Report for 1934

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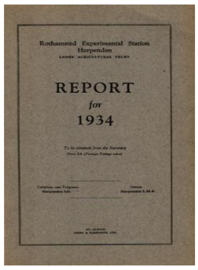
Rothamsted Experimental Station
Harpenden
REPORT
for
1934

Plant Pathology Department

Rothamsted Research

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Family selection group.	Numbers of plants harvested. 1933.	1934.	Average weight of seed produced from each family. 1933.	1934.	Average for two years.
			grams.	grams.	grams.
A. Provence	9	17	18.09	22.90	20.49
B. 33-185	15	15	18.40	21.71	20.05
C. 32-50	2	5	29.70	27.92	28.81
D. 32-33	16	24	26.86	21.52	24.19
E. 13-1	10	14	26.81	28.50	27.65
F. 24-26	12	13	11.74	10.68	11.21

A. Provence from commercial seed. B, C, D, E, F, progeny of hybrid selections.

Maize and Soya Beans at Woburn. Certain Manitoba varieties grew and ripened successfully, producing good well-matured seed. These experiments are to be extended.

PLANT PATHOLOGY DEPARTMENT

MYCOLOGY

Mr. G. Samuel, the successor to Dr. Stoughton, began his work at Rothamsted by making a survey of the fungus diseases situation. He has shown that a kind of antagonism exists between certain groups of soil fungi so that one cannot develop when the other is present. This suggests possibilities of controlling pathogenic soil fungi that will be further studied. Meanwhile an interesting side line has been opened up : some of the actinomycetes picked out from the soil have the power of making fragrant perfumes. As the subject lies outside our purview it is being studied by a well-known manufacturer of scents and perfumes. This same expert found among the by-products of the milk effluent investigations a substance which we had been seeking to destroy but which he regards as of considerable potential value as a means of enhancing scents. Truly it is impossible for anyone to know where a scientific investigation may lead.

VIRUS DISEASES

When the Imperial Agricultural Conference of 1927 recommended that a central station should be set up at Rothamsted for research on virus diseases, it was recognised that their control would best be achieved by a study of the viruses themselves. It was realised that if the pathogenic viruses were living entities their mode of life must be something different from that of a bacterium or fungus, and no satisfactory treatment could be devised without an adequate understanding of their nature and the conditions of their activity. The work at Rothamsted accordingly was designed by Dr. Henderson Smith and the staff of his department for more general study of viruses rather than the specialised investigation of the individual disease and the individual crop, and the research now in progress continues to bear this character. Particular diseases are studied in detail from time to time as occasion demands, *e.g.*, the aucuba disease of the tomato, the virus diseases of *Hyoscyamus*, but always with the object of furthering the more general research.

The precise nature of a virus is still uncertain, and the work continues to probe deeper into this question. It has been shown that the virus is almost certainly particulate, and not diffused throughout the liquids in which it is found, that it is of a definite size which remains the same, independent of the host from which it is taken, and that different viruses are of different sizes. The virus could not be obtained wholly free from nitrogen nor could we substantiate the statement that it is crystallisable ; we have, in common with all other virus workers, failed to obtain multiplication in the absence of living cells, and have produced some evidence that it is not, at least in the case of one virus investigated, an invisible stage in the life history of a visible bacterium. Its physical and chemical properties, its behaviour under enzyme and photodynamic action, and other characters have been studied. The discovery in America of the local lesion technique has greatly facilitated examination, but this technique is itself not so straightforward and simple as it seemed at one time, and its results are largely dependent on the previous history of the inoculated plant. All these questions are still under examination, and are taken up again and again as further knowledge suggests possibly fruitful lines of attack. At present our position is that it is difficult to deny the living character of viruses, but their extremely small size, approaching molecular dimensions, suggests that they are alive only in the limited sense in which a gene is alive, and that they are incapable of independent existence.

