

Immature Stages of *Nephrotoma virgata* (Diptera, Tipulidae) from Korea

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한국산 황각다귀(파리목, 각다귀과)의 미성숙 단계의 형태

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ABSTRACT : The immature stages of *Nephrotoma virgata* Coquillett (Diptera, Tipulidae) are described. Detailed illustrations of the immature stages are provided. It is the first to deal the immature stages of the genus *Nephrotoma* in Korea.

KEY WORDS : *Nephrotoma virgata*, Immature stages, Descriptions, Crane-fly, Tipulidae

초 록 : 한국산 황각다귀(*Nephrotoma virgata* Coquillett)의 알, 유충, 번데기 단계에 대한 분류학적 연구를 수행하였으며, 각 단계별로 형태를 스케치하고 특징을 기재하였다. *Nephrotoma*속의 미성숙 단계는 한국에서 처음 기재된다.

검색어 : 파리목, 각다귀과, 황각다귀, *Nephrotoma virgata*, 미성숙단계

The genus *Nephrotoma* Meigen, 1803, includes 125 species, which shows a great uniformity of size and color except the considerable diversity in the structure of the male antennae (Alexander, 1919). In many instances the species of *Nephrotoma* run close to those of *Tipula*, and the two genera are very close together in the superficial appearance. The species of *Nephrotoma* have brilliantly colored body with red, yellow, orange, or black, while the colors of *Tipula* are brown, grey, and yellow. The known species of *Nephrotoma* live in moist soil or in decaying wood during their immature stages, and some species are injurious to young seedlings of coniferous plants (Alexander, 1919, 1920).

In Europe, Beling (1884) described the life histories for eight common species of *Nephrotoma*. In North America the most common species, *N. ferruginea* Fabricius,

1805, has been discussed several times about its economic aspects to agriculture. Hart (1898) gave an excellent description of the immature stages of the species.

In Korea, Alexander (1935) described *Nephrotoma pselliphora*, and he (1945) described nine new species and one new subspecies of Tipulidae. Kim (1971) reviewed 17 known species of Tipulidae from Korea. All these species, however, have been based on adults. Kim and Lee (2002) described and illustrated each immature stage of *T. latemarginata* Alexander, 1921, from egg to pupa, which was the first study to investigate the relationships among larvae, pupae and adults of *Tipula* in Korea.

The relationships among larvae, pupae and adults of the genus *Nephrotoma* has not been carried out in Korea to date. We investigate *Nephrotoma virgata* Coquillett,

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1898, which is widely distributed in Korea. The immature stages including eggs, larvae, and pupae of the species are described and illustrated in this study.

Materials and Methods

The egg, larval and pupal specimens were collected in the field and reared in the laboratory from May 2001 to December 2003. The larvae used in this study were killed by dropping them into hot water near boiling. After 5 minutes, specimens were transferred to 10% formalin and left for several weeks. Then they were preserved in 70% ethanol for permanent storage. Pupae were immersed in Kahle's fluid for two days, then they were transferred to 70% ethanol for permanent storage. For the morphological study of microstructures, the parts were mounted on slides and observed through a compound microscope. The abbreviations used in this paper are as follows: V, ventral; L, lateral; D, dorsal region. Materials examined in this paper are deposited in the Insect Collection of the Animal Taxonomic Laboratory, Andong National University (ADU), Andong, Korea.

Systematic Accounts

Nephrotoma virgata Coquillett, 1898 황각다귀 (Fig. 1)

Egg

Length 0.66-0.68 mm; width 0.30-0.32 mm. Coloration of chorion shining dark. Form oval, rice seed-like (Fig. 1O). Egg without a micropyle and a thread-like filament, two sides equally wide and pointed.

Material examined. 56 indiv., Bonghwa, Gyeongbuk Prov., 12 September 2002.

