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Published By: Society of Southwestern Entomologists

DOI: [http://dx.doi.org/10.3958/059.037.0218](http://dx.doi.org/10.3958/059.037.0218)

Ovipositor of *Catolaccus hunteri* Burks (Hymenoptera: Pteromalidae) and Implications for its Potential as a Biological Control Agent of Pepper Weevil

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The pepper weevil, *Anthonomus eugenii* Cano (Coleoptera: Curculionidae), is the key pest of pepper (*Capsicum* spp.) crops in tropical and subtropical America, and its control depends mostly on insecticides (Elmore et al. 1934, Riley and King 1994). Females lay individual eggs on floral buds but mainly in immature fruits. Larvae and pupae develop completely inside the fruit and are inaccessible to insecticides. There are no commercial natural enemies of the pepper weevil, but recently, in Florida, weekly releases of the equivalent of 8,000 *Catolaccus hunteri* Burks per hectare resulted in fewer weevil infested fruits at the end of the season compared to plots where parasitoids were not released (Schuster 2007). Some authors argued *C. hunteri* might not be a good control agent because it only attacks the third instar of pepper weevil, which is usually deep within the pepper fruit. According to Riley and Schuster (1992), *C. hunteri* was not recovered from fallen fruits larger than 2.5 cm in diameter. The impact of *C. hunteri* could be especially effective in pepper weevil small-fruited hosts, such as nightshades, *Solanum* spp., or early in the pepper crop cycle when only floral buds or small fruit are available (Schuster 2007). In this study, the ovipositor of *C. hunteri* and relationship between ovipositor length and parasitoid size were described. Also, we commented on some implications for its potential as a biological control agent.

A random sample of 100 *C. hunteri* females were taken from two generations in a colony reared in a laboratory at Texcoco, Mexico. The insects had been reared for more than 10 generations on cowpea weevil, *Callosobruchus maculatus* F. (Coleoptera: Bruchidae), by using the methods of Vasquez et al. (2005). The ovipositor and right hind tibiae of each specimen were detached and put on to a slide. A Tessovar Carl Zeiss microscope equipped with a digital camera (PaxCam 3) was used to make photographs. The structures of each specimen were measured using The Image Tool 2.01 Alpha 4 program. A few other specimens were used to describe some particularities above the ovipositor.

*C. hunteri* females are synovigenic, meaning they need to feed on a host to obtain protein to produce eggs (Rodríguez-Leyva et al. 2000). Schuster (2007) suggested *C. hunteri* females might feed on eggs or young larvae; thus, the hypothesis was tested using parafilm capsule methodology developed by Cate (1987), and jalapeño, *Capsicum annuum* L., infested fruits collected in the field. The parasitoid was offered eggs (five capsules with five eggs each), young larvae

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(30 capsules with two larvae each), developed larvae (30 capsules with a larvae each), and young pupae (30 capsules with a pupa each). All the parafilm capsules were exposed for 24 hours in a no choice test to a group of 30, 48 hour-old *C. hunteri* females fed honey, and not in contact previously with any host.

*C. hunteri* has an ovipositor structure typical of Chalcidoidea, inserted almost in the base of the metasoma (Fig. 1ab). *C. hunteri* has a large range of ovipositor (1.42 to 2.27 mm) and tibia sizes (0.54 to 0.78 mm), but the averages were 1.91 ± 0.17 mm and 0.73 ± 0.55 mm, respectively. Using a simple regression analysis, a positive relationship was found between the two structures ($R^2 = 0.69$) (Fig. 1d). Thus, the length of the hind tibia can be used as an indicator of ovipositor size.

The distal part of the ovipositor (gonapophysis VIII) immediately before the teeth in lateral view shows the superior and inferior edges almost parallel. There is neither nodus nor notch in side view. The ovipositor tooth area is 57 μm deep and 160 μm long; the same area decreases toward the tip and ends in only a distal tooth. The inferior edge has a row of 10 teeth. Basiconic sensilla are among the 4th to 7th teeth; the sensilla are not longer than the depth of the teeth (Fig. 1c). Because

![Fig. 1. *Catolaccus hunteri*; a) natural position of ovipositor, b) ovipositor structure, c) tip of ovipositor, d) relationship between size of ovipositor and hind tibia.](image-url)
C. hunteri need to reach the host with the tip of the ovipositor to either inject venom to paralyze or to damage the host integument to feed, the place where pepper weevil larvae prefer to develop inside the pods needs to be known. Pepper weevil prefers to feed on floral buds and lay eggs on small immature fruits (Elmore et al. 1934, Patrock and Schuster 1992). More eggs might be laid on floral buds of bell pepper because of the size of the structures compared to other varieties of pepper (E.R.L. unpublished data).

This information may help explain why the natural amount of parasitism by C. hunteri differs among seasons and varieties of pepper; for example, 5-26% on bell peppers (Riley and Schuster 1992). The pepper size or diameter might be a reference to determine on which fruit pepper weevil females prefer to lay eggs (Patrock and Schuster 1992, Porter et al. 2007); however, fruit of different varieties of pepper have different pericarp thicknesses, and most larvae develop on placenta and seeds inside the fruits (Elmore et al. 1934). Future experiments of this parasitoid against the pepper weevil should include determination of parasitism on each size class of fruit. But estimating the distance from the pericarp to the place where third-instar larvae develop inside the fruit would assist in understanding the potential and limitations of C. hunteri as an augmentative biological control agent on different varieties of pepper.

C. hunteri females showed drumming and oviposition behavior on the parafilm capsules that contained any pepper weevil stage (egg, young larvae, mature larvae, and pupae). Nevertheless, females were able to feed only on mature larvae (100%) and young pupae (33%) and lay eggs on the same stages, 40 and 6.6%, respectively. Further studies are needed to determine if C. hunteri females feed on young larvae or eggs of pepper weevil as was suggested by Schuster (2007). This experiment should be done on naturally infested pepper fruits because parafilm capsules cannot offer the needed stimuli in a laboratory.

Acknowledgment

This manuscript was supported by the Program of Incentives for Research, Technological Development and Innovation INNOVAPYME CONACYT, MEXICO, Grant No. 2011-137255 to Koppert Mexico SA de CV.

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