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Prospects in Plant Pathology

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Plant diseases are worst of the natural hazards in farming that make agriculture a gamble. Numerous diseases attack our economic plants and the losses caused are so heavy in certain seasons that famines occur, bringing in untold sufferings to people. Even in advanced countries like the United States of America, where great progress has been achieved in the control of plant diseases, the loss sustained due to diseases is estimated at three billion dollars every year and it needs no mention that in India, where only a fraction of the farmers take to disease control, the loss sustained would be very much greater. The tragic aspect is that much of this loss is a preventible waste. Waste is unworthy of a great nation and is contrary to the laws of nature. However, disease control is not easy in all cases. New diseases and new races of old disease-producing organisms appear all the time. Man's interference with the balance of nature, by domestication of plants, intensive cultivation etc. has brought in an increase in the number and intensity of diseases. Hence much remains to be done and continuous intensive research is needed to minimise the losses due to plant diseases.

The losses caused by plant diseases are sometimes enormous and the cultivation of certain crops in some countries has had to be abandoned in the past, owing to the ravages of disease e. g. coffee cultivation was abandoned in Ceylon due to the severity of the rust disease.

Notable progress has been already made in the investigation and control of a number of plant diseases. Still, there are several diseases which are either very difficult to control or for which there are no effective control measures. A number of diseases like root rots and wilts caused by soil-borne fungi, as well as a number of bacterial, virus and deficiency diseases require further investigation. Even in the case of diseases for which effective control measures exist already the possibility for further improvements by the use of more efficient fungicides and by reduction in the cost of control measures have to be explored.

Among the various methods of disease control, use of resistant varieties is the cheapest metod, as it entails no additional expenditure to the cultivator towards control measures. Evolution of resistant varieties by combining disease resistance with other desirable agronomic characters is not possible in all cases and it needs continuous research

to meet the everchanging situations due to frequent occurrence of new races of pathogens. Though success cannot be assured in all cases, yet this is a very fruitful line of work and has to be pursued to the maximum extent possible, especially in the case of diseases like paddy blast, wheat rust, red-rot of sugarcane etc., which are not easily controllable by chemical methods. Other methods of disease control, such as use of disease-free seed materials, seed treatment, soil sterilization, protective spraying of the crop with fungicides also play an important role in controlling plant diseases and further research is required for testing of new chemicals. Preventive spraying or dusting of fungicides form the most important item of plant protection work. It is interesting to note that a number of new and more efficient fungicides are put on the market in recent years and constant testing of the new chemicals is very essential, to make spraying more efficient and cheaper. Universal application of fungicides to crops whether there is disease or not seems to be in vogue in certain countries but it is a laborious and costly operation. Our experience shows that epiphytotics or epidemics do not occur every year in every place appear but only in certain years where conditions are favourable for its development. If these conditions could be studied and the incidence of disease forecasted in time much of unnecessary spraying operations can be avoided. So research has to be carried out for minimising the area to be sprayed. This can be done only by developing a very efficient and reliable method of forecasting disease incidence, so that spraying can be carried out only tin such localities where the spread of the disease is most likely to occur. Of course the present weekly forecast system in operation in our State is a pioneer work in this direction, but attempts should be made to make it as accurate as possible, as this will ensure savings in the spraying bill, which may otherwise go up to Rs. 40 to 50 per acre for three or four rounds of spraying. Again, disease incidence is governed by three important factors viz. the host, the parasite and the environmental factors. For a correct forecast of disease incidence, all these factors require to be studied in detail, in collaboration with the meteorologist. The possibilities for further research in the selection and use of fungicides, improvement in the spraying and other equipments are indicated in the following paragraphs.

Use of Chemotherapeutants for the control of plant diseases: Much of the work on chemotherapy (that is by introducing curative chemicals into the plant) has been done on systemic diseases. Promising results are reported to have been obtained in the case of Dutch Elm disease, Fusarium wilt of carnations and tomatoes. Inorganic salts, sulphonamide derivatives, hydroquinones, benzoic acids, phenols, 8-quinolinol benzoates, azoderivaties and antibiotics have been used. Of the antibiotics used as systemic fungicides mention may be made of griseo-fulvin which is produced in cultures by *Penicillium nigricans*. Recently it is reported

that *Rhizoctonia* on gilly flower plants could be controlled by soil application of 8-quinolinol sulphate. There are a number of diseases caused by *Rhizoctonia* fungus and further investigations on the above lines may yield fruitful results.

Use of antibiotics for control of plant diseases: Antibiotics is an old phenomenon to the plant pathologist. The first of our modern antibiotics, gliotoxin was discovered and crystalized by a plant pathologist even before penicillin had been purified and the role of gliotoxin in plant protection was investigated as early as 1933.

