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OBSERVATIONS ON SOME PARASITES OF *OSCINELLA FRIT* LINN.

PART II

BY

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OBSERVATIONS ON SOME PARASITES OF *OSCINELLA FRIT* LINN.

PART II.

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(With 2 Figures in the Text.)

I. Parasitisation of *Oscinella frit* during 1929 and 1930.

It has already been shown (Imms, 1930) that the stem generation of the frit-fly in the Harpenden district is subjected to natural destruction, to a marked degree, by the agency of certain hymenopterous parasites. Among these, two species, viz. the Cynipid *Rhoptromeris eucera* Htg. and the Chalcid *Halticoptera fuscicornis* (Walk.) were found to predominate in numbers. Parasitisation, to a lower degree, by the Proctotrypid *Loxotropa tritoma* Thoms. was also noted and the Chalcid *Callitula bicolor* Spin. was recorded for the first time as having been reared from this same host. Evidence was also brought forward which appeared to indicate that the parasitisation of frit-fly by the above combination of species increases in intensity as the season advances. In other words the stem generation of frit-fly, attacking late sown oats, is subjected to markedly heavier parasitisation than when it attacks oat sown earlier in the same season.

During the years 1929 and 1930 observations were continued and extended, at Harpenden, along lines similar to those already described, with the object of testing the conclusions previously arrived at. The results to be described in these pages confirm the previous years' conclusions, and also show that there is considerable fluctuation in the relative status, or frequency of occurrence, among the several parasite species present.

In 1929 oats of the variety "Supreme," supplied by Messrs Gartons of Warrington, were sown on a plot 1/8 of an acre in area, which was set apart for the purpose on the Rothamsted farm. The date of sowing was February 28th and the seed was distributed in parallel drills at the rate of three bushels to the acre. In due course samples of affected plants were examined at intervals and, as soon as pupae of the frit-fly were present in larger numbers than the larvae, all plants that appeared to be attacked were removed to the laboratory. The examination and breeding of host material were carried out in a manner similar to that previously described.

During 1930 three plots, each with an area of about 1/10 of an acre, were sown with oats of the variety already mentioned. These plots were adjacent to

one another and formed part of some land, the rest of which itself was under oats. The sowing dates for the three plots were: Plot I, February 29th; Plot II, March 20th, and Plot III, March 29th. For the purposes of collecting material of the frit-fly host, infested plants were removed from these plots and transferred to the laboratory during the following periods: Plot I, from June 19th to 25th; Plot II, from June 27th to July 3rd, and Plot III, from July 7th to 10th.

Records were kept of the dates of emergence of all individuals of both host and parasites, the rearing of these being carried out in the laboratory.

During 1929, 1225 examples of frit-fly were bred and 447 parasites, the percentage of parasitism being 26·7.

During 1930, when three plots were used, the breeding results were as follows:

Plot I: 603 flies, 217 parasites; parasitism 26·4 per cent.

Plot II: 754 flies, 472 parasites; parasitism 38·4 per cent.

Plot III: 202 flies, 272 parasites; parasitism 57·3 per cent.

It will be evident, therefore, that these two years' results agree very closely with those for 1926 and 1927 (Imms, 1930, p. 12.) With regard to the 1930 results, they confirm the previous conclusion that the parasitisation of frit-fly, affecting late sown oats, is markedly heavier than that suffered by the same generation of the insect attacking oats sown earlier in the season. The details concerning the parasites may be summarised as follows.

During 1929, when one field plot was utilised, 26·4 of the individual insects reared were parasites which consisted of the following species: *Halticoptera fuscicornis* 4 ♂♂, 14 ♀♀; *Rhoptromeris eucera* 133 ♂♂, 75 ♀♀; *Loxotropa tritoma* 112 ♂♂, 84 ♀♀; *Callitula bicolor*, 15 ♂♂, 9 ♀♀; *Eucoila* sp. indet. 1 ♀.

During 1930, when three plots were laid down, the rearings of parasites were as follows:

Plot I: *Halticoptera fuscicornis* 14 ♂♂, 18 ♀♀; *Rhoptromeris eucera* 14 ♂♂, 22 ♀♀; *Loxotropa tritoma* 77 ♂♂, 72 ♀♀.

