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The Madras Agricultural Journal.

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

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EDITORIAL

The New Year. It is very unfortunate to note that as the New Year 1942 has dawned the world is none the bright as the war which was waging in the West has now extended to the East, and is threatening at our very doors every minute. The horrors of war have become very familiar to us and agriculture and trade are suffering the worst. It behoves us to grow as much food crops as possible in that it is not only not possible to depend on imported rice but that the food problem may become more and more acute in our own land. Published elsewhere is a press note on this vital subject by the Director of Agriculture, Madras.

Owing to war conditions we have to face an enormous rise in the cost of printing charges and we are doing our very best to keep up the Madras Agricultural Journal which enters on its 30th year alive, full of hope and faith. We are sure its members will increase in number during the current year to counterbalance the difficulties anticipated in the running of the Journal. We thank heartily our members, subscribers, contributors and readers for their continued support and wish them one and all a very happy and prosperous New Year. We pray that very soon the war will be over and our Empire will have a glorious victory.

New Year Honours. We are glad to see in the New Year Honours' list that one of the esteemed and old members of our Madras Agricultural Students' Union--Rao Bahadur Sri. T. S. Venkataraman, C. I. E.—has been knighted. He has long been associated with the several activities of our Union as manager, sub-editor and editor of this journal, and president and vice-president. His work on sugarcane is well-known throughout the world for its novel and bold ideas, for using simple and inexpensive methods and for effecting spectacular economic results. His strains are being grown over 90% of the area under cane in India, over 60% in Natal and to an appreciable extent in other cane growing countries of the world. They are responsible for the springing up of numerous new plantations, for the establishment of a number of cane factories, and for the conversion of India from being a major importing country to one with a surplus—all within a period of less than two decades. The honour now conferred on him is a fitting recognition by Government of his great achievements in Economic

Botany and his big contribution to the agricultural and industrial wealth of this country. We offer our hearty congratulations to him and wish him long life.

We are very glad to note that the Government have conferred this year, the title of C. B. E. (Companion of the British Empire) on Diwan Bahadur C. S. Ratnasabapathi Mudaliar, one of our esteemed patrons. Sri C. S. R. Mudaliar is a well known publicist and needs no introduction. He is the President of the Coimbatore Indian Chamber of Commerce and Managing Director of the Pankaja Mills, Ltd. He was a member of the Madras Legislative Council for a number of years. He was also the President of the Coimbatore District Board and Chairman of the Coimbatore Municipal Council for about 9 years. He has been taking a keen interest in our Union and we offer him on behalf of the Union our hearty congratulations and wish him a long life.

We are proud to congratulate one more person this year, and that is Rao Saheb Sri. V. Krishna Menon, B. A., D. A., who is awarded a Rao Bahadur. Sri V.K. Menon was a distinguished alumnus of this College who passed out as early as 1899 winning two of the much coveted prizes namely the Robertson prize for Agriculture and the Clogstoun prize for 'General Proficiency'. Since passing out Sri. V. K. Menon has become one of the leading industrialists of South India and his Standard Furniture Company, Kallai, has established its name all over India. We wish Rao Bahadur Sri V. K. Menon a long life, all prosperity in his industrial pursuits, and hope this is only a forerunner of further greater honours.

Mixed Cropping—A Review.

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Mixed cropping is a system of Agriculture in which two or more crops are grown together at the same time in the same land. It is a common practice in tropical countries both with annual field crops and with perennial plants like fruit trees, flower plants and plantation crops. This type of cropping prevails in Africa, India, Ceylon, Malaya, China and West Indies. It is also usual to grow annual herbaceous crops in the midst of woody perennial trees of economic importance such as coconut, mango, jack and other fruit trees. "The group of plants growing together form a 'plant society' like the natural plant societies that occur on any piece of land left to nature." (Willis, 1909).

The system of mixed cropping is practised in various ways. The most common is one in which the seeds of different crops are mixed together and then sown. In parts of the Coimbatore district *periamanjal cholam* (sorghum) and cowpea or *naripayaru (Phaseolus aconitifolius)* are grown as a mixed crop by sowing a mixture of the seeds; while lablab, red gram and castor, one or more of which are also usually grown mixed with sorghum, are sown in lines soon after the mixed seeds of sorghum and cowpea or *naripayaru* are sown. In places where crops are usually sown with a drill different crops are sown in different lines, as in the case of cotton and Italian millet in the Bellary district. In some mixtures different crops are sown at different periods. In the South Arcot district groundnut is planted between rows of *ragi (Eleusine coracana)* when the latter is in the flowering stage. In parts of Mysore horsegram is recommended for sowing between *ragi* plants when the latter are in flower, and *ragi* between lines of cotton when the latter is two months old (*Mysore Agricultural Calendar,* 1940-41). This system of cropping in which different crops are sown at different times is reported to be a common practice in parts of China (King, 1911). It is also common to grow annual crops among perennials, like fruit trees and plantation crops, especially when the latter are young. Mixed cropping is referred to in some literature as inter-cropping or inter-planted crops, or growing multiple crops.

Nicol (1935), in his paper on "Mixed cropping in primitive agriculture", has stated—"In his survey of agricultural India (*India in 1887*) Wallace devoted a special chapter to rotations and mixed crops. He wrote—'The growth of mixed crops is a widespread practice which is well worth consideration and study..... The advantages under Indian conditions are distinctly great..... There is but one explanation of the existence of these

practices (mixed cropping), viz, that they have been found advantageous after long experience and much careful consideration on the part of a body of workers who, for power of observation and an intelligent interest in and knowledge of every day occurrences would put to shame those classes which hold a corresponding position in educated Europe". Voelcker (1893), in his *Report on the Improvement of Indian Agriculture*, wrote, "It is quite a mistake to suppose that rotation is not understood or appreciated in India. The contrary is the case. Frequently more than one crop at a time may be seen occupying the same ground, but one is very apt to forget that this is really an instance of rotation being followed. The next year the same mixed crops may be sown again and thus to the casual observer it might appear that continuous cropping was being practised. This however is not so, for there is a perfect rotation of cereal and legume. This is, perhaps, the simplest form of rotation, but there are many more complicated than that of mixed cropping." The simplest form is thus one in which individuals in cereal and pulse and other crops in the mixture get the fullest chance of exchanging their places with each other. Mollison (1901) wrote —"The system of mixed crops so common in India is undoubtedly a successful and profitable method which probably has done more to uphold the fertility of the Indian soils than any other practice ..... The successful practice of growing mixed crops in India points to the fact that the practical experience of the uneducated Indian *rayat* has determined centuries since a means of providing an inexhaustible supply of nitrogen for the soil, whilst enlightened European agricultural chemists have only recently begun to see the way".

In the 1903 Proceedings of the Board of Agriculture in India, Appendix C, dealing with the improvements in methods of cultivation in connection with the progress of agricultural experiments and programmes of work, the system of mixed cropping is characterised as 'most slovenly'. The verdict thus swings between two extremes. No serious, systematic and sustained attempts have been made to understand the rationale of this long-existing practice. Even the Royal Commission on Agriculture, while devoting some attention to the problem of rotation of crops, make no mention of this widely prevalent practice of mixed cropping. In the reports on the progress of the action taken on the recommendations of the Commission, Bombay and Madras touch on mixed cropping while dealing with the rotation of crops.

The practice of mixed cropping in agriculture is more commonly adopted in the cultivation of lands which depend upon rainfall for water supply. Out of a total area of about 360 million acres under cultivation in India, in more than 80 per cent. crops are raised with the help of rain. The crops in these dry lands are mainly millets and partly pulses, oil seeds, fibre and other crops. Weather conditions are precarious and the problem of manuring is not easy. This vast extent of arable land has thus to be maintained on an efficient system of tillage and cropping. Mixed cropping is a widely prevalent practice and its importance is thus obvious.

While the full understanding of prevalent mixtures in the cropping of dry lands has not been examined critically, industrial crops like cotton, groundnut, tobacco, etc., began to figure very prominently in the agriculture of dry lands, and they stimulated the need for a system of rotation and mixtures with a view to ensure the success of the expansion of the area of these industrial crops, while at the same time maintaining soil fertility and catering to the current economic needs of the cultivators. The result is that what little knowledge we have on mixed cropping is recent and with reference to problems arising out of cotton and groundnut cultivation. The factors behind this ancient practice still remain subjects for guess and speculation.

The Director of Agriculture, Mysore, has stated, "I attribute the perennial poverty of the dry land cultivator in Mysore to his inability to earn money in addition to food and fodder out of his agriculture." "The largest scope for increasing income per acre from dry farming and raising it from a means of bare livelihood to a lucrative industry lies in inter-cropping or in raising of two compatible crops from the same land in the same season so as to double the income from dry farming." (*Mysore Agricultural Calendar*, 1940—41.) Inter-cropping of a cereal with a legume is common. Fresh areas have been thrown open to cultivation in the Irwin canal area of Mysore. More cotton is required by the State. A successful method of inter-cropping cotton with the staple cereal, *ragi*, has been evolved and introduced. Similar problems are to be faced and solved in other parts of India.

Almost every field crop grown in India is often grown as a mixture with some other crop or crops, in some part of the country or other. An idea of the various crop combinations commonly met with in some parts of India can be obtained by a reference to the *Imperial Gazetteer of India*, Vol. III and Mollison's *Text-book of Indian Agriculture*. Mann (1917) and his associates have given the various mixtures which they observed in a Deccan village. A paper on crops grown mixed with sorghum in the Madras Presidency was published in the February 1941 number of this Journal (Rangaswami Ayyangar and Sankara Ayyar).

Pulses, oilseeds and fibre plants are grown mixed with or subordinate to cereals like sorghum, *bajri (Pennisetum typhoides)* or wheat. Almost all the pulse crops except gram (*Cicer arietinum*) are grown with sorghum and *bajri*. The most common mixtures are some of the following:— Redgram, *Phaseolus mungo, P. radiatus, P. aconitifolius, P. sublobatus, til (Sesamum indicum)*, castor, *Hibiscus cannabinus* and cotton. The seeds of the different crops are generally mixed together before sowing, and the mixture is sown with a drill. Gram is grown mixed with wheat or barley also. Cotton is usually grown alone or mixed with redgram or sorghum. On alluvial soils it is commonly mixed with redgram, maize or sorghum. In parts of Bengal and the United Provinces linseed is grown mixed with wheat, rape seed and various rabi pulses. Gingelly when grown as a *kharif*

crop is usually mixed with sorghum, *bajri* or cotton. *Bajri* is usually a mixed crop and "as a mixed crop it may be grown on the same land continuously without any apparent exhaustion of soil or diminution of outturn if the cultivation is fairly liberal" (Mollison, l. c.). Subordinate crops sown with *bajri* are redgram, in separate rows, and a sprinkling of *Phaseolus mungo, P. aconitifolius, Dolichos biflorus, Hibiscus cannabinus,* etc., in the same row as *bajri*. In Gujarat, cotton in rows is found with *bajri*. In some places rice and sorghum are grown together, while rice is sometimes grown subordinate to cotton also. In areas where rainfall is not a limiting factor a number of crops, with a wide range in habit and duration, such as rice, sorghum, *ragi*, redgram, gingelly, cotton and other similar crops are all grown together on the same land. They are all sown at the same time, but harvested according to their ripening. This practice is prevalent in the uplands of the coastal districts in North Madras. A mixed crop of wheat and gram is reported to be a common practice in the wheat zone in Berar. This mixture is sown, harvested and threshed together, and the mixed grain thus obtained is ground and used as food by a large section of the people. It is stated that this practice of mixed cropping has been the salvation of the wheat soils, which otherwise would have long ago reached a state of exhaustion for remunerative crop production.

