ROTHAMSTED RESEARCH

Rothamsted Report for 1947

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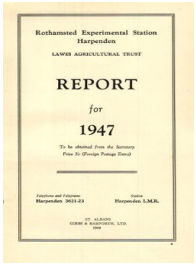

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DEPARTMENT OF PLANT PATHOLOGY

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Viruses and virus diseases

The main lines of work described in previous reports were all continued. In the laboratory particular attention was paid to the conditions that affect the extraction of potato virus X from plants and that cause it to aggregate and inactivate (69 and 70). Extracts of *Phytolacca* species have long been known to inhibit plant viruses; the inhibitor was isolated and identified as a glycoprotein (82).

Electron microscopy showed that particles of potato virus X vary in size in a similar manner to those of tobacco mosaic virus. Some thousands of particles of tobacco mosaic virus from preparations made in different ways were measured to see whether any basic particles could be identified. Using micro-dissection methods, specimens suitable for examination in the electron microscope were made from cell contents of infected plants. These preparations showed the presence of large numbers of virus particles in X-bodies and crystalline inclusions caused by tobacco mosaic virus. The cytoplasmic inclusions produced by severe etch virus were found to contain large numbers of sub-microscopic crystals of various forms.

The effects of fertilisers and environmental conditions on the susceptibility of plants to virus infection were studied in the glasshouse. The susceptibility of bean and tobacco plants to tobacco necrosis, and of *Nicotiana glutinosa* to tobacco mosaic and tomato bushy stunt viruses, was consistently increased by placing plants in the dark before they were inoculated. Short periods in the dark produced responses similar to those found for prolonged periods of shading. Twenty-four hours in the dark usually produced the maximum response with beans, but with tobacco plants periods of up to 5 days increased susceptibility. Placing in the dark after inoculation had relatively little effect, but most often decreased susceptibility. It seems that infection occurs in two stages, the first of which is hindered by the presence of large amounts of photosynthetic products.

Interpreting the effects of fertilisers on susceptibility to viruses is complicated because of the effects of nutrition on the size of the plants. Assessing susceptibility by numbers of lesions per leaf may give different results than if numbers per unit area are considered. Also, when assessing susceptibility on the basis of virus concentration, there may be large differences depending on whether amount of virus per plant or per given volume of extract is considered. Phosphorus is much more important than nitrogen or potash in increasing susceptibility of plants to infection with tobacco mosaic virus and in increasing virus multiplication, but it is also the most effective nutrient in increasing plant size. Assessing susceptibility by numbers of lesions per leaf, phosphorus increased susceptibility

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by about 5 times, but assessing it by lesions per unit area, phosphorus increased susceptibility by less than 50 per cent. Phosphorus doubled the concentration of virus in sap and increased the total virus content of plants by 10 times. In the presence of phosphorus, but not in its absence, nitrogen also increased the concentration of virus in sap and the total content of infected plants. Virus isolated from the differently treated plants did not differ in infectivity.

Fertilisers had no effect on the susceptibility of tobacco plants to potato virus Y when plants were colonised with single infective aphides.

Strains of cucumber mosaic virus obtained from different naturally-infected hosts differed, not only in host range and symptoms produced, but also in the ease with which they are transmitted by aphides, and the concentration they reach in plants. The last probably accounts for the differences found in such properties as dilution end point and thermal inactivation point. *Phaseolus vulgaris* var. Bountiful was found to be a suitable host for local lesion work with cucumber mosaic virus. During the winter it produces discrete necrotic local lesions, but during the summer it appears to be immune.

Studies on the insect relationships of pea mosaic and pea enation mosaic viruses showed the first to be a non-persistent and the second a persistent virus. A virus found causing severe damage to broad bean in the field seems to be different from any previously described in that it was transmitted by inoculation but not by aphides.

Field work on the epidemiology of sugar beet diseases was continued. The relationship between the aphis infestations of crops, trap catches of winged aphides and the prevalence of virus yellows was studied in the main beet-growing districts of eastern England. In a detailed survey of a limited area of Lincolnshire, infection varied in individual crops from 5 to 100 per cent. Rate of infection could not be correlated with any known over-wintering sources of virus or aphides, but it was increased by late sowing and thin stands of plant. The effect on the incidence of virus yellows in sugar beet stecklings sown at different dates and in different districts was studied. Healthy seed crops were produced by raising stecklings in districts removed from other sugar beet, but as a practical measure it raises difficult problems in transporting stecklings to the seed grower at planting time. To avoid these difficulties, experiments on clamping stecklings have been started. Tests of various strains of sugar beet and lines selected by the Plant Breeding Institute, Cambridge, were made in the field for any tolerance to yellows.

