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Report for 1939-45

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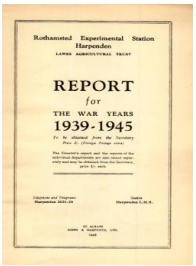
Rothamsted Experimental Station
Harpenden
LAWES AGRICULTURAL TRUST

REPORT
for
THE WAR YEARS
1939-1945

Virus Diseases of Plants

Rothamsted Research

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The results of soil-cultivation experiments on different soils and in different seasons are consistent with the laboratory and drain-gauge work and with comparable experiments in the United States and elsewhere. They demonstrate the depression of crop yield due to weed competition, but show that inter-row cultivation does not reduce direct evaporation from the soil.

Nodule bacteria and other soil micro-organisms

Some strains of nodule bacteria, particularly on clover, produce nodules practically ineffective in fixing nitrogen. These appear to be characteristic of poor pastures in hilly districts in the west and north of Britain, and the possibility is being investigated of improving the clover content of such pastures by inoculation with effective strains of nodule bacteria. The problem is by no means simple, however, for effective strains are liable to mutate and become ineffective on certain soils: moreover, acute competition has been found to take place between the nodule bacteria introduced by inoculation and those already present in the soil. The cause of ineffectiveness appears to be the inability of certain strains to grow strongly on the host-plant tissues or to survive therein long enough to fix appreciable amounts of nitrogen. The behaviour of the nodule bacteria is controlled by genes in the host plant as well as by the nature of the bacterial strain.

A study of the chemical nature of the bacterial secretions which cause deformation of root hairs by nodule organisms eventually led to the discovery of the high toxicity to many dicotyledonous plants of 2:4 dichlorphenoxyacetic acid. This and a closely related compound are now in practical use in this country and in America as differential weed killers for use in cereal crops.

Studies on the general micropopulation of field soils have been facilitated by the development of a new direct method of counting bacterial cells and of estimating the quantity of mycelium in soil by direct microscopical observation. A greatly improved technique for estimating numbers of protozoa in soil has also been devised. By the use of these improved techniques several groups of micro-organisms, formerly thought to be very rare or even adventitious in soil, have been found to be true and widely distributed soil inhabitants. These include giant rhizopods, acrasieae and myxobacteria. Of special interest are the myxobacteria which secrete compounds that destroy and dissolve gram-negative as well as gram-positive bacteria. Most of the former group are not attacked by penicillin. Soil protozoa and acrasieae have been found to be very selective in their bacterial food so that they are capable of altering the quality as well as the total size of the soil bacterial flora.

Virus diseases of plants

Plant-pathological work has increased greatly since 1939 and particular attention has been given to the diseases of potatoes, sugar beet and cereals. As far as possible all the lines of work both with viruses and fungi that were being studied in 1939 have been continued, and a good deal of advisory work has also been undertaken.

The study of viruses has been facilitated by the acquisition of an ultra-centrifuge and an electron microscope. New viruses have been

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isolated and identified as crystalline nucleoproteins, and studies have been made of their physical, chemical and serological properties. The serological work has led to the development of a rapid method of diagnosis for some of the commoner virus diseases. Wide variations in the size and shape of tobacco-mosaic virus have been detected and the conditions responsible for the variations have been determined. The shape of the virus particles has been found to account for their serological behaviour. The factors responsible for flagellar and somatic-type serological behaviour have been elucidated. The manner in which viruses are held in infected tissues has been studied, and it has been found that infected plants contain much more virus than was previously suspected. The work has included studies of the origin and significance of intra-cellular inclusions, new types of which have been found in infected plants and new insects have been identified as vectors. The intricate relationships between viruses and their vectors have been studied, and in the field special attention is being given to the factors which affect the spread of virus diseases particularly in potato and sugar-beet crops. Annual surveys of the insects and virus diseases of these two crops have been made and much information has been obtained on the effects of weather on the insect vectors, the relative importance of different species of insect in causing spread, the distance over which spread occurs and the important sources of infection. A book on Plant Viruses and Virus Diseases was published by F. C. Bawden in 1939 (second edition, 1943).

Biochemical work on normal and virus-infected leaves has been in progress since 1940 and has included studies of the conditions governing the release of normal protein from the leaf fibre. Use has been made of methods involving fine grinding and enzymatic disintegration. Work has also been done on plant proteases and on pectase. Extraction and fractionation of tobacco-mosaic, tomato bushy-stunt and the tobacco-necrosis viruses were carried out in the Biochemical Section.

Fungus diseases

Increased attention has been given to field work on fungus diseases. Surveys of commercial crops in many districts have shown the importance of Eyespot of wheat (*Cercosporella herpotrichoides*), and many experiments have been made to ascertain the conditions favouring this disease and to devise control measures. A survey of the causes of wastage in stored potatoes showed that *Phytophthora infestans* was the main cause but also revealed a previously unsuspected cause *Fusarium avenaceum*. Studies have been made of the environmental conditions affecting the survival of soil-borne fungi, their ability to cause infection and their survival in the absence of susceptible crops. Among the fungi studied were *Ophiobolus graminis*, *Fusarium culmorum*, *Plasmodiophora brassicae*, *Rhizoctonia solani* and *Verticillium albo-atrum*. A book on Root Disease Fungi by S. D. Garrett was published in 1944.

Studies of earthworms, slugs and various insects

Work in the Entomology Department can roughly be grouped into three divisions, a study of the causes of insect outbreaks, secondly work on particular pests—not necessarily insects—such as