generally extracted faster with 150 W than with 50 W bulb (Table 1). All the dead mites except *Steganacarus striculus* were of large size and it is assumed that they behave slowly (WALLWORK, 1967). A quick rise of temperature is considered to cause them death.

In this study the efficiency of extraction was made certain by direct observations to search for the remaining animals in the soil sample after extraction. But there is a great possibility that oribatid mites such as immature, soft-bodied or small-sized species, may be overlooked as pointed out by NIJIMA (1967). Furthermore, there still remains the problem of efficiency in case of extraction from mineral soil samples. This apparatus cannot be used for extraction from sandy or clay soil.

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Fig. 3. The extraction—time curves to the cumulative numbers and histograms of extracted individuals.

REFERENCES

- NIJIMA, K. (1967) *Edaphologia* 1 : 10-16. (In Japanese).
 WALLWORK, J. A. (1967) In '*Soil Biology*', Academic Press, London and New York, pp. 363-395.

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Discrimination of Stadium and Sex of Nymphs in *Nephotettix cincticeps* (UHLER) (Hemiptera : Cicadellidae)¹

Simple and reliable discrimination of nymphal stadia and sexes in *Nephotettix cincticeps* (UHLER) has been necessitated by recent studies on phenology, diapause, behaviour, mechanisms causing aberrant sex-ratios, and effects of parasites on their hosts. In order to obtain virgin adults for cross-breeding experiments, Furthermore, reliable and rapid methods for separating the sexes of nymphs prior to the imaginal moult are required.

WEBER (1931) and LINDBERG (1939) showed in *Erythroneura comes* (Cicadellidae) and *Chloriona unicolor* (Delphacidae) respectively that the nymphal stadia are identified by the shape of the wing-pads. NASU (1961) mentioned that clear-cut distinc-

tion between the 1st and the 2nd instar can be made in *N. cincticeps*, by the over-all body size, but not by the shape of the wing-pads. The discrimination of sex of the final instars in Cicadellidae is shown not only in *N. cincticeps* (ESAKI and HASHIMOTO, 1934; MOCHIDA, 1963) but also in *Inazuma dorsalis* (ESAKI and HASHIMOTO, 1934), *Homalodisca coagulata*, *Oncometopia nigricans*, and *O. undata* (POLLARD, 1962). So far as is known, however, there is no paper on the discrimination of sex of the earlier instars in Cicadellidae.

The present paper deals with a study on the distinction of the nymphal stadium and sex. The linear measurements of relatively inflexible structures at each stadium could provide data to place specimens in their proper stadia when unknown.

MATERIALS

Leafhoppers in five preceding generations were maintained under a constant condition of 25°C

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and 16 hr daily illumination as a stock at the station. Twenty adult females and 10 males from the stock were kept together in each ca. 11 cm × 12 cm × 18 cm glass-vessel with rice seedlings for several days. After some eggs were laid, they were taken away from the vessel. The nymphs reared together in vessels under constant conditions were used as the specimens for measurements and drawings in the present investigation. As the membranous parts at the suture between the sclerites of dried specimens are usually shrunk, and sometimes the three notums of the thoracic part look more or less overlapped in appearance, the specimens for measurements were not dried but living nymphs etherized or killed in 70 % ethanol.

Nymphs collected in the field were compared for morphological features with those kept under

the constant conditions as mentioned above.

FEATURES OF EACH NYMPHAL INSTAR

The dorsal view of nymphs in the 5 stadia is given in Fig. 1.

1st instar: The rudimentary anterior and posterior wing-pads do not yet appear on the notums. The metanotum is the longest on the mesal line, but the mesonotum is the shortest (cf. Table 1).

2nd instar: The rudimentary anterior wing-pads slightly appear on the mesonotum. However, the rudimentary posterior ones do not emerge on the metanotum yet; the posterior margin of the metanotum is not curved but approximately linear. The three notums of the 2nd instar are slightly different from the corresponding ones of the 1st instar in form. However, it is rather difficult to distinguish the 1st instar from the 2nd by the forms of notums.

