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IMMATURE STAGES OF *PYRRHALTA HUMERALIS* (CHEN) AND *GALERUCA VICINA* SOLSKY FROM JAPAN (COLEOPTERA, CHRYSOMELIDAE)

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Abstract

The egg, larva and pupa of *Pyrrhalta humeralis* (Chen) and larva and pupa of *Galeruca vicina* Solsky are described and illustrated. Morphological change in the course of larval growth and some biological notes are also given.

Pyrrhalta humeralis (Chen) and *Galeruca vicina* Solsky are common Japanese leaf beetles associated with *Viburnum odoratissimum* Ker. and *Petasites japonicus* Maxim., respectively. Ecological and morphological notes of immature stages of F! *humeralis* have been described several times (Nakanisi, 1962 ; Takenaka, 1963) because this species is an important pest, but those of G. *vicina* have not previously been described.

In the present paper, I am going to describe the chaetotaxy, tubercles and make some biological notes on immature stages of these two species belonging to non-glanduliferous group of Japanese Galerucinae.

The terminology of setae used in this study is the same as that used by Anderson (1947) which was intended for larval Curculionidae and could be adapted readily for chrysomelid larvae (LaSage, 1982). The terminology of tubercles follows essentially to Kimoto (1962) as described in the preceding paper (Lee, submitted for publication). Abbreviations L, S and M standing for long, short setae and microsensilla, respectively. The descriptions of larvae are primarily made on the last instar larva, and then those of earlier instars are given in comparison with the last instar.

Before going further, I wish to express my deep gratitude to Prof. K. Yano (Yamaguchi Univ.) for his continuous guidance and encouragement throughout the course of this study. Sincere thanks are due to Prof. K. Morimoto (Kyushu Univ.), Prof. S. Kimoto (Kurume Univ.), Dr. H. Takizawa (Japan Tobacco Inc.) and Mr. S. Hamasaki, for their valuable suggestion and information.

Pyrrhalta humeralis (Chen)

(Figs. 1-4)

Egg. Length 0.49-0.53 mm (M=0.51, n-30) ; width 0.36-0.40 mm (M=0.38), ovoid, chorion with penta-hexagonal microsculpture.

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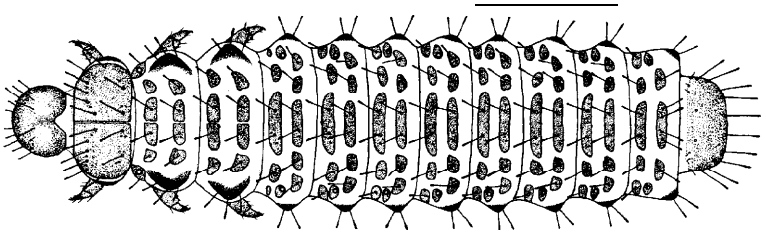

Fig. 1. *Pyrrhalta humeralis* **(Chen),** last instar larva. Scale : 2.0 mm.

Last instar larva. Body length 10.5 mm, yellowish brown with setae creamy yellow, short and club-shaped setae on dorsal side ; subparallel-sided ; head, prothoracic shield and tubercles dark brown ; legs reddish brown with orange yellow at inner side. Granular tubercles large and sparse.

Head. Width 0.82 mm ; longer than wide, round, strongly sclerotized, hind corners of epicranium moderately produced posteriorly. Epicranial suture Y-shaped ; coronal suture about one-fourth of head capsule ; frontal suture distinct. One pair of stemmata well-developed behind antennae ; with 3 pairs of setae. Epicranium with 4 pairs of posterior epicranial sensilla ; 3 pairs of dorsal epicranial setae. Frons with 3 pairs of frontal setae and a pair of sensilla ; anterior margin of frons strongly sclerotized ; frons completely divided by endocarina. Clypeus slightly sclerotized posteriorly, with 3 pairs of clypeal setae and a pair of clypeal sensilla. Labrum oblong-oval antero-laterally, concolorous with the clypeus, middle of anterior margin moderately notched and anterior comers strongly arcuate. Epipharynx with 6 pairs of epipharyngeal spiniform setae ; 4 pairs of epipharyngeal sensilla arranged in single cluster. Antenna l-segmented ; with a subconical sensory papilla, 8 sensilla basiconica and 2 sensilla at apical disc. Mandible bright brown anteriorly, dark brown posteriorly with 5 distal teeth, the fourth nearly fused with fifth ; 2 mandibular setae and a sensillum located on dorsal surface ; penicillus well-developed, with 10-12 setae generally, pectinate shape. Maxilla with a small cardo ; a large rectangular stipes, with 3 setae and a sensillum ; maxillary palpus 4-segmented, segment 1 with 3 setae, segment 2 with a sensillum, segment 3 with 2 setae, segment 4 with a seta and a sensillum. Lacinia distally pectinate, carrying a row of about 9 setae in same length. Galea armed with 8 spine-like setae. Labium with prementum and postmenturn separated by a narrowing sclerotized membrane ; prementum with 9 pairs of spine-like setae, 3 pairs of setae and a pair of sensilla located at apex and at middle ; postmentum with 3 pairs of setae. Labial palpus with 2-segmented, segment 1 with a sensillum, segment 2 with a sensillum.

