

# Description of the Japanese plum sawfly larva *Monocellicampa pruni* (Hymenoptera: Tenthredinidae) in South Korea

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## 자두수염잎벌 *Monocellicampa pruni* (벌목: 잎벌과) 유충의 형태적 특징

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**ABSTRACT:** This study described and illustrated the morphology of the sawfly's larva *Monocellicampa pruni* Wei, 1998 for the first time. Our observations confirmed that its larval biology associated with Japanese plum *Prunus salicina* Lindl included five instars. The larvae of *M. pruni* are allied to the general morphology of subfamily Nematinae with a cylindrical body, globose head, 4-segmented antenna, thoracic legs with a distinct claw, and 5 dorsal annulets on abdominal segments I - VIII. The absence of anal prolegs after the first molting shows a distinction with the larvae of genus *Hoplocampa*.

**Key words:** *Monocellicampa*, *Hoplocampa*, larval morphology, Nematinae, *Prunus salicina*

**초록:** 자두수염잎벌(*Monocellicampa pruni* Wei, 1998) 유충은 자두(*Prunus salicina* Lindl)의 어린 과일 속에서 5령까지 경과하였다. 자두수염잎벌 유충의 형태적 특징을 관찰한 결과, 원통형의 몸 구조, 구형의 머리, 4마디의 더듬이, 뚜렷한 발톱을 가진 가슴다리, I ~ VIII복부마디 등쪽에 5개의 주름이 있어 수염잎벌아과(Nematinae) 유충의 일반적인 형태적 특징을 공유하였지만, 첫번째 탈피 이후 복부끝다리(anal prolegs)가 사라진다는 점에서 *Hoplocampa*속의 유충과 차이를 보였다.

**검색어:** *Monocellicampa*, *Hoplocampa*, 유충형태, 수염잎벌아과, 자두

The genus *Monocellicampa* Wei, 1998 is a small group of subfamily Nematinae. It contains two species *M. pruni* and *M. yangae*, that both hosted to Japanese plum (*Prunus salicina* Lindl.) in China (Wei, 1998; Liu et al., 2017).

Recently, a report has confirmed the distribution of one species *M. pruni* in South Korea. In which, the authors described damages caused by the insect was so severe that no production was gained in an organic-based farming plum orchard in Jeonnam province (Park et al., 2019). The infes-

tation is quickly spreading, raising scientific concerns about the species. Several researchers previously studied adults morphology of *M. pruni*, and stated that it is allied to *Hoplocampa* Hartig, 1837 (Wei, 1998; Prous et al., 2014; Liu et al., 2017; Park et al., 2019). Until now, the larvae of *M. pruni* are remaining unknown.

This study aims to describe and illustrate the larva's main features of *M. pruni* hosting to Japanese plum in Korea. The distinction with *Hoplocampa*, a genus which also contributes two plum associated sawfly species of *H. minuta* and *H. flava*, was also discussed.

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## Materials and methods

The larvae of *M. pruni* were collected from infested Japanese plum fruitlets in Okgok-myeon, Gwangyang-si, Jeollanam-do, South Korea at an altitude of 160m above sea level (N34058.1190, E127042.5460).

Five net bags were used to cover five plum branches before the flowering stage to investigate the larval stage. At blossom, about 50 pairs of *M. pruni* adults were released into each net bag for oviposition to verify the species. Twenty flowers (at early) or ten damaged fruitlets (later) were picked daily in each bag. Samples then were dissected under the microscope Leica® EZ4 HD to collect and determine the larval instars. The experiment ended when the larva started escaping from the fruit. Collected larvae were preserved in 70% ethanol for further observations.

Photos of living larvae were captured using the microscope Leica® EZ4HD. Larva head capsule's width perpendicular to the body axis was measured for each instars using Leica Application Suite v4.9.