Brash (1939) has stated that "most Africans when they plant their gardens plant a mixture of crops. In one garden it is possible to find maize, peas, beans, potatoes and sweet potatoes all growing mixed up together." In West Africa yams and millets are reported to be grown along with Guinea corn (sorghum). "In the upland rice fields of Sierra Leone several crops are planted in small quantities amongst the rice. Okroes, peppers and pumpkins are grown amongst the rice, and young cotton plants follow on, maturing later after the rice is harvested". (Irvine, 1934).

Cereals grown in dry lands are thus usually grown mixed with many other crops which produce some article of every day need to the cultivator. The nature and number of crops mixed differ in different areas. It is difficult to obtain definite information as to why certain crops are mixed in certain areas and in what proportions, and what are the definite advantages of growing such mixed crops. Economies in cultivation and land, provision for the domestic needs of the cultivator, a system of insurance against weather and pests, some vague ideas of maintaining soil fertility, etc., are some of the observations with which this well established practice has been dismissed without a rational analysis.

Among the various reasons why some crops are often grown as mixtures, the most important appears to be to guard against the risk of a total failure of harvest in an unfavourable year; but there are no long range experiments to prove this. The average holding of the Indian cultivator is small. To ensure that he obtains some produce or other from the limited land he has, he grows a mixture of crops so that even in years of deficient rainfall he is able to secure some produce for his household needs. On

the other hand if the season is favourable he may harvest a plentiful crop. It is a common practice in some parts to grow even different millets like sorghum, *cumbu (Pennisetum typhoides)* and *tenai (Setaria italica)*, besides pulses and oil seed crops, all together in the same plot of land. Moreover the *rayat* with limited land is not in a position to grow different crops separately; he presumably resorts to mixed cropping to obtain most of his personal needs from the bit of land he has. There is a saving not only in land but in labour also. Usually the average *rayat* does not engage outside labour but cultivates his land with the help of the members of his family. As different crops come to harvest at different times, the limited labour is utilised to the fullest advantage in the harvesting and preparation of the produce of different crops. The system of *udu* cultivation in the Tanjore delta in which two varieties of rice of different durations, *kuruvai* and *ottadan*, are planted together, is an instance of mixed cropping with a view to economise land and labour (cultivation expenses). Both are planted together at the same time as a mixed crop. The *kuruvai* is harvested in about three months, and the *ottadan* another four months later. This aspect of saving in land and labour has been stated by King (l. c.) as that which appeared to him to be the main reason for growing multiple crops in China. These aspects need scrutiny from an economist's point of view.

It is recorded that the process of nitrification in soils is much more active when a growing crop is on the ground than when the land is left fallow. Sometimes a long and short duration crop such as sorghum and *tenai* or sorghum and redgram are grown mixed to get the maximum outturn from the land. The short duration crop is harvested first and the other continues in the field and if the season is favourable yields almost as much as a pure crop. What are known as catch crops come under this category. Maize, pulses, onions, melons, vegetables, etc., are grown in sugarcane fields when the cane crop is young. Similarly such crops are also grown in gardens among fruit trees when the latter are young.

Various pulses are cultivated in India, and most of them are usually grown as mixtures among the cereals or other crops of commercial value. This is considered to be a sound agricultural practice as the legumes help by their symbiotic activity to keep up the supply of combined nitrogen in the soil and maintain soil fertility. It has been recorded by Loehwing (1937) that under American conditions natural processes of fixation restore on the average about 60 lb. of nitrogen per acre per year under legumes and 10 lb. under non-legumes. Not all leguminous crops increase the nitrogen content of the soil; Howard has recorded that Java indigo seriously depletes the supply of combined nitrogen in the soil. Inter-cropped legumes are said to increase also the available lime, potash and phosphorus in the soil by their greater solvent action and the ability of their deeper root system to raise these nutrients to the surface layers (Loehwing, l.c.) This

° Royal Commission on Agriculture in India Report, 1928, P. 85.

probably explains how the Indian *rayat* is able to grow the same mixed crops year after year on the same land without the addition of manure.

A legume grown mixed with a cereal increases the fodder value of the latter. It is also reported that in some instances the protein content of the cereal grown in combination with a pulse is increased thereby. (Thornton & Nicol, 1934; Nicol, 1934 & 1936; Hutcheson *et al* 1936). This has been recorded to be obtained in pastures where legumes are grown in combination with grasses. This system of growing legumes in combination with other crops is being now followed in the maintenance of pastures and in the cultivation of silage crops in Europe and America. The full implications of this combination in the case of regular field crops have to be investigated; the more so, as the only means of toning up quality.

By growing together crops with differences in root habits, the plant food and moisture in the soil is utilised to the best advantage. As their roots feed at different depths in the soil there is no competition for plant food or moisture. Root studies at the Dry Farming Station, Bellary, have shown that Setaria-groundnut and Setaria-horsegram mixtures are ecologically sound combinations; while, *Setaria-cotton* mixture is not sound, as there is severe root competition between the two components of the mixture, both feeding in the same zone. Such root studies should be made on a more comprehensive basis and extended to all crop combinations. The combination of a shallow and deep rooted crop is reported to improve soil tilth and texture also (Lcehwing l.c.).

Soil erosion studies at the Dry Farming Station, Bellary, have shown that *Pillipesara (Phaseolus trilobus)*, groundnut, horsegram and mixtures of groundnut and horse gram with Setaria are comparatively more efficient in preventing soil erosion. Trailing crops like *Phaseolus aconitifolius* or horsegram grown mixed with cotton or sorghum, which are usually widely spaced, help to prevent the erosion. This aspect merits a more comprehensive examination.

Some components of mixtures afford protection to weaker crops. Pigeon pea is usually grown as a subordinate crop along with cotton in the Punjab, where it is considered it protects the cotton from the desiccating effects of the hot winds (Milne and Ali Mohammad, 1931). Sorghum and *bajri* when grown mixed with *mung (Phaseolus radiatus)*, afford shade to the latter. The stalks of sorghum serve as supports to lablab and cowpea usually grown mixed with it. Stray plants of sorghum in a field of other crops act as a check on cattle being allowed to trespass and graze on the young crop, as sorghum plants in the young stages are poisonous to cattle. Border crops of linseed in wheat fields are said to keep off cattle; (Voelcker, 1893); so also safflower round sorghum fields. *Sesbaia aculeata*, redgram, *hemp (Hibiscus cannabinus)*, castor etc., are grown on the borders of sugarcane fields to serve as protection to sugarcane.

Some crops may be grown as trap crops for insects or animals. Sorghum or maize may serve useful as trap crops for stem borers of sugarcane.

Damage due to insects and diseases are sometimes lessened by growing mixed crops (Irvine, 1934; Hutcheson et. al. l. c.). The disease or insect does not spread so quickly as when pure crops are grown. It has been recorded by Luthra and Vasudeva (1940) that mortality in cotton due to root-rot disease was reduced considerably by growing cotton and sorghum mixed; a mixture of *moth (Phaseolus aconitifolius)* also reduced mortality of cotton due to root-rot

It is not economic to grow some crops like green gram or cucumber (a field variety) as pure crops; they are therefore always grown as mixtures. In pastures, a mixture of grasses is considered to be more advantageous as the mixed hay obtained gives a variety of feed and a better balanced one than a single kind (Hutcheson et. al. l. c.). Legumes in pastures are considered to act as a check to the growth of weeds (Loehwing, l. c).

Attempts at experiments on mixed cropping have been made in various centres with the starting of many Agricultural Research Stations. But in many of these the experiments do not appear to have been pursued long enough or well enough to draw useful conclusions. Experiments on mixed cropping have to be conducted for a series of years and at various centres so as to study the results in relation to soil and climatic variations. The intensity and complexity of the problem seem to have deterred a pursuit of it on sound foundations. Experiments on mixed cropping should be laid to begin with, only in such areas in which the system of mixed cropping is prevalent. The possibility of successful experimentation depends upon the nature of the soil and the seasonal conditions that will admit of suitable sowing facilities and growth period for the crops forming the mixture. The results of experiments in this line are summarised below in so far as they could be gathered from literature available in the Coimbatore library. They tend to emphasise the need for a comprehensive record of existing practices and laying down suitable experiments on modern lines to elucidate the many problems confronting the mixing of crops, both old and new.

Sorghum and other millets are usually grown mixed with pulses and other crops. Experiments conducted at various stations in the Province have not led to any definite result with regard to the suitability of any particular subsidiary crop or combination of crops or the benefits derived by growing such mixtures. At the Cotton Breeding Station, Coimbatore, various pulses were grown in combination with sorghum, in different proportions and in different soils. It was observed that on the three different soil types in which the trials were made, the mixing of pulse both with irrigated and rainfed sorghums did not benefit either the sorghum or the succeeding cotton; the mixing of pulse on the other hand lowered the total straw weight. The after effects of growing leguminous crops on cotton were not alike. Cluster beans were observed to be most beneficial in the case of irrigated sorghum, while lablab and cowpea appeared to do good to rainfed sorghum. Soy beans, greengram and cowpea did more harm than good when they preceded Cambodia cotton in summer. *Pillipesara*

likewise depressed the yield of *karunganni* cotton that followed it. In a rotation experiment conducted at the Hagari Agricultural Station, mixtures of sorghum and Bengal gram in two different proportions were tried. But as the experiment was discontinued after two years no conclusions could be drawn from them. Later experiments conducted for a period of five years led to the conclusion that sowing a mixture of sorghum and pulses, except Bengal gram, is not feasible under Hagari conditions, as the pulses have to be sown in the *mungari* (June—July) and the sorghum in the *hingari* season (September—October) Sorghum-groundnut mixture is a good combination provided there is equal distribution of rain, but as the tract experiences mostly unequal distribution of rain this combination is not feasible. And the local practice of mixing Bengal gram and sorghum has been observed to be ecologically undesirable, as the roots of both crops feed in the same level in the soil, resulting in severe root competition. At Nandyal, *pillipesara*, when grown as a mixture with sorghum, had a depressing effect on the yield of sorghum. In a trial with mixtures of blackgram, greengram and horsegram, the mixture of horsegram appeared to be the best. In a rotation experiment conducted from 1920 to 1923, it was observed that cotton after *pillipesara* is more profitable than after pure sorghum or sorghum and *pillipesara* mixture. At Guntur, *pillipesara* was grown mixed with sorghum for fodder. There was no increase in yield by growing this mixture. But this mixture is reported to be common in the area, as the mixed fodder obtained is believed to have a higher nutritive value due to the legume in the mixture. The effect of pulses (blackgram and greengram) in combination with sorghum on the succeeding cotton crop was tried at the Koilpatti Agricultural Station, and it was observed, that this mixed cropping did not reduce the harmful after effects of sorghum.

Experiments conducted at the Koilpatti Agricultural Station showed that *cumbu* when grown mixed with red gram, lablab or Bengal gram yielded as good as and sometimes better than the cereal grown alone, if the crop is sown early. If, however, the sowing is delayed, it is advantageous to grow the *cumbu* as a pure crop. In a rotation experiment at the Poona Agricultural College Farm it was observed *bajri-tur* mixture grown every year gave the highest return over other rotations: *bajri* and sesamum rotation, *bajri* and *kulthi* rotation, and *bajri* every year.

In trials at the Hagari Agricultural Station, mixtures of pulses with Italian millet proved to be comparatively more economic than growing pure Italian millet. Of the pulses, groundnut, horsegram and *pillipesara*, tried, groundnut gave the best results. Ecologically also the combination was sound. Experiments are in progress to test the advisability of growing the two crops millet and groundnut, in 'strips'.

