From all this it is evident that we cannot entirely duplicate the results of America in India, because the Indian farmer is not on the same educational level, to be receptive to developments to the extent that we would wish, and to organise himself to develop as a group. Education and organisation of the farmers should be the keystone of our agricultural policy. That a whole generation of farmers cannot be made overnight to read and write is not a matter of despair. Audio-visual aids come to our rescue and if these aids are properly used and if men with ideas are utilised to develop the material required in script and presentation, there is a tremendous possibility. Besides this, the Indian tradition is so full of village dramas, rural folk songs and dances that we can utilise them to the advantage of the former. As far as organisation of the farmer is concerned, training of local leaders becomes a matter of utmost importance —leaders who are trained to be scientific farmers, and who are respected by the local community.

Deficiencies of minor elements responsible for diseases of crop plants in this province*

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Crop plants remove considerable amounts of mineral nutrients from the soil during their life. A small percentage of these may be returned to the soil by the disintegration of those parts left in the soil. But the major proportion contained in stem, leaves, fruits and seeds does not come back at least to the same place. Consequently replenishment of the loss is necessary. For this purpose manures have to be applied to the cropped areas. Knowledge of the nutritional requirements of plants have undergone change in recent years. At one time it was thought that the plants were in need of only ten essential elements for growth. Recent work especially during the last three decades has however resulted in the development of our knowledge of the part part played by various other elements in the life of the plants and has led to the addition of more elements under this category. These later additions are usually termed as "minor elements" "trace element" or "micronutrients" and have been found to be equally essential though they are required only in extremely small quantities. Though the role of these elements fall within the realm of physiological studies, the absence or deficiencies of these elements lead to the development of pathological symptoms of crop plants

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and these are of considerable interest to the plant pathologist. Furthermore there is more information of the pathological aspect of these trace elements than their physiological functions.

In our province a certain amount of investigation of the pathological aspect of some of these elements has been made by the mycology section and the results are included hereunder.

One of the trace elements whose deficiency has been exhibited by disease symptoms in plants is boron. During the World War II intensive cultivation of vegetables was undertaken on the Nilgiris for the benefit of the army. Extensive areas were under turnip, beet root, cauliflower and cabbage. The turnips, beet roots and cauliflowers grown in some localities near Ootacamund developed certain pathological symptoms. The core of the root in turnip was soft and presented a discoloured water-soaked appearance (water core) instead of being white and hard. In beets the crown was often found rotten, blackened and the young leaves at the top were also involved. The cauliflowers in some fields did not develop the normal creamy curd but had poor flowers of varying shades of brown. Pathogenic organisms were not present in the affected portions. Similar symptoms on these crops have been described from other countries as being caused by boron deficiency. The only way to test this was by supplying the deficiency. With the co-operation of one of the leading ryots of Ootacamund, field experiments were conducted for over two seasons, for the control of water core of turnips. Boron was applied to the soil in the form of boric acid a few days before sowing at the rate of five, ten, fifteen and twenty pounds per acre. Spray inoculation of a 0·2 percent solution of boric acid on the foliage was also tried. An examination of the tubers from the various plots showed that all the treated plots had very little or no symptoms of the disease and that spray application was as effective as application to the soil. Thus it was proved that boron deficiency was responsible for the symptoms of water core of turnips. Based on these experiments the ryot was advised to broadcast 5 pounds of boric acid per acre. It is also concluded that the pathological symptoms observed on beet roots and cauliflower must be due to the same cause, and boric acid application will be beneficial.

Boron deficiency affects growth of many other crops also. Excess of boron is however toxic to plants and this has to be borne in mind in recommending the dosage of the element to be applied.

Zinc is another minor element whose deficiency in the soil or non-availability to the plant is evident in many parts of the province. Orange trees in several districts of the plains exhibit symptoms of zinc deficiency. The growth of the tree is arrested. The leaves develop yellow blotches between the veins presenting a characteristic mottled appearance. The leaves become progressively smaller; fruits are produced and in course of time the tree deteriorates and falls a prey to other pathogens.

There are two ways of supplying this deficiency, either by application of zinc sulphate to the soil or by the spray application on the foliage. Addition of zinc sulphate to the soil was done by placing it in holes 9 inches deep all round the tree or by broadcasting the salt over the soil round the trees and working it in. Both these methods failed to produce any response in the trees. The spray application was next tried. The composition of the spray fluid was varied according to the intensity of symptoms. In trees which had initial stages of deficiency symptoms zinc sulphate-lime mixture of the formula of 5 – 2½-100 was used and in more severe chronic instances the formula 10 – 5-100 was followed. Zinc sulphate was dissolved in water in one vessel. In another bigger vessel the lime was slaked and later diluted with the required quantity of water. The zinc sulphate solution was poured into the lime solution and stirred. The resulting mixture was sprayed on the foliage. The best period for spraying is when the trees are putting forth new flush of leaves. Two applications are necessary in a year and these can be adjusted with reference to the flushing period in each locality. It is better not to spray when the trees are in flower. Experience in America and in our Province has shown that there is no harm when the trees with fruits on are sprayed provided the mixture is correctly prepared (neutralised). The response is much quicker when the spray is made on young foliage than on old ones. Application of large quantities of farm yard manure in addition to the spray will also be beneficial. Zinc salts may be present in the soil but do not become available to the plants and that is the reason why soil applications do not produce any response. The results of these experiments have been given wide publicity and several orange growers are regularly spraying the trees with zinc sulphate. The department had arranged to distribute over 5 tons of zinc sulphate in 1947 and larger amounts are being used at present.