The last instar larva morphology was studied under the microscope Leica® DMC 2900 and Scanning Electron Microscope COXEM® EM-30. Living larvae were killed by 70% ethanol then incubated in 5% KOH solutions at 55°C for ten minutes (Stehr, 1987). The head part was dissected for further observation on the mandible, clypeus, labrum, maxillary palp, and labial palp. Larva's details were drawn using Illustrator® 2020 (Adobe® Inc.).

All materials were examined and deposited at the Department of Plant Medicine, Sunchon National University (SCNU), Suncheon 57922, Korea. The morphological terminology follows Stehr (1987). The name of the mentioned host plant follows 'The Plant List' (<http://www.theplantlist.org/>).

## Results

### *Monocellicampa pruni* Wei, 1998

Materials examined: SOUTH KOREA. Jeollanam-do, Gwangyang-si, Okgok-myeon, Singeum-ri (N34058.1190, E127042.5460). The 1<sup>st</sup> instars were collected from 2 - 14.IV. 2020 (83 specimens); the 2<sup>nd</sup> instars were from 10.IV - 25.IV.

2020 (155 specimens); the 3<sup>rd</sup> instars were from 15 - 30.IV.2020 (203 specimens); the 4<sup>th</sup> instars were from 23.IV - 04.V.2020 (164 specimens); and the 5<sup>th</sup> instars were from 30.IV - 3.V. 2020 (58 specimens). All larvae were collected inside the fruitlets of *Prunus salicina* by the first author. Further observations on morphology and size were performed with at least 15 specimens for each instar larva.

### Larval instars

Before escaping from fruitlet, the larva of *M. pruni* went through 4 moltings. The larval instars could be determined by the number of head capsules remaining after dissecting the infested fruit or the head capsule's width (Table 1).

Body of the newly hatched larva is pale and transparent white with a dark-brownish head that fades to light brown at later instars (Fig. 1). The 1<sup>st</sup> instar larva possesses 7 pairs of prolegs on abdominal segments II - VII and X (Fig. 1A and B). However, the anal prolegs are absent at the following instars after they have already entered inside fruitlet. Body of the last instar larva is yellowish-white with a light-brownish head (Fig. 1F).

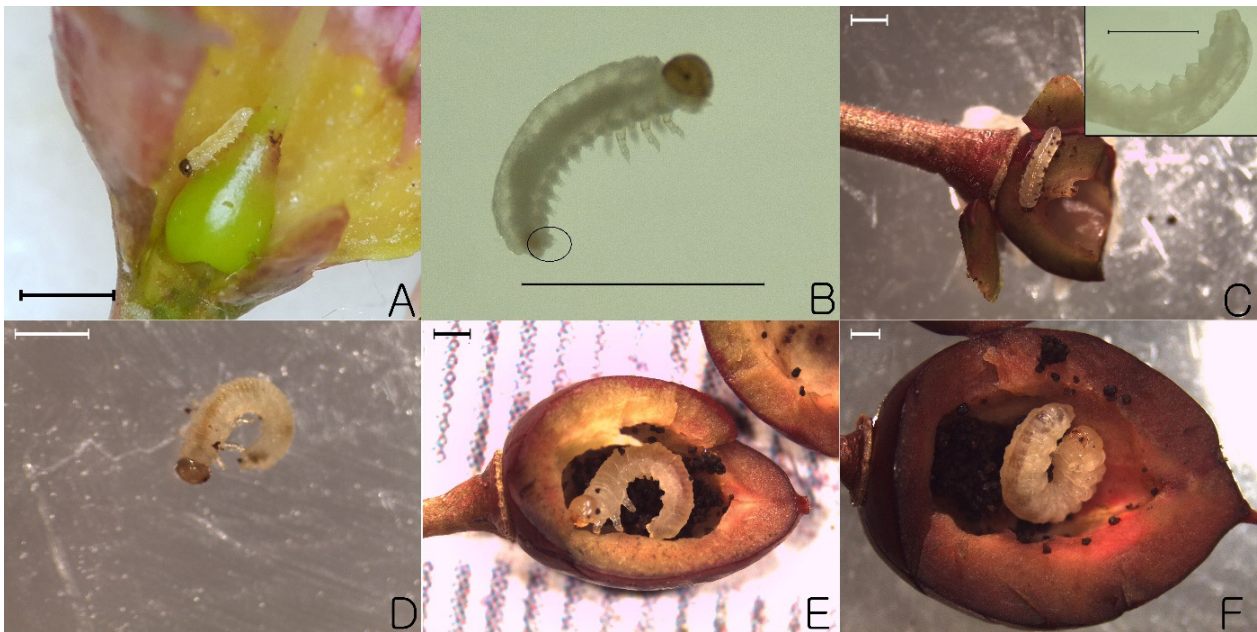
### Description of the last instar larva

