

7. It may now be asserted that we have a potent weapon in the latest insecticides and that we can certainly contribute towards maximisation of production through their use. The research staff that has to work on the fundamentals has to be strengthened for intensive work to secure the maximum benefit out of these wonder drugs. There are a number of new insecticides and their combinations, on the market such as Metaldehydes, Dichloro-propane, Ovicide, etc., and it is quite possible that some of these might prove even more effective than BHC or DDT. The plant protection staff is also to be further augmented.

8. *Storage:* Due to vagaries of seasons coupled with the changing economic conditions in the country, the production of food grains is not up to our requirements. To augment our stocks of food grains in the country, large consignments of food materials have had to be imported. It then devolved upon the Government not only to protect the growing crops in the field but also the stored food reserves. The imported grains had to be examined and fumigated for safe storage. Necessary precautions had to be taken to see that these are not reinfested until released for consumption. A separate organisation of entomologists under the control of the Board of Revenue was created to attend to the problems of food storage. These entomologists, have added not a little to the country's stock of food grains by preventing losses in the produce harvested and in their storage.

9. The expenditure incurred on the plant protection and storage service is very little when compared to the other protections the State is affording to its people. The State can and should encourage this service that is now proving its usefulness to the agriculturists and secure maximisation of production to make up the country's deficit in food crops.

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The importance of disease control in Maximisation of Food Production

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All of us realise only too well that the needs of our nation for a good many years to come, are going to depend very much on the amount of food and other raw materials we can grow in our country. In many ways, in spite of all our efforts, the position is just as serious as it was in the immediate post-war years. This paper will indicate briefly the heavy toll taken by the various crop diseases and the methods adopted to check or control them, so that we may attain the maximum yields for the crops grown in this country.

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Crop diseases cause in some years considerable losses to the farmers. Exact statistical data as maintained by other countries like the U. S. A. are not available in this country. Still there are some approximate estimates in regard to certain important diseases. The smut of sorghum was reported to be responsible for a loss of over one crore of rupees in the Bombay Province alone before control measures were undertaken. The loss from this disease in this State also used to be very high. The rusts of wheat reduce the yield to the tune of 10 crores of rupees. In our State the blast disease of rice is often severe in Nellore and Tanjore districts, reducing the yield by 50%. In other diseases like the *Mahali* of arecanuts and fruit-rot of oranges the entire yield may be wiped out in some years if proper precautions are not taken. These instances illustrate the enormous losses in food material and other products caused by plant diseases.

Most of the crop diseases are caused by parasitic organisms which infect particular crops in particular seasons. For the widespread occurrence of a particular disease the presence of the parasite in large numbers, the prevalence of suitable environmental conditions and the presence of the concerned host at the right stage of growth in large areas must synchronise. If it is possible to control one or other of these factors the intensity of the disease can be appreciably reduced. The plant pathologist is often faced with difficult problems. He gets information about the occurrence of a disease only after the parasite has established itself and has caused appreciable damage. At this stage he is expected to do something and cure the disease. It must be stated at the outset that this is well-nigh impossible. Unlike in human diseases in most of the plant diseases, only protective measures are practicable. Curative measures are not very effective. It must be remembered that once a plant has been invaded the progress of the parasite cannot be controlled by administration of medicines. The only course open is to remove and destroy the affected member so that the rest of the population may be saved. In this respect the plant doctor has an advantage over the human doctor.

Therefore protective measures have to be adopted in time to prevent the occurrence of diseases. These measures aim at the destruction of the parasite, improvement of the host or alteration of the environment. In a number of diseases affecting food crops, the parasite is present on the seed used for sowing and it is able to infect the plant in the seedling stage. Immediate destruction of the host may take place as in foot-rot of rice and seedling blight of various crops or the destructive action may be delayed as in the smuts. In both cases loss of the crop results. If it were possible to destroy the parasite which is present on the seed without affecting the seed, the disease can be prevented. Fortunately this is easily practicable and seed treatment with chemicals is an effective way of improving the stand and increasing the yield of crops like rice, sorghum, wheat,

tenai, peas, beans etc. Organo-mercury compounds like Ceresan and Agrosan and also sulphur have been found to be very effective in many instances. Besides destroying the parasites present on the seed the organo-mercury compounds protect the young seedlings from being infected by parasites prevalent in the soil. Over 30,000 acres of rice and 1,20,000 acres of sorghum have been sown to treated seeds during the year 1949-50 in this State.

Destruction of parasites present on the surface of the foliage, flowers or fruits like the powdery mildew of mango, grape, orange, bhendi, cucurbits etc. is easily brought about by dusting finely powdered sulphur on the affected parts. The earlier the treatment is carried out the better would the results be.

But in a large number of cases the parasites are internal and any fungicide applied after infection will have no effect on the parasite. In these cases preventive treatments have to be adopted. The diseases usually break out during or after the rains or when heavy dews are falling. From previous experience the normal period of incidence will be known. Before this period it is necessary to cover the surfaces of the vulnerable parts of the host plant with a fungicide so that the parasite when it falls on the host is immediately killed. Care has to be bestowed on the selection of the fungicide, as some may have toxic effects on the host. Others may become toxic if they are not carefully prepared. Bordeaux mixture which is prepared by mixing together solutions of copper sulphate and calcium hydroxide is a very good fungicide. It is used all over the world for protecting crops against diseases. In our State it is used for controlling diseases of potato, tomato, rice and ragi nurseries, oranges, grapes, coffee, areca and rubber. It is sprayed on the plants before infection. Unless it is prepared in the correct manner and applied in time the results may not be encouraging. Various proprietary preparations are now in the market for use as protective and preventive sprayings. Plant sanitation also helps in reducing the population of the parasite and thus checking the spread of the disease. These measures can be profitably adopted in the case of vegetables, orchard crops and bananas.

