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PROGRESS OF WORK ON SEXAVA SPP., THE COCO-NUT TREEHOPPER.

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A summary of the investigation into the bionomics and control of this pest up to the latter part of 1935 was published by the Entomologist, Mr. J. L. Froggatt, in Vol. 1, No. 1, of this journal. Since then, further work has been done, which is briefly outlined in this article.

The research station was transferred from New Hanover to Arawe Plantation, New Britain, at the end of April, 1935, the object being to establish the two egg-parasites, *Leefmansia bicolor* and *Dorinia leefmansi*, in that district. In early February, 1936, New Hanover was again visited, and a large number of eggs, parasitised by various species of wasps, was collected. These eggs were then taken per the M.V. *Poseidon* to Mokareng Plantation, Manus, the original site of the research station, and work has been in progress in this locality up to the present time.

Life-history and Habits.

Technique of Breeding.—Rearing of the treehoppers was carried out in a calico enclosure 6 feet by 6 feet by 6 feet. In the New Hanover structure there was a double roof, the two pieces of calico being separated by a space of a foot. This proved fairly satisfactory, but was too warm, the temperature frequently reaching 100 degrees Fahr. In Manus, a thatched roof was first constructed, about 11 feet high, and covering an area 12 feet by 12 feet. Under this the calico enclosure was built, portions of the roof and sides being made of fly-wire, to permit of adequate ventilation. The floor was of galvanized iron sheets, to prevent the females from laying indiscriminately in the soil, and a tray containing moist soil was provided for oviposition. This was frequently sieved during the egg-laying period, and the number of eggs counted. The enclosure had, of course, to be made proof against the entry of predators such as small lizards. Fresh food was provided daily, portion of a coco-nut frond moistened with water being suspended from a wire stretching from side to side of the roof. The insects could then be taken from the old frond and placed on the new, their numbers and stage of development being noted at the same time. In these calculations, mortality was found to be very heavy during the first nymphal stadium. Out of 155 newly-hatched nymphs which were used at Manus, 58 died before reaching the second instar. Of the remaining 97, 67 reached the adult stage. Probably there is a similar mortality in the field, as the first-instar nymphs seem particularly vulnerable to adverse conditions.

Information Obtained.—Results of rearing treehoppers in Manus show that the life-history here is very similar to that of the New Hanover species. The only species recorded from Manus is *Sexava novae-guineae,* whereas in New Hanover this species is present together with *S. nubila.* The characters which separate the two species are not known to the writer, but it seems probable that *S. nubila* is the dominant species in New Hanover, and that it was the species on which life-history studies were carried out in that locality. One definite difference in life-history was noted to exist between the Manus and New Hanover treehoppers. In the latter, the males have six and the females seven nymphal stages. The Manus species has seven nymphal instars in the female, but only one-third of the males have six instars, the remaining two-thirds having seven, as in the female. The two types of sixth-instar male can be distinguished by the development of wings and elytra, and have been called the macropterous (large-winged) and the micropterous (small-winged) types. The former corresponds to the normal New Hanover male, while the wing-development in the latter proceeds as in the female nymphs.

Copulation was not witnessed in New Hanover, though it was thought to take place between midnight and the following dawn. In Manus, it has been seen on several occasions, and takes place at about sundown. The males show sexual excitement by stridulating and depressing the abdomen convulsively. The actual act of copulation takes a very short time. The male ranges himself alongside the female, facing in the same direction. He then curves his abdomen under that of the female, brings his genitalia in contact with hers, and extrudes a whitish, gelatinous blob, which remains attached to the female for a period of from 12 to 24 hours. This blob of fluid is the spermatophore, a gelatinous envelope containing the seminal fluid. In New Hanover, females were known to have copulated during the first 24 hours of their adult life, but in Manus there were no indications that mating had taken place until ten days after the first female had reached the adult stage. Since then, copulation has taken place daily in the breeding enclosure, covering a period of nearly eight weeks. Out of the 30 females and 37 male adults which were reared from the time of hatching, there are now 20 female and 27 male survivors.

Oviposition began 33 days after the first female became adult, and during a period of a month 900 eggs have been laid, an average of 30 per adult female. When oviposition is completed, the average will possibly be between 40 and 50.

The eggs which have been incubated in the laboratory have hatched in from 49 to 59 days from the time of laying, with an average incubation period of 51 days. The numbers handled so far have been comparatively small, so that later results may give a somewhat different figure.