At full maturity, the last instar larvae are about 11 mm in length. Body pale, yellowish-white color, and possesses three distinct parts of a light brown head, 3-segmented thorax, and 10-segmented abdomen. There are prominent lobes on the body where setae arise (Fig. 2A). Wingless spiracles are small, elongate, and located on prothorax and abdominal segments I - VIII (Fig. 2B).

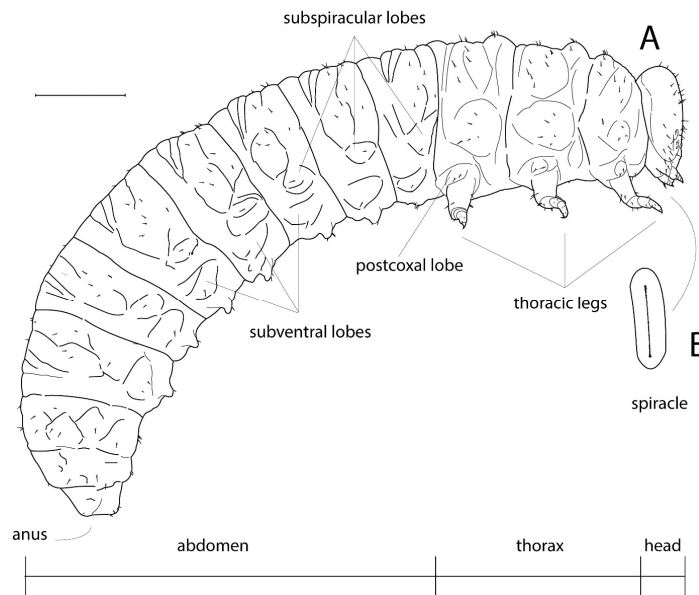
Head is globose, shiny, and covered with setae (Fig. 3A and B). Surfaces, including clypeus and labrum, appear many small

**Table 1.** Mean ( $\pm$  SE) head capsule's width of plum sawfly larva *Monocellicampa pruni*

Larval instar	n	Head capsule's width (mm)
1st instar	15	0.234 $\pm$ 0.002
2nd instar	15	0.347 $\pm$ 0.002
3rd instar	15	0.522 $\pm$ 0.002
4th instar	15	0.841 $\pm$ 0.010
5th instar (last instar larva)	15	1.154 $\pm$ 0.013



