

28th. Indian Science Congress, Benares, January 1941.

Discussions in the Agricultural Section.

An announcement.

The Agricultural Sectional Committee proposes to hold Discussions on the following subjects during the next Session of the Indian Science Congress to be held at Benares early in January 1941. Scientific workers in India who desire to contribute papers to the above Discussions are requested to communicate with the undersigned. The Rules of the Indian Science Congress Association require that authors of such contributions should be members of the Association of some category.

Discussions.

1. Drought Resistance in Plants:
2. The need for the exploration of wild forms for the improvement of crops.
3. Quality in crops.

10th February 1940.
Indian Institute of Science,
Hebbal P O, Bangalore.

C. N. Acharya,
Recorder,
Agricultural Section.

Weather Review—JANUARY 1940.

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	−0·23	0·0	South	Negapatam	0·0	−1·68	0·0
	Calingapatam	0·0	−0·29	0·0		Aduthurai*	0 15	−3·5	0·15
	Vizagapatam	0·0	−0·46	0·0		Madura	0·0	−0·60	0·0
	Anakapalli*	0·0	−0·27	0·0		Pamban	2·2	+0·07	2 2
	Samalkota*					Koilpatti*			
	Maruteru*	0·0	−0·04	0·0		Palamkottah	0·0	−1·50	0·0
	Cocanada	0·0	−0·19	0·0					
	Masulipatam	0·0	−0·23	0·0					
	Guntur*	0·0	−0·2	0·0	West Coast	Trivandrum	0·0	0·0	0·0
						Cochin	0·1	−0·6	0·1
Ceded Dists.	Kurnool	0·0	−0·18	0·0		Calicut	0·1	−0 3	0·1
	Nandyal*	0·0	0·0	0·0		Pattambi*	0·0	−0·2	0·0
	Hagari*	0·0	−0·02	0·0		Taliparamba*			
	Siruguppa*	0·0	−0·09	0·0		Kasargode*	0·0	−0·2	0·0
	Bellary	0·0	−0·11	0·0		Nileshwar*	0·0	−0·2	0·0
	Anantapur	0·0	−0·35	0·0		Mangalore	0·0	−0·06	0·0
	Rentachintala	0·0		0·0					
	Cuddapah	0·0	−0·43	0·0					
	Anantharaju-pet*	0·0	−1·0	0·0	Mysore and Coorg	Chitaldrug	0·0	−0·27	0·0
						Bangalore	0·0	−0·26	0·0
Carnatic	Nellore	0·1	−1·6	0·1		Mysore	0·0	−0·13	0·0
	Madras	0·1	−1·3	0·1		Mercara	0·0	−0·15	0·0
	Palur*	0·0	−1·9	0·0					
	Tindivanam*	0·6	−1·0	0·6					
	Cuddalore	0·3	−1·3	0·3	Hills	Kodaikanal	0·0	−2·88	0·0
						Coonoor			
Central	Vellore	0·0	−1·49	0·0		Ootacamund*	0·0	−0·6	0·0
	Salem	0·0	−0·31	0 0		Nanjanad*	0·0	−1·1	0·0
	Coimbatore	0·0	−0·59	0·0					
	Coimbatore A. C. & R. I.*	0·0	−0·70	0·0					
	Trichinopoly	0·0	−0 68	0·0					

*Meteorological Stations of the Madras Agricultural Department.

@ From average rainfall for the month calculated upto 1937 published in the Fort St. George Gazette.

Weather Report for January 1940. Isolated light showers have occurred in South East Madras. Pamban reported 0 9" on the 29th. Skies were lightly to moderately clouded in South East Madras and in parts of North Madras Coast and clear or lightly clouded elsewhere. Humidity was generally in excess in South Hyderabad and Mysore and in defect in South Madras and North Deccan, Maximum temperatures were below normal in the Madras Deccan and North Madras Coast. The minimum was above normal in the Bombay Deccan.

The rainfall was generally dry over the Presidency.

Weather Review for the Agricultural College and Research Institute, Observatory Report No. 1/40.

Absolute maximum in shade	...	87·0°F.
Absolute minimum in shade	...	53·0°F.
Mean Maximum in shade	...	83·3°F.
Departure from normal	...	−2·6°F.