3rd-4th instars: The anterior wing-pads are conspicuously visible in the 3rd and the following instars (Fig. 1). They grow larger in size and are transformed in shape in proportion to the increase of nymphal stadia. The posterior margin of the metanotum in the 3rd instar is slightly curved at the middle; the posterior wing-pads are rudimentarily recognizable. The posterior wing-pads in the 4th and 5th instars are much more developed. Female nymphs in each stadium are slightly larger than male (cf. Table 2). However, the dorsal views of the body of both sexes are similar.

IDENTIFICATION OF THE NYMPHAL STADIA

The relative ratios for the mean lengths

Fig. 1. Dorsal view of the 1st to 5th instars.

Table 1. LENGTHS OF THE NOTUMS ON THE MESAL LINE IN THE 1ST AND 2ND INSTARS AT 25°C AND 16 HR DAILY ILLUMINATION

	1st instar			2nd instar		
	pronotum	mesonotum	metanotum	pronotum	mesonotum	metanotum
Mean $\pm$ s. d. (μ)	113 $\pm$ 11	77 $\pm$ 8	159 $\pm$ 12	160 $\pm$ 12	131 $\pm$ 13	216 $\pm$ 14
C.V. (%)	9.9	11.0	7.6	7.4	9.7	6.7
Relative length of each notum for the mean of mesonotum	1.47	1.00	2.07	1.22	1.00	1.64
Approximate ratio of integers	3	:	2	:	4	6 : 5 : 8

Twenty specimens were used for each measurement.

Table 2. SIZE^a OF THE HEAD, THORAX, AND LEG OF NYMPHS REARED AT 25°C AND 16 Hr DAILY ILLUMINATION

Instar	Sex	Vertex			Thorax			Hind femur		
		Length ^b		Width ^b	Length ^c		range (μ)	Length ^d		range (μ)
		mean $\pm$ s.d. (μ)	C.V. (%)		mean $\pm$ s.d. (μ)	C.V. (%)		mean $\pm$ s.d. (μ)	C.V. (%)	
1st	♂ ♀ together	256 $\pm$ 13	5.2	226-278	384 $\pm$ 12	3.2	357-401	348 $\pm$ 20	5.7	299-375
2nd	♂ ♀ together	314 $\pm$ 19	6.2	259-350	497 $\pm$ 17	3.4	473-523	507 $\pm$ 27	5.3	463-550
3rd	♂ ♀	333 $\pm$ 19 348 $\pm$ 18	5.7 5.1	304-368 313-380	617 $\pm$ 22 648 $\pm$ 24	3.6 3.7	577-672 598-691	648 $\pm$ 27 692 $\pm$ 22	4.2 3.1	596-695 651-747
4th	♂ ♀	373 $\pm$ 16 413 $\pm$ 21	4.3 5.1	348-403 373-445	797 $\pm$ 23 871 $\pm$ 24	2.8 2.8	770-849 840-908	901 $\pm$ 30 986 $\pm$ 45	3.3 4.5	850-968 917-1064
5th	♂ ♀	419 $\pm$ 22 466 $\pm$ 23	5.2 4.9	364-455 437-499	1032 $\pm$ 22 1171 $\pm$ 37	2.2 3.1	997-1068 1102-1225	1236 $\pm$ 29 1388 $\pm$ 56	2.4 4.0	1197-1292 1277-1505

^a Twenty specimens were used for each measurement.^b Including both the compound eyes.^c The whole length of the pro-, meso-, and metanotums on the mesal line.^d Excluding the spines.

of pro-, meso-, and metanotum at the mesal line are approximately 3 : 2 : 4 in the 1st instar and 6 : 5 : 8 in the 2nd instar (Table 1). The 3rd to 5th instars in both sexes can be easily distinguished from one another by the shapes of the anterior and posterior wing-pads (Fig. 1).

Table 2 shows some morphological features for identifying the nymphal stadia.