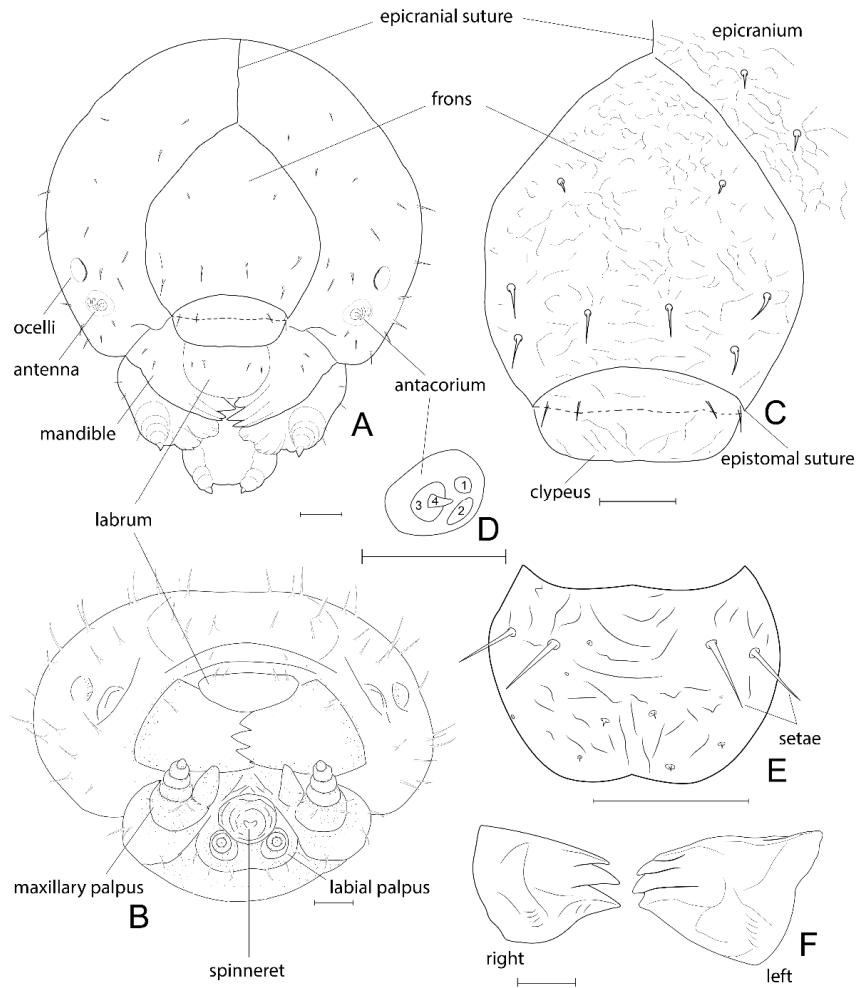
**Fig. 1.** Larval instars of plum sawfly *Monocellicampa pruni*. A: 1st instar; B: anal prolegs of the 1st instar (circle); C: 2nd instar without anal prolegs; D: 3rd instar; E: 4th instar; F: 5th instar (last instar larva); all scale bars are 1 mm.



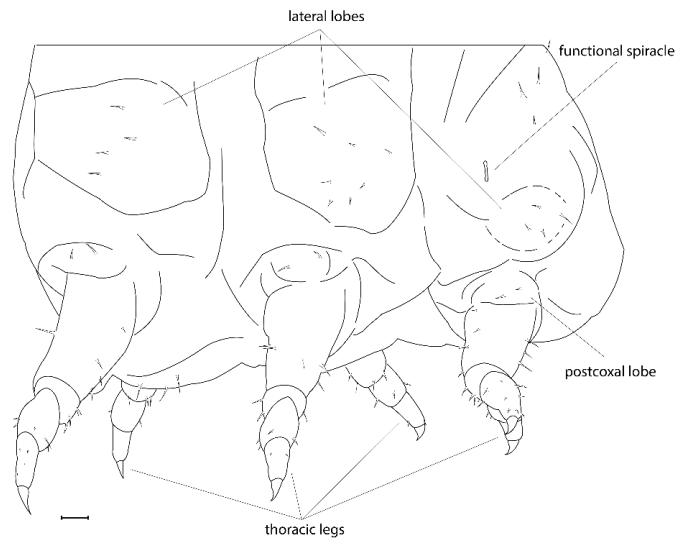
**Fig. 2.** The last instar larva of *Monocellicampa pruni*. A: entire larva in lateral view, scale bar 1 mm; B: functional spiracle.

