



SENSILLA ON THE WINGS OF *EURYDEMA DOMINULUS* (SCOPOLI)

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ABSTRACT

Eurydema dominulus (Scopoli), a phytophagous insect and a pest of many plants. The external morphology of the sensilla on the wings were observed using scanning electron microscope. Based on their morphological structure, different five types of sensilla were distinguished: sensilla trichoidea, sensilla chaetica, sensilla basiconica, sensilla campaniformia and sensilla ampullacea. These sensilla can be related to have mechanosensory, chemosensory and proprioceptive functions. The possible roles of these sensilla are also discussed.

Key words: *Eurydema dominulus*, adult, Hemiptera, forewing, hindwing, dorsal, ventral, SEM, sensilla, morphology, measurements, distribution

Heteroptera (true bugs) represent over 40,000 described species with half-membranous forewings and sucking mouthparts (Weirauch and Schuh, 2011). Pentatomidae, one of the largest groups in the Pentatomomorpha, includes over 900 genera and 4,500 species (Kikuchi et al., 2011). Majority of the pentatomid species are phytophagous, and some of them are known as notorious pests of crop plants. *Eurydema dominulus* (Scopoli), is one of main insect pests of cruciferous crops. Regardless of its economic importance the sensory structure of this insect in different parts of the body have not been subjected to detailed study. Sensilla are sensory receivers with peculiar locations at the insect body being placed at antenna, maxillary palps, proboscis, tarsi etc. Sensilla exist in several forms (Asdelkrim and Mehlhorn, 2006). In case of insects, locating a host plant is crucial to find suitable oviposition sites and to fulfil its nutritional requirements (Quicke et al., 1995). In most herbivorous insects, survival of offspring mostly depends on the selection of suitable host plant (Renwick and Chew, 1994). Plant chemicals influence host plant location and acceptance of suitable plants for feeding and oviposition. Detection of these chemical stimuli is accomplished by an array of sensory capabilities, the gustatory and olfactory sensilla present on antennae and other parts of insect body (Ananthakrishnan, 1992)

Scanning Electron Microscopy (SEM) has become an indispensable and inevitable technique for studying the detailed morphology of cuticular structures (Dey, 1995). SEM for studying the distribution pattern,

directional function, structural features of antennal socket, specialization in position, the nature of association of the sensilla base with the body cuticle and finer detail of the surface of sensilla has been studied by Dey (1995), Dey and Biswas (1996). Insect wings have many sensilla near wing bases and along wing veins and margins which are responsible for sensing as well as for generating airflow (Pringle, 1957; Albert et al., 1976; Palka et al., 1979; Cole and Palka, 1982; McIver, 1985; Yack et al., 2000; Yoshida et al., 2001). The articulation between the wing and body plays an important role in insect wing movement (Snodgrass, 1935), sensilla near the wing bases of several insects have been studied in terms of wing proprioception: neuronal information from campaniform sensilla near the wing bases of locusts (Gettrup, 1966). Sensilla not located near wing bases may also play a complementary role in wing movement regulation, but detailed studies of these roles have not been performed, therefore the present paper gives a description of the external morphology, and distribution of the sensilla that are present on both the fore and hind wings (dorsal and ventral) of *Eurydema dominulus* (Scopoli). The possible role of these sensilla in relation to the insect's behaviour is discussed in relation to the current available literature.

MATERIALS AND METHODS

The insect samples were collected from Umbir village, Ribhoi district (Meghalaya) by hand picking method. The fore wings and hind wings were carefully excised from the insect by using fine forceps. For

scanning electron microscopy, samples were prepared following the method of Dey et al., 1989. Samples were fixed in 2.5% Glutaraldehyde for 24 hr at 4°C and washed 3 times in 0.1 M Sodium Cacodylate buffer for 15 min in each change at 4°C. Then the samples were dehydrated in ascending grades of acetone (30%, 50%, 70%, 80%, 90%, 95% and 100%), keeping in each grade for 15 min for 2 times. After dehydration, samples were dried in Tetramethylsilane for 5-10 min for two times and air dried at room temperature. Then the specimens were mounted on aluminium stubs with the help of double adhesive tapes followed by a 35 mm gold coating (in sputter) and viewed under Scanning electron microscope (Jeol- JSM 6390). The sensilla on the wings of *Eurydema dominulus* were classified following all the available literature and the measurements of the sensilla were done from the SEM micrographs using image J software (latest version).

