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Some observations on the biology of *Notosacantha vicaria* (SPAETH)
(Coleoptera: Chrysomelidae: Cassidinae)

NILESH RANE, SACHIN RANADE & HEMANT V. GHATE
Zoology Department, Modern College, Shivajinagar, Pune 411 005, India
e-mail: hemantghate@hotmail.com

ABSTRACT. *Notosacantha vicaria* completes life cycle on *Carallia brachiata*, a plant belonging to *Rhizophoraceae*. The larva is a leaf miner and even pupation takes place within the leaf mine. The larva is very similar to hispine larvae in general appearance. The lateral processes on abdominal segments are much shorter than in other cassidines and the supra-anal processes or furci are absent. The pupa also differs from that of other cassidines in some respects, e.g. there are no prothoracic spinules and supra-anal furci in the pupa of *Notosacantha*. The pupal mine has a distinctive shape. The beetles feed only by scraping on the upper surface of the leaf, without making holes, and the feeding marks are characteristic.

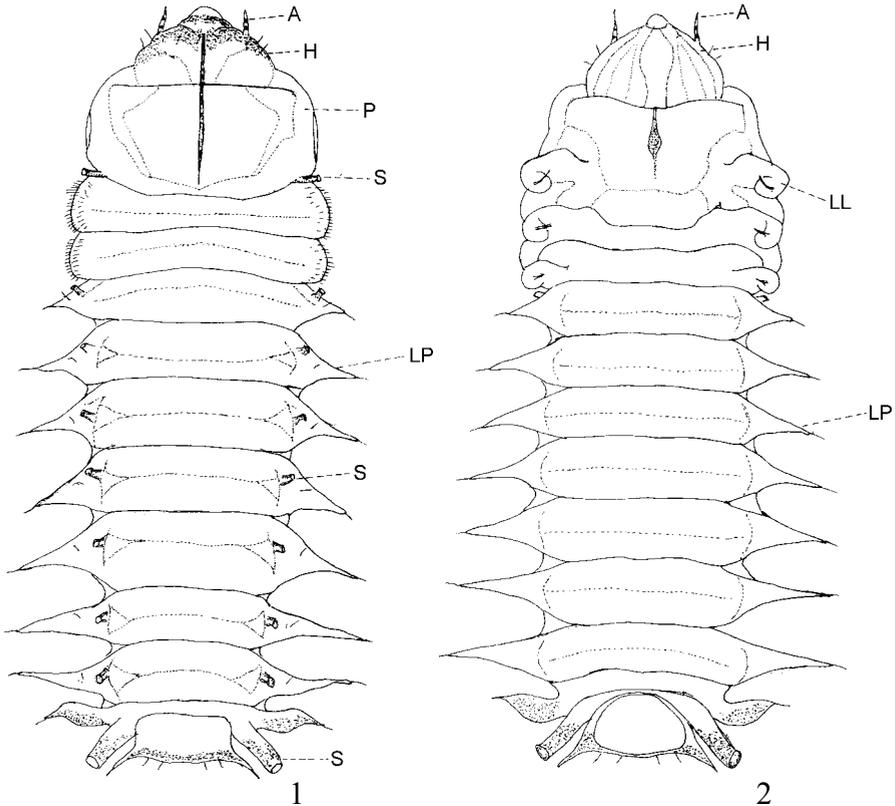
Key words: entomology, biology, immature stages, *Cassidinae*, Oriental region, *Notosacantha vicaria*, *Carallia brachiata*.

INTRODUCTION

The genus *Notosacantha* CHEVROLAT (formerly *Hoplionota* HOPE) is a highly speciose genus with 236 known species distributed in the Oriental, African and Australian regions (BOROWIEC 1999). Most species are rather small and cryptic and perhaps for this reason more than 80% of the species are known original time descriptions only (DĄBROWSKA & BOROWIEC 1996). A concise review of the available species of *Notosacantha* from the then British India has been published in the Fauna of British India volume (MAULIK 1919). A few new species have also been described from India and other countries since then (BOROWIEC & TAKIZAWA 1991, DĄBROWSKA & BOROWIEC 1996). A brief literature survey indicated that the

bionomics of none of the Indian species has been studied so far, although there is an account of bionomics of *Notosacantha siamensis* SPAETH from Vietnam (MEDVEDEV & EROSHKINA 1988). In fact even host plants of most species of *Notosacantha* found in the present Indian Territory are unknown.