DISCRIMINATION OF SEX

Any morphological difference in the 1st and the 2nd instar could not be found between both sexes. On the other hand, clear-cut distinctions in the 3rd to 5th instars are observed in the structure corresponding to the plates of the genital capsule of adult males or the ovipositor of females (Fig. 2). Moreover, as mentioned previously, female nymphs in each stadium are larger than male (Table 2 and Fig. 2).

3rd instar : In the male a short center line is visible at the caudal part of the final or 9th venter but does not reach the basal margin of the venter. In the female a pair of rudimentary saw-cases (3rd valvulae) are visible at the basal margin of the final venter, and a light line is longitudinally visible through the central part of the final venter or a pair of rudimentary 2nd valvulae.

4th instar : In the male 3rd instar features remain basically through the 4th stadium. In the female a pair of rudimentary saw-cases grow larger, but a pair of the rudimentary 2nd valvulae are partly visible.

5th instar : In the male 4th instar features remain basically through the 5th stadium. In the female a pair of rudimentary saw-cases grow so long that a pair of the rudimentary 2nd valvulae are invisible under cover of the saw-cases. However, the anterior tip of a pair of rudimentary saw-cases does not reach the terminal end of the pygofer in length.

FEATURES OF NYMPHS PARASITIZED BY PIPUNCULIDAE (DIPTERA)

The specimens collected in the field were compared with those reared under the constant conditions. It is assured that the features for determining the nymphal stadia and sexes of the latter can be applied to the former; even nymphs parasitized by larvae in Pipunculidae sp. (probably *Alloneura oryzaetora* (KOIZUMI)).

Fig. 2. Ventral view of the terminal two abdominal segments of the 1st to 5th instars.

REFERENCES

ESAKI, T. and S. HASHIMOTO (1934) Report on the leafhoppers injurious to the rice plant and their

Kyushu National Agricultural Experiment Station, Izumi, Chikugo-City, Fukuoka-Pref., Japan

Received October 21, 1969

natural enemies. No. 5. *Ent. lab., Dept. Agric., Kyushu Imp. Univ., Fukuoka* 40 pp. + 3 pls. (In Japanese).

LINDBERG, H. (1939) *Acta Zool. Fenn.* **22** : 5-179.

MOCHIDA, O. (1963) *Delphax* No. 6 : 4. (In Japanese).

NASU, S. (1961) *Ibid.* No. 3 : 6. (In Japanese).

POLLARD, H. N. (1962) *Ann. ent. Soc. Amer.* **55** : 141.

WEBER, H. (1931) *Biologie der Tiere Deutschlands unter Mitwirkung zahlreicher Fachleute bearbeitet und herausgegeben von Dr. P. SCHULZE.*, **34** : 71-208.

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A Device for Collecting Planthopper and Leafhopper Eggs (Hemiptera : Delphacidae and Deltocephalidae)¹

The capacity to lay eggs on artificial media is a prerequisite for successive rearing of insects on synthetic diets. It is well known that some lepidopterous insects can lay their eggs on paper. However, in the case of planthoppers and leafhoppers it seems almost hopeless to expect any oviposition on paper, although *Macrostelus fascifrons* STÅL has been reported to lay eggs on the surface of the host plant or on the surface of glass occasionally (MITSUHASHI and MARAMOROSCH, 1963). Artificial rearing of hemipterous insects has been attempted for more than 30 years, but little effort has been made to obtain eggs on artificial media. The only report available on this is the oviposition of a froghopper, *Aeneolamia varia saccharina* (DISTANT) on an artificial medium (HAGLEY, 1967).

In the present report, a method to let planthoppers and leafhoppers lay their eggs on artificial media is described. The experiments were carried out mainly with the red-eye strain of the smaller brown planthopper, *Laodelphax striatellus* FALLÉN, which had been maintained for years in this

Fig. 1. Schematic representation of an oviposition cage. The insect cage is fixed to the medium container by means of Scotch tape. The upper part : insect cage; the lower part : medium container; A : screen mesh; B : a hole for introducing insects with a cotton plug; C : a side arm; D : stretched Parafilm M; E : medium.

¹ Appl. Ent. Zool. **5**(1) : 47-49 (1970)