At the Gokak Farm in the Bombay Presidency, a mixed crop of maize and *tur* in rows gave decidedly better results than growing two crops of maize one after another, and it is reported that this practice has been adopted by many cultivators of the canal tract. More recent experiments

have indicated that a mixture of maize and cotton is more profitable than maize and *tur* mixture, as *tur* is sometimes liable to the attack of wilt and consequent reduction in yield. In rotation experiments at Pusa, the highest gain in soil nitrogen was in one series with a mixed crop of maize and *urid* (*Phaseolus radiatus*). (*Review of Agricultural Operations in India*, 1929—30 and 1930—31.)

With regard to wheat, it was observed by Howard (1916) at Pusa, that there was a marked advantage in growing mixed crops of gram and wheat on soils where combined nitrogen is a limiting factor. Experiments at some stations in the United Provinces have shown that the local practice of sowing mixed wheat and gram on irrigable black soils is less profitable than sowing wheat and gram in rotation. But in spite of this there appears to be a preference to grow the two crops mixed, for in the report it is stated that "the practice of mixed cropping however will probably take a long time to die out."

As early as 1909 experiments were started at the Central Farm, Coimbatore, to try the effect of growing cotton mixed with *tenai*, horsegram and coriander. This was given up after two years trials, which indicated that the combination of cotton and *tenai* was the best. The experiment was again repeated in 1914, in a modified form. The crops in combination were sown both in separate rows as well as mixed. From the results it was concluded that "with cotton at its normal price, it would probably not be profitable to grow any mixture, though the demand for fodder may make it good farming." With the spread of Cambodia cotton as a rain-fed crop in the heavy black soils of the Guntur and Kistna districts it was felt necessary to find out the effect of growing cotton mixed with other crops; so trials of cotton grown mixed with groundnut, Italian millet, and rice were started at the Guntur Agricultural Station in 1935. From the results of three years trials it was observed that cotton and groundnut mixture gave the best monetary return, followed by cotton and Italian millet mixture. Growing cotton alone was financially a loss. Trials of cotton mixed with horsegram were conducted at the Nandyal Agricultural Station from 1909 to 1914. The results indicated that there was no difference in the total outturn whether cotton is grown alone or mixed with horsegram. The main advantage of mixing was that a little horsegram necessary for cattlefood was obtained cheaply. As regards the residual effect of horsegram, this was non-existent or so small as to be negligible.

An experiment to compare cotton grown alone with cotton and Italian millet mixture was conducted at the Hagari Agricultural Station from 1919 to 1924. The results of five years taken together showed that it was more economical to grow a mixture of cotton and Italian millet than cotton alone. The local practice is to grow two rows of Italian millet between two rows of cotton, or alternate rows of Italian millet and cotton. To test the efficiency of this system experiments were again started in 1935. The results of four

years showed that pure cotton was the best economically. The mixed cropping was less profitable compared to pure cotton, whether the sowing is done early or late. It was also observed that both the main and secondary roots of the cotton and the millet feed in the same zone of the soil, and hence there was severe competition between the root systems of these two crops. In view of these findings, experiments have been started in 1939 to try growing these two crops in alternate 'strips'. Experiments with Bengal gram, coriander, and horsegram grown mixed with cotton were conducted at the Koilpatti Agricultural Station from 1912 to 1915. The monetary value of all the mixtures tried was less than that of cotton grown pure. Of the crops mixed coriander gave better returns than the other two. A mixed cropping experiment was again started in 1934 to test how the cotton crop is affected by mixing coriander in different ways and to assess the value of the crop as a whole. Results of three years indicated that a small mixture of coriander with cotton was profitable, and that it did not affect the yield of cotton. With the idea of utilising the excess of moisture in the soil in the early stages of the cotton crop and thus to reduce its bad effects, different crops, such as sannhemp, blackgram, greengram, redgram, horsegram, coriander, *kudiravali (Echinocloa colona* var *frumentacea)* and onions, were grown mixed with cotton in 1935 and 1936. None of the crops tried had any beneficial effect. A thick stand of cotton reduced the bad effect. *Kudiravali* reduced the yield of cotton considerably. In experiments conducted at the Gokak Farm (Bombay Presidency) from 1924 to 1929, a mixed crop of cotton and Italian millet gave better results than cotton grown alone. At the Dharwar Farm, it was observed, cotton and groundnut sown in alternate rows gave better results than cotton and groundnut in blocks. With regard to after effects, the succeeding crop of sorghum gave higher yield in the former plots than cotton and groundnut in blocks taken together.

Groundnut is an introduced crop, and in certain areas it replaced not only other commercial crops but also food and fodder crops. In the South Arcot district, it is stated, that the area of groundnut increased from 3,000 acres in 1851 to 333,350 acres in 1920. With the increase in area and due to the incidence of diseases and pests the groundnut did not prove quite so remunerative after a period ; so the growing of cereals alone or in combination with it was resorted to. To find out whether the rotation of a cereal or groundnut, or a mixed crop of cereal and groundnut is more profitable, and the particular cereal best suited for this purpose, experiments were conducted at the Palur Agricultural Station from 1907 to 1920. The results led to the conclusion that mixed cropping of groundnut interplanted in a cereal was more advantageous from a monetary point of view, than a cereal groundnut rotation. Of the cereals tried *ragi* proved to be the best to grow mixed with groundnut, and in places of low rainfall *cumbu* was observed to be the best. It was also observed that a change in the cereal had a better effect on the yields of groundnut and the cereal, than when the same cereal was repeated every year. Experiments are in progress at

the Agricultural Station, Tindivanam, in which groundnut is grown mixed with sorghum, *cumbu*, *tenai*, cotton, redgram or castor. Mixed cropping resulted in the depression of the yield of groundnut in all cases, but the monetary return, however, was more from a mixed crop than when a pure crop of groundnut was raised. The best returns were obtained by growing groundnut in association with sorghum, castor, redgram or cotton. Except *tenai* or *cumbu* mixtures all others gave higher monetary returns than the pure cropping. But it was observed the mixtures affected adversely the development of the groundnut plants, and of the different crops grown mixed, sorghum depressed the yield to the maximum extent, while redgram affected it the least. It has been reported to be more profitable to grow groundnut between rows of *arhar* (redgram) in the United Provinces.

In a rotation experiment conducted at the Central Farm, Coimbatore, from 1909 to 1921, a mixture of castor and lablab was compared with castor alone, in rotation with sorghum. It was observed that the legume influenced the yield of cereal, though the increase was slight and not consistent. The yield of castor was comparatively very poor in the mixed crop.

The above review shows the need for a thorough examination of this important agricultural practice of mixed cropping. A full record of all existing practices throughout India should be made and examined. Such experimental work as has been done in this line in the various Provinces should be brought together for scrutiny. The agronomic and economic backgrounds of these practices should be investigated through suitable long range experiments and improvements on them suggested. The introduction and expansion of the area under commercial crops necessitate the designing of suitable mixtures with a view to conserve soil moisture and fertility, and ensure the production of the cultivators' personal needs. In 1937, Sir John Russell, in his Report on the work of the Imperial Council of Agricultural Research, has stated—"The agricultural economic aspects of mixed cropping should be studied in view of the widespread use of this practice and the probability that some crops mix better than others". The initiation of a comprehensive enquiry and the laying down of suitable experiments in this line are necessary in the interests of the cultivators of the vast rain-fed areas in India.

Literature.

Brash, J. G. (1939). *A Text-book of Agriculture.* The Sheldon Press, London.

Howard, A. (1916). *Agri. Jour. India*, 11 : 308

Hutcheson, T. B., Wolfe T. K. and Kipps, M. S. (1936). *The Production of Field Crops.* McGraw—Hill Book Co Inc. New York.

Irvine, F. R. (1934). *A Text-book of West African Agriculture.* Oxford Univ. Press, London.

King, F. H. (1911). *Farmers of Forty Centuries.* (U. S. A.).

Loehwing, W. F. (1937). *Bot. Rev.* 3 : 195.

Luthra, J. C. and Vasudeva, R. S. (1940). *Curr. Sci.* 9 . 466.

Mann, H. H. (1917). *Land and Labour in a Deccan Village.* Univ. Bombay Econ. Ser. No. 1.

Milne, D. and Ali Mohammad, K. S. (1931). *A Handbook on Field and Garden Crops of the Punjab.* Punjab Govt. Publn.

Mollison, J. (1901). *A Text-book of Indian Agriculture.* Vol. I. Bombay Govt. Publication.

Nicol, H. (1934). *Biol. Rev.* 9 : 383.

,, (1935). *Emp. Jour. Exp. Agri.* 3 : 189.

,, (1936). *Monthly Bul. Agri. Sci. Pract.* (Rome) 1936 : 201 and 241.

Rangaswami Ayyangar, G. N. and Sankara Ayyar, M. A. (1941). *Madras Agri. Jour.* 29 : 57.

Thornton, H. G. and Nicol, H. (1934). *Jour. Agri. Sci.* 24 : 540.

Voelcker, J. A. (1893). *Report on the Improvement of Indian Agriculture.*

Willis, J. C. (1909). *Agriculture in the Tropics.* Univ. Press, Cambridge.

Our Present Position with Regard to the Control of Fruit Pests.*

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Introduction. It is a welcome sign that increasing interest is being taken in fruit culture by the public. This has been particularly the case ever since the Government opened the Fruit Research Station, Kodur. Expansion of orchards is bound to result in the near future and with it the problem of tackling the pests is bound to come into more prominence. It is therefore thought that a brief account of the major pests of the more important fruit trees and their control will be of special interest to those in the line and also to those who propose taking up fruit culture.

Mango Pests. Of the various fruit trees grown in this Presidency mango is one of the most important. There are about two dozen pests affecting the mango of which the blossom hopper (*Idiocerus* spp), the stem borer (*Batocera rubus*) and the fruit flies (*Dacus ferrugineus* and *Dacus ferrugineus incisus*) are the most important. Among the other insects which do some damage occasionally may be mentioned the leaf caterpillar (*Parasa lepida*), the shoot webber (*Orthaga exvinacea*) and the nutweevil (*Cryptorhynchus mangiferae*). The hoppers — both adults and nymphs — infest the blossoms and injure them by sucking the sap with the result that they are either shed or prevented from setting into fruits. Spraying with fish oil rosin soap at a strength of one pound in ten gallons of water is found effective against the pest. In Bombay, dusting with flowers of sulphur is recommended. This treatment is being tested here with a view to finding out its effect against the pest and the cost of the treatment. How far dusting will interfere with the setting of fruits is also receiving attention. The stem

* Paper read at the thirtieth College Day and Conference of the M. A. S. Union, July 1941.

borer is another serious pest of the mango ; the stout grubs bore into the stem and branches and cause them to dry up. Injection of a mixture of chloroform and creosote in equal proportions into the larval tunnels and closing the entrance hole with wet clay is generally recommended for the destruction of the grubs in deep tunnels. An equally effective method is the use of a mixture of kerosene and petrol in the proportion of 10:1. If the grubs are found just under the bark hooking them out with a flexible wire is often done.

Fruit flies are also serious pests of the fruits ; their maggots feed inside the pulp and spoil the fruits. Three or four treatments are in vogue. Systematic destruction of fallen fruits so as not to allow the maggots therein to come out and pupate in the soil, raking up the soil round about the trees if the maggots have already pupated, spraying a dilute solution of crude oil emulsion as a repellent to prevent flies from laying eggs on the fruits and bagging in the case of costly fruits are some of the methods recommended against fruit flies.