But these methods are not of much use against certain diseases affecting rice, wheat and other cereals and root diseases of orchard crops. Blast of rice, rusts of wheat, sorghum etc., virus diseases and root-rots of fruit trees are examples of such diseases. It is however well known that in these crops there exist certain varieties or species which do not get affected or which are able to grow normally in spite of the disease or in other words they are immune, resistant or tolerant to the diseases. Many of these varieties are not commercially important. Herein the pathologist and the breeder can cooperate and combine the resistant and desirable characters into one strain by breeding methods. Several instances of successful control of the disease by production of resistant varieties

are available. The rice cultures Co.25 and Co.26 are highly resistant to paddy blast and over 20,000 acres have been cultivated with these in Tanjore with great benefit and have given high yields while other varieties were affected. Similarly in tenai, a culture has been isolated at Hagari which is highly resistant to rust. A number of varieties of wheat are resistant to black rust. Sugarcane varieties resistant to mosaic are now under cultivation. In the vegetables examples of resistant varieties are found in peas, beans, turnips, tomatoes etc. This method of controlling diseases is by far the easiest. But there is one snag about it. Each crop is susceptible to several diseases. It is impossible to get one variety or strain which is resistant to all diseases. Wheat is infected by three kinds of rust. Great difficulty is experienced in producing one variety which is resistant to all the rusts. Furthermore, a resistant variety does not behave in the same manner always when grown in another locality. Besides, the parasites are living organisms and mutation and hybridisation occur in them also. These result in the development of more virulent races of the parasitic organisms themselves. The sudden appearance of severe epiphytotics in a variety after a number of years of resistant behaviour has to be attributed to these causes. It puts back the clock of breeding work and the whole problem has to be tackled again. Thus there is no peace to the pathologist or the breeder and breeding resistant varieties is an eternal struggle in which success cannot always be assured.

The effects of crop diseases can be minimised to some extent by proper manuring and irrigation. Over-irrigation or lack of water both affect the root system and reduce the vigour of plants. Blast disease of rice is more severe in fields lacking proper water supply. Root rot of oranges are common in orchards which are over-irrigated and under-manured. Excess of nitrogenous manures increase the susceptibility of several varieties of rice to blast disease. Thus proper attention to the cultural and manurial requirements helps to control certain diseases by improving the condition of the plants. Starvation weakens the plants and makes them liable to infection by various parasites. In this the grower has to see that the plants are well taken care of.

Changes in the environment often produce conditions either favourable or unfavourable to the onset of crop diseases. Soil, atmosphere and sunlight form the chief environmental factors influencing the incidence of diseases. If it were possible to modify or adjust these factors so that they are unfavourable to the occurrence of the disease the crops may escape or avoid the infection. By reducing soil acidity by addition of lime to the soil the club root disease of cabbage can be reduced. Soil temperature and moisture influence root rots and wilt diseases. By regulating the time of sowing and depth of sowing soil-borne infection is avoided in diseases affecting sorghum and oats. Under local conditions—September, planted ragi often suffers heavily from blast. By adjusting the time of sowing

this can be avoided. Late-sown crops of sorghum are usually affected by sugary disease. The only way of avoiding this disease is to sow early. Under rainfed conditions this is not always easy. Sunlight favours some diseases like coffee rust and provision of shade helps in reducing the intensity. Chillies fruit-rot is reported to be less under shaded conditions. But shade favours certain other diseases like mildews and black rot of coffee. Lessening the shade will be helpful in such cases.

Legislative measures are sometimes employed with the hope of checking certain crop diseases. These usually aim at preventing the spread of diseases by prohibiting the transport of diseased materials from one State to another or within the State itself the movement of the particular crop plant may be restricted. Or the diseased plants are compulsorily destroyed to reduce foci of infection. Quarantine regulations at ports are designed to prevent the entry of other diseases from outside. Sometimes cultivation of certain crops are banned either completely or in certain seasons. This legislation must be introduced only after all other methods of control have failed, and if it is fully supported by scientific evidence. At present the cultivation of summer wheat has been banned in this State in the hope of reducing wheat rust in peninsular India. This was based on the presumption that the Nilgiris and Pulneys form the centres of infection. Results of surveys of rust incidence on wheat have shown that black rust of wheat for the control of which this ban has been introduced, occurs much later on the hills than in the plains. This indicates that the hills are not the centres of infection. Moreover, though the ban has been in operation for four years, there is no evidence to show that the incidence of rust has been reduced in peninsular India on this account. Besides wheat, other grasses serve as hosts for this rust and they are common on the hills. More food can be produced by removing the ban on wheat. It is hoped that the ban will not be further extended. The interesting point is that samba wheat grown on the hills exhibits high field resistance to black rust and yet it is banned.

An attempt has made to indicate the losses caused to agricultural crops in general and the food crops in particular by plant diseases and also how by the adoption of various measures it is possible to reduce or control the diseases and increase production. But as already stated, everything depends on the timely adoption of the correct methods of control. These differ in different diseases. Close cooperation between the grower and the pathologist will lead to the successful control of many diseases. The plant pathologist is not a magician and he cannot do much to save a crop after it has become badly infected.