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Entomology Department

C. B. Williams

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DEPARTMENT OF ENTOMOLOGY

By C. B. WILLIAMS

During the year the permanent scientific staff has consisted of C. B. Williams, H. F. Barnes and A. C. Evans. An Indian post-graduate student S. N. Banerjee has worked in the Department since March, 1946; and in April C. G. Johnson was appointed to an A. R. C. grant to investigate the long distance movements of insects, and particularly *Aphis fabae*. W. S. Guild has held a grant from the Agricultural Research Council for the study of earthworms. W. S. Richards has also worked during the year on the ecology of British Harvest Mites (*Trombicula*) with a grant from the Medical Research Council.

A.—Field work on the relation of activity and abundance of insects to weather conditions was resumed at the end of April, 1946, as the use of light traps was again possible after the war. Three traps were in use during the year, instead of one in the pre-war years, as it is proposed in the future to pay less attention to the total number of insects and more to single species. Greater total numbers must be captured to get sufficiently high numbers of one species for statistical analysis.

All calculations so far completed support the results obtained in the earlier years.

Work on the analyses of mixed insect populations—arising originally out of the light trap samples—has also continued and developed, and once more the new year's samples obtained from the trap have been found to support the previous results. The "Index of Diversity" as a measure of "richness" of a population has been found to be a valuable conception in understanding the relative numbers, and changes in numbers, of species under natural conditions when in contact with many other species. Botanical applications of the same technique have also been found. This work is developing into an important branch of "Synthetic" field ecology as opposed to analytical laboratory studies, and may prove to be fundamental in understanding insect outbreaks under the complicated conditions of field agriculture.

Work on insect migration has continued to occupy a small amount of time, and this has chiefly been used in filing records received from observers in this country and abroad. Several papers have appeared during the year which were written in previous years.

B.—The twentieth successive year of Dr. Barnes' long-term study of the incidence of the wheat blossom midges on Broadbalk was successfully completed. There was a still further increase in the numbers present and the following table shows a comparison of the last three years. It is quite obvious that these midges

	Numbers of larvae in 500 ears of wheat			Per cent. grain infestation		
	1944	1945	1946	1944	1945	1946
<i>C. tritici</i> ...	1,030	24,643	29,638	1	6.8	13.3
<i>S. mosellana</i> ...	133	3,557	3,853	$\frac{1}{2}$	11.0	13.3

caused damage to wheat both in 1945 and in 1946. There have now been four peaks of high infestation during the last twenty

years. It can be expected that the peak of the present outbreak has been reached and that during the next two or three years the numbers of midges will drop, while the numbers of their natural enemies are increasing. The presampling necessary to establish the correct sampling date was done during 1946 on Plot 14 owing to the prevalence of wild oats on Plot 2. The study of the longevity of the larvae of these midges in the soil was continued. *S. mosellana* collected in July, 1939, still continued emerging in 1946, and about 60 per cent. of the 1940 and 1941 larvae have now emerged.

It is obvious that this long-term study is still yielding unique results and should be continued as long as possible.

A joint study by Dr. Barnes and Mr. J. W. Weil of slugs in Harpenden gardens was brought to a temporary close in December, 1945. It was restarted in September, 1946, in both Bedford and Harpenden with a view to finding out if the results obtained in Harpenden are equally applicable in other places. The second part of the results of the first two years' work was published in the November, 1945. This contained three coloured plates. These consisted of paintings generously provided free by Miss Evelyn M. Tuke, and the publication costs were defrayed entirely by Messrs. H. R. Napp, Ltd., the manufacturers of metaldehyde used in baiting slugs.

A paper embodying the results of the third and fourth years' work has now been completed and the results of the incidence of the slugs during the four years discussed. The data provides a beautiful demonstration of rhythms in numbers and weights as well as the use of field observations both to obtain biological information as well as the need for continuous data, on a statistical basis, before drawing conclusions as to the abundance or otherwise of pests.

The results of weighing the slugs individually has been held over for further study.

In the meantime experiments have been initiated to establish the lapse of time between mating and oviposition and between oviposition and hatching.

The first two Volumes of Dr. Barnes' work on *Gall Midges of Economic Importance* were published in June, 1946. The publication of Volumes 3 and 4 due in autumn of 1946 was delayed by a printer's "go-slow" policy. The final checking of Volumes 5 and 6 approached completion.

C.—Dr. Evans' work on the relations between earthworms and soil fertility has continued with the assistance of W. S. Guild.

Laboratory studies.—The work on the life-cycles of the common species of earthworms is continuing. Many data have been obtained on the following points:

- (a) incubation periods of the cocoons;
- (b) number of cocoons produced at different times of the year;
- (c) number of worms issuing from 1 cocoon;
- (d) growth period from hatching to sexual maturity;
- (e) occurrence of parthenogenetic reproduction in certain species. A technique has been devised by which 95 per cent. of the immature worms in field collections can be identified.

The type of organic matter on which worms feed has a great influence on their rate of reproduction. The droppings of herbivorous animals proved the best source of food, closely followed by peat. Well decayed organic matter such as farmyard manure and sewage sludge was quite unsuitable as was straw, with and without additional inorganic nitrogen.

Field studies.—The numbers of earthworms and the proportions of the different species present on various fields at Rothamsted is determined by the agricultural history of the field. Investigations in the Stirling area of Scotland show that soil type has a big influence on the number and proportions of the different species present. The production of wormcasts in a pasture field was found to be dependent on the activity of 2 species only out of the 7 species present. Fluctuations in soil temperature and moisture largely determine the seasonal activities of earthworms.

Pot culture studies.—The effect of one species of earthworm has been studied in a factorial experiment comparing grass and animal droppings as source of food, and the effect of no added nitrogen against added sulphate of ammonia. The results showed a highly significant effect of worms in increasing the yield of the test plants, mustard, and a highly significant positive interaction between worms and sulphate of ammonia.

D.—Dr. Johnson has done a certain amount of exploratory field work on a method of sampling bean aphid on plants and trapping them in the air.

In connection with possible longer range movement work it is hoped to get two 105-ft. masts from the Air Ministry which can be used for experiments in trapping airborne aphids into a suction trap which is due for delivery early next spring (1947).

A net which is impregnated with a toxic material and which immobilises aphids which are carried on to its surface, as it orientates to the wind, shows promise for short range low level studies.

Publications (including Summaries), page 110.