Different species of caterpillars also attack the leaves. One of these is the nettle grub—*Parasa lepida ;* it is covered with hairs which are irritating to the touch. Handpicking is therefore out of question and spraying with calcium or lead arsenate has been found to be effective. As the caterpillars pupate at the base of the stems inside hard cocoons these may be crushed so as to kill the pupae. Another caterpillar known as the shoot webber is sometimes troublesome ; it webs together the leaves and feeds on them voraciously. In the case of small trees the caterpillars can be controlled by mechanical means while in the case of tall trees stomach poisons have to be applied. The nut weevil is another pest found especially in the fruits of *neelum.* Direct control of the weevil in the fruits is rather difficult as the infection starts early when the fruits are tender. Destruction of adults when they come out of the fruits and proper disposal of nuts are two of the measures which may be attempted.

Citrus Pests. Citrus is another important fruit tree and has, like the mango, a long list of pests. Of the more important pests, mention may be made of the fruit sucking moths (*Ophideres* spp.), the leaf eating caterpillar *(Papilio demoleus),* the bark borer *(Arbela tetrconis)* and the leaf miner *(Phylloenistis citrella).* The other pests which are sometimes found doing damage are the stem borer (*Chelidonium* sp.), the fruit fly (*Dacus* sp.), plant lice *(Aphis tavaresi),* mealy bugs (*Pulvinaria* sp.) and scale insects.

The fruit sucking moths by means of their serrated probosces suck the juice from the fruits at night and cause them to drop. The loss due to this pest is sometimes considerable Eggs are laid by the moth not on citrus but on a weed known as *Tinospora* and the caterpillars feed on the leaves of this plant. The measures generally suggested against the pest are (1) destruction of the weed to prevent breeding of the moth, (2) screening of the fruits with palmyra baskets, (3) spraying of the fruits with repellents,

and (4) handpicking of the moths especially on small trees. When a light is directed towards the moths these creatures become stupefied when hundreds of these can be easily caught and killed. Some of these methods have their own drawbacks. So, another method, i. e, growing tomato as a trap crop is being experimented upon. It is found that the moths have a special preference to fruits of tomatoes as against those of citrus. This partiality is being used to advantage by raising tomatoes in citrus gardens. It is so arranged that both these come to fruiting at the same time when moths transfer their attention to tomato fruits whereby the citrus fruits are left free.

The citrus caterpillar is yet another widely distributed pest. It defoliates the plant and in the case of young plants much damage is done. Prompt handpicking of the caterpillars has been found to be an economical and efficient method. Spraying of arsenical is suggested in the case of big trees. In this connection it may be stated that trials with cheaper insecticides are in progress. One such substance that is being tried—seed of *Thevetia* plants found growing in large numbers in many parts of the Presidency—is giving hopeful results.

Another pest of citrus is the bark borer found mostly in the Circars. The caterpillars which hatch out of the eggs laid on the bark bore into the stem. They come out at night and feed on the bark under cover of galleries while during day time they hide inside the holes. Injection of a mixture of kerosene and petrol suggested against the mango stem borer is effective against this pest also. The catterpillars may also be killed with pointed wires.

The citrus leaf miner is a tiny caterpillar which mines into the leaves making them curl and fade. In the case of young plants the damage done is serious. This is one of the pests against which some effective remedy is needed. Rubbing of the attacked leaves to crush the different stages of the pest found in the mines and spraying of deterrents alone may be suggested now. Besides the pests mentioned above, Psyllids, mealy wings, mealy bugs and plant lice are occasionally come across. Tobacco decoction is very effective against these pests. Our studies have shown that tobacco stems which are generally discarded can also be used for preparing the decoction with equally good results. Spraying has, in all cases to be done in time.

Other Fruit Pests. Banana is yet another fruit crop grown all over the Presidency. Fortunately for us no serious pest has been noted so far on them. Grapevine is often attacked by a flea beetle—*Scelodonta strigicollis*, and the leaf mite—*Tetranychus telarius*. The beetle feeds on the leaves and the tender shoots; this can be controlled by spraying with arsenicals. Mites which suck the sap from the leaves can be checked by dusting with flowers of sulphur. The pomegranate fruit's worst enemy is the butterfly—*Virachola isocrates*. A remedy often suggested is the use of paper or muslin bags to prevent the butterfly from laying eggs on the fruits.

Destruction of the first attacked fruits will also reduce the infestation. The most important pest of guavas—the scale insect *(Pulvinaria psidii)* can be controlled by spraying contact insecticides. The Ber fruits at Panyam and other places are attacked by a fruit fly *(Carpomyia vesuviana)*. Our recent studies have shown that the maggots pupate in the soil and remain as such for months before the emergence of adult flies. Raking up of the soil round about the trees, if carried out properly and at the correct time, will reduce the fly incidence considerably.

Pests of Hill Fruits. Cultivation on a small scale of fruits like apples, pears, peaches, plums, etc., is done on the Nilgiris, Shevaroys and Pulneys. One of the serious pests of apples the woolly aphis—needs some mention in this connection. Our studies have shown that spraying with contact insecticides to be effective has to be repeated a number of times. Biological method of control is therefore being attempted. A parasite—*Aphelinus mali*—which is found effective in the temperate regions, has been introduced in the Pomological Station, Coonoor. Counts taken recently have shown 40 % parasitisation especially at the beginning of the season and there is reason to hope that the parasite will check the pest considerably.

Scope and Possibilities for Further Work. As stated elsewhere in this paper there is scope for work in the direction of finding cheaper indigenous insecticides to suit the pockets of the Indian *ryot*. Another line of investigation which is likely to show promise is the utilisation of resistance in the evolution of resistant types against specific pests. With the help of the Fruit Specialist it is possible to evolve suitable varieties to replace the more susceptible ones. Though this is an achievement that is likely to take a long time, in view of the fact that the fruits are mostly perennials, it is worth a trial.

Need for Plant Quarantine Service. Lastly, a word may be said about the urgent need for plant quarantine service. Some foreign pests have already found their way unnoticed into India. The woolly aphis and the fluted scale and other foreign pests are already present in this Presidency. San Jose Scale and the Codling Moth—also foreign pests—have recently been reported from North India. We have already in this province a formidable number of pests—over 500—attacking different crops and surely it should be our chief concern to see that this number is not allowed to increase by unrestricted invasion of foreign pests. Knowing as we do how the other countries have suffered and are spending large sums in fighting the insect menace, it is our imperative duty to see that serious pests are successfully intercepted from gaining a foothold in our country by the establishment of effective quarantine stations at the ports of entry manned by expert staff.

SELECTED ARTICLE

Why Cattle Need Minerals.

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Work was started in 1935 at Coimbatore, under a scheme financed by the Imperial Council of Agricultural Research, to study the requirements of calves and cows for calcium and phosphorus. The experimental animals were fed with rations containing known amounts of the minerals, and the quantities excreted were determined; by subtracting the quantities excreted from the quantities fed the quantities retained in the body of the animals were determined. If more was consumed than excreted, the animals were considered to be getting sufficient for their needs, and if the quantity excreted was more than that consumed, the animals were considered as not getting sufficient for their needs. The requirements for a given mineral were estimated by the quantity required to be consumed to just balance the amount excreted.

Chronic deficiencies. As a result of this work it was found that a heifer calf from the time it was weaned up to the time it grew up and matured, required about 1 oz of calcium and 1 oz. of phosphorus daily in its diet to supply its requirements for growth and bone building. When the heifer was pregnant and up to the time the calf was born the requirements for the minerals remained of much the same order; with the onset of lactation in the cow it was found that the requirement for phosphorus remained at about 1 oz. but the requirement for calcium depended on the quantity of milk given. A cow giving about 15 to 20 lb. of milk per day required 2 oz. of calcium per day and proportionately greater quantities for greater quantities of milk yielded. The requirement for calcium was appreciably higher in the cow in milk than when she was pregnant or when she was a young growing animal. The rations fed during the experimental period were liberal ones providing an ample supply of concentrates consisting of cotton seed, groundnut cake, rice bran, *dal* husk, and green *cholam* or maize fodder or guinea grass or green grass; in addition 1 oz per day of mineral mixture consisting of bonemeal and shell lime was given. This ration was fed on a sliding scale according to the size of the animal. The ration was liberal and provided for sufficiency of all nutrients, i. e. proteins, carbohydrates and fats and mineral matter for calves and heifers, but with the cows in heavy milk it was not found to be possible to supply sufficient calcium for their requirements and the animals were always excreting more calcium than what they got in their food. The quantities of phosphorus were usually sufficient. It is plain that a heavy yielding cow is chronically in a state of deficiency for calcium, even with a liberal ration *plus* a mineral supplement.

Valuable data at Coimbatore. The experiments at Coimbatore have given data on (i) the requirements of calves, heifers and milking cows which have not been known till now, (ii) have shown that even with a liberal ration as fed on Government farms, unless the ration contains 1 oz. of mineral mixture, it does not supply sufficient mineral matter to meet the needs of calves and heifers, and (iii) that with the cows yielding 15 to 20 lb. of milk per day, the liberal ration fed with the mineral mixture was not able to supply sufficient calcium to supply their requirements.

No experiments were conducted with working bullocks but the results obtained at Dacca (Bengal) by J. B. Chatterjee have shown that bullocks on a

ration of paddy straw and linseed cake required about the same amount of calcium per day, i. e., 1 oz. and about a quarter of that quantity of phosphorus for their daily requirements.

Analysis of pastures. A study was also in progress regarding the mineral content of natural pastures in the Province by a pasture survey. Samples of grasses from all parts of the Province were obtained and analysed for their chemical composition with special reference to their mineral value. It was seen that while in the greater part of the Province, the grasses had a good content of both calcium and phosphorus, those of the Malabar district were poor in both the minerals, the northern part of Salem district had a low calcium content in its grasses, while in Kurnool and parts of the Anantapur districts the calcium content was good but the phosphorus content was very low. The east coast districts had natural pastures of high nutritive value, and also the Coimbatore district in the south. The area of deficient minerals was therefore the Malabar district, while the North Salem and Kurnool district and parts of Anantapur were areas of imbalance with a good calcium and low phosphorus content.

Deficiency disease. When these results were studied in connection with the condition of the cattle in the areas, it was seen that in the areas of deficiency, i. e., Malabar district, the cattle are generally short in stature and in poor condition, and that good cows when introduced there rapidly deteriorated in yield of milk and in general condition. This could be explained by the poverty of the pastures in both minerals. In the Kurnool district the cattle, though in general satisfactory condition, suffered in some talukas from a disease known locally as *Vayu-potlu* or *Vayu-noppulu* diagnosed as rheumatic arthritis, which results in the animals being crippled by swelling and pain in the limbs, and unable to do any work. This disease affects working bullocks mainly but a few cases occur among cows and fewer among buffaloes. This disease is associated with an imbalance between calcium and phosphorus in the natural pastures of the area; the calcium content is high while the phosphorus content is very low.

Blood studies were conducted at Coimbatore and it was seen that the blood also had an abnormal imbalance of the minerals in it.

The study of the disease was extended to the water supplies of the areas where it occurred in a severe form and results revealed the presence of an element, fluorine, in the well water. Fluorine affects the absorption of phosphorus into the animal body after digestion and its presence probably aggravates the effects of a poor supply of phosphorus in the food of cattle in the affected areas. Further studies are in progress to find methods for the prevention and cure of the disease along the lines of the use of a mineral mixture to supply sufficient phosphorus lacking in the food and to remove the fluorine in the water of wells in the affected villages by a simple method.