wrinkles. Frons has 8 setae divided by 4 on each half, which are symmetrical to the epicranial suture axis. The setae are apically sharp and arise from small basal rings (Fig. 3C). The antennae are conical and 4-segmented; segments I - III are incomplete sclerites located in the membranous area (antacoria) from which the antennae arise (Fig. 3D). Clypeus has 2 setae

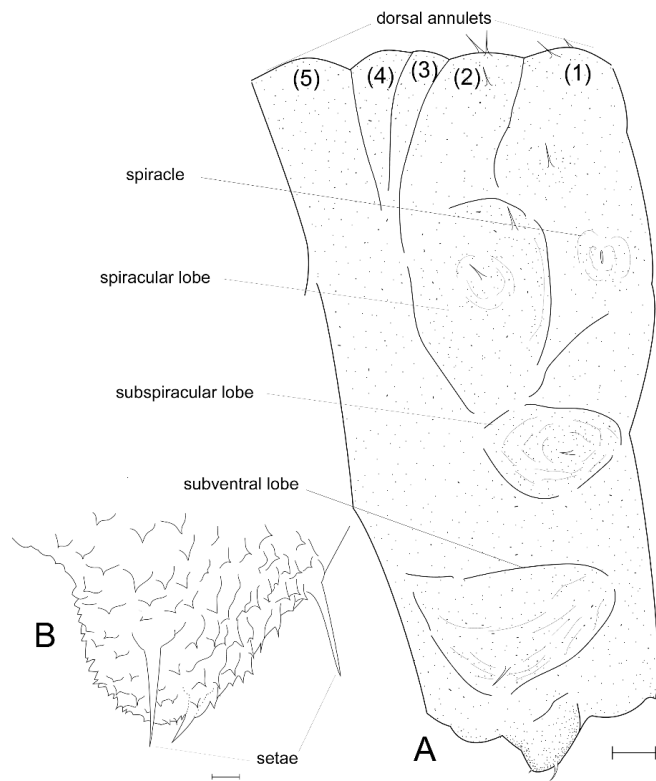
on each half (Fig. 3C). The labrum is roundish, and possesses 4 long, hard setae divided by 2 on each side. There are also several small spines distributed throughout the labrum surface (Fig. 3E). The mandible is asymmetrical, with the right one is tridentate and the left has 4 apical teeth (Fig. 3F). On the outer side of both mandibles, there are two hard setae at the base.



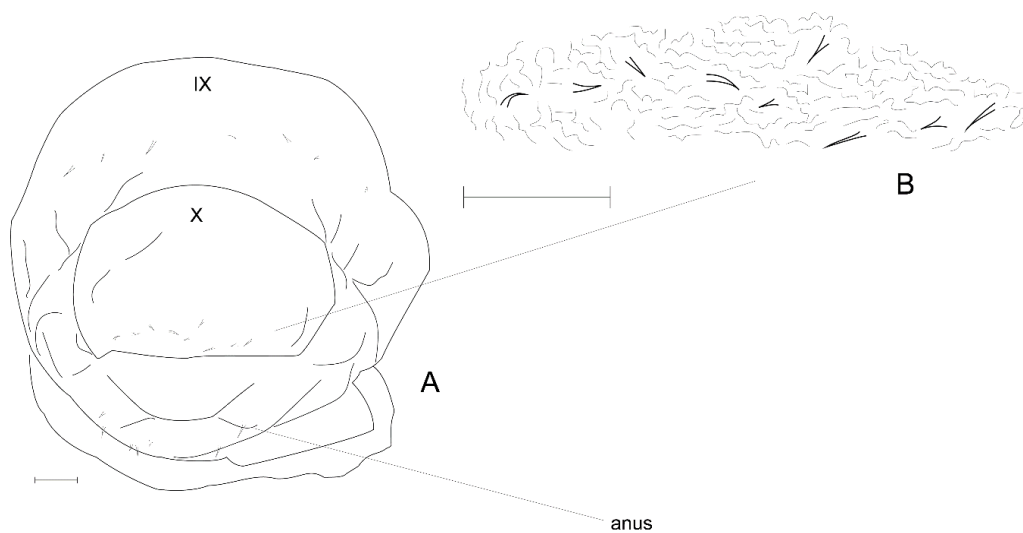
**Fig. 3.** Head part of *Monocellicampa pruni* last instar larva. A: head in frontal view; B: head in ventral view; C: frons, clypeus, and part of epicranium; D: antenna; E: labrum; F: right and left mandibles (inner view); all scale bars are 0.1 mm.