Plot II: *Halticoptera fuscicornis* 44 ♂♂, 54 ♀♀; *Rhoptromeris eucera* 49 ♂♂, 68 ♀♀; *Loxotropa tritoma* 161 ♂♂, 63 ♀♀; *Callitula bicolor* 17 ♂♂, 13 ♀♀; *Eucoila* sp. indet. 2 ♀♀; *Halticoptera* sp. indet. 1 ♀.

Plot III: *Halticoptera fuscicornis* 22 ♂♂, 32 ♀♀; *Rhoptromeris eucera* 24 ♂♂, 32 ♀♀; *Loxotropa tritoma* 76 ♂♂, 34 ♀♀; *Callitula bicolor* 28 ♂♂, 24 ♀♀.

The most noteworthy conclusions to be drawn from these results are that during 1930 the dominant parasite species was the Proctotrypid *Loxotropa tritoma*. *Rhoptromeris eucera*, the dominant parasite during 1926, 1927 and 1929, fell to second place and *Halticoptera fuscicornis* declined to third place. *Callitula bicolor*, a species which was only represented by two examples during 1927, was reared in considerable numbers during 1929 and 1930.

Evidence collected during the years 1926–30 on several hundred host larvae and puparia, each individual being isolated in a separate vial, showed that the imagines of all four of the species of parasites mentioned emerged from frit-fly puparia. Furthermore, with one single exception, in which two males of

Loxotropa tritoma issued from one host puparium, only one parasite emerged from each individual host attacked. It may be taken, therefore, that each individual parasite represents the destruction of one host individual.

Before the actual collection of frit-fly larvae and puparia was undertaken, carefully randomised samples of the plants growing on each of the three 1930 plots were obtained. These were taken up by the roots irrespective of their being infested by frit-fly or not, and they served to ascertain the approximate degree of infestation on each of the plots concerned. The number of plants gathered was neglected and only the actual number of shoots, infested or not, was taken into account. The degree of infestation in each case was determined by the frequency of frit-fly larvae and puparia present in relation to a known number of shoots. The latter, it may be added, included shoots which were healthy, infested or killed, in variable proportions, all being included in the counting. The result of the sampling was as follows:

Plot I: Number of shoots examined 528; number of frit-fly larvae and puparia present 118; percentage of infestation 22·3.

Plot II: Number of shoots examined 1119; number of frit-fly larvae and puparia present 422; percentage of infestation 37·7.

Plot III: Number of shoots examined 961; number of frit-fly larvae and puparia present 289; percentage of infestation 30·1.

While these observations are, by their nature, open to some criticism they appear to show (*a*) the advantage of early sowing of oats in order to reduce infestation by frit-fly; and (*b*) that the high percentage of parasites reared from frit-fly affecting Plot III is due to an increase in the parasite population rather than to an increase in the host population available for parasitisation.

Taken collectively, the observations made between 1926 and 1930 cover a period during which the oat crop in England and Wales suffered low or moderate infestation by frit-fly, and no widespread severe outbreak of this insect was recorded by the Ministry of Agriculture. The percentage of natural parasitisation to which the frit-fly was observed to be subjected may be divided into two classes in direct relation to the sowing date of the oats which the insect infests. (1) In cases where the sowing date for the experimental plots was on or before March 15th the mean percentage of parasitisation was 23. (2) Where the sowing date was after March 15th and up to as late as April 25th the mean percentage of parasitisation was 43·5. It would appear, therefore, that the more intensive parasitisation prevails when the frit-fly affects spring oats sown later than is customary for any average season in England and Wales.

II. On *Callitula bicolor* Spin.

Detailed descriptions of three out of the four species of parasites reared from puparia of the frit-fly have already been given in a previous paper (Imms, 1930), and *Callitula bicolor* alone remains for further consideration. This species is a member of the family Pteromalidae and belongs to the subfamily Merisinae as defined by Ashmead (1904). The tribal division of the Merisini to which

Callitula is relegated includes species that are predominantly parasites of Diptera.