Prevention and cure of deficiency. The results of the Coimbatore experiments have shown not only the importance of the problem of mineral matter to cattle but also a way of overcoming deficiencies in its supply. In all experiments described above a mineral supplement was used to balance the supply of calcium and phosphorus to the animals, so that in addition to the calcium and phosphorus they consumed in the rations, additional quantities of the two minerals could be drawn upon from the mineral supplement fed to the animals. The mineral supplement consisted of equal parts of burnt shell lime and steamed bonemeal ground into a fine powder, mixed in equal proportions. Both shell lime and bonemeal are cheap and easily available in this Province. The burning of shell lime and steaming of bonemeal are comparatively simple processes, and as a result the mineral mixture can be had easily and cheaply. Such a

mixture is available at about Rs. 6 per cwt. There are many other mineral supplements put up in various forms on the market, but those cannot compete in price with the mineral supplement used at Coimbatore.

By the use of the mineral supplement, animals which are suffering from a gross deficiency of the minerals of any one or any imbalanced supply of either in relation to the other in their food are enabled to make good the deficiency or imbalance. For cows or calves which are generally undernourished as regards minerals or for animals living in a mineral-deficient area, the mineral supplement will make good the deficiencies and prevent the onset of symptoms of disease caused by the deficiency.

The table below gives approximate quantities to be fed to calves, cows, bullocks and breeding bulls. No information is available for sheep, goats and pigs and hence no recommendations have been made for these animals.

Class of animals.	Quantity of mineral mixture per day.	Remarks.
Calves 6—18 months.	1 oz.	
Heifers 18—24 months.	1 oz.	Also when pregnant.
Cows in milk.	2 oz.	If yielding above 20 lb. per day an extra ½ oz. per day.
Cows dry	2 oz.	
Bullocks working	1 oz	To be increased to 1½ oz.
Stud bulls.	2 oz.	in animals above 1,500 lb.

The mineral mixture should be fed mixed with the concentrate ration since it often has a smell which some animals do not relish, though they get used to it in course of time; if fed with concentrates the smell is not marked.

In the areas known to be deficient in the minerals, i. e., Malabar, Kurnool, North Salem and probably Tanjore districts, the quantities recommended above may be doubled to meet deficiencies of the minerals in the natural pastures.

The use of the mineral mixture should be constant. It is no use to feed it for a day or two and then to discontinue its use. Mineral mixture is cheap and in the quantities recommended will not cost more than one pie per day per animal. [*Indian Farming*, December, 1941.]

ABSTRACTS

The Growth of the Sugarcane Plant in India, Part I. Age-Fertilizer effects on the Physiology and Chemistry of Sugarcane. B. N. Singh, *Proc Indian Acad. Sci* B. 14: 201—234. The investigation deals with the effects of sulphate of ammonia (N), superphosphate (P), and sulphate of potash (K) applied singly or in combination at two levels each upon (i) height, tillering, leaf number, length and breadth of leaf, girth of stem, and nodes exposed; (ii) dry matter accumulation, photosynthetic and respiration rates, chlorophyll content and yield of stripped canes; and (iii) juice characters such as sucrose, glucose, Brix, purity, and extraction percentage of sugarcane *var.* Co. 312.

The canes were grown in standard size internally waxed pots in farm soil (sandy loam) and the records with respect to the characters mentioned above taken at successive stages of the life-cycle of the crop. The data are subjected to statistical analyses. The following conclusions are the outcome of these researches:—

(i) The nature of fertiliser effect varies both with respect to the age of the plant and the fertilisers used. In some cases such as assimilation, respiration

and chlorophyll the treatment effects are well marked at a very early stage of the life-cycle; in others such as height, tillering, length of the leaf, girth of the stem, dry matter accumulation, juice character, greater differences from treatment to treatment are noted towards the later stages of growth.

(ii) Increases in age, in general, increase the magnitude of the various characters such as cane height, number of leaves, leaf size (length and breadth of leaves), exposed nodes, girth, and dry matter upto a certain stage of the life-cycle and later bring about a fall in the values. Photosynthesis and respiration rates on the other hand show two cyclic changes more or less similar in nature though differing in intensity, one during the early stages of growth (45–135 days) and the other during the later stages (135–240 days). The chlorophyll content of leaves on the contrary maintains a higher value at later stages. The differences in the period of attainment of maximum efficiency or its period of lull, however, depends largely upon the type of the fertiliser added to the soil.

(iii) The available evidences give indication to the view that there are certain specific directions in which the effect of a fertiliser is mostly felt. Thus with respect to the soil used and the specific doses of fertilisers applied, the responses to nitrogen, phosphorus, and potash are noted as under:—

Nitrogen. Increases height, number of leaves and girth of the stem; augments dry matter accumulation; increases assimilatory efficiency of leaves at all stages of the life-cycle and respiration only during early stages; induces high yield of sugarcane but reduces juice purity.

Phosphorus. Reduces the number of leaves and girth of the main stem; reduces assimilatory efficiency of leaves throughout the life-cycle; augments respiration during second half and diminishes it in the first half of the age-cycle.

Potash. Increases assimilatory efficiency and respiration during first half and decreases assimilation during the second half of the life-cycle. Purity is increased.

Significant roles of Trace-elements in the Nutrition of Plants—H. Shive, *Plant Physiology*, 16 (1941) 435–445. Improved technique and purification of nutritive material have made it possible to add to the list of nutritive materials, boron, manganese, zinc and copper. More may be added to this list if the materials are purified further and technique still further improved. An element is essential if it be present in a substrate more than one part in a billion. The presence of minute trace of an element may stimulate growth. This does not constitute proof of essentiality nor does failure to stimulate mean that it is not essential. An element is necessary if the plant cannot complete its life-cycle without it, but it is difficult to say why they are essential.

In corn (monocotyledon) it is seen that boron deficiency symptoms are same as those for calcium deficiency under identical conditions. Further, they are together found to be essential in meristems. Boron is intensively used in reproductive organs. From experiments with various species it was not possible to find out the exact physiological functions of boron and calcium, but they show that boron was in a soluble and mobile state and its concentration in the plant tissue depended on its amount in the substrate. There was relation between boron and active calcium in the tissues but no relation between the boron content and the total calcium in the tissues, nor between soluble and total calcium in the plants. It can be concluded that the amount of calcium translocated to points of activity depends solely upon the supply of boron in the tissues, which depends on the boron content of the substrate. The property of

boron of rendering calcium mobile is made use of in industries to eliminate calcium occurring as impurity.

The same relationship was found to exist between the two elements in dicotyledons (*Vicia faba*), but only a relatively small fraction of total boron was soluble. In dicotyledons, in the toxic range of boron concentration in the substrate, accumulation of calcium was impeded causing a retardation in the rates of calcium absorption and hence in the rates of growth. Under identical conditions the total calcium and total boron content were much higher in dicotyledons than in monocotyledons. But the amount of soluble boron relative to the total was always much lower in dicotyledons resulting in a low fraction of soluble calcium relative to the total. The optimum boron requirement of dicotyledons was approximately 5 to 10 times as high as for monocotyledons.

Exclusion of boron from media destroyed the metabolism of calcium and plants showed deficiency symptoms. It is not known whether the symptoms are due to boron or calcium deficiency. If the required boron was supplied and calcium excluded, calcium deficiency symptoms were not seen until the calcium in the tissues became inadequate.

Microchemical investigations with meristems show that boron plays an important part in carbohydrate synthesis and fat metabolism. Plants grown with deficient boron gave positive tests for pectin and negative tests for fats while those grown in excess of boron gave the reverse results. Plants in optimum boron range gave positive tests for both. Experimental evidences suggest that boron may play similar indirect roles in the metabolism of other major elements.

Iron and manganese are two other important trace elements highly interdependent in the effects they produce. Ferric salts taken by the plant are converted into ferrous salts and unless this reaction is restrained by an oxidising agent, they become toxic producing pathological symptoms. Manganese serves this purpose of retarding reduction and oxidising existing ferrous salts in which state they are precipitated. These processes have been verified experimentally with plant materials and inorganic systems but the exact sequence of events is not well known. Culture experiments show that there can be a fluctuation in the iron content for normal growth if there is corresponding fluctuation in the manganese content and *vice versa*. The ratio of iron to manganese in the substrate is found to be one to two If the supply of manganese is less than is required the excessive iron activity produces iron toxicity or manganese deficiency symptoms, if manganese in excess we find iron deficiency or manganese toxicity symptoms. The ratio of active iron to active manganese inside the plant is more important than their proportion in the substrate. For a particular species their range was found to extend approximately between 1·5 to 2·5 but the same range of values need not be effective with all other species.

It is always safe to assume that each of the elements is a vital factor in nutrition since we cannot assign one particular function to each. K. V. R.

Tannin from kernels of green betel nuts. L. Baens, *Phil. Jou. Sci.* 75 (1941), 363—367.

The article gives the results of investigation indicating the possibility of a tanning extract from betel nuts grown in plantations in the Philippines where the betel nut palms (*Areca Catechu*) are grown throughout the country. The trees bear fruits about 4 years after planting and it takes about 6 months for the fruits to mature.

In betel nuts the tannin is located almost entirely in the kernel and the husk contains only traces of the same. The tannin content decreases as the green nut ripens. Mature kernels have only an equal tannin content as those of the ripe nuts collected from the same tree. When the kernel is just about reaching maturity with the outside husk still green, the highest tannin content is obtained.

The kernels of fully mature nuts from different trees gave a tannin content varying from 12·98 to 26·98 per cent Grown 8 feet apart there are 1680 trees to the hectare (2·47 acres). The results show that 1556 kilo grams of solid betel nut extract may be obtained from one hectare. The solid betel nut extract contains 65·34 to 66·96 per cent of tannin. In composition it compares very well with cutch (extract from bakauan bark) and also with foreign extracts. The quality is very good and almost unequalled for light leather tannage.

An unusually smooth grain and a fine natural colour are obtained when the extract is used for tanning goat skins and sheep skins. K. N. R.

Press Note.

Increase of Production of Food Crops in the Madras Presidency. No less than 2¾ crores of acres i e ⅛ of the total area are under food crops in the Province of Madras. Of this area, over one crore of acres i. e., about ⅓ of the cultivated area is under paddy cultivation and the rest of the area under other food crops like Jonna, Sajja, Korra, Ragi, Arika, Sama. Bengal gram. Green gram, Horse gram, black gram, etc. But still we are importing every year 7 lakhs tons of rice from Burma and other provinces and large quantities of gram from other provinces in India. Madras in turn exports nearly 3 lakhs tons of rice every year to Ceylon and other places so that if all our exports of rice are stopped we still require 4 lakhs tons of rice from other places. Cochin and Travancore States also import roughly 4 lakhs tons of rice and if they are deprived of these imports they will have to depend upon Madras for rice supply. Taking therefore the whole of South India into consideration our nett deficit is over 8 lakhs tons. Other grains cannot be had from other countries as they are not grown there. Now that the imports of rice from Burma have dwindled due to war and that they are even likely to be stopped altogether if the war extends to far east it is of vital importance that we should make the Madras Province independent of any country in the matter of rice and other food grains supply; otherwise, we may have to suffer. There are two ways of increasing food crops, viz., by expanding the area under cultivation and by increasing the yield per acre by intensive methods of cultivation. As for the expansion of the area all the land that can be profitably cultivated has already been brought under cultivation and most of the cultivable waste which has not been brought under cultivation is too poor for cultivating grain crops without irrigation and will be useful only for crops like horse gram, castor and similar crops. Government are trying their best to bring more land under irrigation but this cannot be done at a moment's notice and will take time. Every attempt is, however being made to lessen the area under commercial crops like groundnut, sugarcane, etc. The only other alternative is intensive methods of cultivation. This may not be possible in the case of unirrigated crops as they depend upon rainfall, and rainfall is irregular and sometimes undependable. The only improvements that can be suggested in dry crops is to conserve moisture in the soil and to grow better yielding strains. Every attempt is being made by the Agricultural Department to demonstrate in fields to prevent the run off of rain water in order that more water might get into the soil. Cultivation is another factor which helps better yields. With the local wooden plough the land has to be ploughed as many as 5–7 times but with the improved iron plough the same or