Thorax. Prothorax with a narrow longitudinal line on dorsum ; dorsal side with a tubercle D-DL(8L, 3S, 4M) ; epipleural region with a tubercle EP(3L) ; pleural region with a tubercle P(2S) : sternal region with two tubercles ES-SS(2S) anteriorly and ES-SS(2S) posteriorly. Mesothorax with a longitudinal line on dorsum; dorsal side with five tubercles Da(1L, 1M), DLai(1S), Dp(1L, 1M), DLpi(1L, 3M) and DLe(3L, 1M) ; epipleural region with two tubercles EPa(1L) and EPp(1L) ; pleural region with a tubercle P(2S) ; sternal region with two secondary tubercles asl(lS) anteriorly, asl(1S) posteriorly ; ES with two short setae. Metathorax with the chaetotaxy as in mesothorax. Thoracic spiracles annuliform, located on EPa.

Fore leg with coxa having anterior and posterior plates, each with a seta ; trochanter with 11 setae ; femur with 9 setae ; tibia as long as femur, with 5 setae ; claw falciform, with pointed tip, enlarged basally with a seta, pulvillus whitish, bladder-like, as long as claw. Mid-and hind legs similar to fore leg.

Abdomen. First abdominal segment with five tubercles Da(lL, 1M), DLa(1L), Dp(1L, 1M),

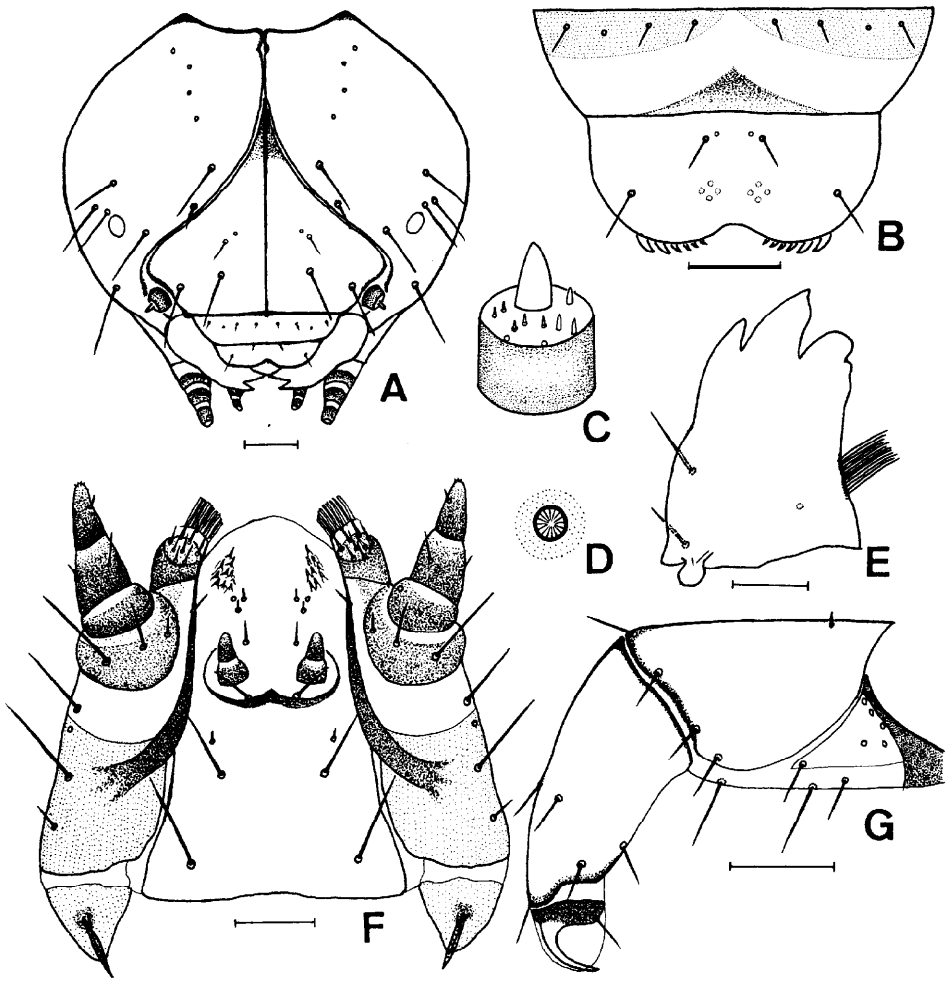

Fig. 2. *Pyrrhalta humeralis*, last instar larva. A, head ; B, clypeus and labrum ; C, antenna ; D, spiracle ; E, mandible ; F, lower mouth parts ; G, fore leg. Scale : 0.1 mm.