The genus *Callitula* was established by Spinola (1811) in his paper entitled "Classification des Diplolepaires." This latter is a synoptic key to Chalcid genera and contains no complete description of *Callitula* whose only species, viz. *C. bicolor* Spin., is unaccompanied by any description other than the characters upon which its genus was founded. Walker, in 1833, described the insect as a new genus and species, *Micromelus rufomaculatus*. Förster (1856) incorrectly stated that Walker's generic name of *Micromelus* was preoccupied, and substituted the new name of *Baeotomus* in consequence. Two years later Reinhard regarded Spinola's diagnosis as being invalid and adopted Walker's generic and specific names. In Dalla Torre's Catalogue (1898) Förster's nomenclature is accepted, the species being listed as *Baeotomus rufomaculatus* (Walk.). Ashmead (1904) followed Reinhard and accepted *Callitula* as being a synonym of *Micromelus*, but in 1923 Gahan and Fagan pointed out that, according to the rules of nomenclature, the names of both the genus and species, *Callitula bicolor* Spin., are valid and consequently antedate *Micromelus rufomaculatus* Walk.

This insect has been recorded by Marchal, Kurdjumov, Leonardi and others, under the name *Micromelus rufomaculatus*, as a parasite of the Hessian fly (*Mayetiola destructor*) in Europe. Whether it is a primary parasite or a hyperparasite appears to be uncertain, but Kurdjumov (1913) states that he has always found it as a hyperparasite. Its relationship with *Oscinella frit* has not been determined, and it may possibly prove to be a secondary parasite of that species also.

This insect was reared singly from frit-fly puparia between July 18th and 27th, 1929, and between July 19th and August 7th, 1930. I am indebted to Dr Ch. Ferrière of the Imperial Institute of Entomology for confirming my identification. The only previous record of the occurrence of this species in Great Britain is that of Walker (1833) who gives the following: "June: grass in fields: near London. New Lanark, Scotland." Walker's specimens probably parasitised frit-fly affecting wild grasses.

Description of the Female. (Fig. 1.)

Coloration. Head and thorax black with dark metallic green or bluish green reflection. Eyes dark chocolate: ocelli translucent brown. Antennae dark fuscous brown with proximal half of scape testaceous. Mandibles yellow-brown. Legs ochreous yellow to testaceous, fifth joint of tarsi and claws dark fuscous. Tegulae testaceous. Wings hyaline with the veins smoky or smoky yellow. Abdomen black or brown-black, shining, with slight bronzy reflection: and irregular ochreous mid-dorsal area on first and second segments. Ventrally, abdomen is testaceous with the apical half suffused with fuscous.

Head. Facial aspect rather broader than long, as 3 : 2. Eyes moderate-sized, separated on the vertex by a distance equal to the frontal depth of the

head. Ocelli disposed in the form of a flattened triangle, the medium ocellus only slightly in advance of the lateral pair: lateral ocelli separated by an interval rather greater than the distance of either ocellus from the inner margin of the compound eye of its side. Toruli situated near the middle of the facial aspect of the head and separated by a distance rather more than their individual diameter. A rather deep broad antennal fovea extends upwards from just behind the toruli. Clypeus narrow, transverse, its lateral angles rounded and separated by a wide but shallow sinus. Surface of head sculptured with a reticular pattern of hexagonal or pentagonal cells: towards the clypeus the cells become elongated and ultimately become converted into ridges which converge around the clypeus.