even better results can be obtained with less number of ploughings. These ploughs are stocked in Agricultural Depots at every taluk headquarters. These ploughs do not cost more than Rs. 6 to 10 each. If cultivators are to poor to purchase them for cash they can have them under the Takkavi loan system. The Agricultural Demonstrator will arrange this and the cost of the implement may be paid in one or two instalments along with land kist. Cattle manure is better fitted for dry crops such as Jonna, Korra, Sajja, etc., and also for garden crops. It is therefore more economical to apply this manure to dry and garden lands. If the cultivator has no such lands then he can use it for his paddy fields. Irrigated lands offer, however, better scope of increasing food crops, particularly paddy. The average yield of paddy is estimated at about 1200 lb. per acre which is certainly low as compared with the yields of paddy in other countries This low yield is partly due to unirrigated and partially irrigated crops which cannot be expected to yield as heavily as paddy grown under puddled condition. The low yield is also due to absentee landlords who own a fairly large proportion of the irrigated paddy lands. They are concerned only with regular income and are not interested in the improvement of their lands. Better yields cannot be expected from these lands unless the cultivator evinces interest in the land. This can be done only if the minimum period of lease is extended up to about 8—10 years and the landlords are made to pay a share of expenditure on any improvement effected in the land. This requires legislation and any reform of this kind requires time and there is no use of looking for any improvement in this direction The only possible way of increasing yields is to induce the owner cultivators and also the tenant cultivators to adopt better methods of cultivation and use better seed. The Department of Agriculture have produced as many as seventy improved varieties of paddy suitable for different kinds of soils over the province. They yield 8 to 15% more than local paddy besides being superior in quality and their seed is within easy means of almost every cultivator. If every cultivator gives up the local inferior varieties of paddy and takes to the improved strains it is quite possible to increase the average yield of paddy in the whole province up to 8% but not less than 5%. Better seed is always available with the Agricultural Department in limited quantities. They have made arrangements during the current season to produce larger quantities of seed and are likely to be able to supply the requirements to cultivators to a very large extent, if not in full. Cultivators are still in the habit of using a large quantity of seed which results not only in waste of seed but in poor yield. The local seed rate varies from 50 lb. to 100 lb. per acre but if it is reduced to 20 lb. as recommended by the Agricultural Department the saving effected in seed alone will be several tons while transplanting with less seed rate will result in higher yield depending upon the kind and quantity of manure applied. The best way of increasing paddy yields is by liberal application of suitable manures. A good crop of paddy removes from the soil 48 lb. of nitrogen and about 23 lb. of phosphoric acid besides 41 lb. of potash. Our soils are rich in potash and do not require any potash manure. They are poor in phosphoric acid and nitrogen and unless these two manures are applied in adequate quantities in some form or other it is futile to expect decent yields. Our paddy soils are not receiving enough manure, though they are cropped twice and even thrice a year. They are therefore in a poor condition. Unless therefore their fertility is increased by judicious application of manures it is of no use complaining and comparing our yields with those of other countries where special attention is paid to the problem of manures. Many cultivators are of opinion that manuring paddy fields adequately is beyond their means. Many cultivators are unfortunately of opinion that the manures recommended by the Agricultural Department are beyond their means. This is not true and the Agricultural Department never advocates a thing unless it is within easy

reach of an average cultivator. Of the two manures mentioned above as very important for paddy cultivation, viz., nitrogen and phosphoric acid, nitrogen is by far important. It is this manure that helps the plant growth. It can be applied to the soil in a number of ways, in the form of cattle manure, green leaf, oil cakes and nitrogenous fertilizers such as ammonium sulphate, calcium cyanamide, sodium nitrate, etc. The cheapest way of applying nitrogen to paddy crop is in the form of green manure. It costs very little to the cultivator beyond the cost of seed and a little of labour. Green manure grown in an acre of land is ordinarily sufficient for two or three acres and quantity required per acre does not cost more than Rs. 2 to 4 per acre. This is quite cheap. All that the *ryot* has to do is to sow the seed just before the harvest of the standing paddy crop or immediately after the crop is cut and give it one or two irrigations. If it is a single crop land water can be had for one or two irrigations free of assessment to wet the green manure crops. To gain knowledge of all the improvements advised by the Agricultural Department in the matter of increase of food crops it is necessary that the *ryots* co-operate with the demonstrator in his endeavour to arrange local organisation in agricultural associations and have the benefit thereof.

Groundnut Strain A. H. 25. The superior qualities of A. H. 25 groundnut namely, its heavier yield than the local variety by about 25 per cent, its drought resistance, bigger and plumpier seeds, etc., were broadcasted in the form of a dialogue in Tamil from the Trichinopoly All-India Radio Station on the 20th December 1941. (*Ed*)

Crop and Trade Reports.

Statistics—Paddy—1941-42—Intermediate Report. The main crop of paddy has been or is being harvested in parts of the Circars, the Deccan, the Central districts and Tanjore. The yield per acre is reported to be normal in Guntur, Bellary, Anantapur and Salem and below normal in the other districts.

The crop has been affected to some extent by insufficient rainfall in parts of Vizagapatam, East Godavari, Kistna, North Arcot, Ramnad and Tinnevelly, by cyclone in South Arcot and by attacks of insect pests in parts of Anantapur, Coimbatore and Malabar. The condition of the crop is generally satisfactory in the other districts of the Province.

The wholesale price of paddy, second sort, per imperial maund of 82⅔ lbs. (equivalent to 3200 tolas) as reported from important markets on 5th January 1942 was Rs. 4—0—0 in Vellore, Rs. 3—13—0 in Rajahmundry, Rs. 3—12—0 in Chittoor, Rs. 3—10—0 in Vizianagaram, Ellore and Tinnevelly, Rs 3—8—0 in Cocanada, Bezwada, Anantapur, Trichinopoly and Madura, Rs. 3—7—0 in Masulipatam, Guntur and Virudhunagar, Rs. 3—5—0 in Kumbakonam and Mangalore, Rs. 3—2—0 in Cuddalore, Rs. 3—0—0 in Hindupur and Negapatam, and Rs. 2—8—0 in Conjeeveram. When compared with the prices published in the last report, i. e. those which prevailed on 8th December 1941, these prices reveal a fall of approximately 23 per cent. in Conjeeveram, 17 per cent. in Hindupur, 13 per cent. in Madura, 11 per cent. in Masulipatam, 10 per cent. in Guntur, 8 per cent. in Bezwada and Chittoor, 7 per cent. in Anantapur, 5 per cent. in Virudhunagar 4 per cent. in Cocanada and Negapatam and 3 per cent. in Ellore and a rise of approximately 6 per cent. in Cuddalore, 4 per cent. in Kumbakonam and two per cent. in Rajahmundry, the prices remaining stationary in Vizianagaram, Vellore, Trichinopoly aad Tinnevelly.

Statistics—Crop—Groundnut—1941—Fourth or final report. The average of the areas under groundnut in the Madras Province during the five years ending

1939–40 has represented 45·2 per cent of the total area under groundnut in India. The area sown with groundnut in the Province in 1941 is estimated at 2,762,500 acres When compared with the corresponding estimate of 3,820,000 acres for the previous year and the actual area of 3,922,497 acres according to the Season and Crop Report of the previous year, the present estimate reveals a decrease of 27 7 per cent. and 29·6 per cent respectively. The estimated area for this year is less than the average area of 3,422 210 acres by 19·3 per cent.

The decrease in area is general outside Malabar and is due partly to the propaganda for the restriction of groundnut cultivation and partly to the receipt of insufficient rains at the time of sowing. The decrease in area is marked in Vizagapatam (– 57,500 acres) Guntur (– 121,100 acres), Kurnool (– 201,700 acres), Bellary (– 185,800 acres), Anantapur (– 100,800 acres). Cuddapa h (– 50,500 acres), South Arcot (– 99,600 acres), North Arcot (– 58 400 acres), and Salem (– 52 000 acres). The area in Guntur and the Ceded districts fell from 1,765 885 acres in 1940–41 to 1,106,000 acres in the current year i. e. by 37·4 per cent. The area estimated now in Guntur, Kurnool, South Arcot and Tanjore is the lowest reported in recent years.

The harvesting of the summer and early crop of groundnut had concluded by the end of October. The harvesting of the winter or main crop is proceeding. The crop was affected to some extent by insufficient rains in all districts except Nellore, Salem and Tinnevelly, by heavy rains in Tanjore and by insect pests in parts of South Arcot and Madura. The yield per acre is expected to be above normal in Salem, normal in Nellore and Tinnevelly and below normal in the other districts. The yield per acre is estimated to be low in East Godavari (60 per cent.), West Godavari, Kurnool and Malabar (71 per cent. in each), Tanjore (73 per cent.) and South Arcot (76 per cent.). The seasonal factor for the Province as a whole works out to 86 per cent. of the average as against 98 per cent. in the previous year according to the Season and Crop Report. On this basis, the yield is expected to be 1,185,800 tons of unshelled nuts as against 1,924,010 tons in the previous year, a decrease of 38 4 per cent. The yield in an average year is estimated at 1, 710,550 acres.

The wholesale price of groundnut (shelled) per imperial maund of 82⅔ lbs. (equivalent to 3,200 tolas) as reported from important market centres on 5th January 1942 was Rs. 5—0—0 in Vizagapatam, Rs. 4—12—0 in Vizianagaram, Rs. 4—10—0 in Guntur, Bellary, Tadpatri and Cuddalore, Rs. 4—9—0 in Coimbatore, Rs. 4—8—0 in Vellore, Rs. 4—7—0 in Cuddapah, Rs. 4—5—0 in Adoni, Rs. 4—4—0 in Hindupur and Rs. 4—0—0 in Salem. When compared with the prices published in the last report i. e. those which prevailed on 3rd November 1941, these prices reveal a rise of approximately 19 per cent. in Bellary, 14 per cent. in Coimbatore, 13 per cent. in Hindupur, 12 per cent. in Tadpatri, 11 per cent. in Adoni 9 per cent. in Cuddapah, 6 per cent. in Vizianagaram, 4 per cent. in Vizagapatam and Vellore and 1 per cent. in Cuddalore, the prices remaining stationary in Guntur and Salem.

Statistics—Crop—Gingelly—1941-42—Third Report. The average of the areas under gingelly in the Madras Province during the five years ending 1939–40 has represented 15·8 per cent. of the total area under gingelly in India. The area sown with gingelly up to 25th December 1941 is estimated at 535,800 acres. When compared with the area of 558,300 acres estimated for the corresponding period of last year, it reveals a decrease of 4·0 per cent. The estimated area is the same as that of last year in Guntur, Kurnool and Cuddapah. An increase area is estimated in Vizagapatam (plus 20,000 acres), East Godavari, West Godavari (plus 17,000 acres), Kistna, Bellary, Trichinopoly (plus 15,000 acres), Madura, Malabar and South Kanara and a decrease in area in the other districts of the

Province, especially in South Arcot (-10,000 acres), North Arcot (-28,500 acres) and Salem (-2),000 acres) owing to insufficient rainfall during the sowing period.

The main crop has been harvested except in the South. The yield per acre is estimated to be normal in Guntur, Cuddapah, Salem, Coimbatore and South Kanara and below normal in the other districts, especially in East Godavari and Kistna (70 per cent. in each). North Arcot (75 per cent) and Kurnool (76 per cent).

