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THE IMMATURE STAGES OF MIRIDS (HETEROPTERA) OCCURRING ON BROOM (*SAROTHAMNUS SCOPARIUS* (L.) WIMMER) WITH SOME REMARKS ON THEIR BIOLOGY

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I. Introduction

It is commonly supposed that closely allied species of similar habits are unlikely to occur in the same habitat, or if they do, their habits are likely to change in some way. Therefore, the occurrence of three closely related species of *Orthotylus* (*O. adenocarpi* (Perris), *O. virescens* (Douglas and Scott) and *O. concolor* (Kirschbaum), of another Orthotyline (*Heterocordylus tibialis* (Hahn)) and yet another Phyline mirid of the

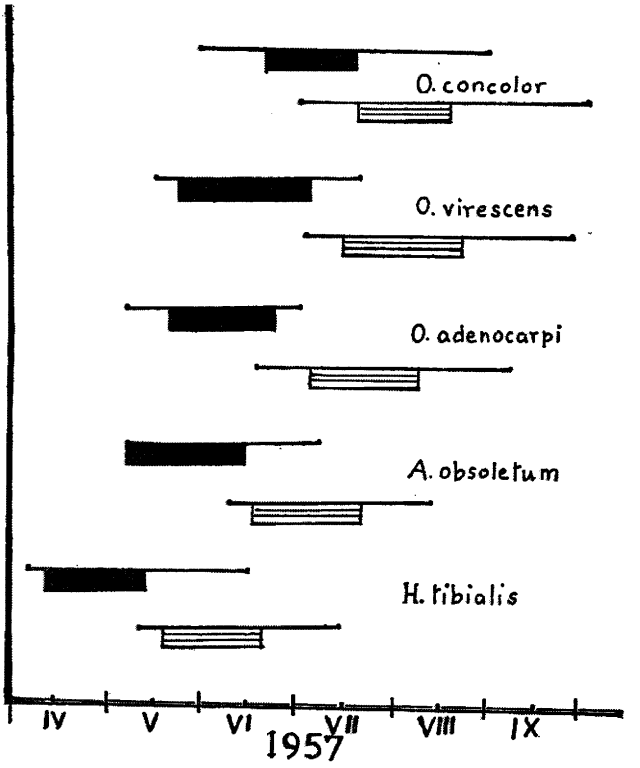


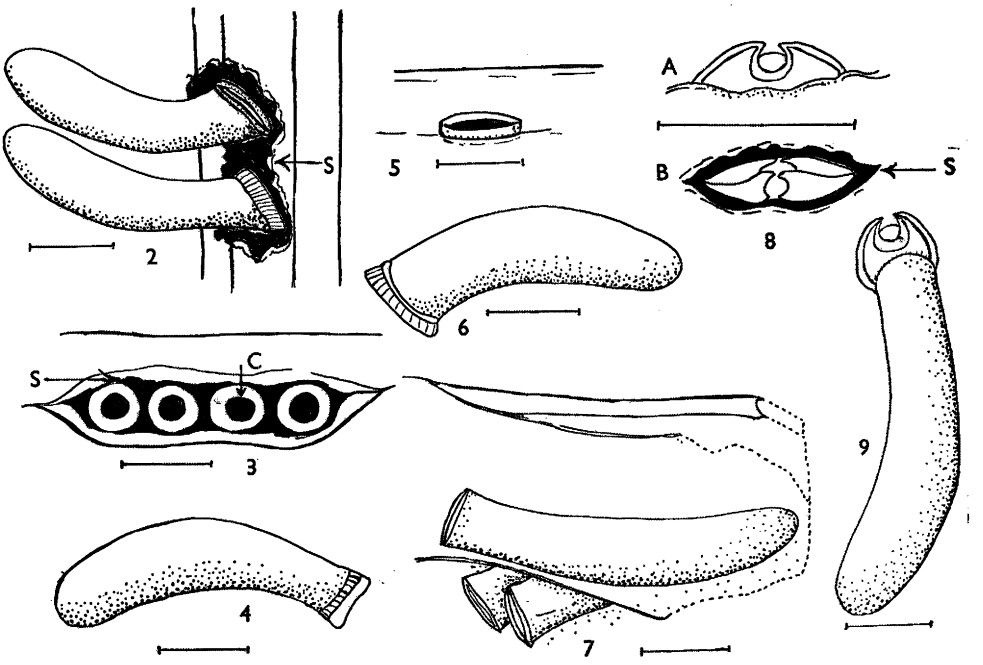
Fig. 1.—Periods of occurrence of mirids on broom (Silwood Park, Berks., 1957). (*Black areas*, times of abundance of larvae; *stencilled areas*, times of abundance of adults.)

same appearance and size (*Asciodema obsoletum* (Fieber)) on the same food plant, *Sarothamnus scoparius*, is a phenomenon of both ecological and evolutionary interest. The first four species are essentially restricted to broom, while the last is also found on gorse (*Ulex europaeus* L.).

