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ROTHAMSTED RESEARCH

Report for 1930

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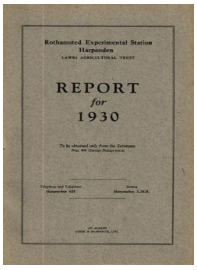

The Plant in Disease . Insect Pests and Their Control. Insecticides and Insect Pests. Mycology

Rothamsted Research

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These results are proving of great importance to maltsters and brewers. English brewers require a barley containing about 1.3 to 1.4 per cent of nitrogen; this seems to represent good normal barley in our conditions.

A survey is in hand of the malting barley production in Britain, showing the yields and qualities that can be expected in different parts of the country, and the comparison of quality of British and foreign barleys.

THE PLANT IN DISEASE. INSECT PESTS AND THEIR CONTROL. INSECTICIDES

Pyrethrum flowers contain substances highly poisonous to certain insects and quite harmless to plants and animals. Since pyrethrum is easily grown in this country there is the possibility that its cultivation may prove of considerable commercial interest. Dr. Tattersfield and his colleagues have studied the active principles; they find that the maximum yield is obtained when the flowers are fully opened, *i.e.*, when the disc florets are opening; they should be harvested at this stage and not later, otherwise there is risk that the achenes, which contain most of the poison, may be lost. Flowers differ considerably in their pyrethrin content, however, the range has been from 0.4 to 2.0 per cent. A method has been worked out for determining the quantity in a single flower head, and this can be used in plant breeding experiments to try and raise a strain of plants of high toxic value.

THE INSECT PESTS

In agriculture as distinct from horticulture a direct attack on the insect by sprays and other methods is not always possible, and for the insect pests of ordinary farms it is necessary to rely on some other means.

The natural control of insect pests is by their parasites, and this is being studied by Dr. Imms and Dr. Barnes. The Frit fly of oats is usually parasitised to the extent of about 30 to 35 per cent, the range during the past four seasons has been 27 to 37 per cent; parasitism becoming heavier as the season advances. There has been no severe attack during this period.

Willow midges during the last three years have also been well parasitised, the range being from 51 to 64 per cent, but foxtail midges have been more variable; there was 38 per cent parasitism in 1928, only 3 per cent in 1929, and 19 per cent in 1930; it is not yet known why the parasites did so badly in 1929.

Immune Varieties. The simplest way of dealing with the Willow midges, however, is to grow varieties of willow immune to its attacks. Unfortunately the most desirable commercial species, *Salix triandra*, is susceptible, as are all its varieties. On the other hand, *S. purpurea*, *S. alba* var. *vitellina* and *S. viminalis*, and their varieties, also the cross *S. viminalis* x *S. purpurea*, are immune. It should not be impossible to cross *S. triandra* with one of these immune varieties, and so finally obtain a new variety, immune to the midge, but with the commercial value of the old *triandra*.

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It remains to discover why some varieties are immune and others are not. There is evidence that the immune varieties contain a chemical substance which keeps off the midges ; when an extract of an immune variety is painted on the susceptible varieties they cease to be so attractive. Further work is being done in the hope of discovering the substance and studying it in detail.

Problems of great biological interest, though not of obvious agricultural significance, are suggested by Dr. Barnes' discovery that the midge *Rhabdophaga heterobia* produces families of one sex only ; some mothers producing males only, and others females only. Apparently it is the mother, not the father, that determines the sex of the offspring. The investigation has necessitated breeding lines of pedigree male and female midges, studying and rearing their progeny for successive generations.

Bees. In drawing up the programme of the Bee Research the department is assisted by a committee of practical bee keepers who report from time to time the problems which are of special concern to them. In the main their difficulties arise from diseases which from the outset the Bee Research Staff were, by the terms of the grant, precluded from studying. In consequence the work has been confined to questions of management which are not only difficult, but completely lacking in interest to the non-technical person. The chief problem has been the study of the differences between the " warm way " and the " cold way " of arranging the frames in the hive ; the warm way being the one in which the frames are placed parallel to the front so that the first frame acts as a kind of door shutting off the rest, while in the cold way the frames are placed at right angles to the front. The differences were only slight, but by taking numerous observations continuously for several years, certain conclusions have been reached.

(1) In *summer* the temperature inside the hive is almost entirely independent of the temperature outside, and completely independent in the brood chambers.

(2) In *winter* the temperature inside is affected by that outside ; it changes by 0.6° to 1° for each 1° change outside, and the change was greater in the " warm way " hives than in the " cold way " hives, especially on the north and east aspects.

(3) In spring and winter the inside temperature seems to vary with the outside temperature.

A second question asked by the practical keepers was whether cane sugar or beet sugar is the more suitable winter food ; there is a strong feeling in favour of cane sugar. Prolonged trials, however, failed to reveal any difference.

The work at present is concerned mainly with the study of brood food in relation to swarming and other activities of the bee.