The seasonal factor for the Province as a whole works out to 92 per cent. of the average as against 94 per cent. for the corresponding period of last year. On this basis, the yield is estimated at 67,400 tons as against 70,700 tons for the corresponding period of last year, a decrease of 4·7 per cent. The wholesale price of gingelly per imperial maund of 82⅔ lb. (equivalent to 3,200 tolas) as reported from important markets on 5th January 1942 was Rs. 7—4—0 in Tinnevelly and Tuticorin, Rs. 7—3—0 in Cuddalore, Rs. 7—2—0 in Cocanada, Rs. 6—14 -0 in Trichinopoly, Rs 6 -9—0 in Rajahmundry, Rs. 6—6—0 in Salem, Rs. 6—3—0 in Ellore, Rs. 6—0—0 in Vizagapatam and Rs. 5—14—0 in Vizianagaram. When compared with the prices published in the last report, i. e., those which prevailed on 3rd November 1941 these prices reveal a rise of approximately 14 per cent. in Tuticorin and 4 per cent. in Rajahmundry and a fall of approximately 10 per cent. in Salem, 3 per cent. in Tinnevelly, 2 per cent. in Cocanada and 1 per cent in Trichinopoly, the prices remaining stationary in Vizagapatam, Vizianagaram, Ellore and Cuddalore.

Statistics—Castor—1941—First or final report. The average of the areas under castor in the Madras Province during the five years ending 1939-40 has represented 18·0 per cent. of the total area under castor in India.

The area under castor in the Madras Province up to 25th November 1941 is estimated at 244,900 acres. When compared with the area of 250,000 acres estimated during the corresponding period of last year, it reveals a decrease of 2·0 per cent. The estimate of last year was less than the actual area of 266,786 acres by 6·3 per cent.

The crop is mainly grown in Guntur (28,000 acres), the Deccan (122,000 acres), Nellore (32,000 acres) and Salem (20,000 acres). It is, not grown in Chingleput. The area is estimated to be the same as that of last year in Trichinopoly and Malabar. An increase in area is estimated only in South Arcot and Salem and a decrease in area in the other districts of the Province.

The yield per acre is expected to be below normal only in Guntur, Kurnool and Anantapur, above normal in Salem (110 per cent.) and normal in the other districts of the Province The seasonal factor for the Province as a whole is estimated at 98 per cent. of the normal. On this basis, the yield is estimated at 24,300 tons as against 24,900 tons estimated for the corresponding period of last year and 27,390 tons estimated in the season and Crop Report of last year.

The wholesale price of castor seed per imperial maund of 82⅔ lb. (equivalent to 3,200 tolas) as reported from important markets on 22nd December 1940 was Rs. 5—14—0 in Vizianagaram, Rs. 5—12—0 in Vizagapatam, Rs. 5—8—0 in Guntur, Rs. 5—5—0 in Nandyal, Rs. 4—12—0 in Cuddapah, Rs. 4—8—0 in Anantapur, Rs. 4—4—0 in Bellary and Rs. 4—2—0 in Hindupur. When compared with the prices reported in the previous year, i. e., those which prevailed on 16th December 1940, these prices reveal a fall of about 15 per cent. in Bellary, 14 per cent in Cuddapah, 11 per cent. in Nandyal and Hindupur, 10 per cent. in Anantapur, 8 per cent. in Guntur, and 6 per cent. in Vizianagaram, the prices remaining stationary in Vizagapatam.

Statistics—Ginger—1941—Final Report. The area under ginger in 1941 is estimated at 11,600 acres in Malabar and at 600 acres in South Kanara as against

the actual area of 11,541 acres in Malabar and 655 acres in South Kanara in the previous year.

The condition of the crop is satisfactory and the seasonal factor is estimated to be normal in both the districts as against 95 per cent. in Malabar and 100 per cent. in South Kanara in the previous year. On this basis, the yield is estimated at 4,360 tons of dry ginger (4,150 tons in Malabar and 210 tons in South Kanara) as against 4,360 tons in the previous year (4070 tons in Malabar and 290 tons in South Kanara).

Statistics—Pepper—1941—Final Report. The area under pepper in 1941 in Malabar and South Kanara is estimated at 105 600 acres (97,000 acres in Malabar and 8 600 acres in South Kanara) as against the final area of 104,112 acres (95,371 acres in Malabar and 8,741 acres in South Kanara) in the previous year.

In Malabar the crop is reported to have been affected to some extent by the heavy rains and cyclone in May—June and by the heavy rains in November. The seasonal factor is estimated at 95 per cent. of the normal in Malabar and 100 per cent. in South Kanara as against 100 per cent in both the districts in the previous year. On this basis, the yield is estimated at 9,680 tons (8,850 tons in Malabar and 830 tons in South Kanara) as against 9 990 tons (9,140 tons in Malabar and 850 tons in South Kanara) estimated in the previous year.

The wholesale price of pepper per imperial maund of 82⅔ lbs. (equivalent to 3200 tolas) as reported from important markets on 5th January 1942, was Rs 10—11—0 in Calicut, Rs. 10- -2—0 in Tellicherry and Rs. 13–7–0 in Mangalore. When compared with the prices published in the last report i. e. those which prevailed on 8th September 1941, these prices reveal a fall of approximately 10 per cent. in Calicut and Tellicherry and a rise of approximately 11 per cent. in Mangalore.

Statistics—Cotton—1941–42—Third forecast report. The average of the areas under cotton in the Madras Province during the five years ending 1939–40 has represented 9·7 per cent. of the total area under cotton in India.

The area under cotton up to 25th November 1941 is estimated at 2,036,200 acres. When compared with the area of 1 874,300 acres estimated for the corresponding period of last year, it reveals an increase of 8·6 per cent.

The area is the same as that of last year in West Godavari, Chittoor, Tanjore and South Kanara. A decrease in area is revealed in Vizagapatam, East Godavari, Guntur, Kurnool and Malabar, an increase in area in the other districts of the Province. The increase is marked in Bellary (plus 30,000 acres), Anantapur (plus 20,000 acres), South Arcot (plus 14,000 acres) Salem (plus 25,700 acres), Coimbatore (plus 16,700 acres), Madura (plus 23,000 acres) and Ramnad (plus 17,000 acres).

The area under irrigated cotton, mainly Cambodia, is estimated at 243,700 acres as against 226,300 acres in the corresponding period of last year, thereby representing an increase of 7·7 per cent.

The mungari or early sown crop in parts of the Deccan is in flowers and bolls. The yield per acre is expected to be below normal due to insufficiency of rains.

Normal yields are expected in all districts outside Vizagapatam, Kistna, Guntur, Kurnool, Bellary, Cuddapah and South Arcot. The seasonal factor for the Province as a whole works out to 96 per cent. of the average as against 99 per cent. for the corresponding period of the previous year. On this basis, the total yield is estimated at 441,100 bales of 400 lb. lint as against 410 400 bales of last year, thereby representing an increase of 7·5 per cent. The crop is young and it is too early to estimate the yield with accuracy.

The estimated area and yield according to varieties are given below:—

(Area in hundreds of acres i. e., 00 being omitted; Yield in hundreds of bales of 400 lb lint, i. e. 00 being omitted.)

Variety.	Area from 1st April to 25th November		Corresponding Yield	
	1941	1940	1941	1940
1	2	3	4	5
	Acres.	Acres.	Bales.	Bales.
Irrigated Cambodia	2 357	2,126	1,474	1,325
Dry Cambodia	2.716	2,147	569	460
Total, Cambodia ...	5,073	4,273	2,043	1,785
Uppam in the Central districts	164	123	27	19
Nadam and Bourbon	330	298	17	15
Total, Salems ...	494	421	44	34
Tinnevellies*	4,080	3,827	1,017	940
White and Red Northerns ...	1,300	1,500	154	188
Westerns	8,350	7,620	965	953
Warrangal & Cocanadas ...	1,002	1,027	181	195
Chinnapatti (Short staple) ...	63	75	7	9

* Includes Karunganni in Coimbatore and Uppam, Karunganni and mixed country cotton in Madura, Ramnad and Tinnevelly.

The local cotton trade is not generally active at the time of the year. The average wholesale price of cotton lint per imperial maund of 82⅔ lb. as reported from important markets on 8th December 1941 was Rs. 17—5—0 for Cocanadas, Rs. 20—9—0 for white Northerns, Rs. 18—2—0 for red Northerns, Rs. 16—10—0 for Westerns (Mungari), Rs. 20—7—0 for Westerns (Jowari), Rs. 44—8—0 for Coimbatore Cambodia, Rs 39—7—0 for Coimbatore Karunganni and Rs. 29—6—0 for Nadam cotton. When compared with the prices published in the last report, i. e, those which prevailed on 3rd November 1941, these prices reveal a rise of 13 per cent. in the case of Coimbatore Cambodia, 11 per cent. in the case of Coimbatore Karunganni, 9 per cent. in the case of Westerns (Mungari) 5 per cent. in the case of Nadam cotton and 2 per cent in the case of Westerns (Jowari) the prices remaining stationary in the case of Cocanadas and Northerns (red and white varieties)

Statistics—Cotton—1941-42—Intermediate report. Pickings of the mungari or early sown crop in parts of the Deccan are in progress and the yield is expected to be below normal due to insufficiency of rains. The main crop is affected by insufficient rainfall to some extent in parts of the districts of Vizagapatam, Kistna and Bellary. The condition of the crop is generally satisfactory in the other districts of the Province.

The average wholesale price of cotton lint per imperial maund of 82⅔ lb. (equivalent to 3200 tolas) as reported from important markets on 5th January 1942 was Rs. 16—7—0 for Cocanadas, Rs. 16—10—0 for Westerns (Mungari), Rs. 20—7—0 for Westerns (hingari). Rs. 41—5—0 for Coimbatore Cambodia, Rs 36—12—0 for Coimbatore Karunganni and Rs. 28—6—0 for Nadam cotton. When compared with the prices published in the last report, i e. those which prevailed on 8th December 1941, these prices reveal a fall of seven per cent. in the case of Coimbatore Cambodia and karunganni, five per cent. in the case of Cocanadas and three per cent. in the case of Nadam cotton, the prices remaining stationary in the case of Westerns (mungari and hingari).

(From the Director of Industries and Commerce, Madras).

Cotton Raw in the Madras Presidency. The receipts of loose cotton at presses and sppinning mills in the Madras Presidency from 1st February 1941 to 9th January 1942 amounted to 637,371 bales of 400 lb. lint as against an estimate of 503,500 bales of the total crop of 1940—41. The receipts in the corresponding period of the previous year were 528,510 bales. 619.338 bales mainly of pressed cotton were received at spinning mills and 61 782 bales were exported by sea while 122,415 bales were imported by sea mainly from Karachi and Bombay.

(From the Director of Agriculture, Madras).

Mofussil News and Notes.

Agricultural Exhibition, Kalpathi, Palghat. A small Agricultural Exhibition was held at Kalpathi on the occasion of the car festival from 13th to 15th November (both days inclusive). Samples of improved paddy seed, green manure seed, graft mango plants, and posters on improved crops and control of insect pests and diseases were put up with explanatory notes. Cooper No. 25 plough, sprayer and the bee-hive were also put up. Departmental publications were distributed to the visitors; 43 calendars and 4 bulletins and 10 mango graft plants were also sold out on the occasion.