**Fig. 4.** Thorax of *Monocellicampa pruni* last instar larva, scale bar 0.1 mm.



**Fig. 5.** The abdominal segment III of *Monocellicampa pruni* last instar larva. A. lateral view, scale bar 0.1 mm; B. the proleg with 3 setae, scale bar 0.01 mm.



**Fig. 6.** The caudal segments of *Monocellicampa pruni* last instar larva. A: view from behind; B: a setae row on dorsum end of the abdominal segment X (or anal segment); all scale bars are 0.1 mm.

Maxillary palp is 5-segmented, and labial palp has 4 segments (Fig. 3A and B).

Thorax includes 3 segments. The lateral lobe on prothorax is

prominent, while it strongly develops on mesothorax and metathorax. There are 4 - 7 setae arise from those lobes. The functional spiracle locates on the prothorax, next to the lateral

lobe. Each thoracic leg has 4 segments with a distinct claw. Postcoxal area of each leg arises a prominent lobe with 2 setae (Fig. 4).

Abdomen possesses 6 pairs of prolegs on abdominal segments II - VII. Prolegs are non-segmented, without crochets, the surface is finely spinulose. Spiracles are wingless, located on abdominal segments I - VIII. Body with several setae arises from dorsum and lobes. Subspiracular lobes bear 1 - 2 seta (e). Each subventral lobe on abdominal segments I - VI has a seta.

The abdominal segment III has 5 dorsal annulets, and the spiracle locates on the first annulet, next to the spiracular lobe on the second annulet which contains 2 setae. Each subspiracular and subventral lobe contains a seta (Fig. 5A). The segment's prolegs possess 3 setae (Fig. 5B).

The last abdominal segment or abdominal segment X is cylindrically rounded without lobes or tubercles and prolegs (Fig. 6A). There is a row of 9 small setae horizontal relative to the body axis distributed evenly on the dorsum end (Fig. 6B). Subanal margin arises several setae.

## Discussion

The genus *Monocellicampa* has been established with two species of *M. pruni* and *M. yangae* from China (Wei, 1998; Liu et al., 2017). Recently, only one species *M. pruni* has been recorded in South Korea (Park et al., 2019). As sawfly species associated with plum, the morphology of their adult was described and said to be quite similar to that of *Hoplocampa*, but can be distinguished by the following characters: vein m-cu of the hind wing absent, thus cell M open; epicnemial surface weakly outlined by furrow; mandible tridentate; ovipositor sheath shorter than the hind femur; penis valve with a distinct subapical spine; and claws simple (Prous et al., 2014; Liu et al., 2017). Identification of the species at the adult stage usually provides more reliable results, but not always an advantage with the species most present in the larval form such as sawflies. However, no information is known about the larval morphology of those insect pests. This study presented here is the first time a larva of *Monocellicampa* was described and illustrated.

The morphological characteristics of the larva of *M. pruni* observed in our study are allied to the general morphology of

subfamily Nematinae, which is characterized by a cylindrical body, globose head, 4- or 5-segmented antenna, thoracic legs with a distinct claw, and 3 - 6 dorsal annulets on abdominal segments. The typical feature of those larvae is that of having prolegs on abdominal segments II - VII (rarely II - VI) and X (Stehr, 1987; Liston et al., 2019). We also found that prolegs are present on abdominal segments II - VII of *M. pruni* larvae, but prolegs on the abdominal segment X occur only at the 1<sup>st</sup> instar larva. Interestingly, the anal prolegs are absent after the first molting, illustrating a significant difference from *Hoplocampa* species that possess 7 pairs of prolegs on abdominal segments II - VII and X at all larval instars (Miles, 1932; Petherbridge et al., 1933; Stehr, 1987).