The tribe *Notosacanthini*, to which the genus belongs, has a mosaic mixture of hispid and cassidoid characters. Because of this the phylogenetic relationship of these insects is not resolved. A detailed discussion on the subject was presented by BOROWIEC (1995). The larvae of these beetles are found to be mining in the leaves, very much like the hispine larvae (MEDVEDEV & EROSHKINA 1988) and, as far as we are aware, this was the first conclusive proof of leaf mining habits in the larvae of *Notosacantha*. MONTEITH (1991) also observed a mining activity in an Australian species, namely *N. dorsalis* (WATERH.), though no mention was made of the place of pupation, etc. TAKIZAWA (1980), citing the work of GRESSITT and KIMOTO (1963), mentioned that the genus *Notosacantha* has “apparently a



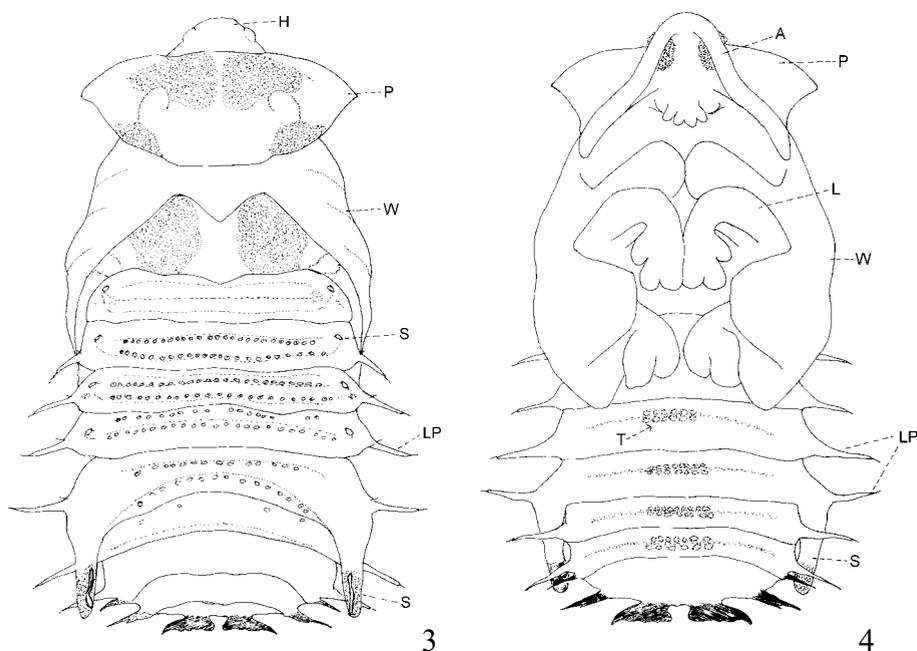
1-2. *Notosacantha vicaria*, larva: 1 - dorsal view, 2 - ventral view (lettering: A-antenna, H- head, LL- larval leg, LP- lateral processes, P- prothorax, S- spiracles)

leaf-mining larva". BOROWIEC & TAKIZAWA (1991) reported that *N. nepalensis* was reared from larva mining on (leaves of) *Cleyera japonica* (family: *Theaceae*).

We are now presenting additional data on *Notosacantha vicaria* (SPAETH), wherein we have found live leaf mining larvae as well as live pupa residing in the leaf-mine. The host plant has been determined as *Carallia brachiata* (family *Rhizophoraceae*). The adults, two larvae and a single pupa were collected in a forest near Mulshi dam area, about 75 km W of Pune City, Maharashtra State. The adults were first collected on 20th September 1998 along with evidence of mining larvae and the characteristic pupal cases. Larvae and pupa were collected later, in August 1999. The adults are small, with an average length of 4.16 mm (maximum 4.5 mm) and breadth 3.43 mm (maximum 3.6 mm) (based on measurements of 6 specimens). Overall the females are larger than the males. The description as well as the figures of larva and pupa are presented below.

LARVA: (figs 1-2)

The larva (the last instar) is dorsoventrally flattened, parallel-sided and elongated (length about 5.2 mm and breadth about 1.5 mm, excluding lateral projections). Head is visible from above and is sclerotized. There are two, very short, 3-segmented antennae, showing three dark transverse bands. Close to the



3-4. *Notosacantha vicaria*, pupa: 3 - dorsal view, 4 - ventral view (lettering: A-antenna, H- head, L- developing leg in pupa, LP- lateral processes, P- prothorax, S- spiracles, T- small tubercles,