A. G. N.

Rasipuram Taluk Rural Uplift Tournament-cum-Health and Baby Week. An Agricultural and Industrial Exhibition was held in connection with the Health Week and Tournament from 18th to 21st December 1941 in a spacious pandal at Rasipuram. Besides the exhibits put up by the Health, Forest, Co-operative and Agricultural Departments, a large number of *ryots* and village *sangams* had brought a variety of exhibits both agricultural and industrial, and these covered nearly 1,000 sq. feet of floor space. The produce from the Kollimalais formed a very attractive feature and won the rolling cup for the best all-round exhibits. The exhibition of bee-hives and poultry by *ryots* showed that they pay well as side industries. One *ryot* Sri. Sundaresa Padayachi of Mangalapuram was awarded a silver medal for the record yield of GEB 24 paddy of 4000 lb. per acre by following departmental methods of cultivation. 10 others secured prizes and several others certificates of merit.

P. K. N.

The Second Half-yearly Conference of the District Work Officers of Anantapur and Bellary districts was held at Hindupur between the 15th and 22nd December 1941 under the Presidency of Nawabzada Saadat-ul-lah Khan, Esq., M. A., (Oxon), Bar-at-law, I. A. S., Deputy Director of Agriculture, Cocanada. Sri T. Budhavideya Rao Nayudu, Headquarters, Deputy Director of Agriculture, Madras, was present during the early days of the Conference. The Conference was also attended by Sri S. N. Venkataramana Ayyar, Assistant Marketing Officer, Madras, during the last few days. The Conference unanimously passed a resolution expressing profound sorrow at the untimely demise of Sri Rao Bahadur K. Gopalakrishna Raju, Provincial Marketing Officer, Madras. Basing the future work on a war-time policy, the different methods of increasing food production by intensive and extensive measures were discussed in detail. Among other things, the marked improvement in Hindupur where groundnut cake application to paddy reached the figure of about 4,500 tons cake in the second year, was observed as a useful method for copying elsewhere. A number of resolutions concerning the activities of the department in these two districts were discussed in detail and passed. Besides the District Work Officers and the Mycology Assistant, the Secretary of the Cotton Market Committee, Adoni, and the Millet Assistant, Dry Farming Station, Hagari and the Marketing Assistant, Madras, attended the conference and gave the benefit of their experiences.

V. N. S.

The Taluk Agricultural Improvement Committee of Hindupur celebrated its first anniversary at Hindupur, by holding an Agricultural and Industrial Exhibition and Cattle Show between the 15th and 21st December 1941, synchronising with the Conference of the District Work Officers of Anantapur and Bellary. The Agricultural Department exhibited the seeds of improved strains, manures and implements, methods of control of insect pests and diseases, malt making and cream jaggery preparation methods, fruit preserves and charts and posters on fruit cultivation and the marketing section exhibited appliances and charts for grading and marketing. The exhibition attracted large crowds daily when departmental publications were distributed to the visitors. During each day of the Exhibition Week, lectures on agriculture and kindred subjects were arranged and on the last day, prizes in the shape of seeds, implements and certificates were awarded to the best exhibits. The Deputy Director of Agriculture, Cocanada, gave away the prizes. The celebrations concluded with an agricultural drama.

V. N. S.

Estate News.

Students' Corner. *Tour:* The second year class was taken on a tour between the 3rd and the 17th of January to the following important places of agricultural interest, namely—Erode, Tindivanam, Palur, Aduturai, Pattambi, Mettupalayam, Coonoor and Kallar. The party was led by Sri P. A. Venkateswara Ayyar, Teaching Assistant in Agriculture and Hostel Warden, and Sri K. P. Anantha-narayana Ayyar, Assistant in Entomology, accompanied the party to explain to them things of entomological interest. The party had a pleasant and instructive time through the kind help of the various officers of the department in the places visited for which the party thanks them fully.

Victory Cup. Hockey Match Finals 1—12—41. Class III won over Class I by 1 goal to nil. Class III annexed the Cup having won in cricket also.

Table Tennis. All-India Championships: We are glad to learn that Sri N. M. Nayudu with V. Sivaraman of Madras as his partner has won the Doubles title in the All-India Table Tennis tournament conducted at Delhi. We congratulate him on his success.

The Agricultural College Estate Bhajana Association. The Dhanurmasa pujas conducted as usual under the auspices of the Agricultural College Estate Bhajana Association, concluded with Sri Radha Kalyanam celebrations on Sunday, the 18th instant, in a special pandal erected for the purpose. There was poor feeding on the occasion followed by a Harikatha Kalakshepam "Rukmini Kalyanam" by Brahmasri Gopala Bhagavathar of Biskshandarkoil. The day's function concluded with a procession and bhajana at night. Sri Hanumath Jayanti was also celebrated on Monday, the 19th instant with Deepapradakshinam and Bhajana.

Visitors. Sri Rao Bahadur B. Viswanath Garu, F. I. C., F. C. S., Director, Imperial Agricultural Research Institute, New Delhi, paid a visit to the Imperial Sugarcane Station, when he was entertained at a tea by Rao Bahadur Sri T. S. Venkataraman.

Academic Council. Sri P. N. Krishna Ayyar, B. A., of the Entomological section was elected as a member of the Madras University Academic Council to represent the teaching staff of the College in the seat vacated by Sri T. V. Subrahmanya Ayyar.

Departmental Notifications.

Gazetted Service.

Transfers and Postings.

Names of officers.	From	To
Sri Rao Bahadur G. N. Rangaswami Ayyangar,	Millets Specialist and Geneticist (on leave),	Millets Specialist and Geneticist and Principal.
,, Y. G. Krishna Rao Nayudu,	Dy. Director of Agriculture (on leave),	S. L. A. and Supdt., Central Farm, Coimbatore.
,, R. N. K. Sundaram,	D. A. O. Bellary (on leave),	D. A. O. Bellary.
,, S. Sitharama Patrudu,	D. A. O. Cocanada (on leave),	D. A. O. Cocanada.
,, M. Chinnaswami Nayudu,	D. A. O. Cocanada,	Agronomist in charge, A. R. S. Siruguppa.
,, C. V. Ramaswami Ayyar,	Asst. Agri. Chemist, A. R. S. Siruguppa,	Asst. Agri. Chemist, Coimbatore.
Dr. S. Kasinatha Ayyar,	Asst. Agri Chemist, Coimbatore,	Asst. in Chemistry, Coimbatore.
Sri C. Vijayaraghavacharya,	Offg. Millets Specialist, Coimbatore,	Gazetted Asst. to the Principal.

Leave.

R. C. Broadfoot Esq., Principal and Senior Lecturer in Agriculture, Coimbatore, leave on average salary for 16 days from 20-1-42 preparatory to retirement.

Subordinate Service.

Transfers and Postings.

Names of officers.	From	To
Sri S. R. Srinivasa Ayyangar,	Upper subordinate (on leave),	A. D. Orathanad, Tanjore Dt.
,, K. Sitharama Ayyar,	A. D. (on leave),	A. D. Attur.
,, S. S. Katchapeswara Ayyar,	Agricultural subordinate service on deputation.	A. D. Coonoor.
,, K. Raman Menon,	A. D. Coonoor,	F. M. Nileshwar.
,, G. Venkatakrishna Ayyar,	F. M. Agri. College Orchard, Coimbatore,	F. M. Burliar and Kallar Fruit Stations.
Muhammad Zainulabdeen Sahib,	Asst. in Paddy, A. R. S. Maruteru,	Asst. in Paddy, A. R. S. Buchireddipalam.
Sri V. V. Jagannatha Rao,	A. D. Anakapalle,	A. D. Tenali.

Leave.

Names of officers.	Period of lea
Sri P. M. Appaswami Pillai, A. D. Attur,	L. a. p. on m. c. for 2 months from 15—2—41.
,, G. Venkatakrishna Ayyar, F. M. (on leave),	Extension of l. a. p. on m. c. for d.3

Sri K. M. Krishna Menon, Asst. in Chemistry,	L. a. p. for 30 days from 5—1—42.
„ R. Kolandavelu Naicker, A. D., Peravurni.	Extension of l. a. p. for 1 month from 7—1—42.
„ B. N. Padmanabha Ayyar, A. D., Puttur.	Extension of l. a. p. for 1 month from 9—1—42.
„ S. Varadarajulu Nayudu, A. D, Dhone.	Extension of l. a. p. for 1 month from 24—12—41.
„ C. Annamalai, A. D., Madanapalle.	L. a. p. for 2 months from 2—2—42.
K. Soopi Haji Sahib, A. D. Manjeri.	L. a. p. on m. c. for 2 months from 2—1—42.
Sri K. Jayaram, A. R. S., Tindivanam.	L. a. p. for 34 days from 8—1—42.
„ M. Srinivasa Rao, A. D., Kavali.	L. a. p. for 30 days from 26—1—42.

Agricultural College and Research Institute, Coimbatore.

ADDITIONS TO THE LIBRARY DURING THE QUARTER ENDING 31st DECEMBER 1941.

A. Books.

1. *The Advance of the Fungi.* Large, E. C. 2. *The Land now and Tomorrow.* Stapledon, R. G. 3. *American Husbandry.* Carman, H. J. 4. *Malayan Agricultural Statistics.* 5. *The Madras Treasury Code. Vols. 1 & 2* 6. *Statistical Abstracts for Br. India from 1929–30 to 1938–39.* 7. *Report on the Marketing of Rice in India and Burmah.* 8. *The Madras Account Code. Vol. 1.* 9. *Royal Commission of Agriculture.* Abridged Report. 10. *Fertilizer Experiments on Sugarcane in India, 1932–39.* 11. *The Madras Financial Code, Vols. 1 & 2.* 12. *Report on the Development of Irrigation under Cauvery Mettur Project.* 13 *The Madras Treasury, Financial and Account Codes, Explanatory Memo.* 14 *Raja Sir Annamalai Chettiar Commemoration volume.* 15. *Some South Indian Villages—A Resurvey.* P. J. Thomas and K. C. R. 16. *Peasant Life in China.* Hsiao Tung Fei. 17. *Report on the Marketing of Tobacco in Madras.* 18. *Health Bulletin No 23. The Nutritive value of Indian Foods and the planning of satisfactory diets.* 19. *The Baking Quality of S. African Wheat Varieties.* 20. *Fruit Pectins, Their Chemical Behaviour and Jellying Properties.*

B. Annual Reports, Reviews, Proceedings, etc.

1. Ontario Agric. Dept, Annual Report, 1939. 2. Bristol Agricultural and Horticultural Research Annual Report, 1940. 3. Co-operative Societies, Administration Report for 1938—1939. 4. Co-operative Societies, Administration Report for 1939—1940. 5. Empire Cotton Growing Corporation, 20th Annual Report. 6. Report on Agriculture in Malaya for 1940. 7. S. S. & F. M. S. Botanic Gardens Annual Report for 1939. 8. Mysore Agricultural Calendar for 1941–'42. 9. Indian Sugar Manual, 1941. 10. Proceedings of the Assn. of Official Seed Analysts of N. Amer. 1940. 11. Annual Review of Biochemistry for 1940, 12. Annual Report on the Progress of Chemistry, V. 37 (1940). 13. Annual Report of the Society of Chem. Industry on the Progress of Applied Chemistry, 1940. 14. Gneneda Agric. Dept., Annual Report for 1939—1940. 15. Villagers' Calendar, Malayalam Edn., 1941–'42. 16. P. W. D. Madras Administration Report for 1939–'40. 17. British Chemical and Physiological Abstracts A1. (1940). 18. I. A. R. I. Scientific Report for 1939–'40. 19. Imperial Dairy Department Annual Report for 1939–'40. 20. Ceylon Agric. Department Administration Report for 1940. 21. Baluchistan Agency Administration Report for 1940. 22. N. W. F. Province, Dept. of Agriculture Annual Report for 1939–'40. 23. Central Provinces, Report on the Experimental Farms for the year ending 31—3—40.