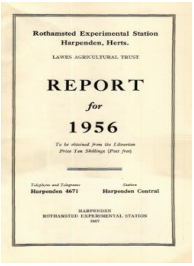
ROTHAMSTED RESEARCH

Report for 1956

Full Table of Content



Nematology Department

F. G. W. Jones

F. G. W. Jones (1957) *Nematology Department ;* Report For 1956, pp 121 - 126 **- DOI: https://doi.org/10.23637/ERADOC-1-117**

NEMATOLOGY DEPARTMENT

F. G. W. Jones

F. G. W. Jones succeeded B. G. Peters as head of the Nematology Department on 1 January 1956, and H. R. Wallace joined the staff on the same date. D. W. Fenwick spent three months in Trinidad studying red ring disease of coconut palms. The department helped to organize a fortnight's intensive course in Nematology for members of the National Agricultural Advisory Service and of Universities held at the Provincial Headquarters of the National Agricultural Advisory Service in Bristol. Six members of the staff attended for various periods and gave lectures and practical demonstrations. In the Michaelmas Term, F. G. W. Jones gave a course in Plant Nematology at Cambridge University. During the year numbers of visitors have been taught the basic concepts of nematology. This relatively great expenditure of time on teaching arises from the absence of interest in plant nematology at most Universities.

F. G. W. Jones has acted as advisory editor to the new journal *Nematologica* and as British representative of the Society of European Nematologists. D. W. Fenwick, H. R. Wallace and J. J. Hesling gave short talks at the British Association meeting in Sheffield.

The following visitors worked in the department during the year : Mr. J. W. Meagher, Plant Research Laboratories, Victoria, Australia (to 9 March); Mr. A. G. Whitehead, holder of a Colonial Service Studentship (to 27 July); Mr. H. E. Welch, Department of Agriculture, Entomology Laboratory, Belleville, Ontario, Canada (to 7 December); Mr. R. C. Anderson, Ontario Research Foundation, Canada (from 22 October); Mr. C. Logan, Empire Cotton Growing Corporation, Kampala, Uganda (30 July–10 August); Mr. B. Sripathi Rao, Rubber Research Institute, Kuala Lumpur, Malaya (23 July–3 August) and Mr. C. O. R. Everard, Regent Street Polytechnic, London (3–15 December). Other visitors included Dr. H. Goffart, Biologische Bundesanstalt, Münster, Germany, and Dr. J. W. Seinhorst, Instituut voor Plantenziektenkundige Onderzoek, Wageningen, Holland.

The revised edition of the late T. Goodey's *Nematode Parasites of Plants Catalogued Under their Hosts*, completed by J. B. Goodey and Mary T. Franklin, has now been published. The Ministry of Agriculture technical bulletin on *Laboratory Methods for Use with Plant and Soil Nematodes*, also by the late T. Goodey, has been revised by J. B. Goodey and is now published. A Ministry of Agriculture bulletin on *Sugar Beet Pests*, by F. G. W. Jones, is also in the press.

During the year many specimens for identification and many inquiries have been received from home and abroad.

https://doi.org/10.23637/ERADOC-1-117

Non-cyst-forming and Other Soil Nematodes

Work has continued on the relationships to mushroom mycelium of various nematodes, particularly *Aphelenchoides* sp. and *Paraphelenchus* sp. When cultures are inoculated with small numbers of *Aphelenchoides* the population increases to a high level and the mushroom mycelium gradually disappears. Ultimately the *Aphelenchoides* population declines and is replaced by saprobic nematodes which increase greatly in numbers. Nematodes are an important factor in the production of mushrooms commercially, and may be controlled by peak heating of compost and the exercise of care and adequate hygienic measures in the beds.

A comparison has been made of the rates of population increase of *Ditylenchus dipsaci* on a susceptible and a resistant variety of oats. Seedlings were grown in pots and on paper pads and inoculated with the eelworms. Samples of seedlings were taken at standard intervals and the nematodes within their tissues counted either by a staining method or after maceration in a blender. Population increase is rapid in the susceptible variety and almost non-existent in the resistant variety, although invasion is heavy.