A group of people comprising Professor O. W. Richards, Dr. J. P. Dempster and the present authors hope to study the population dynamics and the interactions of

these species and as a first step it was necessary to distinguish the immature stages.

The terminology used in the descriptions of the eggs is that of Southwood (1956*a*). The eggs were first identified in a series of tests in which the mirids were presented with a choice of shoots of different diameters, and the sites of oviposition were confirmed by the examination of numerous cuttings of field broom. The eggs of *H. tibialis* are laid on the sides of the two- to four-year-old stems, while those of *O. virescens* are found on the sides of younger, one-year-old shoots. *A. obsoletum* oviposits in the superficial tissues of the leaf bases of green shoots, while *O. adenocarpi* lays in one- or two-year-old stems, the eggs lying outside the xylem cylinder and often penetrating the buds of the flowering shoots with the operculum lodged in the



FIGS. 2–9.—(2) *Orthotylus adenocarpi* (Perris), eggs. (3) *O. virescens* (Douglas and Scott). (4) *O. virescens*, egg. (5) *O. concolor* (Kirschbaum), chorion rim of egg. (6) *O. concolor*, egg. (7) *Asciodema obsoletum* (Fieber), eggs (broken lines indicate cut tissues of leaf-base). (8) *Heterocordylus tibialis* (Hahn), chorion rim of eggs (*A*, side view; *B*, view from top). (9) *H. tibialis*, egg. (*C*, chorion rim of egg; *S*, scar in stem tissue (Scale line equals 0·25 mm.))

stem ridge. Most of the eggs of *O. concolor* are found in the lateral depressions below the ridges of young stems. Thus, the oviposition sites of the five species do not overlap to any serious extent and the species also differ in the time of their appearance (*see* fig. 1). Another point of general interest is in the gradual divergence in the lengths of the rostrum of the three species of *Orthotylus* (*see* Table I).

The larvae can be identified by a key (p.45) that includes other Heteroptera commonly found on broom, and the adults of *Orthotylus* species by one to be found in Southwood (1953). Descriptions of the eggs and larvae of *Anthocoris nemorum* L. can be seen in Sands (1957) and Hill (1957); those of *A. sarothamni* Douglas and Scott in Sands (*loc. cit.*), of *Orius minutus* (L.) in Fulmek (1930), and a key and descriptions of *Deraeocoris ruber* L. and *Heterotoma merioptera* Scopoli in Southwood and Scudder (1956).

TABLE I.—*Diagnostic measurements, in thousandths of a mm.*

(Rostrum length in brackets followed by the length of first, second, third and fourth antennal segments).

Larval instar	*Heterocordylus tibialis*	*Asciodema obsoletum*	*Orthotylus adenocarpi*	*Orthotylus virescens*	*Orthotylus concolor*
1st	(395) 115:175:170:245	(465) 70:120:120:185	(380) 80:150:165:225	(400) 105:175:210:240	(400) 70:130:160:185
2nd	(530) 140:265:235:255	(555) 80:165:165:215	(571) 90:235:190:250	(450) 130:260:290:270	(480) 120:200:235:230
3rd	(685) 190:365:300:275	(705) 125:245:245:250	(710) 140:330:250:190	(495) 160:350:360:295	(585) 140:305:320:260
4th	(865) 205:565:370:275	(965) 145:465:395:305	(945) 205:600:425:375	(610) 215:600:600:350	(755) 200:515:525:325
5th	(1050) 305:835:485:330	(1220) 215:690:600:380	(1195) 230:920:580:440	(775) 275:875:860:425	(985) 275:860:810:365

II. DESCRIPTION OF IMMATURE STAGES

1. Phylinae

Asciodema obsoletum (Fieber)

Egg (fig. 7)

Delicate, transparent, curved eggs, tapering slightly at base; rim of chorion narrow, more opalescent than chorion, but somewhat transparent, blending with surrounding plant tissues. Average length (10 eggs) 0·95 mm., greatest width 0·21 mm.