Their relation to the living plants in which they are found has been, and is being, studied in great detail. During the last few years virus research everywhere has passed out of the descriptive stage, in which an account of the symptom-syndrome of a disease was considered sufficient, into a stage that is much more analytic ; and the generalisations of the earlier period are found to be inaccurate. It has been shown here, and is now generally believed, that a virus disease is not necessarily a general systemic disease, as was at one time thought, but may be localised within the infected plant to definite circumscribed areas, in which the virus multiplies. The mode of movement of the virus within the plant was considerably clarified when it was shown here, for the first time, that virus did not travel in the water-stream, as had always previously been assumed, but was associated with living tissue only. There is still scope for much work to be done on this subject, and on the methods of infection and the factors which influence success or failure in inoculation. The effect of viruses on the metabolism of the infected plant, with which is bound up their symptomatology and the damage they inflict, has been and is being studied. A recent development, of which the further outcome cannot yet be foreseen, is the discovery that a plant inoculated with one strain, possibly of low virulence, of a given virus is protected against later inoculation with a second, possibly more virulent, strain of the same virus. The occurrence of strains differing from one another in one or more respects is coming into more and more prominence, and it seems certain that such strains may arise in nature as well as in response to artificial treatment. These questions have occupied us during the past year, and will continue to do so in the immediate future ; and some preliminary work has been done on the introduction of serological methods into our plant virus research.

The intimate changes which the presence of virus produces within a cell have received much attention in the Department in recent years. The demonstration that the intracellular inclusions, which were long regarded as characteristic of the presence of virus,

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are not a stage in the life history of the virus but are in the main a reaction of the cell-components to the virus, a demonstration which had been based on direct observation of the changes occurring in the infected cell, has been strikingly confirmed by the further proof that it is possible by chemical agents, *e.g.*, molybdic acid, to induce the formation of similar inclusions in the absence of virus. The conditions which control this formation of inclusion-bodies are still obscure, and we have been endeavouring by micro-manipulation and micro-dissection methods to study the changes induced inside the cell on virus introduction. This is a highly skilled and difficult technique, which is not yet fully perfected, but it ought to add considerably to our knowledge of what occurs within the cell as the consequence of the entry of the virus particles.

The fact that in nature virus is mainly transmitted from plant to plant by the agency of insects has led to much laborious work within the Department. The determination of the insects mainly responsible for dissemination of the viruses studied here is comparatively straightforward, though the fact that the vector for one of the commonest of our potato-virus diseases is still unidentified shows that the task is not always easy. But there are many problems still unsolved which deal with the mechanism of the transference from plant to plant, and the behaviour of the virus within the insect. It is generally assumed that the virus is introduced into the plant with the saliva of the infecting insect ; but it is not clear how the virus reaches the saliva, what interferes with it in those insects which do not function as vectors, nor why one insect can carry while another of similar habit does not. It is evident that the quantities of juice must be very small indeed which can be taken into the alimentary canal through the tiny stylets of, say, an aphid in the few minutes sufficient to infect the insect, and we have tried to obtain some idea of the quantities involved. Three methods were used, including feeding the insects on radio-active material, whose presence in minute quantity can be measured ; and the results are in fair concordance. The amount is so small as practically to demonstrate that multiplication must occur within the insect in those cases where the insect remains infective throughout its life after a single short period of feeding on the infected plant. We have tried throughout to introduce into our entomological work quantitative methods, and an extensive study, still in progress, has been made of the quantitative relations between number of insects, time of feeding, and resultant infection. To obtain results statistically valid, this involves a very large number of plants and much replication, but it has already led to the detection of a marked seasonal variation in the infectivity of the insects used, and will itself place on a firm foundation much that is commonly accepted on rather uncertain evidence.

ENTOMOLOGY

The work of 1934 was mainly concerned with studies of the factors determining the fluctuations and migrations of insect populations. It involves taking frequently and systematically a census of the populations of insects concerned and methods of doing this have been worked out. The results are then correlated with climatic factors, and, for the night flying insects, with moonlight and cloudiness of the

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