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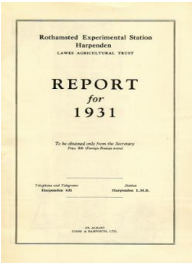
ROTHAMSTED RESEARCH

Report for 1931

Full Table of Content



Bacterial Diseases

Rothamsted Research

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it is artificially liberated. In none of the experiments devised to test the point did virus enter an unbroken cell. Large quantities of virulent juice can be injected into the leaf of a plant through the stomata, but symptoms will not develop unless some of the cells are ruptured. The development of virus in the leaves of an infected plant is followed by considerable alteration in the enzyme content. The mechanism of respiration is also greatly affected. This is being investigated in detail, and the work is still incomplete, but it seems clear that one of the first effects of the entry of virus into the cell is a greatly enhanced respiration rate and a state of general excitation.

3. *The relation of Virus to Insect-vectors.* By the development of a technique for maintaining insects upon solutions apart from the plant, considerable control has been obtained over the conditions determining the infection of the insect. Data have been obtained as to the time required for dyes and other substances taken in by the alimentary canal to reach the salivary glands, information which is necessary for the correct evaluation of the incubation or non-infective period after the insect has fed upon diseased material. By use of this technique it has become possible to investigate such problems as the filterability of viruses which are not transmissible by juice, e.g. leaf-roll of potatoes, and to approach the question why one insect carries and another does not.

A new virus disease has been discovered in *Hyoscyamus*, which is readily transmitted both by needle and by aphis, and has an incubation period in the insect. At the same time, at least two other unrecorded virus diseases were distinguished in commercial crops of this plant. These may prove to be due to viruses already better known in other crops, e.g. potato; and there is reason to believe that one at least of these new diseases is a composite disease caused by the simultaneous action of two different viruses.

BACTERIAL DISEASES OF PLANTS

The angular leaf-spot or " black-arm " disease of cotton is being investigated by R. H. Stoughton in considerable detail, because of its importance in many of the tropical cotton-growing countries of the Empire. The results have proved to be unusually interesting.

The responsible organism, *Bacterium malvacearum*, is of great bacteriological interest, as it possesses a nucleus and forms accessary reproductive bodies never previously described in this group of bacteria. It appears also to pass through a conjugation stage in which two cells join together to form a fusion-body or zygospore, of possibly different potentialities. It also " dissociates " or breaks down into a number of strains, quite unlike in pure culture and having different degrees of virulence. Strongly virulent strains may give rise to almost non-virulent ones, and these again revert to the culturally-unlike virulent form. The possible relation of this production of variants to the life history is now being studied.

The geographical and climatic distribution of the disease indicate that meteorological factors play a large part in determining its severity. Careful study has therefore been made of the separate effects of air temperature, soil temperature and air humidity.

Cotton plants were grown in special chambers in which these three factors are controlled automatically over a wide range so that

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each can be kept constant or made to vary uniformly as desired. The plants are grown entirely by artificial light, so that experiments at different times of the year are strictly comparable.

Air temperature plays the chief part in the development, as distinct from the spread, of the disease. Black-arm is essentially a high temperature malady, and in the control chambers severe secondary infection of the growing plant by spraying with a virulent culture is only obtained at temperatures above 30°C. The physiological reasons underlying this are under investigation ; they appear to be bound up with the relative rates of growth of the parasite and the plant, and the carbohydrate metabolism of the plant as shown by its sugar content. Fluctuating temperatures, whether soil or air, which resemble more closely natural conditions, give the same result as a constant temperature near the mean of the varying factor.

Soil temperature is less important. It plays, however, some part in determining the amount of disease on the very young seedlings grown from infected seed. The amount of this primary infection is reduced by high soil temperatures, e.g. above 30 C., but not sufficiently to offer any prospect of control by this method.

Air humidity is the chief factor determining the spread of the disease, but it is important only during the short period required for inoculation. Humid conditions are necessary for successful penetration of the tissues by the bacteria on the surface, however they have got there, but once penetration has been effected the external humidity has little direct effect.

Internal infection of seed, which has been suggested as a serious cause of primary infection, was found to be very rare ; external infection is the usual source. The primary infection can be controlled and healthy seedlings raised by complete sterilisation of the outside of the seed, indicating that the organisms are usually carried on the fuzz of the seed coat.

The costly appliances needed for this work were purchased and are maintained out of grants made by the Empire Marketing Board.

FUNGUS DISEASES OF PLANTS

W. B. Brierley continued his study of racial problems in fungi. A number of natural infections of different hosts by *Botrytis cinerea* were intensively analysed and, with few exceptions, two or more races of the parasite were obtained from any single lesion. In certain cases the fungus produced infections which could not be distinguished from each other but the host lesions contained populations consisting of different races or of assortments of the same races in different proportions. This method of intensive analysis was extended to other fungal parasites with similar results, and it seems possible that, in many diseases, infection may be caused by genetically complex populations rather than by single races of specific fungi.

Numerous experiments designed to study the educability of individual races of *Botrytis cinerea* produced no evidence of change lasting beyond the one generation.

M. D. Glynne continued her study of the wart disease of potatoes. Among varieties which, on the basis of field trials, have been officially certified as immune are some which, under the more stringent con-

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