Another minor element whose deficiency has been found to produce pathological symptoms is copper. Citrus plants readily exhibit the deficiency of this element. The disease known as 'Exanthema' or 'one form of die back' is due to this. In the initial stages of copper deficiency the young branches are frequently angular and 'S' shaped with multiple buds instead of being round with usually one bud as in normal plants. In acute stages the twigs begin to die back and gum pockets develop at the leaf bases. The branches may be covered with brown gummy excrescences and ultimately defoliation takes place. The rind of the fruit also may exhibit hard brown excrescenses.

Spraying the trees with Bordeaux mixture has resulted in marked response and the disappearance of the symptoms. Bordeaux mixture is sprayed on orange trees for protection against several diseases and this treatment serves also for making good the copper deficiency. Copper sulphate can be applied to the soil also with good effect about half to two

rendering all help in solving the problem. With the kind help of the Government Agricultural Chemist the samples were converted into ash and taken to Coonoor for the analysis. Dr. De the assistant chemist, helped in the analysis. Several readings were made. It was clear from the spectrograph that the leaves from diseased plants had deficiencies of several elements when compared to healthy ones. Zinc was absent in all specimens. The leaves from affected trees exhibited deficiency of phosphorous, magnesium, manganese and boron whereas no differences could be made out between the two with regard to calcium and iron.

It is clear from the analysis of the leaves that the trees are lacking in several nutrients. There is agreement between the soil and leaf analyses in the matter of phosphorus. But the deficiencies of manganese, boron, magnesium and zinc (in all cases) which have been revealed by the leaf analysis could not be easily made out in soil analysis. Furthermore the minerals may be present in the soil but may not be available to the trees. Citrus trees are known to grow well at pH 7 but very often the nutrient substances do not become available to the plants from the soil at this reaction. The soil at Kodeneri estate was found to have a reaction in the neighborhood of pH 7. Moreover lack of boron has been reported to inhibit absorption of phosphates from the soil. So it is quite possible that the trees are not able to obtain their requirements from the soil due to these causes.

In Florida where deficiencies of various elements have been observed in orange gardens a new technique is being employed for replenishment of the nutrients, i.e., by spraying a combination mixture of phosphorus, potassium, maganesium, manganese, boron etc., instead of applying these to the soil for quick response. It has been decided to try this method at Kukal. Mr. Athrey has agreed to place his garden at our disposal for the conduct of these experiments and we thank him for it.

The usefulness of leaf analysis in determining the nutritional requirements of crop plants is brought out by these experiments. This method of tackling some of the diseases has been attempted for the first time in this province not only in the case of orange but also in the case arecanut. A spectrograph however is essential for this type of work as one cannot be always troubling other institutions for this. I understand that sanction has recently been accorded for purchasing one for this institute. Various undiagnosed troubles without any associated pathogens occur in many crop plants and fruit trees e.g., areca, orange, plums, vegetables etc. The analyses of plant parts may often help in solving some of these problems and a quick and efficient method of doing this is by the spectrographic analysis.

Summary. Several pathlogical symptoms caused by deficiencies of minor elements have been observed in this province. Boron deficiency causes water core of turnips and crown rot of beets on the Nilgiris. Mottling of orange leaves due to deficiency of zinc is prevalent in many districts. 'Exanthema' of citrus is caused by copper deficiency, Methods of supplying these deficiencies are described.

Recently a decline of oranges in Kotagiri, Yercaud and other hilly districts has been attributed to deficiencies of several elements including zinc, manganese and boron. This was revealed by spectrographic analysis of plant tissues with a view to obtain a correct estimate of the nutritional status of the plants is stressed.

Gleanings

The peasant and the commisar. An analysis of Russian agricultural policy: For 32 years Russia has been attempting to convert agriculture into an industry on the same lines as the heavy industries. In the plan, control of all farm production was to be centered in Moscow. Workers were to be regimented in the same way as factory hands and miners. The experiment has not succeeded even to the small extent achieved in other industries. According to the "Soviet Encyclopaedia", Lenin, in 1919, wanted to encourage the small farmers to join co-operatives, i. e. groups in farmers help each other by lending implements, machinery and (somotimes) workers. Most small farmers had no objection to this scheme; it helped them by opening up marketing co-operatives as well. Afterwards, if the plan worked, they were to be plunged into collectivi- [redacted] (i. e. communisation in which the State owns all implements, equipment and cattle). This was known as "Lenin's Co-operative Plan". Its ultimate object, however, was not "co-operation" as such, but the complete submerging of agriculture into the Soviet economic plan. Large landowners had been liquidated, the Kulaks (independent farm owners) were necessary for the time, because of their experience. Peasants, who formed the major part of the producing farmers, had to be encouraged.

Stalin impatient: Stalin, on the other hand, was more impatient. In an essay "Problems of Leninism" written in 1926 he discussed an alliance between the labouring masses and the peasantry, and wrote: "This special form of alliance consists in that the guiding force of this alliance is the proletariat. This special form of alliance consists in that the leader of the State, the leader in the system of the dictatorship of the proletariat, is one party ..... the party of the Communists, which does not and cannot share that leadership with other parties. In fact, the alliance is of the nature of the relationship between officer and man". The Russian peasantry of 1926 was, therefore, in the position of having been manoevred into bringing in the new "officers" to replace the old landlords. The main difference was that the "officers" were controlled by the central Party in Moscow. The fifteenth Party Congress in December 1927 adopted a resolution for "positive measures to be taken to collectivise peasant farming". These measures included the abolition of the Kulaks and controlling of agriculture by thousands of bureaucrats drawn from the proletariat. By November 1929, more than 25,000 city workers had been sent to the country to organise farms on Stalinist lines. Their duties were political but they became virtually "bosses of the peasantry".