DLpi(lL, 1S,1M) and DLpe(1L) on dorsal side ; epipleural region with three tubercles EPai(O), EPi(0) and EP(2L); pleural region with a tubercle P(1L,1S,1M); sternal region with three tubercles ES(2S), PS-SS(2S) and a secondary tubercle SS(1S). Second to 7th abdominal segments essentially similar to 1st abdominal segment except for EPai(lL). Eighth abdominal segment essentially similar to 2nd abdominal segment except for Dp(2L, 2M) and DLp(1L,1S.1M). Ninth abdominal segment with a large tubercle D-DL-EP(5L,4S,1M) and ES-SS(2S,1M). Tenth abdominal segment with 4 short setae and 3 sensilla. Spiracles on segments l-8 similar to prothoracic spiracle but smaller.

First **instar** larva. Similar to the last instar larva except for the following characters.

Body length 1.8 mm ; creamy yellow with head dark brown, shiny ; prothoracic shield, spiracle and tubercles brown; legs yellowish brown with yellowish inner side. Egg-bursters absent.

Head. Width 0.30 mm ; coronal suture one-sixth length of head capsule ; clypeus 0.15 mm in length ; labrum, 0.11 mm in length ; epipharynx with 5 pairs of submarginal setae ; mandible, 0.08

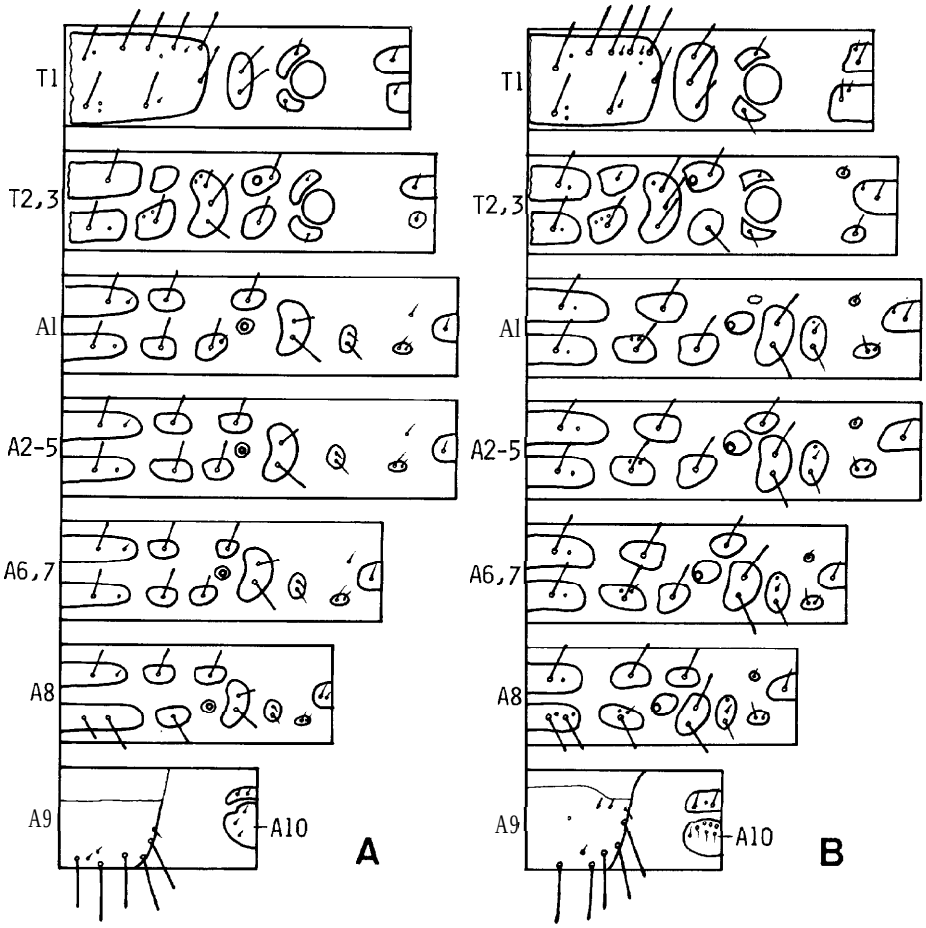

Fig. 3. Chaetotaxy of *Pyrrhalta humeralis*. A, 1st instar larva ; B, last instar larva.

mm in basal length ; antenna, *0.016* mm in diameter.