In a recent report from Italy wheat was said to be attacked by *D. dipsaci*, but the symptoms described resembled those caused by *Anguina tritici*. Italian wheats have been grown in pots inoculated with either *D. dipsaci* or *A. tritici*. In no case was there a subsequent attack by *D. dipsaci*, whereas symptoms and ultimately galls developed on the plants exposed to *A. tritici*. (J. B. Goodey and D. J. Hooper.)

A new species of *Hoplolaimus*, found associated with the roots of the oil palm *Elaeis Guineensis*, has been described, after making a detailed examination by serial sections of the structures, particularly the telamon, in the male tail.

Revision of the late T. Goodey's *Soil and Freshwater Nematodes* is proceeding slowly. (J. B. Goodey.)

Several populations of *Aphelenchoides* nearly related to *A. parietinus* have been obtained from mushroom compost and decaying plant material. Attempts have been made to culture these on fungus on agar plates, and four populations have been established. Morphological comparisons have shown that at least two morphologically distinguishable species occur which will not interbreed and have not been described in the literature. Data for their description are being assembled. Some of the known plant-parasitic *Aphelenchoides* have been tried in cultures to discover whether they are obligate parasites on higher plants, but only one, *A. fragariae*, was found to thrive on fungus. (Mary T. Franklin.)

D. W. Fenwick spent three months in Trinidad at the request of the Colonial Office, studying red ring disease of coconut palm. He confirmed that the disease was caused by the nematode *Aphelenchoides cocophilus*, but little evidence was obtained in support of the view that the palm weevil *Rhyncophora palmarum* acted as a vector. Examination of trees indicated that red ring started at the base of the trunk and extended upwards to the growing point, giving rise to the cylinder of red tissue characteristic of the disease. The occurrence of the worm in the roots of trees showing very slight

https://doi.org/10.23637/ERADOC-1-117

symptoms suggested that worms entered the base of the tree from the roots. The presence of the nematode in soil suggested that the disease was soil-borne, and this conclusion was confirmed by the patchy distribution of Red Ring within plantations. In two cases nematodes were recovered from the husk of dropped seed nuts, suggesting that spread might occur by this means to new plantations. A report on this visit, with recommendations for further work, has been prepared and forwarded to the Colonial Office.

Greenhouse tests with numerous populations of *Meloidogyne* have been continued. Knowledge of the host ranges and morphology of the known species has been extended by some of the tests, and others have been for the purpose of identifying populations received for diagnosis. A slide collection of various stages of the different species is being formed. (Mary T. Franklin and A. Rae Forster.)

Cyst-forming Nematodes of the Genus *Heterodera*

Potato-root eelworm (Heterodera rostochiensis *Woll.*)

A survey of the soil populations of cyst-forming nematodes in experimental sites at Rothamsted and Woburn has begun. Most of the land at Woburn carries potato-root eelworm and, on some experiments, the infestation is sufficiently high to complicate the results of potato yields. The low level of accuracy obtained in this sampling has underlined the necessity for further investigations into the errors attendant on soil sampling, and a study of the source of these errors has begun. (D. W. Fenwick, Elizabeth Widdowson and Joan M. W. Hurrell.)

Experiments on hatching from free eggs of *H. rostochiensis* show that, although the general relationships are similar to those for the hatching of larvae from eggs within cysts, it is doubtful whether the technique is as useful for assay purposes as the cyst-hatching method. (D. W. Fenwick and Elizabeth Widdowson.)

A single-cyst hatching experiment has been conducted to test earlier results, which suggested that the percentage hatch was small from large, full cysts and to explore methods of reducing variability in hatching experiments. (J. J. Hesling.)

Joint work on the chemical nature of the hatching factor produced by potato roots with Professor Sir A. R. Todd of Cambridge and Professor R. H. Stoughton of Reading has ceased, but work is continuing in conjunction with the Biochemistry Department. Progress on the chemical aspects of the problem has been made by G. H. Wiltshire. Numerous chemical fractions have been bioassayed, and large quantities of potato-root diffusate for the work have been produced from potted plants. An attempt has also been made to produce diffusate hydroponically in jars of 1 litre capacity to avoid impurities from soil. Experiments using water and nutrient solutions have shown that diffusate can be produced under these conditions but does not exceed in concentration that produced in pots. Further experiments are in progress to determine the conditions under which rapid root growth can be encouraged and maintained. Attempts are being made to culture roots and infect

https://doi.org/10.23637/ERADOC-1-117

them with sterile larvae of potato-root eelworm. (D. W. Fenwick and Elizabeth Widdowson.)

