ROTHAMSTED RESEARCH

Report for 1927-28

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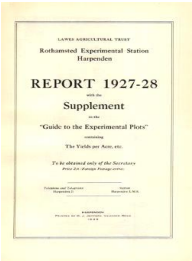

Disease Organisms and Pests

Rothamsted Research

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(2) when living at the surface of the soil they increase the supply of easily decomposable organic matter rich in energy;

(3) when living below the surface, they assimilate soluble or easily decomposable organic matter in addition to the nitrate and other nutrients referred to above;

(4) they can thus be regarded as agents for increasing the stock of energy material in the soil and for immobilising soluble nutrients and organic compounds, converting them into an insoluble but readily decomposable form.

DISEASE ORGANISMS AND PESTS.

Disease in plants may result from several causes: from insufficiency or excess of some essential requirement, from the attack of a parasite, either fungus, bacterium or insect, or from a virus, a name given to some obscure agent, the nature of which is not understood. For the present, the first group, the so-called physiological diseases, are not studied although numerous instances occur on our plots where deficiencies or excess of the various nutrients have become intensified by long continuance on the same land of an unaltered scheme of cropping or manuring.

One of the difficulties of the work is that some of the organisms, especially, perhaps among the fungi and bacteria, may not be fixed in their relationship to the plant or, indeed, in their own characters. Under constant or changed conditions a species may assume a different form, sometimes with different properties and, indeed, may be mistaken for a new or another species; further, while harmful in some conditions, it may be relatively harmless in others.

Dr. Brierley is studying the nature and the extent of the changes that can be induced in the common parasitic fungus *Botrytis cinerea,* by alteration in its food and other environmental factors. He finds that some of these changes are purely temporary, disappearing at once when the old conditions are restored; some are more permanent, lasting for a number of generations and showing gradual reversion whilst still others are apparently quite permanent. Further work is necessary to ascertain the consequence of these important results and their relation to the incidence of disease in crop plants. Further changes in conditions may influence greatly the effectiveness of a fungus in attacking plants.

Dr. and Mrs. Brierley find that certain species of Fusarium which cause root disease in wheat behave differently in pure culture and in soil: in pure culture the development of the fungi shows a marked relation with temperature, being slow at 13° C., more rapid at higher temperatures, but ceasing above 30° C. In soil, however, no difference could be observed, the amount of disease produced at 30° C. being apparently just as much as at lower temperatures.

These and other observations show the necessity for close study of the conditions in which a disease organism is acting, and they have led some to adopt the view that studies of crop diseases can be made only in the actual district where the disease occurs.

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With improvements in electrical equipment it has become possible to maintain experimental conditions constant for long periods and, in consequence, to reproduce in the laboratory specified conditions, especially those of temperature and moisture.

In order to see how far the studying of a tropical disease is useful in an English laboratory, an investigation is being made by Mr. Stoughton of the "angular leaf spot" type of the "Black arm" disease of cotton caused by *Bacterium malvacearum*.

Cotton is grown in glasshouses and develops ripe bolls with good lint and healthy seed. Infection experiments under controlled atmospheric conditions are carried out on these plants. Cotton is also grown from seed in a series of special chambers in which light, air and soil conditions are controlled, and the natural and artificial infection of young plants is examined in relation particularly to air and soil temperature, and air moisture. The results are compared with those obtained by Major Archibald and Mr. Massey in the Sudan. Already it appears that this co-operation of tropical and British workers is advantageous: it is certainly economical to do as much as possible of the pure investigation work at home, reducing labour for the tropical worker and allowing him to devote himself wholly to those problems which can be solved only on the spot. The funds for this investigation have been provided by the Empire Marketing Board.

Wart disease of Potatoes.

In spite of much investigation, no field method has yet been discovered for treating the soil so as to kill all sporangia of the organism (*Synchytrium endobioticum*) causing this disease. Treatment with sulphur has been effective on occasion, but not always: apparently, therefore, the active agent is not the sulphur itself, but some substance formed from it. The acidity produced by the sulphur accounts for part of the effect: the disease is almost completely suppressed when the soil acidity is raised to pH 3.4. But this is not the whole explanation: suppression sometimes occurs at lower acidity. Experiments by W. A. Roach and Miss Glynne suggest that thiosulphuric acid (a possible product of oxidation of sulphur in the soil) has a special toxic effect over and above that due to the hydrogen ion concentration. This investigation will be followed up when suitable methods can be found.

Miss Martin has confirmed the fact that the fungus is not confined to potatoes, but can attack various other solanaceous plants, and has discovered a number of additional hosts.

Virus diseases of plants.

These diseases are spreading and they have caused so much loss at home and in the Empire that the Empire Marketing Board has made a special grant for five years to allow of the appointment of an entomologist, a cytologist and a plant physiologist to work in collaboration with Dr. Henderson Smith, and to provide special equipment and the necessary, but costly, insect-proof glasshouses in which the investigations may be carried out.

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Nothing is known of the nature of virus except that it is not a recognisable organism; the name is entirely non-committal and is used to denote the agent causing these particular diseases. Virus is often contained in extracted plant juice, and certain of its properties have been studied, *e.g.*, its reaction towards alcohol, temperature and ageing, but the problem is rendered difficult by the circumstance that a virus disease apparently may not in all cases be a single disease, but a complex caused by two or more viruses closely related, but differing in stability or other property. A virus may not be specific to one plant: the foliage of potatoes suffering from mosaic will infect tomato plants, though that of healthy potato plants will not. Other solanaceous hosts may also be infected with the virus of potato mosaic, but not the non-solanaceous hosts tested. Two viruses mixed may give a disease different from that caused by either: the aucuba mosaic of tomato *plus* potato mosaic causes a Tomato Streak Disease; Miss Jarrett has shown that the mottled type of Streak Disease *plus* potato mosaic also gives a Streak Disease.

These investigations are further complicated by the great difficulty of getting healthy plants for experiments: plants may have a virus disease, but show no symptoms. With certain viruses, intracellular bodies have been found in the cells of diseased plants, but their nature and significance are still uncertain.

ENTOMOLOGY.

In the Entomology Department the main work has been the study of certain insect pests and possible methods for their control. In nature, control is largely effected by parasites, and this fact has led to the investigation of the extent to which some of our insect pests are parasitised in the field. Special attention has been devoted to the parasites of Frit fly and of certain injurious Gall Midges with reference to the species involved and their economic status.

Preliminary trials by Dr. Davidson on the effects of certain substances, absorbed by the roots of plants, on sap-sucking insects have led to further exploration of its possibilities. In conjunction with Mr. Henson, Dr. Davidson has shown that broad beans watered with suitable concentrations of pyridene could be rapidly freed from aphis attack. Aphides infesting such plants failed to multiply to any appreciable extent and rapidly died. On control plants without pyridene, infestation was constant and multiplication rapid. The effects of pyridene on the plants, in the lowest effective concentrations, was noticeable in a reduction in the dry weights of those plants, but the subject is one requiring much fuller investigation. Dr. Barnes has studied the life-histories and parasites of injurious gall-midges affecting osier willows, meadow foxtail and wheat, with a view to discovering possible means of their control. In the case of species infesting osier willows, evidence of significant varietal differences in susceptibility to attack is receiving attention, both under experimental and field conditions.

Grants from the Empire Marketing Board for the purpose of controlling noxious weeds by insects, have led to work being undertaken on this subject in conjunction with the New Zealand Government and the Cawthron Institute at Nelson. The bramble

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