Thorax. Prothorax with five tubercles D-DL(8L, 2S, 4M), EP(2L), P(2S), ES-SS(lS) anteriorly and ES-SS(1.S) posteriorly. Mesothorax with five tubercles Da(1L), DLai(O), Dp(1L, 1M), DLpi(lL, 2M) and DLe(2L, 1S, 2M) on dorsal side ; epipleural region with two tubercles EPa(1L) and EPp(1L) ; pleural region with a tubercle P(2S) ; sternal region with two tubercles ES(1S) anteriorly, ES(1S) posteriorly. Metathorax with the chaetotaxy as in mesothorax.

Abdomen. First abdominal segment with Da(lL, 1S), DLai(lL), DP(1L, 1M), DLpi(lL) and DLp(1L, 1S) ; EPai(lL), EPi(0) and EP(2L) ; P(1L, 1S) ; ES(1S), PS-SS(2S) and a primary seta on SS region. Second to 7th abdominal segments with DLp(1L). Eighth abdominal segment with Da(lL, 1S), DLai(1L), Dp(2L) and DLp(1L) ; EPai(lL), EPi(0) and EP(2L) ; P(2S) ; PS-SS(2S) ; ES(2S). Ninth abdominal segment with D-DL-EP(5L, 3S) and ES-SS(2S). Tenth abdominal segment with 3 short setae.

Pupa. Body length 5.9 mm, yellowish brown.

Head. Width 1.4 mm ; slightly longer than wide, strongly deflexed and directed backwards, not visible from above ; 3 pairs of setae on head.

Table 1. Changes of characters in larval instars of *Pyrrhalta humeralis.*

Character (Instar)	No. setae and others 1st	last
spiniform setae on epipharynx	5	*6*
mandibular dents on the 2nd tooth	5	*0*
setae on T2, 3 (Dae)	0	1S
tubercles on T2-A8 (SS part)		2
setae on Al (Dlae)	1s	0
(DLpe)	1L-1S	1L
setae on Al-8 (Dlpi)	1L	1L-1S-1M
(P)	2s	2S-1M
setae on A8 (DLpi)	2L	2L-2M
(DLpe)	1L	1L-1S-1M
setae on anal plate	5L-3S	5L-4S-1M
setae on A10	3s	4S-3M

L : long setae, S : short setae, M : microsensilla

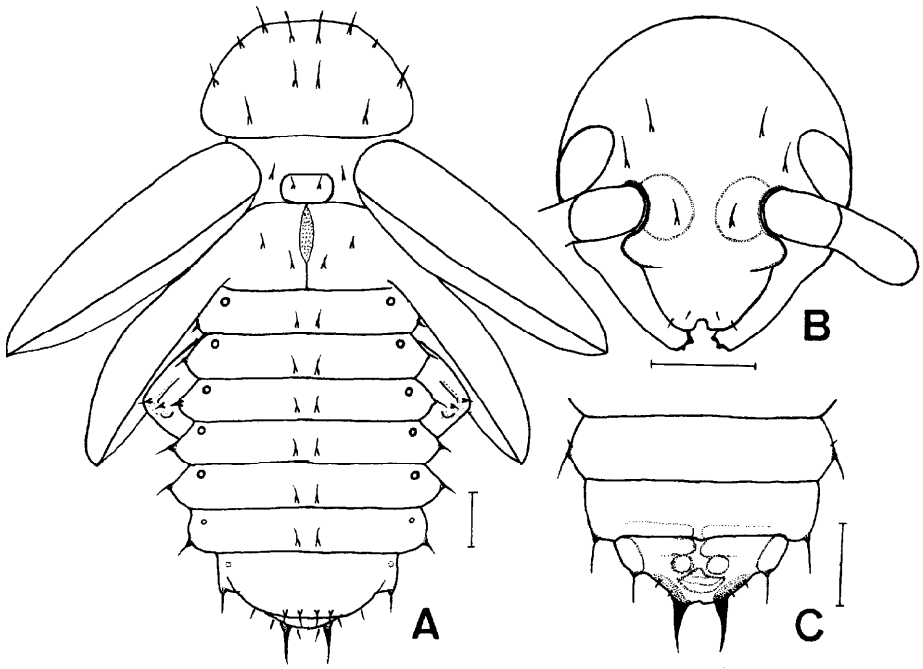

Fig. 4. *Pyrrhalta humeralis,* pupa. A, dorsal view ; B, head, dorsal view ; *C,* abdominal segments *7-9,* ventral view. Scale : *0.5* m m

Thorax. Pronotum with *6* pairs of setae, weakly sinuated laterally. Mesonotum with 2 pairs of setae ; pterothecae bare and moderately outstretched, extending to second abdominal segment ; scutellum rectangular. Metanotum with 2 pairs of setae; pterothecae slightly outstretched and extending to fourth abdominal segment. Podothecae bare, posterior pair partly visible in dorsal view at level of fourth abdominal segment.

