ROTHAMSTED RESEARCH

Rothamsted Report for 1932

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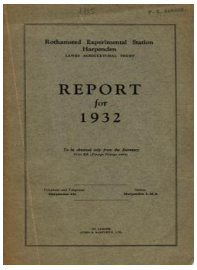

Plant Pathology

Rothamsted Research

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Investigations of the process, however, still proceed and much new information has now been obtained.

Of the various forms in which nitrogen was supplied for the rotting of straw, ammonium salts seemed to be the best in the early stages of the decomposition, although in the end they were no better than nitrate. When nitrate was used, however, any excess of nitrogen beyond what the organisms needed to effect the decomposition of the cellulose tended to be lost ; this did not happen with the ammonium salts.

Some of the products of the decomposition of straw and similar materials by the mixture of micro-organisms usually occurring on straw are very sticky when wet and possess considerable cementing power when dry ; these are formed during the making of good farmyard manure. Alkalinity is a necessary condition ; maximum stickiness is attained when the pH rises to 9.5 or 10, as happens when nitrate of soda is used as the source of nitrogen. The stickiness of a rotted manure may be increased by adjusting the pH to this value, and for this purpose sodium or potassium ions are more effective than calcium or magnesium.

The mixture of organisms contains both fungi and bacteria, but the fungi, while they can themselves decompose cellulose, produce no sticky substances ; the active agents appear to be bacteria which operate after the fungus attack and make the sticky substance from the fungus mycelium. The process is being further studied.

Purification of effluents. These investigations are made under the aegis of the Department of Scientific and Industrial Research. A purification process based on our knowledge of biological oxidation was worked out in the Rothamsted laboratories and developed to the semi-commercial scale at the Colwick factory. It is proving quite satisfactory in practice and has definitely shown that the discharge of unpurified effluents into rivers need not occur.

The purification of effluents from milk factories is being attempted on the same general lines as for the sugar beet effluents but modifications are necessitated by the fat which is always present, and which leads to clogging of the filters. Various methods are being tried to overcome this difficulty.

PLANT PATHOLOGY

The department of Mycology suffered a severe loss in 1932 when Dr. W. B. Brierley, who had had charge since its inception in 1918 and had developed it to a high state of efficiency, left it to take up the Professorship of Agricultural Botany at Reading University. Further loss occurred a few months later when Dr. R. H. Stoughton, who had been in charge of investigations on bacterial diseases of plants, was appointed Professor of Horticulture in the same University.

The Lawes Trust Committee decided to reorganise the department and reconstitute it as a Department of Plant Pathology with Dr. Henderson Smith as Head.

During his fourteen years service at Rothamsted Dr. Brierley devoted much attention to the genetical analysis of the fungus

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Botrytis and isolated large number of races. He found that new strains might arise but they could not be produced at will by varying the conditions ; a strain could be temporarily altered by changed conditions but it returned to its old characteristics on reversion to the old conditions. Apparently pure natural infections often consist of a mixed population of various races, but artificial infections give rise only to the original infecting race. All this work is now being written up for publication.

Before leaving Dr. Stoughton completed his study of the important parasite *Bacterium malvacearum* which causes Black Arm disease in cotton. Contrary to the general belief about bacteria it has apparently a sexual stage characterised by the fusion of two cells and the formation of a fusion body or zygospore. Further, it exists in many different strains, and these may remain constant for a long time then suddenly they may " dissociate " into new strains which either persist or reproduce the parent type. This dissociation cannot be controlled. The disease study was financed by the Empire Marketing Board and done in conjunction with the workers in the Sudan where Black Arm is troublesome : very useful help has been given to them and it is shown that this type of collaboration is not only practicable but economical and very effective.

VIRUS DISEASES

The general purpose of these investigations made by a team of workers under Dr. J. Henderson Smith is to obtain information about the nature of the pathogenic agent, its mode of propagation and dissemination within the infected plant, its spread from plant to plant, the effects it produces and the mechanism by which it produces them ; and as a consequence of the knowledge obtained to arrive if possible at some method of effective control. Direct attack on the nature of the agent is hindered by the failure hitherto to grow any virus in the absence of living cells. Several attempts have been made to achieve this, as yet without success, but new methods are tried from time to time.

While many viruses are able to pass fine porcelain filters which hold back all bacteria, others cannot pass even coarse filters through which bacteria pass readily ; but owing to the highly absorptive properties of porcelain it is unsafe to draw conclusions as to the size of the particles passing. By using collodion membranes of known and graduated porosity, however, it has been possible to estimate the limits of size of particles producing the various diseases. Some of the estimates are :

Tobacco or yellow mosaic ..	15$\mu\mu$
Aucuba mosaic	40-50$\mu\mu$
Hyoscyamus virus	150$\mu\mu$

Whether the particle is itself the virus or only the carrier is not yet known. It has been possible in some cases to analyse the virus and separate it into two components each producing different symptoms in the plant.

A dilution method of counting the number of virus particles in a given quantity of the juice of diseased plants is being worked out : the method is based on the fact that one particle can apparently produce one disease spot.

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These new discoveries have greatly facilitated the study of the group of virus diseases. It is shown that the virus moves freely in the plant from cell to cell along the protoplasmic strands ; also that it multiplies ; the rate of multiplication is much more rapid in some plants than in others. It is further shown that one of their effects is to inhibit the development of the plastid primordia so that chloroplasts do not form.

Some of the virus diseases are carried by aphids but the virus seems to undergo some change in the aphid's body. This is being investigated by Dr. Hamilton : the work is complicated and retarded by the difficulty of rearing aphids on artificial foods and by their small size which makes it difficult to follow the movements of the virus particles round their bodies and into their saliva. Polonium (Radium D) is now introduced with the food solution of the aphids so as to follow better the course through the body ; in this work useful assistance has been rendered by Dr. Chadwick of the Cavendish Laboratory.

The study of intracellular inclusions has been further advanced. Soon after infection minute particles of protein appear in the cytoplasm, are carried about the cell by its streaming, and coalesce when brought together. By successive fusions a large spherical body is gradually built up. This mode of origin lends support to the view that these " inclusions " are essentially products of interactions between the host cell and the virus. Hitherto these bodies have been found only in plants infected with certain virus diseases. If, however, normal plants are supplied with chemicals known to be protoplasm coagulants, symptoms develop within the cells which are similar to the first stages of a virus attack. The effect produced varies in degree with different reagents, but with molybdic acid or its salts it is possible to parallel all the intracellular phenomena which characterize aucuba mosaic disease. This work is to be continued.

Wart disease of potatoes. Some years ago Miss M. D. Glynne devised a rapid test for susceptibility to wart disease by means of which she can ascertain in a few weeks whether a variety is susceptible or immune. This method has now been used for some years for testing the potatoes sent in to Ormskirk for trial and it continues to give satisfactory results.

INSECT PESTS

The chief line of work in the Entomological Department is the study of the factors determining the size of insect populations. Insect pests are always with us, but so long as their numbers are small they are comparatively harmless. Sometimes, however, one species begins to multiply, and its power to increase is so enormous that the harmless few speedily become a serious pest causing great loss of crops. Hitherto the factors responsible for this rapid multiplication have been but little known and consequently it has not been possible to take preventive steps beforehand or even to warn farmers of the probability of attack. This subject is now under full investigation at Rothamsted. Soon after Dr. C. B. Williams entered on his duties as Head of the Department on July 1st, 1932, he began an investigation into the relation of insect numbers to weather conditions. The great difficulty has hitherto been to find some numerical

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