

SOIL-BORNE PLANT DISEASES AND THEIR CONTROL*

ECONOMIC stability and prosperity of our newly constituted motherland is closely linked up with scientific growth and development of agriculture, and we in this Section have to play an important role in the work connected with it. It is the national duty of those concerned with it to strive their best to promote food production.

In India yields are lower than in other countries even in normal times and are further depressed by diseases. Losses on this account have been estimated in the neighbourhood of 10 per cent. which can be averted by application of suitable control measures. A considerable portion of such heavy losses is due to the soil-borne pathogens and, in order to prevent these losses, it is essential to obtain full knowledge about the life-history of the pathogens and their behaviour under controlled conditions, so that they may be attacked at the most susceptible stage of their life-cycles. The activity of a soil-borne pathogen forms only a part of the highly complex associations of living organisms most of which are non-pathogenic. A striking example is that of *Fusarium udum*, the pigeon-pea wilt organism, the growth of which has been found to be adversely affected by *Bacillus subtilis* commonly present in the soil. The population of micro-organisms in the soil attains a state of equilibrium by the continued prevalence of a uniform set of conditions and even a slight variation in these conditions may upset this balance, and affect the number and types of soil microflora. We may, therefore, by adjusting the prevailing agricultural practices be able to change the microbial setup in such a way as to adversely affect the parasitic activity of an organism in the soil.

It is, however, essential to have a sound knowledge of the interrelationship of the individual factors and the pathogen. The conditions under which different soil-borne pathogens flourish are fairly wide. Many of the organisms are highly aerobic and therefore flourish in light soils, but there

are others which flourish in comparatively heavy soils. Such parasitic fungi as *Fusaria* responsible for wilt diseases flourish at comparatively high soil temperatures, but there are others like *Phytophthora infestans* which are restricted to low temperatures and are extremely sensitive to fluctuations in temperature. A reasonably high moisture content is necessary for the development of certain parasitic fungi, but again there are some the spread of which is adversely affected by excessive soil moisture. Reaction of the soil also considerably affects the parasitic activity of a fungus. While diseases such as wilt of cotton and club-root of clovers are favoured by acidity, others like the flag-smut of wheat develop in alkaline soils. Available nutrition in the soil also has a profound effect on the existence and activities of a pathogen. Application of nitrogenous fertilisers has been found to increase the virulence of a disease and the use of phosphatic fertilisers to enhance the resistance of the host. Evidence on this aspect of the question as well as on the effects of other soil conditions on soil pathogen is, in general, not conclusive as contradictory results have been reported very frequently.

Among the Control Measures devised to prevent losses caused by soil-borne pathogens, there is no doubt that the most perfect method is the production and large-scale distribution of seeds of resistant varieties in a country like India where the growers are comparatively poor and cannot resort to expensive methods of control (the efficiency of which is often doubtful). The production of resistant varieties is a long-drawn process and is further complicated by the existence or appearance of physiologic races of the pathogens. Rotation of crops is often beneficial, as it starves out the fungus which requires a suitable host for its existence, but it is to be remembered that even long-term rotations have proved ineffective in certain cases. Sterilization of soil by heat and chemicals is often recommended for the control of soil-borne diseases. Sterilization of soil by heat is not practicable on a large scale and, wherever carried out, it has been frequently found that if the pathogen is introduced afresh from an outside source, it does greater damage than in unsterilized soil which contains generally a large saprophytic

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flora. Sterilization by chemicals has not been found to be effective on a field scale, as a good penetration into the soil is generally not obtained. Biological control offers a good means of preventing soil-borne diseases. Starving out the pathogen or eliminating it altogether by enhancing the antagonistic activities of the non-pathogenic micro-organisms has been found to be possible by modifications of cultural practices or addition of certain manures as in the case of "Take-all" of wheat and potato scab. Field sanitation is another control measure which is often neglected to the detriment of the cultivator. Certain diseases like wilts are known to render fields unfit for cultivation and others like gram-blight perennate on crop refuse in the field. Debris from an infected crop should, therefore, be destroyed and not allowed to disperse. Rogueing diseased plants in the case of annual crops has not always been found to be beneficial, but has given good results in Plantations. Keeping the land fallow has also given good results in certain cases.

Amendment of soil conditions with a view to create unfavourable conditions for the pathogens has been tried with considerable success. Two striking examples are afforded by "Take-all" disease of cereals and root-rot of cotton. In the former case trefoil and Italian ryegrass are intercropped with barley. After barley is harvested in autumn the seed-mixture grows actively and it is harvested in early winter and ploughed in. During its period of growth the mixture utilizes nitrogen essential for the "Take-all"

organism and thus virtually starves it out. If the mixture is ploughed in, it gradually decomposes and liberates nitrogen for the next crop of barley. In the case of root-rot of cotton in the Punjab reduction in field temperature has been obtained by intercropping cotton with *moth* to control the disease. Changing the date of sowing has also proved very effective in controlling this disease. Adjustment of soil reaction by using such chemical substances as sulphur and lime has given successful results as in the case of potato-scab and club-root of clovers, but such methods are generally not practicable on account of the cost involved. Adjusting the soil moisture by giving proper attention to drainage and changing the depth of sowing has in some cases yielded good results, but cannot always be relied upon.

From what has been said about the behaviour of pathogens and control measures it is obvious that, while investigations carried out have cleared many obscure features, there are still more complex ones that require to be elucidated by intensive research involving radical changes in technique and methods of approach. It will be noticed that every one of the farm or garden crops is exposed to attack of some one or other types of soil fungi. The subject of soil pathology has gained importance during recent years. Having attracted the attention of pathologists it offers hopeful signs of solving the diverse pathological problems. For a proper study of these problems, team work of pathologists, soil-chemists, crop-physiologists, geneticists, and agronomists is what is imperatively needed.

SOME ASPECTS OF TUBERCULOSIS IN INDIA AND MEASURES FOR ITS CONTROL*

THE question of Tuberculosis is of vital importance to India at the moment; the defences of the cities against a disease like tuberculosis are yet weak and poor and the author insists that everything should be done to strengthen the defences.

* Abstract of Presidential Address delivered by Dr. M. B. Soparkar, before the Section of Medical and Veterinary Sciences, 36th Indian Science Congress, Allahabad, 1949.

In his Presidential Address, Dr. Soparkar, who has spent more than twenty-five years in the study of the various aspects of the disease both in man and animals, firstly deals with those aspects of tuberculosis which affect animals particularly cattle, because of its intrinsic importance from the agricultural and veterinary standpoint. The second part deals with the disease in relation to its control and eradication in India as it affects human beings.