Abdomen. Abdominal segments 1-6 with a pair of setae on dorsal region and a seta on epipleural region ; segment 7 slightly larger than previous ones, deflexed, with 3 pairs of setae; segment 8

somewhat small, with 3 pairs of setae ; segment 9 small, with 2 pairs of minute setae, which located at the base of cerci ; cerci completely black, with outer margin slightly sinuous and tips sharp and slender. Spiracles on abdominal segments l-5 conspicuous and black ; spiracles 6 and 7 inconspicuous, rather small and yellowish.

Material examined. Yamaguchi Pref. : Hirakawa, 30. III. 1986, larvae collected and reared on leaves of ***Viburnum odorutissimum*** Ker.

Notes. Immature stages of *P. humeralis* used in this study were collected in Yamaguchi City and reared on ***Viburnum odoratissimum*** Ker. in the laboratory. This species has a single generation per year, overwinters in the egg stage, and hatches in late March. The larvae are gregarious on the top of the stem and take twenty to thirty days to become full grown. The larvae spend three instars. Pupation takes place in the ground. The emergence of adults starts in mid-May and lasts until mid-June. The oviposition period starts in late September and lasts until the end of October. The eggs are laid in egg-mass in the shoot of host plant. The larvae of this species is easily distinguished from genus *Galerucella* by the shape of head capsule and creamy yellow club-shape setae. Frontal setae and stipes are also similar to the species of other genus, G. *nipponensis* and G. *grisescens*. This species also resembles to G. *grisescens* in the arrangement and mumber of tubercles as secondary tubercles appearing **on** sternal region.

The larval characters of *P. humeralis* change in the course of growth (Table 1). Secondary setae and tubercles generally increase in number from first to third instars.

The pupae are characteristically furnished with two posterior cerci, which are slender and well sclerotized.

Galeruca vicina Solsky

(Figs. 5-8)

Last instar larva. Body length 13.5 mm, long and thickened, black on dorsal side, brown on ventral side ; subcylindrical and subparallel-sided ; head and tubercles black ; legs black, inner sides dark brown ; tubercles conically elevated and sparse ; setae yellowish brown, more or less long and numerous.

Head. Width 1.5 mm ; wider than long, hind corners of epicranium slightly produced posteriorly, slightly retractile into prothorax. Epicranial suture distinct, Y-shaped ; coronal suture one-fourth length of head capsule ; frontal suture nearly straight. One pair of stemmata well-developed behind antennae ; 4 pairs of stemmatal setae present, well-developed. Epicranium with 5 pairs of epicranial sensilla ; 3 pairs of dorsal epicranial setae. Frons with 5 pairs of frontal setae ; frons divided by

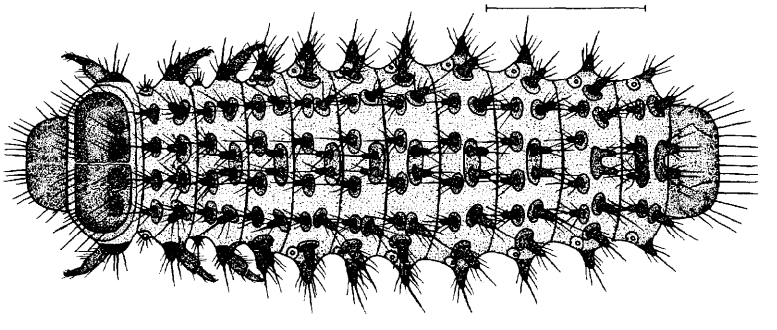

Fig. 5. *Galeruca **vicina*** Solsky, last instar larva. Scale : 3.0 mm.

endocarina which is indistinct anteriorly. Clypeus with 4 pairs of setae. Labrum oblong-oval, middle of anterior margin weakly notched a anterior corners strongly arcuate. Epipharynx with 4 pairs of submarginal epipharyngeal spiniform setae. Antenna l-segmented, with conical sensory papilla, 6 sensilla basiconica and 4 sensilla at apical disc. Mandible reddish brown anteriorly, black posteriorly with five distal teeth, third longest, the fourth slightly fused with fifth, the second to fouth serrated on inner margin ; two mandibular setae and a sensillum located on dorsal surface ; without penicillus. Maxilla with small cardo ; large rectangular stipes, with 3 setae ; maxillary palpus 4-segmented, segment 1 with 3 setae, segment 2 without seta, segment 3 with 2 setae, segment 4 with a seta. Lacinia distally pectinated, carrying a row of 7 setae in same length. Galea armed with 9 spine-like setae. Labium with prementum and postmentum separated by narrowly sclerotized membrane ; prementum with 3 pairs of setae and a pair of sensilla. Labial palpus 2-segmented, segment 1 without seta, segment 2 without seta ; postmentum densely covered with spinules, 6 pairs of setae.