The eggs are not visible externally and in 40 out of the 55 oviposition sites examined, the eggs were laid in the superficial tissues of the leaf bases of the young shoots. In four instances they were found at the junction of two one-year-old branches. A few eggs have also been found in the leaf bases of the older stems. The grouping of the eggs was as follows: 42 were laid singly, 16 were in pairs, and there were three groups of three, one of four and two of five eggs.

Larvae

First instar: pale green, dorsum of thorax and appendages slightly darker; anterior margin of stink gland opening narrowly brown; rostrum reaching beyond posterior coxae; covered with long fine black hairs, the longer ones longer than the basal antennal segment is wide.

Second instar: as first, but with some shorter fine hairs intermixed with the longer ones (fig. 15).

Third and fourth instars: as second.

Fifth instar (fig. 12): as fourth, but with callosities and posterior margin of pronotum and whole of wing pad suffused with brown, the apices of the latter becoming darker just before the last ecdysis.

2. Orthotylinae

Orthotylus adenocarpi (Perris)

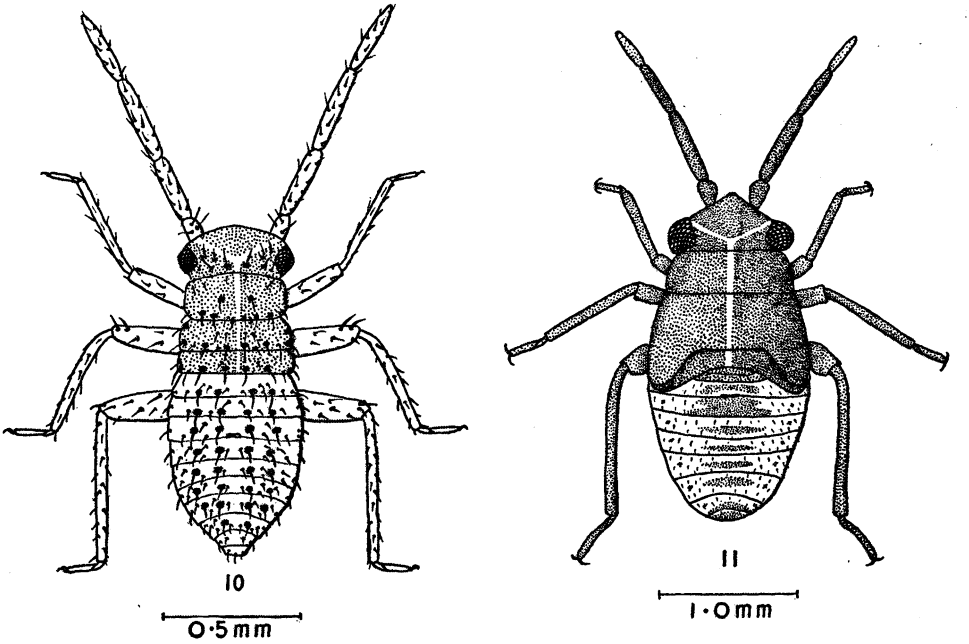
Egg (fig. 2)

Short, strongly curved, tapering gently at base and with a wide, slanting operculum; chorion transparent, cream, with light brown rim, blending with surrounding plant tissues. Average length (10 eggs) 0·84 mm., greatest width 0·21 mm.

In most instances the eggs were found in one- or two-year-old stems, the exposed rim of chorion in the stem ridge and the rest of the egg lying below the epidermis and outside the xylem cylinder and often penetrating into the flower buds. The

eggs were directed at right-angles or at an angle of 45° to the long axis of the stem. The scars left by the ovipositors are often conspicuous and the plant tissues around the eggs have a " bruised " appearance. On drying, the tissues sometimes form brown flaps which conceal the already inconspicuous brown chorion rims. In the older stems (two to four years) the eggs may be laid in the softer tissues of the lateral ridges of the five-sided broom stems. Twelve single eggs were found in these sites ; they were laid straight along the ridges with the opercula directed downwards. The eggs have also been found in one-year-old stems, where they formed dome-shaped swellings under the thin epidermis, through which only the opercula protruded.

Forty-one eggs were found laid singly, but three groups of two, one of three and one of four have also been seen.



FIGS. 10–11.—Larvae of: (10) *Orthotylus virescens* (Douglas and Scott), second instar; (11) *Heterocordylus tibialis* (Hahn), fourth instar.

Larvae

First instar : green with dorsum of head and thorax and appendages olive green ; margins of opening of stink gland brown ; rostrum reaching well beyond posterior coxae ; covered with long black hairs (fig. 16).

Second instar : as first, but with rostrum reaching just beyond posterior coxae ; covered with long black and a few short black hairs (fig. 14).