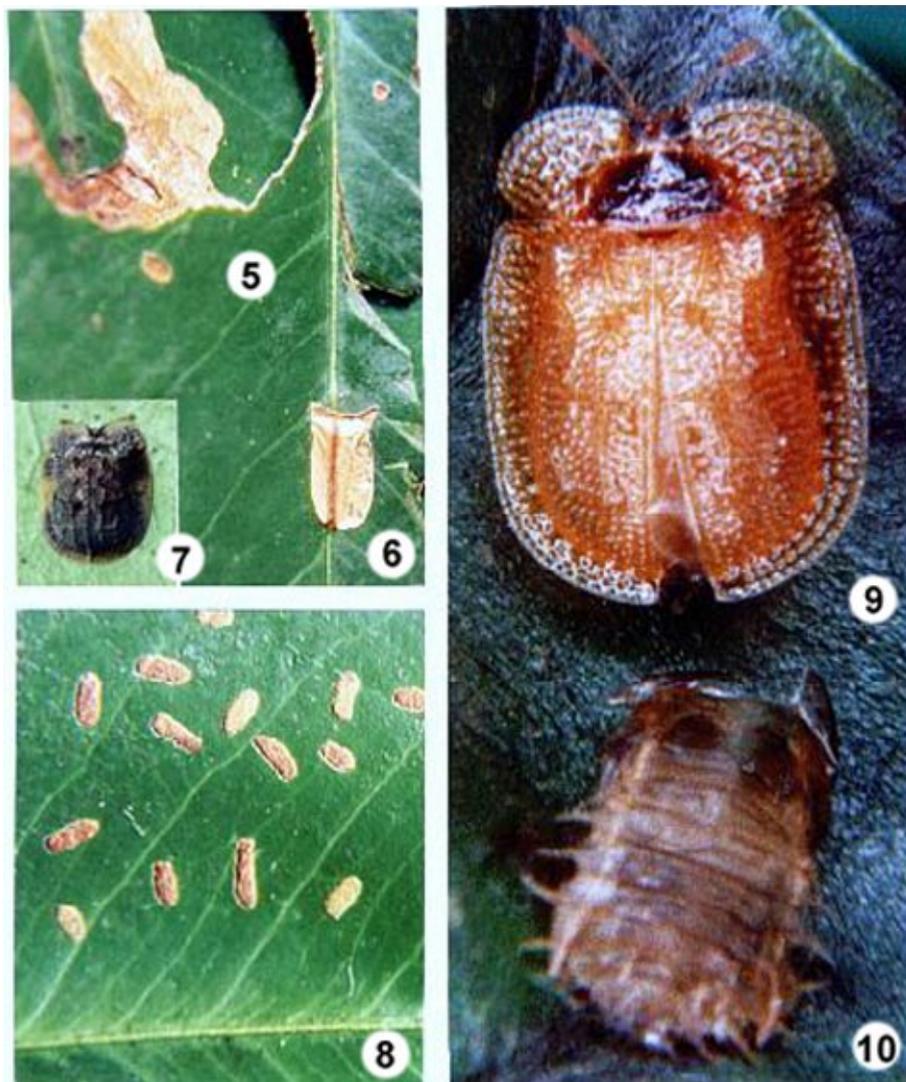
dorso-lateral margin there are 5 ocelli on each side. There is a distinct thin median suture on the head, which extends down to prothorax. The prothorax is plate-like, ca. twice as broad as long. Its antero-lateral margin has a curved, ear-like translucent plate with fine tuberculate appearance. The living larva was found to be capable of moving this plate in antero-posterior direction. This plate is seen only at high magnification and is not shown in the diagram.

The meso and metathoracic segments are six to seven times as broad as long. The lateral margins of meso- and metathorax are lined by fine setae. There is a tubular spiracle situated laterally between pro- and mesothoracic segments. The abdominal segments are of variable length. Each abdominal segment has two short lateral processes, one on either side, with a broad triangular base and a fine terminal seta. Each segment has a transverse median line of depression. There are 8 pairs of spiracles arranged in pairs on 8 abdominal segments. Each spiracle is tubular and is situated dorsally, at the base of the lateral process. The length of spiracles decreases from the 1st to the 7th segment. The first 6 spiracles open laterally. The spiracles of the 7th and 8th segment, however, face posterolaterally. The spiracle of the 8th segment is the longest, broadest and partially chitinized. The 9th abdominal segment is apparently without spiracle and has 6 fine setae and a pair of postero-lateral processes, which also terminate in a fine seta. The larva is broadest in the thoracic region. Its dorsal surface appears as if microtuberculate, under high magnification. There is no definite pigment pattern. There are 3 pairs of legs. Each leg is apparently without segmentation but the chitinized claw is distinct; there are at least 8 prominent setae on each leg. We could observe living larva moving in the mine, making its way by cutting through the mesophyll tissue, with the help of mandibles working like scissors (very much like larvae of a hispine *Platypria*, advancing in the mine of *Ziziphus* leaf: unpublished data of this laboratory, fig. 5).