Thorax. Prothorax with a narrow longitudinal line on dorsum ; dorsal side with a large tubercle D-DL(21L) ; epipleural region with a tubercle EP(9L) ; pleural region with a tubercle P(14S) ; sternal

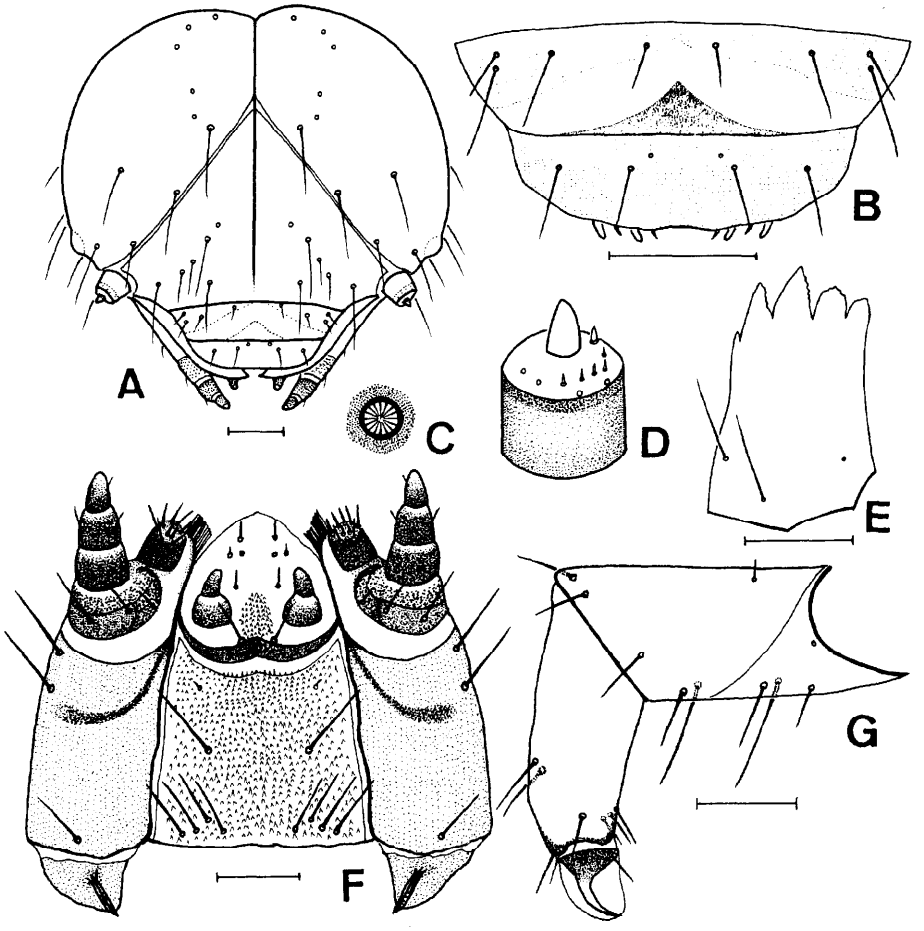

Fig. 6. *Galeruca vicina*, last instar larva. A, head ; B, clypeus and labrum ; C, spiracle ; D, antenna ; E, mandible ; F, lower mouth parts ; G, fore leg. Scale : 0.2 mm.

region with a tubercle ES-SS(1L, 4S). Mesothorax with a longitudinal line on dorsum ; tubercles consist of two rows on dorsal side, first row consists of Da(5L) and DLa(3L, 2S), second row consists of Dp(5L) and DLp(8L), the former slightly elevated and the latter conically elevated ; epipleural region with a two tubercles EPa(5S) and EPp(11L), EPp rather large and convex ; pleural region with a tubercle P(14S) ; sternal region with a two primary tubercles ES(1L, 8S), SS(1S) and a secondary tubercle as1(1S). Metathorax with the chaetotaxy as in mesothorax. Thoracic spiracles annuliform, located on EPa.

Fore leg with coxa having anterior(7S) and posterior plates(7S) ; trochanter with 8 setae ; femur with 9 setae and a sensillum ; tibia about as long as femur, with 8 setae ; claw falciform, with pointed tip, enlarged basally with a seta, pulvillus brownish, more or less hardened, bladder-like, as long as claw. Mid and hind legs similar to fore leg.

Abdomen. First to 6th segments with five tubercles Da(5L), DLa(4L, 1S), Dpi(3L), DLpi(5L) and DLpe(6L) on dorsal side, Da and DLa slightly elevated, Dpi, DLpi and DLpe conically elevated ; epipleural region with two tubercles EPai(0) and EP(6L), EP large and conically elevated ; pleural region with a tubercle P(1L, 5S), conically elevated ; sternal region with three primary tubercles PS-SS(4S), SS(1S), ES(4L) and a secondary tubercle as(1S). Seventh and 8th segments essentially similar to 1st segment except for following characters: Dpi(4L), PS-SS(2S) and ES(3L) on 7th segment, Dai(4L), Dpi(4L, ZS), DLp(6L, 1S) and ES(1L) on 8th segment. Ninth segment with a large tubercle D-DL-EP(12L, 1M) and ES-SS(5S). Tenth segment with 8 short setae. Spiracles on segments l-8 similar to prothoracic spiracles but smaller.