Mean minimum in shade	...	62·8°F.
Departure from normal	...	−1·4°F.
Total rainfall	...	Nil.
Departure from normal	...	−0·7″
Heaviest fall in 24 hours	...	Nil.
Total number of rainy days	...	Nil.
Mean daily wind velocity	...	1·6 m. p. h.
Departure from normal	...	−1·4
Mean humidity at 8 hours	...	73·4%
Departure from normal	...	2·8

Summary. Dry fine weather prevailed during the month. Rainfall during the month was nil. It is 0·7 inches below normal. Both the day and night temperatures were below normal. Skies were moderately to heavily clouded and the relative humidity was below normal. P. V. R. & F. L. D

Departmental Notifications.

Subordinate Services.

1. Appointments.

Sri R. Balasubramania Ayyar, Upper Subordinate IV Grade and Assistant in Cotton Section, Agricultural Station, Guntur, is appointed to a post in category 8 (Cotton section), Class I, Madras Agricultural service and to officiate as temporary Gazetted Assistant with effect from the 1st February 1940 or the date of taking charge.

Sri S. N. Chandrasekhara Ayyar, Assistant in Botany section, Coimbatore is appointed temporarily to officiate as Lecturer in Botany, Agricultural College, Coimbatore in Category 8, Class I, Madras Agricultural Service from the date of taking charge till further orders Vice Sri P. S. Jivanna Rao, on leave.

2 Promotion.

Sri S. Kuppuswami Ayyangar, Permanent Upper Subordinate Agricultural Section IV grade (old) on Rs. 120—10—170 is promoted to III grade (old) on Rs. 200 provisionally with effect from 15th August 1939.

3. Transfers.

Name of officers	From	To
Janab P. P. Syed Muhammad,	A. D. Omalur,	A. D., Tirupur.
Sri K. Hanumantha Rao,	A. D., Hospet,	Special duty at the sugar factory, Hospet.
„ Purushottam,	A. D., Anantapur,	A. D., Hospet.
„ P. Nagadhara Naidu,	A. A D., Madakasira,	Secretary, Cotton Market Committee, Nandyal.
„ U. S. Aiyaswami Ayyar,	A. D. (on leave),	A. D., Tiruvarur.
„ K. Srinivasa Acharya.	A. D , Tiruvarur,	A. D . Kalladakurichi.
„ E. R. Gopala Menon,	Entomology Asst., Tirupattur,	Entomology Assistant, Coimbatore to undergo a course of training in the Mycology Section, Coimbatore.

4. Leave.

Name of officers.	Period of leave.
Sri N. G. Narayana, Asst. in Cotton, Adoni.	Earned leave with pay for 1 month and 26 days from 24-1-40
„ K. Saptharishi, A. R. S., Aduthurai.	Extension of l. a. p. for 1 month from 3-2-40.
„ C. S. Seshagiri Iyer, A. D., Perambalur.	Extension of l. a. p. on m. c. for 2 months from 20-1-40.
„ L. Sankarakumara Pillai, A. D., Rasipuram.	Extension of l. a. p. on m. c. for 3 months from 4-2-40.
„ S. M. Kalyanaraman, Assistant in Cotton, Coimbatore.	L. a. p on m, c. for 1 month from 5-2-40.
Mr. James Colaco, F. M., A. R. S., Nanjanad.	L. a. p. for 1 month from 21-2-40,
Sri Kunhi Kannan Nambiar, Asst. in Paddy, Pattambi.	L. a. p. for 40 days from 10-2-40.
„ T. K. Mukundan. F. M., Central Farm, Coimbatore.	L. a. p. for 1 month from 21-2-40.
„ K. Rajabapaniah. F. M., A. R. S., Guntur.	Extension of l. a. p. for 57 days from 2-2-40.

NOTICE

Such of the Members who have not yet remitted their subscription to the Madras Agricultural Journal for the year 1940 (January 40—Dec. 40) are hereby requested to kindly do so. An early remittance is solicited failing which the next issue will be sent by V. P. P.

Secretary,
M. A. S. U,

The Late Rao Sahib T. V. Rajagopalachariar.