Last (fourth) instar larva

Length 17.8-23.0 mm; width 2.3-3.6 mm. Coloration yellowish brown. Body moderately elongated, somewhat stout (Fig. 1A). Head capsule black, lateral plates reddish brown. Antennae reddish brown. Clypeus yellow. Mentum of head capsule with seven red teeth, median tooth largest (Fig. 1E). Mandible with three red teeth, median tooth

largest (Fig. 1F). Prothorax with a pair of raised welts on dorsal side (Fig. 1G). First abdominal segment shorter than remaining segments; abdominal segments II-VII each divided into two rings, long anterior and short posterior.

Chaetotaxy of abdominal segments II-VII as follows: Dorsum with five setae; D1 short, D2-D3 close together, very long and strong, D4-D5 very slender and short. Lateral region with four setae; L1 short and slender, L2 very short, L3-L4 long and strong. Venter with four setae; V1-V2 close together, very long and strong, V3-V4 close together, short (Fig. 1B).

Spiracular disc with three pairs of lobes; dorsal and lateral lobes conical with pointed tips, length of lateral lobes $2 \times$ length of dorsal lobes, ventral lobes short, with a long seta on apex. Spiracles with two rings, inner ring black, outer ring brown to dark brown. Anal gills four.

Material examined. 38 indiv., Bonghwa, Gyeongbuk Prov., 12 May 2002.

Remarks. The last instar larva of *N. virgata* is characterized by lobes of spiracular disc, and dorsal and lateral lobes conical with pointed tips, ventral lobes short with a long seta on apex.

Pupa

Length: male, 16.5-18.0 mm; female, 18.0-20.0 mm. Width (at the wing base): male, 2.4-2.5 mm; female, 2.7-3.3 mm. Coloration yellowish brown; wing sheaths light brown; pleural region of abdomen light yellowish brown.

Head rather small (Fig. 1J). Antenna slender, moderately elongated, extending some distance beyond wing root. Pronotal breathing horns narrow, short, with tips a little enlarged, flattened, round (Fig. 1L). Labrum broad, apex pointed. Labial lobes oval. Maxillary palpi strongly recurved at tips. Cephalic crest very small, consisting of two blunt lobes. Mesonotum convex, transversely wrinkled, with conspicuous crests. Wing sheaths extending to base of third abdominal segment. Leg sheaths extending to end of anterior ring of fourth abdominal segment.

Abdominal tergites with weak spines; spines with a transverse row at base of posterior ring, no spines on anterior ring. Sternites with very strong spines on posterior