The immature or nymphal stages between egg and adult occupy much the same time as was the case with the New Hanover species. The seven nymphal stages of the female occupied a period of from 90 to 124 days, with an average of 100.9 days (New Hanover 100.6), while the male nymphal instars lasted for from 78 to 117 days, with an average of 92.4 (New Hanover 88.4). In New Hanover, the total time from egg to egg (i.e., one generation) was found to average just seven months, and it is apparent that the results obtained in Manus will be very similar. In the field, however, it is probable that the life-history in New Hanover occupies a period of about a month longer, as the average temperature there is about 2 to 3 degrees Fahr. lower than at Mokareng. The

breeding chamber in New Hanover was of a type which conduced to high temperatures, while that at Mokareng was very cool, so that the difference in field temperature was obscured. The incubation of eggs took place under comparable conditions in the two localities, and the average period of incubation was 61.8 days in New Hanover compared with 51 days in Manus.

Egg-parasites of Sexava spp.

When it was decided to move the research station from New Hanover to Arawe, arrangements were made to transfer three species of parasites to the new site, namely *Leefmansia bicolor, Dorinia leefmansi* and an Encyrtid common in New Hanover, both the latter having been shown to be primary parasites of Sexava eggs. *Dorinia* seemed in particular to have exercised definite control over the treehopper in New Hanover, being widely distributed and parasitising up to 72.5 per cent. of eggs collected in certain localities. (The figures for percentage of parasites were obtained by the dissection of many thousands of newly-collected eggs.) It was also hoped that the Mymarid parasite, which was second in effectiveness to *D. leefmansi*, might establish itself when it emerged from eggs collected in New Hanover, though it had been found that it would not breed satisfactorily under laboratory conditions. Unforeseen delays in transit caused the loss of all the Mymarids and most of the *D. leefmansi*, but *L. bicolor* and the other Encyrtid were successfully transferred. On the way to Arawe, a visit was made to Ablingi Plantation, which was very badly attacked by Sexava, and some thousands of eggs parasitised by *L. bicolor* were suspended in the affected areas. Many thousands of adult *L. bicolor* were also liberated there. It is not known whether or not the parasite has become established in this locality, as it has not since been visited.

Work was carried on for nine months at Arawe, during which time *L. bicolor* became established in several places, but *D. leefmansi* showed no signs of doing so. This was only to be expected, as very few of this parasite had arrived at Arawe, and it is at all times difficult to breed in the laboratory.

As *D. leefmansi* and the Mymarid were so well established at New Hanover, and seemed to have been effective in keeping Sexava attack down to a reasonable level, it was decided that an effort should be made to establish these parasites in Manus, where the depredations of the treehopper are at their worst. As both species, particularly the Mymarid, fail to breed well in the laboratory, the method used was to collect large numbers of eggs at New Hanover, where both parasites occur in very large numbers, and transfer them direct to Manus at the time when the research station was being shifted there from Arawe. It would, of course, have been desirable to have sent a number of shipments of eggs, but transport was not available for the execution of such a scheme.

A visit of about three weeks' duration was made to New Hanover, and a very large number (approximately 1,000,000) of heavily-parasitised eggs was collected, and transferred to Manus per the M.V. *Poseidon*. Numerous samples of these eggs showed a parasitism of 72 per cent. by *D. leefmansi*, and in many cases there were as many as 22 per cent. attacked by the Mymarid. The greater portion of the eggs was distributed throughout Mokareng Plantation, small containers of fly-wire being used to suspend the eggs from palms, and thousands of parasites were seen to emerge. However, there is as yet no evidence that they have established themselves in the field.

Investigations have been made to ascertain whether *L. bicolor*, which was established on Mokareng Plantation in 1934, is still present. So far, results have been disappointing, as none of the wasps have emerged from eggs collected in the field. Of course, this does not prove that the parasite is a failure, for it may be present in small numbers, and may possibly take a number of years to become acclimatized. On the other hand, it is evidently not going to deliver very quick results, so that, while breeding and distribution of *L. bicolor* will be continued, more attention is being paid to the question of control by artificial methods.

Artificial Control.

Experiments have been conducted at Mokareng into the killing effect of arsenate of lead sprays applied to the foliage of the coco-nut palms. A small palm was sprayed with mixtures of ½ oz. and 1 oz. of arsenate of lead powder to the gallon of water, and leaves were then fed to captive treehoppers. Control lots of insects were fed on unsprayed leaves. In every case there was 100 per cent. mortality within from three to five days among those fed on sprayed leaves, while the control lots showed only an insignificant number of deaths. It has not been possible to conduct field trials as yet, owing to the lack of a sufficiently powerful spraying machine. Consideration is being given to the purchase of a dusting machine, so that the arsenate of lead powder can be applied in the dry form. It is considered that this would be much quicker and simpler than spraying, owing to the mobility of the apparatus, and the elimination of the need for large quantities of water.