As a preliminary to work on nematicides, a study of the effects of pure ethylene dibromide upon larval emergence from cysts has begun in order to test the relationship between kill and hatchability. (D. W. Fenwick.)

The six-year co-operative experiment run jointly with the Shell Chemical Co. Ltd. and the West Norfolk Fertilizers Ltd., in which the long-term effects of crop rotation and soil injection with " DD Mixture " were being investigated, terminates at the end of the year. Potato yields show few outstanding increases over those obtained at the start of the experiment. The " DD Mixture " injections have noticeably reduced the growth of weeds. Analysis of the yield and eelworm population figures is in progress. (J. J. Hesling and C. C. Doncaster.)

Resistant crosses of *Solanum andigenum* and *Solanum tuberosum* have been tested against a number of potato eelworm populations obtained from various localities. The existence of resistance-breaking biotypes of the eelworm first noted by Scottish plant breeders has been confirmed, such biotypes having been obtained from Lancashire, Lincolnshire, Kent, Devon and Jersey. Estimates of the proportion of resistance-breaking biotypes in a number of populations have been obtained. (F. G. W. Jones.)

Cereal-root eelworm (Heterodera major *O. Schm.*)

The long-term experiment at Stoke-on-Tern on the build-up of soil populations of the cereal-root eelworm has continued, and the latest population counts show marked differences between the treatments (cereal species, fertilizer, time of sowing). The eelworm population under the oats rose to such a level that in 1956 the oats were a failure. Near Winchester, annual sampling for *H. major* on fields whose cropping plan is dictated by the farmer provided more evidence of the eelworm's behaviour under field conditions. Pot experiments on the population increase of *H. major* under oats, wheat and barley showed that this was greatest under oats, followed by barley and wheat. Plant-height measurements indicated that wheat was more susceptible to eelworm attack than barley. Increase was greatest from low infestation levels; the proportion of large cysts in the total cysts produced fell with increase of inoculation rate.

The efficiency as hosts of *H. major* of four species of common ley grasses has been determined using a series of infestation levels. All these grasses proved to be poor hosts compared with oats; perennial and Italian ryegrasses and cocksfoot were only one-tenth as efficient hosts as oats. Timothy appears to produce no new cysts. Invasion of grass roots by *H. major* larvae is much less than that of cereal roots and, in the range of infestations used in testing the above grasses, there was no evidence of the inverse relationship between population build-up and inoculum level.

The rate of decline of cereal-root eelworm population in pots of fallow soil was investigated. There was little fall in population during the period August 1955–March 1956, but the population fell steadily between March and July 1956.

https://doi.org/10.23637/ERADOC-1-117

Root diffusates from eight species of cereals and grasses did not stimulate the larvae of *H. major* to hatch from cysts.

Further attempts to discover varieties of barley resistant to *H. major* have continued, and a variety testing technique has been tried out. (J. J. Hesling.)

Beet eelworm (Heterodera schachtii *Schm.*)

The influence of soil moisture on movement of larvae of the beet eelworm has been studied from two aspects: the indirect influence of soil moisture through the agency of the host plant and the direct effect of soil moisture on larval activity.

There appears to be an optimum moisture content for beet-root diffusate production which may coincide with optimum conditions for plant growth. It is generally assumed that the root diffusate attracts larvae to the roots, and the properties of diffusate as an attractant are being studied. Attempts are also being made to measure the rate of diffusion of beet-root diffusate in sand at different moisture contents.

The numbers of larvae invading cress seedlings in sand at different moisture contents show that there is an optimum moisture content for invasion which coincides with the optimum conditions for larval emergence from the cysts. Larval movement through sand is greatly inhibited if particle size is reduced to about 50 μ diameter or less. There appears to be a limiting pressure deficiency of the order of 200–300 cm. of water for larval emergence from the cyst and for movement in the soil.