Third and fourth instars : as second.

Fifth instar : as fourth, but with the inner margins and apices of the wing pads becoming brown just before the final ecdysis.

Orthotylus virescens (Douglas and Scott)

Egg (figs. 3 and 4)

Short, curved eggs, narrow at operculum and widening towards base ; chorion shiny white, tough ; rim of chorion tending to be circular, chalk-white. Average length (10 eggs) 0·82 mm., width at base 0·22 mm. and that below operculum 0·16 mm.

The eggs are laid on the one- or two-year-old green shoots, generally in rows, in the incisions made by the ovipositor along the long axis of the stem. The rows

of chalk-white chorion rims are conspicuous under a lens, and just visible to the naked eye. The eggs penetrate the xylem cylinder.

The numbers in a group and the numbers of groups found in 1957 are given below :

Number eggs per group	1	2	3	4	5	6	7	8	9	12
Number groups found	13	38	56	59	41	26	14	5	2	2

Larvae

First instar : green with dorsum of head and thorax and appendages a dusky olive green, opening of stink gland dark brown ; rostrum reaching beyond hind coxae ; thickly covered with long black hairs—as long as the basal antennal segment is wide and arising from dark brown spots.

Second instar (fig. 10) : as first, but with long and short black hairs (fig. 13).

Third instar : as second, but rostrum just reaching hind coxae.

Fourth instar : as third, but rostrum reaching mid-coxae.

Fifth instar : as fourth, but apex and inner margin of wing pads becoming dark brown before the final ecdysis ; rostrum not quite touching mid-coxae.

Orthotylus concolor (Kirschbaum)

Egg (figs. 5 and 6)

Short curved eggs, slightly tapering at base, with a slanting, wide operculum ; chorion transparent, whitish ; rim of chorion white. Average length (10 eggs) 0·82 mm., greatest width 0·24 mm., and that of operculum 0·21 mm.

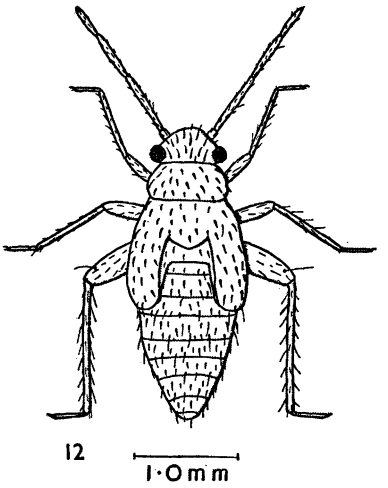


FIG. 12.—*Asciodema obsoletum* (Fieber), fifth instar larva.

Most of the eggs are laid in the two-year-old green stems, more rarely in the shoots which have grown in the current year. The sites of oviposition are mostly in the depressions below the lateral ridges of the five-sided broom stems. The eggs are laid singly, although several may be laid along one side of a stem at short distances from one another. Internally they penetrate the xylem cylinder, externally the elliptical white chorion rims are visible, even to the naked eye, but they are not as conspicuous as those of *O. virescens*.

Larvae

First instar : green with dorsum of head and thorax and appendages olive-green ; opening of stink gland brown ; rostrum reaching well beyond posterior coxae ; covered with long black hairs—but these not arising from black spots.

Second instar : as first, but with numerous shorter hairs present between the longer ones.

Third instar : as second, but olive-green of dorsum of head and thorax not as distinct from general coloration.

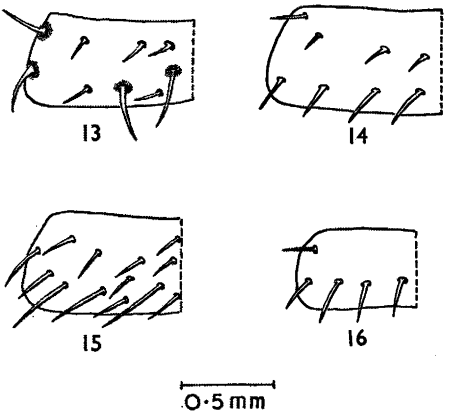
Fourth instar : as third, but now more thickly covered with long hairs as long as basal antennal segment is wide, and shorter black hairs, the former sometimes arising from very small light brown dots.

Fifth instar : as fourth, but apices only of wing pads becoming dark just before final ecdysis ; opening of stink gland light brown.

Heterocordylus tibialis (Hahn)

Egg (figs. 8 and 9)

Curved and asymmetrical, broadly rounded at base, whitish rim of chorion drawn out into 2 incurved processes ; chorion tough, transparent, creamy-white. Average length (10 eggs) 1·09 mm., greatest width 0·28 mm.