Like some species in *Hoplocampa*, there were also five instars of *M. pruni* larva found when they hosted to Japanese plum. But instead of causing damage on several (3 - 6) fruitlets such as plum sawfly *H. flava* (Petherbridge et al., 1933), *H. minuta* (AgroAtlas, 2020), or apple sawfly *H. testudinea* (Miles, 1932), we observed *M. pruni* damage only one plum fruitlet in its lifetime. This biological characteristic might be the reason for the disappearance of the anal prolegs after the first molting, as the larvae do not migrate to other fruits within their developmental duration.

Identification of the larval stage always plays an essential role in quick detection of pests, especially with a univoltine species such as sawflies of which the larval stage appears mostly in the field (adults are present in a short period within 2 - 3 weeks). Until now, no information is yet to know about the morphology of the remaining species *M. yangae*. However, this study still provides the first significant sense about a larva of *Monocellicampa*, key features to identify and distinguish different plum sawfly species, and contributes inputs for further studies on larvae of the genus.

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## Statements for Authorship position & contribution

- Nguyen, N.H.: Suncheon National University, Researcher.  
Carried out the survey, drew pictures, and wrote the manuscript.
- Im, M.-H.: Bio-Plant Environment Research Center, Researcher. Carried out the survey;
- Hong, K.-J.: Suncheon National University, Professor;  
Designed the research and revised the manuscript. All authors read and approved the manuscript.

## Literature Cited

- AgroAtlas. 2020. *Hoplocampa minuta* Christ. - Black Plum Sawfly. [http://www.agroatlas.ru/en/content/pests/Hoplocampa\\_minuta/index.html](http://www.agroatlas.ru/en/content/pests/Hoplocampa_minuta/index.html) (accessed on 30 Sep 2020).
- Liston, A., Prous, M., Vardal, H. 2019. A review of West Palearctic *Hoplocampa* species, focussing on Sweden (Hymenoptera, Tenthredinidae). J. Zootaxa 4615: 1-45.
- Liu, T., Liu, L., Wei, M. 2017. Review of *Monocellicampa* Wei (Hymenoptera: Tenthredinidae), with description of a new species from China. Proceedings of the Entomological Society of Washington 119: 70-77.
- Miles, H.W. 1932. On the biology of the apple sawfly, *Hoplocampa testudinea* Klug. Ann. Appl. Biol. 19: 420-431.
- Park, B., Nguyen, N.H., Lee, J.-W., Hong, K.-J. 2019. A new sawfly pest, *Monocellicampa pruni* Wei (Hymenoptera, Tenthredinidae) attacking fruitlets of Japanese plum in South Korea. Korean J. Appl. Entomol. 58: 329-333.
- Petherbridge, F.R., Thomas, I., Hey, G.L., 1933. On the biology of the plum sawfly, *Hoplocampa flava* L., with notes on control experiments. Ann. Appl. Biol. 20: 429-438.
- Prous, M., Blank, S.M., Goulet, H., Heibo, E., Liston, A.D., Malm, T., Nyman, T., Schmidt, S., Smith, D.R., Vårdal, H., Viitasaari, M., Vikberg, V., Taeger, A. 2014. The genera of Nematinae (Hymenoptera, Tenthredinidae). J. Hymenopt. Res. 40: 1-69.
- Stehr, F.W. 1987. Immature Insects, vol. 1, Kendall/Hunt Publishing Company, Iowa.
- Wei, M. 1998. Two new genera of Hoplocampinae from China with a key to known genera of the subfamily in the world (Hymenoptera: Nematidae). J. Cent. South Univ. 18: 12-18.