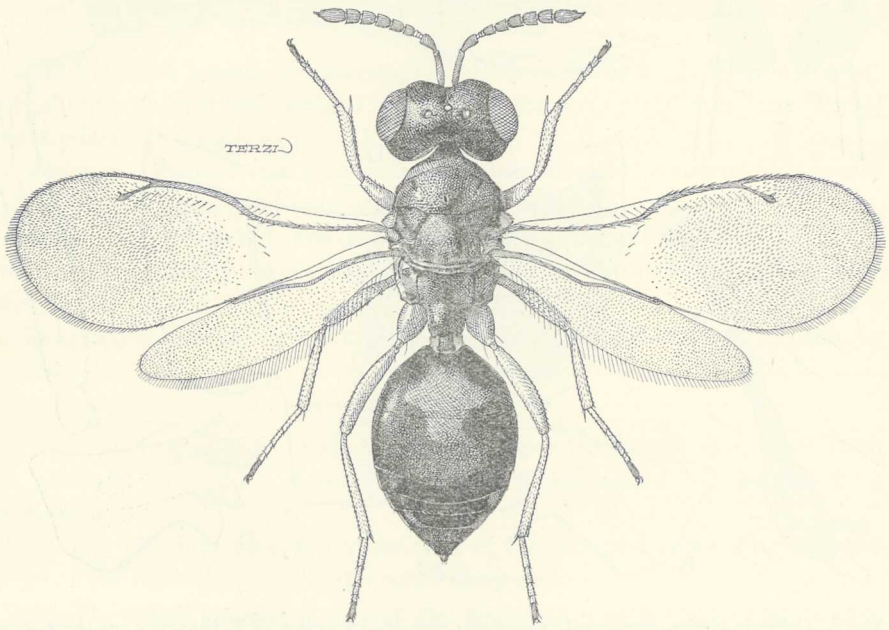

Fig. 1. *Callitula bicolor* Spin., female. ×40.

Antennae. (Fig. 2 A.) Eleven-jointed. Length 0·6 mm.: scape 0·2 mm. long (including small basal sclerite) and 0·02 mm. broad, related in length to pedicel as 9 : 2. Pedicel longer than any of the funicular joints. Ring-joints three, collectively slightly shorter than first funicular joint: joints 1 and 2 together equal in length to 3. Funicular joints subequal in length, diameter of successive joints increasing somewhat. Club half the length of scape—drawn out apically into a rather slender process. Sensoria six to eight on each funicular joint and three whorls on the club.

Mouth-parts. Mandibles (Fig. 2 B, C) heterodont: right 0·16 mm. long and 0·09 mm. broad, with four teeth; left very slightly smaller and with three

teeth. Maxillary palpi four-jointed: joints related in length as 7 : 6 : 5 : 10. Labial palpi three-jointed, second joint minute and obscure.

Thorax. (Fig. 1.) Dorsal and lateral surfaces with a reticulate pattern very similar to that of head and coarsest on mesonotum. Prescutal[1] furrows (notauli) very indistinct and extending only a short distance backwards: scarcely evident in some examples. Scutellum markedly convex from side to side. Metanotum in form of shining upraised transverse band. Propodaeum (Fig. 2 D) sculptured with a finer cellular pattern than on thorax: two longitudinal carinar on either side, innermost pair the better developed: spiracles ovoid.

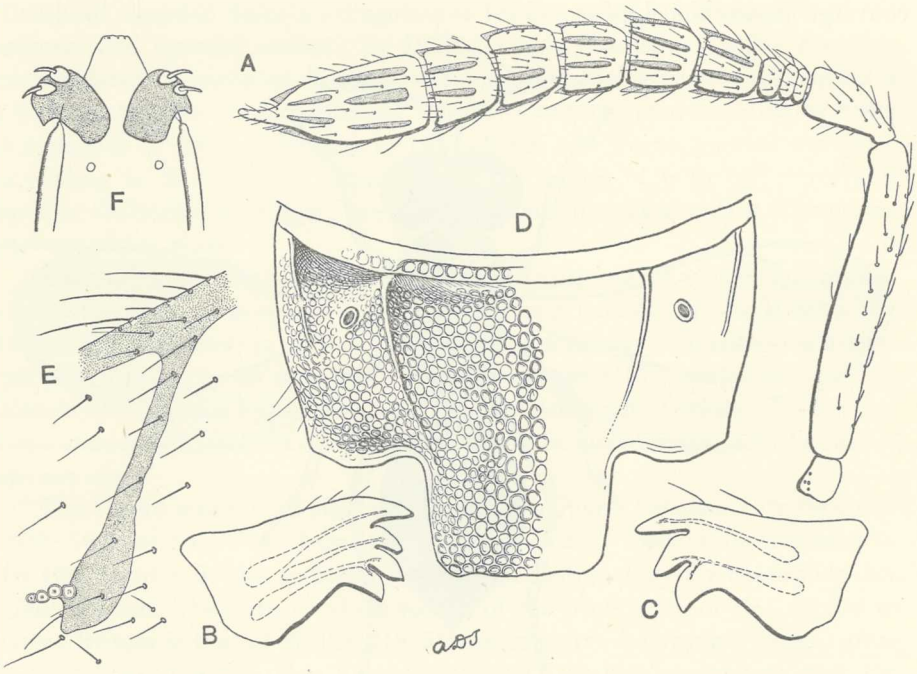

Fig. 2. *Callitula bicolor*, structural characters: with the exception of F, the parts are those of the female. A, left antenna, × 70. B, right mandible, × 182. C, left mandible, × 182. D, propodaeum, × 328. E, stigmal vein and adjacent portion of costal area of left fore-wing, × 350. F, male genitalia, × 130.