The comparative effects of yellows and mosaic in reducing the yield of sugar beet and mangolds infected at different dates were tested in a field experiment.

The usual field surveys and experiments on potato virus diseases and their insect vectors were made. The results are described in the review of work on potato virus diseases done in the department since 1940, which in part summarises the Research Bulletin prepared by Doncaster and Gregory (68).

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Mycology

Work was continued on the violet root rot disease caused by *Helicobasidium purpureum* Pat. After completing a study of the production and growth of mycelial strands, attention was turned to the conditions influencing the survival of the fungus in the soil. The survival of colonies of *H. purpureum* on nutrient agars of different composition, buried in the soil, was first investigated. Plates of different nutrient agars were inoculated with *H. purpureum* and incubated for 2 months at 25°C.; the fungus colonies were buried in soil for 3–4 months, and then tested for viability by inoculation to carrot seedlings. Survival was prolonged by raising the carbohydrate concentration of the medium, but shortened by excess of nitrogen. The optimum nitrogen requirement for survival increased with rise in carbohydrate content of the medium. Survival of colonies was correlated with the production of firm resilient sclerotia around the centre of the colony. The depressing effect of excess nitrogen upon production of sclerotia and survival of colonies is attributed to an increased density of mycelial growth, leading to reduction of carbohydrate level below that required for maturation of viable sclerotia. The effect of various farming practices on the incidence of violet root rot on sugar beet crops was also studied.

Experiments have been carried out on survival in soil of the resting spores of *Plasmodiophora brassicae* Woron., the cause of clubroot. Under soil conditions favourable to infection, resting spores obviously germinate spontaneously in fallow soil, for tests show that the spore population falls by about 90 per cent. during the first few weeks after a spore suspension has been added to the soil. Thereafter, decline in viable spore population is slower. The spore population falls less rapidly in dry soils and alkaline soils than in wet or acid ones; thus soils unfavourable for infection seem also unfavourable for spontaneous spore germination. Some indication was obtained that many spores germinate soon after an alkaline soil is acidified. Trials have been carried out with substances likely to promote spore germination in fallow soil, such as allyl isothiocyanate, benzaldehyde, and picric acid. The life-cycle of the parasite is still imperfectly understood, and to gain more information attempts were made to prepare bacteriologically sterile spore suspensions with which to inoculate sterile plants and establish the organism in pure culture.

There was less eyespot (*Cercosporella herpotrichoides* Fron.) at Rothamsted in 1947 than at any time since research was first made in 1937. The late spring and dry summer both limited infection, and the results of field experiments contrasted strikingly with those obtained in 1946. In 1946 eyespot was prevalent on the experiment on Little Knott, straw was long and there was much lodging, but there were few weeds. Straw and grain yields were 67·4 and 27·0 cwt./acre. Spraying with sulphuric acid reduced eyespot, reduced lodging and increased yield by 1·8 cwt./acre. Increasing seed rate from 1½ to 3½ bushels/acre and of ammonium sulphate from 0 to 4 cwt./acre increased lodging, but had little effect on yield. In 1947 the eyespot was little, straw was short and there was no lodging, but there were many weeds. Straw and grain yield were 36·7 and 26·0 cwt./acre. Spraying reduced weeds greatly and increased

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yield by 1·6 cwt./acre. Increasing rate of sowing from 1 to 3 bushels/acre gave increased yields only when nitrogen was applied.

From the results of experiments and surveys made during the last 10 years the effects on the incidence of eyespot of increasing the frequency of wheat and barley in the rotation were assessed quantitatively. Next to rotation spring rainfall was the most important determinant, though any factors that increase humidity within the crop favour eyespot and lodging.

Experiments were made to assess the effect of downy mildew (*Peronospora Schachtii* Fuckel.) on yield of sugar beet and to test the effects of planting date, isolation from other beets and sprays in controlling infection of stecklings.

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