Second instar larva. Similar to the last instar larva except for following characters.

Body length 7.7 mm ; head and dorsal side blackish ; labrum unicolored ; ventral side brownish gray ; setae brownish.

Head. Width 1.1 mm ; coronal suture one-sixth length of head capsule ; clypeus 0.54 mm in length, with 2 pairs of clypeal setae and a pair of clypeal sensilla ; labrum 0.36 mm in length ; antenna 0.06 mm in diameter, bearing a sensilla basiconicum and 7 sensilla ; mandible 0.26 mm in basal length.

Thorax. Prothorax with four tubercles D-DL(26L, 2S), EP(8L, 1S), P(14S) and ES-SS(7S). Mesothorax with 11 tubercles Da(lL, 4S), DLa(lL, 2S), Dp(1L, 4S) and DLp(1L, 4S) on dorsal side ; epipleural region with two tubercles EPa(5S) and EPp(11L) ; pleural region with a tubercle P(14S) ; sternal region with two primary tubercles ES(10S), SS(1S) and a secondary tubercle as1(1S).

Abdomen. First to 6th abdominal segments with Da(2L, 2S), DLa(1L, 2S), Dpi(3L), DLpi(lL, 4S) and DLpe(lL, 6S) ; EPai(0) and EP(2L, 5S) ; P(1L, 5S) ; PS-SS(1L, 4S), SS(1S), ES(3L) and a secondary tubercle as1(1S). Seventh and 8th abdominal segments similar to 1st abdominal segment except for following characters; Dpi(4L), DLpe(2L, 3S) and ES(1L, 1S) on 7th abdominal segment, Dai(2L, 2S), DLa(lL, 3S), Dpi(4L), DLp(1L, 5S), P(7S), PS-SS(2S) and ES(1L) on 8th abdominal segment. Ninth abdominal segment with D-DL-EP(5L, 6S, 1M) and ES-SS(6S). Tenth segment with 11 short setae.

Pupa. Body length 9.2 mm, dark brown.

Head. Width 2.1 mm ; slightly longer than wide, strongly deflexed backwards, not visible from above; with five pairs of setae.

Thorax. Pronotum with 12 pairs of setae, weakly sinuated laterally. Mesonotum with 3 pairs of setae ; pterothecae bare and extending to third abdominal segment ; scutellum somewhat large and rounded. Metanotum transverse, with 2 pairs of setae ; podothecae bare, posterior pair partly visible in dorsal view at level of fourth abdominal segment.

Abdomen. Abdominal segments 1-6, subequal in size, with 7 pairs of setae (2 pairs of them very short), conically elevated on dorso-lateral and epipleural region ; abdominal segment 7 more or less triangular shape, with 6 pairs of setae ; abdominal segment 8 and 9 with 4 pairs of setae, respectively.