The most common method of application of antibiotics is to use them as spray solutions. Streptomycin is reported to give perfect control of fire blight on both apples and pears, bacterial spot of tomato, common blight of beans, and wild fire of tobacco. Another antibiotic viz. terramycin, which has also been extensively tested, gives control of bacterial diseases. The antifungal agent actidione is very effective against powdery mildews of various crops, though its toxicity to the host plant should be taken into consideration. Another promising use of antibiotics is in seed treatment. Even deep-seated infections of seeds by fungi are reported to be eradicated by actidione and helixin B. Budwood of plum trees is reported to have been freed of *Phytomonas pruni* by soaking infected twigs in solutions of streptromycin G. The antibiotic has been injected in trees by various techniques and shown to have a protective effect against certain pathogens. The ideal type of treatment would be a soil drench. The plant could then absorb the antibiotic from the substrate and transport it to the place of infection and this aspect requires further research. Antibiotics are often quite specific in their action; some will inhibit only a few species of microorgansms, while others will inhibit a vide variety. Expansion in the application of antibiotics to agriculture is possible only after extensive experimentation with various crops under local conditions. Several new organisms can be isolated from soil and tested for their ability to produce antibiotics which will control plant diseases.

Virus diseases: The importance of serology in virus research and the utility of the electron microscope in plant virus research have already been realized. Just as the optical microscope made a major contribution to bacteriology, the electron microscope has extended our limits of observations and the virologist can now observe the infectious virus particles. In course of time the electron microscope would make a contribution to virology comparable to that of the microscope to bacteriology. Observing viruses in their host cells has now become possible through the development of techniques for cutting ultra-thin sections. Virologists have already applied the thin-sectioning technique to a study of virus development in tissue cultures in the case of animal viruses.

This may be a fruitful field of investigation for plant viruses also. Since it has not been possible to see any internal detail in plant viruses, successful attempts have been made at breaking the virus into smaller fragments and this could be called a dissection, (undoubtedly the smallest on record) and examining them. Quantitative electron microscopy for the determination of the number of virus particles in a preparation merits a wider application. The picture already obtained by the present freeze-drying method are much superior to those obtained by the ordinary air-dry techniques and more study of the freeze-drying method is needed. A number of virus diseases affecting such crops as potato, tomato, tobacco, sugarcane, sandalwood etc., occurring in our State require detailed investigation.

Toxins and plant diseases: The micro-organisms causing diseases produce toxins (microbial poisons) that penetrate into host tissues. Although considerable study has been made of the toxins produced by pathogenic bacteria in medicine, its implication in plant pathology are only beginning to be appreciated. Knowledge of these toxins opens up new possibilities of eventually combating plant diseases, not by attacking the parasite itself but by inactivating its toxins by means of substances which would render them harmless, as is done in the medical treatment of diphtheria.

Low-volume spraying: The adoption of low-volume spraying technique whenever possible will have many advantages over high volume spraying. A large proportion of the cereal weed spraying with hormone weed-killers is now reported to be carried out using low volume spraying equipment. By applying a fungicide with a low volume sprayer, large areas can be treated very quickly with small demands upon labour and with only 10% of the water required for high volume spraying and with quite large savings in the actual amount of active chemical required per acre. However there are certain limitations, one of which is the factor of evaporation in warmer climates. In order to obtain an even coverage the size of the droplets must of necessity be small. Such small droplets of a water-based spray tend to evaporate very rapidly under tropical or semitropical conditions and this has restricted the adoption of low-volume technique. The results obtained elsewhere during the past two seasons have brought out the efficacy of oil-based fungicides in overcoming the evaporation factors. The following spray formulation 4 gallons of white oil, 4 gallons of diesel oil and 17½ lb of copper oxychloride containing 50% copper was reported to give excellent control of banana leaf-spot, using only five gallons of the mixture per acre. There was no scorching effect due to diesel oil. On the other hand the oil seems to play some synergistic role in the spray fluid. It is suspected that the oil itself has some fungicidal value. The use of oil-based sprays is only in its infancy and there is

need for further investigations before their true value can be assessed, though there seems to be a good future for oil-based sprays.

Of late a number of fungicides on the market are claimed to be specific against certain kinds of diseases. These require careful screening and testing so that only the best of the lot may be recommended for large-scale use.

Finally it may be said that knowledge is never complete and there remain many mysteries of Nature yet to be understood. In this connection it may be mentioned that the great American essayist Emerson has written :

"He in whom the love of truth predominates ..... will abstain from dogmatism. ..... He submits to the inconveniences of suspense and of imperfect opinion but he is a candidate for truth ..... and respects the highest law of his being". The real man of science, the seeker after truth is conscious of the paucity of his real knowledge, but has confidence in his ability to know and to understand.