FIGS. 13–16.—Left-hand side, dorsal aspect, second thoracic segment to show chaetotaxy : (13) *Orthotylus virescens* (Douglas and Scott), second instar larva ; (14) *O. adenocarpi* (Perris), second instar larva ; (15) *A. obsoletum* (Fieber), second instar larva ; (16) *O. adenocarpi*, first instar larva.

The eggs are laid mostly in two to four-year-old green stems ; none have been found in the softer one-year-old shoots. The delicate and inconspicuous chorion rim projects above the stem epidermis, while the rest of the egg penetrates deeply into the xylem cylinder. The scars made by the ovipositor are small and inconspicuous. Most of the eggs are laid singly or in pairs and of the 78 examined, 22 were laid singly, 34 in pairs and the rest in groups of three or four in a common incision.

Larvae

First instar : bright red with head and dorsum of thorax, except for a Y-shaped central line, margins of coxal cavities, margins of stink gland opening, posterior of abdominal segment 10, all segment 11 and anal cone dark brown ; rostrum reaching well beyond posterior coxae ; sparsely covered with short and a few long black hairs.

Second instar : as first, but with a distinct white line under eye and on outer margins of thoracic segments ; coxae and pleurites banded with white ; trochanters white ; area of abdominal segments 2–9 with a brown median blotch, and segments 4–9 with a brown lateral dot also, rostrum only just reaching posterior coxae.

Third instar : as second, but with dark markings on dorsum now almost black ; white banding of coxae and pleurites more marked and apical segment of antennae slightly paler than the rest.

Fourth instar (fig. 11) : as third, but pleurites and ventral surface of head largely white and lighter parts of abdomen more greenish-red.

Fifth instar : as fourth.

III. Key to Larvae

The instar can be determined by reference to the degree of development of the thorax, as described by Southwood (1956*b*). The first and second instars are most conveniently separated in the green species by the presence of only one length of hair in the first instar, whereas in the second there are numerous additional shorter hairs. Determinations of the more important species should be checked by reference to the diagnostic measurements (Table I).

1 Green or green and brown 2
– In part or entirely red or black or entirely brown 5
2 Longest hairs arising from brown spots, less marked in first instar; in later instars rostrum short, not reaching third coxae **Orthotylus virescens** Douglas and Scott
– Longest hairs not arising from brown spots; rostrum reaching just or well beyond third coxae 3
3 Opening of stink gland not easily visible, with only anterior margin narrowly brown; pubescence of long fine hairs (fig. 15), all as long as basal antennal segment is wide, some much longer; claws of phyline type with hair-like arolia . . . . . **Asciodema obsoletum** Fieber
– Opening of stink gland easily visible, margins deep brown; pubescence of shorter hairs, much shorter than basal antennal segment is wide; claws of orthotyline type with convergent flap-like arolia 4
4 In second-fifth instars, third antennal segment distinctly shorter than second; in fifth instar, ratio of third : second less than 2 : 3 **Orthotylus adenocarpi** Perris
– In second-fourth instars, third antennal segment longer than second, in fifth only slightly shorter . . . . . **Orthotylus concolor** Kirschbaum
5 Three dorsal abdominal glands 6
– Less than 3 dorsal abdominal glands 8
6 More ovoid; yellow-brown or olive-brown . . . . . **Orius** spp.
– More elongate; yellow-brown or reddish 7
7 In third-fifth instars apices of wing-pads pale . . . **Anthocoris nemorum** L.
– In third-fifth instars apices of wing-pads deep reddish **Anthocoris sarothamni** Douglas and Scott
8 Two dorsal abdominal glands; in later instars, head with spinose projections; first and second antennal segments about equal to fourth **Dictyonota fuliginosa** Costa
– One dorsal abdominal gland: head without spinose projections; second antennal segment greater in length than both first and fourth 9
9 Body covered with clavate hairs (deep reddish-purple; last abdominal segment tubular) . . . . . **Deraeocoris ruber** L.
– Body not covered with clavate hairs 10
10 Elongate in form; antennae longer than total body, not thickened **Miris striatus** L.
— More oval in form; antennae not longer than total body, second segment thickened, especially in later instars 11
11 Antennae in part pale yellowish or whitish, second segment strongly thickened in third-fifth instars . . . . . **Heterotoma merioptera** Scopoli
— Antennae entirely dark red or brown-black; second segment only slightly thickened in fourth and fifth instars . . . **Heterocordylus tibialis** Hahn

IV. Acknowledgments

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