PUPA: (figs3-4)

The larvae mine extensively, covering almost half of the leaf area. Apparently the larva leaves the occupied leaf at this stage to enter a fresh leaf. Even when it is about to pupate, it will leave this leaf to enter a fresh leaf or at least leave its original mine and select a fresh uneaten area of the same leaf for pupation. Generally, the area selected for pupation is close to the midrib of the leaf. The pupal mine has a characteristic shape (fig. 6), and is usually longer than broad (average of 5 observations: 9 x 5.4 mm). At the time of pupation the outer cover of the mine is distinctly brown (dead epidermis and cuticle of the leaf). The pupa is somewhat broader than larva. It is also dorso-ventrally flattened. The length of the pupa is 4.9 mm and the breadth is 3.3 mm.

Viewed dorsally, the head is visible, as well as the developing eyes. The anterior region of the head has numerous fine setae. The prothorax is in the form of a broad triangular plate with a diffuse brown pigment patch separated by a thin yellow suture medially. There is also a diffuse brown pigment patch on the



5-10. *Notosacantha vicaria*: 5 - larval mine, 6 - pupal mine (average size 9.0 x 5.4 mm), 7 - ten day old imago after acquiring typical colour, 8 - feeding marks of the imago, 9 - freshly ecdoded imago, 10 - cast pupal skin

metathorax . The abdominal segments are very much like those of the larva. There are two rows of small tubercles on each segment dorsally and a pattern of larger tubercles ventrally.

There are lateral processes on each abdominal segment except the first. There is a progressive increase in the length of the lateral processes from the 2nd abdominal segment to the 5th. The processes of the 5th and 6th segments are more or less of equal length. The 6th, 7th and 8th abdominal segments have lateral processes that progressively decrease in length. There is only a single lateral process on each side of segments 2 to 6; however, segments 7 and 8 possess processes that are double. On segment 7, the two processes are distinct but the double nature of the processes on the 8th segment can be seen only at a higher magnification. The 9th segment has a flat, wedge-shaped lateral processes.

There are 5 abdominal spiracles, out of which 4 are in the form of very minute tubes opening more or less dorso-laterally on the 1st to 4th segments. The 5th segment has a posteriorly directed, tubular, broad and partially chitinized spiracle; the opening of this tubular spiracle is, however, slit-like and dorsal. The overall colour of the pupa is brownish and the surface appears microtuberculate under high magnification; there are also some larger tubercles (fig. 3).

In the ventral view a nearly mature pupa shows eyes, antennae and legs. The abdominal segments ventrally show transverse median ridges. In the case of 4th to 7th segments, these transverse ridges bear prominent tubercles (fig. 4)

We have observed neither egg laying nor earlier instars so far. However on the basis of leaves with typical larval mining, which we have studied, it appears that the breeding season is from July to September. Freshly eclosed beetles, probably the first generation of the season, have all been observed in September. It is likely that the emerged *Notosacantha* mate and lay another batch of eggs, like some other cassidines we have observed in that area. The duration of the various larval instars is entirely unknown but the pupa ecloses after the 7th or 8th day. The fresh imago has shining, yellowish elytra and deep brown prothorax (fig. 9). Within 2 hrs it becomes totally brown, showing the pattern characteristic of the species. In nature the adults are often found with a coating of waxy material on head, prothorax and elytra so that the insect appears whitish and dull. Even the laboratory-hatched imagines became whitish in about 10 to 15 days. Imagines were found to feed and rest on the upper surface of the leaf only, in nature as well as under laboratory conditions.

REMARKS

N. vicaria is known from India and Sri Lanka. In India it has been recorded from the Andaman islands, Tamil Nadu and Bombay (former Bombay State?) (MAULIK 1919, BOROWIEC & TAKIZAWA 1991, BOROWIEC 1999). Thus, according to MAULIK (1919), this species has been reported only a few times. This note

therefore is the first ever report of larval and pupal morphology of *Notosacantha vicaria* and also of its host plant. Its presence in the forested area around Pune (Maharashtra State) is also an additional locality record.

The present findings further confirm that *Notosacantha* larvae are leaf-mining larvae and that the pupation also takes place within the specially prepared mine. There is one paper dealing with the biology, larva and pupa of a Vietnamese species, namely *Notosacantha siamensis* SPAETH, published by MEDVEDEV & EROSHKINA (1988). Our observations regarding the larva and pupa, and larval mining, generally agree with those of MEDVEDEV & EROSHKINA (1988). Even the shape of the pupal mine is similar to that of *N. siamensis*. There is another observation on an Australian species (*Notosacantha dorsalis*) regarding some aspects of adult behaviour and feeding (HAWKESWOOD 1989). In the case of *N. vicaria* we observed that the feeding takes place only on the upper surface of the leaf, as is true for other species of *Notosacantha*. The feeding pattern of the imago appears as small clusters of scrapings; never in the form of complete holes like in other cassidines (fig. 8). It may again be pointed out here that MONTEITH (1991) observed leaf-mining in *N. dorsalis* and stated that larval leaf mining might be common in the genus.

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