Fore-wing. (Fig. 1). With distal three-fifths clothed with fine hairs, basal two-fifths hairless but crossed by an oblique row of four macrochaetae which extends downwards from near the bend of the submarginal vein. Average dimensions of wing (including marginal fringes), length 1·25 mm., breadth 0·55 mm. Submarginal, marginal, postmarginal and stigmal veins related respectively in length as 47 : 25 : 17 : 11. Submarginal vein with twelve macrochaetae: costal cell with a distal row of five or six macrochaetae, re-

[1] Parapsidal furrows of most authorities. For the use of the terms see G. S. Tullock (1929), *Psyche*, **36**, 376.

mainder of cell hairless. Marginal vein with a row of nine or ten macrochaetae along edge of wing: on the wing membrane is a row of nine to eleven macrochaetae near the marginal vein and parallel to it. Stigmal vein with a chain of four annuli (Fig. 2 D).

Hind-wing. Average dimensions (including marginal fringes), length 1·05 mm., breadth 0·29 mm.: marginal vein related to length of wing as 5 : 8.

Legs. Fore-leg with coxa moderately swollen, its length related to breadth as 2 : 1. Femur about equal in length to tibia, its length related to breadth as 13 : 3. Tibia with a spur 0·05 mm. long and unequally bifid at the apex. Tarsal joints[1] related in length as 10 : 7 : 5 : 4 : 7.

Middle-leg with femur related in length to tibia as 6 : 11. Tibia with a slender seta-like spur 0·06 mm. long. Tarsal joints[1] related in length as 13 : 10 : 7 : 5 : 9.

Hind-leg with length of coxa related to its breadth as 2 : 1. Femur slender, only slightly shorter than tibia (7 : 8). Tibia with a spur 0·05 mm. long. Tarsal joints related in length as 15 : 11 : 8 : 6 : 9.

Abdomen. Pedicel with a reticulate pattern dorsally: constricted laterally so as to appear somewhat hour-glass shaped.

Gaster elongate ovoid: first and second terga subequal in length. Spiracles rather large, circular. Apex of ovipositor slightly projecting but not conspicuous.

Length (six examples) 0·95 mm. to 1·25 mm., expanse of wings 2·4 mm. to 3·2 mm.

Description of the male.

The male is similar to or slightly smaller than the female and, apart from the genitalia (Fig. 2 F), it may be readily distinguished by the following characters.

(1) The terminal process on the club of the antenna is wanting and the joints of the funiculus are slightly more elongated.

(2) The dorsal testaceous area on the abdomen is larger and extends over the greater part of the first and second terga.

(3) The ventral fuscous area on the abdomen is more reduced in extent and occupies only the apical one-fourth of that region.

III. General conclusions.

As the result of observations carried out at Harpenden during the years 1926–30, the following conclusions are drawn.

1. The extent of destruction of the stem generation of *Oscinella frit* through the agency of parasites increases progressively with the normal advance of the season. When the host insect infected oats that were sown between February 28th and March 15th the mean percentage destroyed by parasites was 23. When

[1] Measured along the dorsal border.

the sowing dates of oats were between March 20th and April 25th the mean percentage of host insects destroyed by parasites was 43·5. The increase in intensity of parasitisation appears to be correlated with an annual seasonal increase in the parasite population.

2. Three species of primary parasites were involved, viz. the Cynipid *Rhoptromeris eucera* Htg., the Proctotrypid *Loxotropa tritoma* Thoms. and the Chalcid *Halticoptera fuscicornis* (Walk.). A fourth species of parasite, viz. the Chalcid *Callitula bicolor* Spin. occurred in smaller numbers and its status was undetermined. The possibility of its being a secondary parasite requires investigation.

3. The species *Callitula bicolor* is recorded for the first time as a parasite of *Oscinella frit* and a detailed description of the insect is given.

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