MYCOLOGY

A fundamental difficulty in mycological work is that some of the most serious fungus pests are not simple species which are sharply distinct and easily characterised, but groups consisting of numerous races which are so like each other as to be distinguishable only with great difficulty if at all on the attacked plant. Some races, however, may be almost harmless while others may be very injurious. Dr. Brierley is investigating one of the most important

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fungi, *Botrytis cinerea*, of which he has already found over 200 races, some of which are apparently saprophytic, others parasitic on a limited range of plants, others again parasitic on a wide range of hosts. Even the parasitism, however, is not simple but depends upon the condition of the host and its environment. Further it is sometimes easy to infect a plant with a race which under natural conditions, does not seem to attack it, while on the other hand, a race which in nature has virulently attacked a plant may fail to attack it in the experimental house. The various races, the question of their permanence in relation to external and other conditions, and their relation to the host plant are being studied by Dr. Brierley, and the investigation is cast on broad lines so that the results are significant for other phases of plant pathology.

Miss Glynne has developed a method of testing potatoes for immunity or susceptibility to wart diseases so that it is now more sensitive than the ordinary field test besides being more rapid, needing only a few weeks, instead of two or three years. The practical question has arisen and needs settling whether a variety in order to be classed as immune, needs to pass the Glynne test in its most severe form, or to pass the field test that corresponds in severity with ordinary field conditions.

The liability of a plant to disease may be affected by the conditions in which it is grown, and it has been found by L. M. Kramer that dressing with phosphate reduced, and dressing with nitrogenous fertiliser increased, the liability of potatoes to the fungus *Corticium solani*. In practice, however, the position of the potatoes in the clamp may be the more important factor.

Bacterial Diseases. Mr. Stoughton is continuing the investigation on the angular leaf spot disease of cotton caused by *Bacterium malvacearum*. The disease organism may be carried on the seed coat and in the fuzz, but only rarely within the seed coat. Thorough disinfection of the exterior of the seed almost eliminates disease of the seedling, but if contaminated seed is not disinfected it produces diseased seedlings. The amount of infection decreases as the soil temperature rises above 30°C though infection may still occur at 40°C. Later on the plants grow out of the disease. They may, however, again become infected, and the progress of the disease is not affected by the soil temperature but by the air temperature, being at a maximum between 30°C and 35°C.

Virus Diseases. Dr. Henderson Smith is in charge of this work and is aided by Drs. Caldwell, Hamilton and Sheffield.

Up to the present most of the work has as a matter of convenience been done with the Aucuba Mosaic of tomato plants. It has suffered from the disadvantage that the winter grown plants are very different from those of the summer—as is well known to all practical growers—and, although they take the disease, they do so only slowly and with abnormal symptoms. The difference between summer and winter results has been traced to the difference in the hours of light ; when the winter day is extended by five hours of good artificial light (from 4.30 p.m. to 9.30 p.m.) the summer disease symptoms are produced and, conversely, when the summer day is shortened by cutting off the light, the plants take the disease only slowly and abnormally, while in complete darkness, the plants fail to develop symptoms of the disease.

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Dr. Caldwell has shown that the virus cannot travel across dead tissue, nor can it enter the living cells of the plant from the xylem unless some rupture has occurred. Where a leaf is inoculated the virus travels to the stem and then moves up and down at approximately the same rate.

Dr. Sheffield has studied the mode of formation of the intracellular inclusions found in cells of the diseased plants. Small particles carried in the streaming protoplasm coalesce to form larger masses and ultimately unite to form a spherical mass which becomes vacuolate and may take on an amoeboid appearance which caused them to be regarded at first as parasitic organisms. The process has been photographed cinematographically and the film has attracted much attention.

Dr. Hamilton has devised new and better methods for the study of the insect transference of virus diseases.

THE FARM

During the year the farm and laboratories were visited by over 2,000 agricultural and scientific visitors, some of whom stayed for an extended period. Members of the staff gave over 79 lectures to farmers, students and others, these being arranged either by the County Organiser, or by the National Farmers' Union in collaboration with the organiser, or by a college or university.

GEOLOGY OF THE ROTHAMSTED EXPERIMENTAL FIELDS REPORT BY MR. H. G. DINES, GEOLOGICAL SURVEY

The Rothamsted Experimental Fields were surveyed in 1903 by H. B. Woodward, and the result of his work was published,[1] together with a map, which, it was claimed, showed "the distribution of the subsoils and soils" of the area. In February, 1930, the Geological Survey undertook a re-examination of the farm for the purpose of bringing Woodward's map up to date. No alteration was found necessary and, apart from the additional survey of some fields that had been added to the farm since 1903, no changes of any importance were made.

In the light of present knowledge of soils and subsoils, Woodward's map cannot be regarded as a soil map, but only as a geological map showing divisions of the clay-with-flints which are usually unnecessary from a geological point of view.

The farm is situated on a dip-slope of the chalk area of the Chiltern Hills, and the fields, for the most part, are on high ground, which is covered with an irregular accumulation of clay and loam with abundant flints, known as clay-with-flints. This was originally considered to be derived, in great part, from slow decomposition of the chalk under atmospheric action. This view was later disputed by various writers on the grounds that the constituents were not present in such ratios as would result from simple solution of the calcareous portion of chalk; the clay proportion is far too high as compared with that of the flints. Close examination of the deposit also reveals that a considerable part is composed of remnants of Tertiary Beds. Flint pebbles, blocks of pudding-stone, masses of bright red clay and sarsen stones from Eocene formations, and

1 Summary of Progress' for 1903 (Mem. Geol. Surv.), 1904, Appendix I, pp. 142-150