Galactinol, inositol and glutamic acid are claimed by some American workers to be the major constituents of the exudates from beet roots. Bioassays show, however, that they have no significant stimulatory properties; the actual active factor is still unknown. Larval emergence in sugars suggests that the beet eelworm used in the experiments consisted of two distinct populations with different optimum concentrations for emergence. (H. R. Wallace.)

In the field, difficulties are experienced in measuring the rate of increase of soil populations from low levels and in assessing their effects upon yield. For these reasons, an experiment was made using large pots holding 10 kg. of sterilized soil to which numbers of cysts of known average egg content were added in a logarithmic series and in which single sugar-beet plants were grown. The lowest population level was equivalent to 0·0001 cysts/g. (0·003 eggs/g.) of soil and gave a yield of roots and tops significantly higher than the control pots to which no cysts were added, suggesting that small numbers of nematodes have a stimulatory effect. Apart from this there was a significant linear regression of yield upon log initial eelworm population. These results agree with those of previous pot experiments on *Heterodera rostochiensis, H. cruciferae* and *H. tabacum* (1954 Report). (F. G. W. Jones.)

Cabbage-root eelworm (Heterodera cruciferae *Franklin*)

Further details of morphology and development of juvenile stages of the cabbage eelworm have been obtained from examinations of whole mounts and microtome sections. Various embedding

https://doi.org/10.23637/ERADOC-1-117

media and methods of dehydration have been tried, including paraffin wax/ceresin mixtures, double embedding with celloidin and paraffin wax, embedding in Nonex 63 (the water-soluble monostearate of polyethylene glycol 1,000), and attempts are now being made, with assistance from H. L. Nixon, to embed and section in butyl methacrylate. Two types of simple differentiator tubes have been made and used with success for gradual transference of specimens from one reagent to the next in the course of dehydration and clearing.

A plot experiment was set up in mid-May to determine the number of generations of *H. cruciferae* per year. Winter rape has been sown at fortnightly intervals, and plants have been examined weekly from the time of germination to the first appearance of first-stage larvae within the eggs of the *H. cruciferae* which have developed on the roots. The second generation was completed by 1 October, each complete cycle taking about 10 weeks up to that time. (C. C. Doncaster.)

Predators of the Heteroderidae

Using a funnel-type soil fauna extractor and culture chambers, designed by P. W. Murphy, four common species of Collembola have been found to be predatory on cysts of *H. cruciferae*. One of these, *Onychiurus armatus*, which is probably the most important predator as well as the most abundant of the four species, also fed on cysts of *H. schachtii* and of *H. schachtii* var. *trifolii*, at least one *Dorylaimus* species and one *Mononchus*.

A rough estimate of the number of cysts damaged was attempted from a pot culture of *H. cruciferae*. Out of a total of 1,216 cysts recovered, 84 (6·9 per cent) showed characteristic collembolan damage, while a further 89 (7·4 per cent) showed damage of uncertain origin, possibly due to Collembola. A total of 251 *Onychiurus armatus* was recovered from the same soil sample; one to about every five cysts. As the remains of damaged cysts may be lost or become unrecognizable, and as immature females may be completely demolished, this estimate of attack is the lowest possible figure.

Photomicrographs, using electronic flash illumination, have been obtained of *Onychiurus armatus* feeding on *H. cruciferae* cysts. (C. C. Doncaster.)

Nematodes Parasitic in Insects

The taxonomy, life history and development of two new species of Allantonematidae parasitic on six species of *Drosophila* have been studied. The incidence, host–parasite relationship and host specificity of two of the nematodes have been investigated in detail. The taxonomy of the Mermithidae has been reviewed. The original descriptions and diagnoses of the species and genera have been examined and a number of causes found for the well-recognized confusion in the taxonomy of this family. Suggestions have been made for the reduction of this confusion by the strict application of the International Rules of Nomenclature and the reassignment of species to genera. Both lines of work have been embodied in a thesis presented for the degree of Ph.D. in the University of London. (H. E. Welch.)

https://doi.org/10.23637/ERADOC-1-117