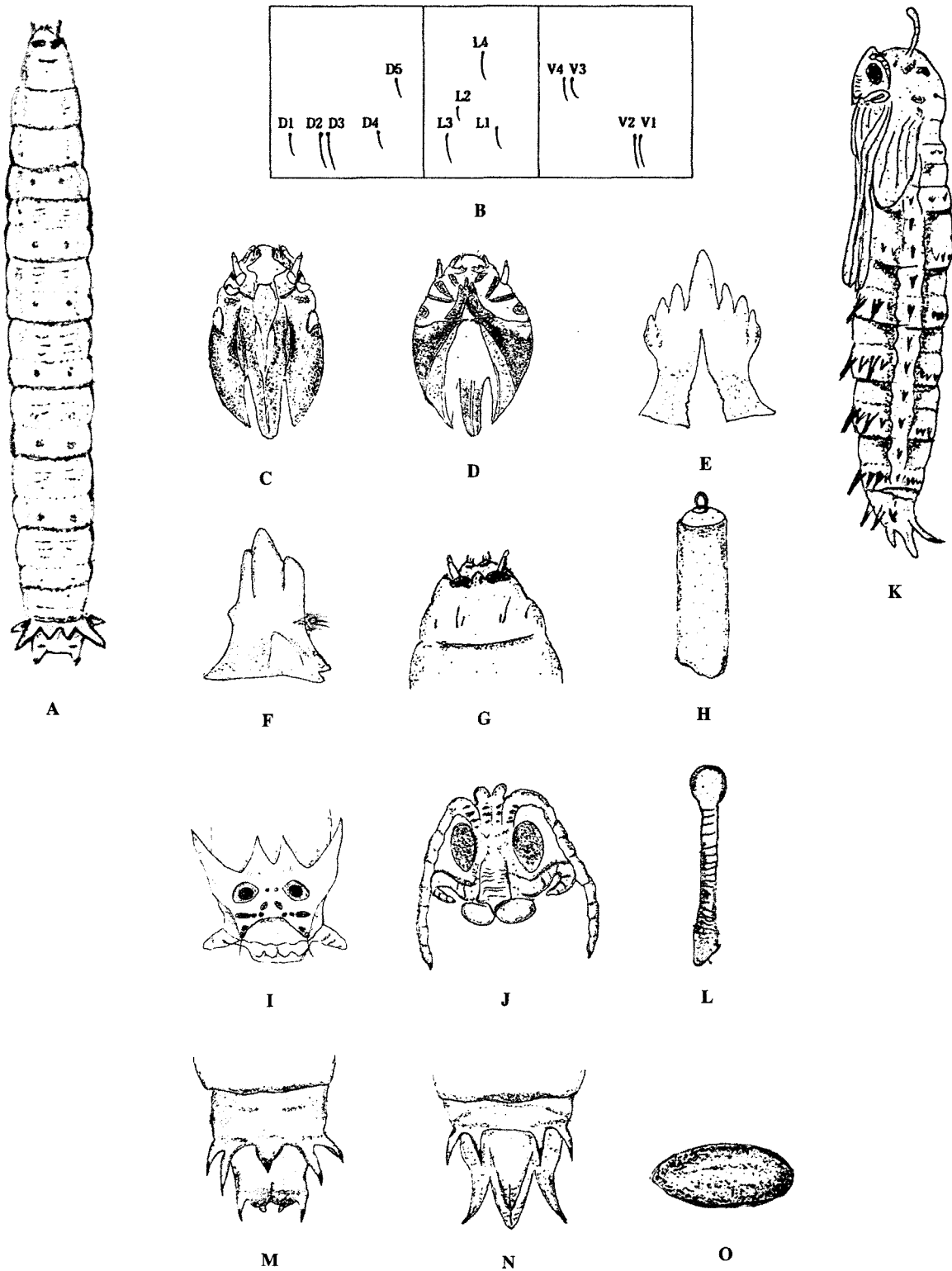


Fig. 1. Immature stages of *Nephrotoma virgata*. Last (fourth) instar larva (A-I); A: body in dorsal view, B: chaetotaxy of abdominal segments II-VII, C: head capsule (dorsal view), D: head capsule (ventral view), E: mentum, F: mandible, G: prothorax (dorsal view), H: antenna, I: spiracular disc; pupa (J-N); J: head (ventral view), K: lateral view of female, L: pronotal breathing horn, M: cauda (δ), N: cauda (♀); egg(O).

ring; abdominal segments III-IV four spines, two inner spines strong, two outer spines setigerous; abdominal segments V-VII five spines, three inner spines very strong, two outer spines small and setigerous. Pleurites with a single setigerous spine on each ring.

Male cauda on dorsum with six lobes; two dorsal lobes small, spinous; two lateral lobes large, horn-like, spinous and very powerful; two ventral lobes small, no spines. Eighth segment with seven spines; on ventral and lateral region with five very powerful spines, on dorsal region two strong hook-like spines. Female cauda on dorsum with four spinous lobes, two lobes large, horn-like and powerful, two lobes small; female ovipositor elongate, tergal valves long and straight, sternal valves a little shorter, separated from tergal valves. Eighth segment on ventral and lateral region with four strong spines.

Material examined. 12 ♂♂, 22 ♀♀, Bonghwa, Gyeongbuk Prov., 20 May 2002.

Distribution. Korea, Japan, Taiwan.

Habitats. The larvae of *N. virgata* were collected in the soil of the fields or grass fields as terrestrial species. Pupae of the species were found in the same places where the larvae lived.

Biological notes. The adult emergence of *N. virgata*

took place two times a year, spring and autumn, periodically in the field. The larvae of the species are herbivorous and feed on roots of plants and leaf litters in the soil.

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