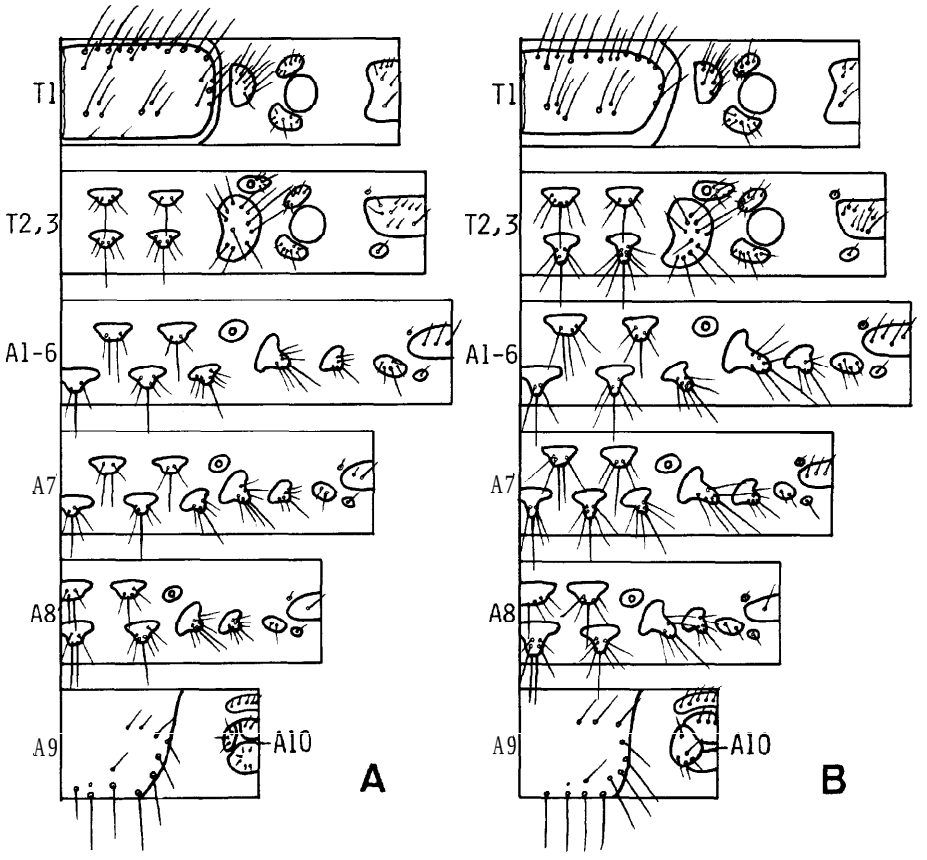

Fig. 7. Chaetotaxy of *Galeruca vicina.* A, 2nd instar larva ; B, last instar larva.

Table 2. Changes of characters in larval instars of *Galeruca vicina.*

Character (Instar)	No. setae and others 2nd	last
sensilla on antenna	1B-7M	6B-4M
setae on pronotum	26L-2S	21L
tubercles on T2-A8		2
setae on Al-6 (Da)	2L-2S	5L
(DLa)	1L-2S	4L-1S
(ES)	3L	4L
setae on A7 (Dpi)	4L	4L-2S
(ES)	1L-1S	3L
setae on A8 (Dpi)	2L-2S	4L-2S
setae on A10	11s	8S

B : sensilla basiconica, L : long setae, S : short setae, M : microsensilla

Spiracles on abdominal segments 7 and 8 inconspicuous, rather small and dark brown.

Material examined. Hokkaido : Nukabira, 29. VI. 1986, larvae collected and reared on leaves of ***Petusites*** *japonicus* Maxim.

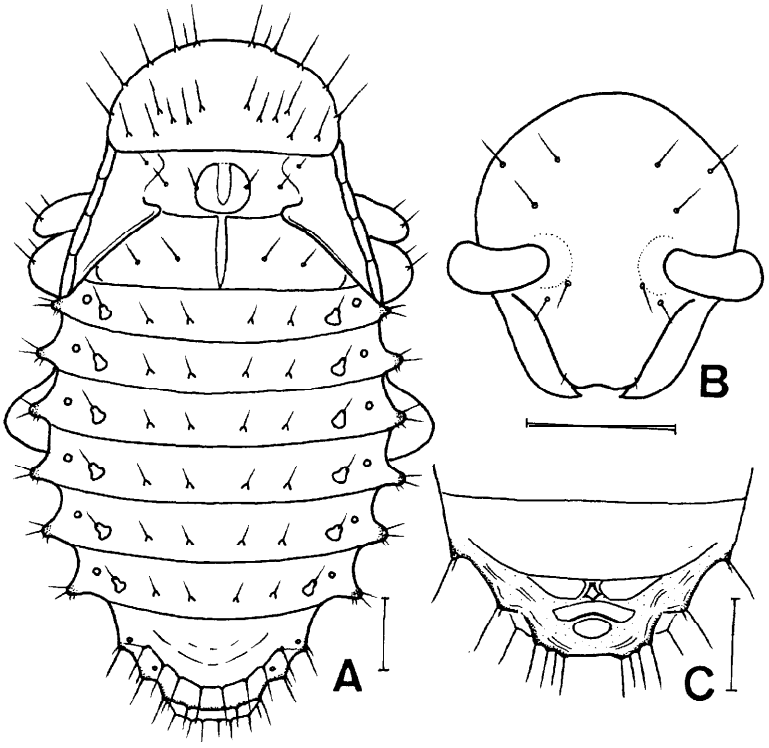

Fig. 8. *Galeruca vicina*, pupa. A, dorsal view ; B, head, dorsal view ; C, abdominal segments 7-9, ventral view. Scale : 1.0 mm.

Notes. This species apparently has a single generation per year. The larvae are gregarious on the leaves. Pupation takes place in the ground. The larvae of this species is easily distinguished from the known Galerucine species in general appearance. Body is large and long, with five pairs of frontal setae ; without penicillus on mandible ; postmenturn with six pairs of setae and densely covered with spicules ; tubercles sclerotized and conically elevated.

The larval characters of G. *vicina* change in course of the growth (Table 2). Setae and cone-shaped tubercles increase in relative length in the course of the larval growth. Secondary setae and tubercles generally increase in number during the development of larval instars but some characters, microsensilla of antenna, setae on pronotum and 10th abdominal segment, decrease in later instars.

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