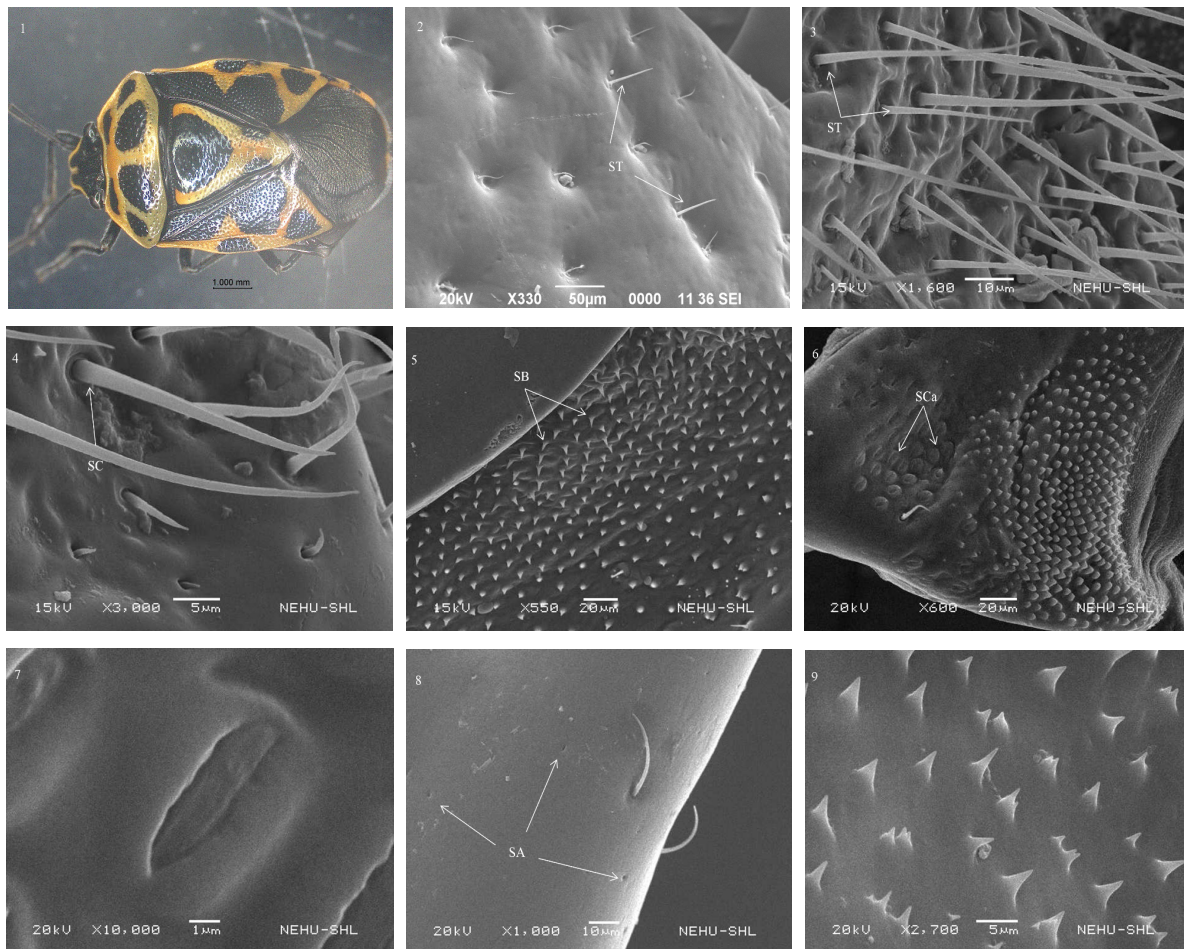
RESULTS AND DISCUSSION

Based on their morphology, distribution and cuticular attachment, five types of sensilla were identified. They were classified as: sensilla trichoidea (ST), sensilla chaetica (SC), sensilla basiconica (SB), sensilla campaniformia (SCa) and sensilla ampullacea (SA). No sensilla were observed on the membranous portion of the fore wing. Sensilla trichoidea (ST) are porous or aporous, ribbed or smooth, with a slightly rounded or sharp tip and flexible or inflexible sockets. These sensilla were observed in the fore wings (dorsal) in between the radius, media and corium of the wings (Fig. 1-3; Table 1). The structural features of the sensilla indicated that they function as mechanoreceptors (Thurm, 1964, 1965; Gaffal and Hansen, 1972; Altner et al., 1983; Gnatzy and Tautz, 1980; French and Sanders, 1981). Apart from its mechanosensory role, sensilla trichoidea also appears to play a chemosensory function.

Sensilla chaetica (SC) are stiff hair like structures that are long and straight with a blunt and tapering tip and are thicker than sensilla trichoidea. All of their stems are ribbed and arise from a cuticle with a flexible socket (Fig. 4; Table 1). These sensilla were observed on the fore wings and hind wings (dorsal side). Sensilla chaetica may play some mechanical role, since they have been shown to be non-innervated (Schmidt and Smith, 1985). Variety of insects representing different orders have been shown to be contact chemo-sensilla (Kaestner, 1972; Wigglesworth, 1972; Horn, 1982). In many cases these receptors also respond to the presence of dissolved carbohydrates (Anderson, 1932)

and are involved in the feeding responses of the insects. In *Eurydema dominulus*, the distribution pattern of sensilla Chaetica suggests that they are in contact with the substrate when the insect moves or stands. The porous nature of the sensilla as revealed by magnified SEM micrographs suggests their chemoreceptive role (Faucheux, 1991). In this context, it should be mentioned here that the contact-chemoreceptive function of sensilla chaetica has been previously demonstrated in some lepidopterans (Anderson and Hallberg, 1990).

Sensilla basiconica (SB) are cones that arise from flexible or inflexible sockets. Their surface may be porous or aporous. The stem of the sensillum is thick at the base and tapers upwards (Fig. 5; Table 1). Sensilla basiconica were observed on the dorsal side of the forewing and hindwing. Silva et al. (2010) suggested that this type of sensillum may be related to finding food or suitable habitats. Some authors have assigned a thermo- or chemoreception function to these sensilla (Chapman 1982, Zacharuk 1985). Sensilla campaniformia (SCa) are flat, oval shaped discs. They are sparsely distributed on anterior region of both the fore and hind wings and have flexible sockets (Fig. 6,7; Table 1). Campaniform sensilla were observed at the wing base on the dorsal side of forewing and hindwing. Sensilla campaniformia are also found on various parts of the insect's body such as wings, ovipositor, antenna, mouth parts and legs (Pringle, 1957). They result from cuticular stress due to compression and stretching of the surrounding cuticle. The campaniform sensilla has directional sensitivity which has been described by Pringle (1968) and Chapman (1965). The position and orientation of the sensilla in the joint or anterior region of the wings suggest that they monitor strains that develop during dorsal and ventral bending. In addition, campaniform sensilla could also provide information about the muscular force required to maintain a fixed relation between body parts despite changes in the insect's position relative to gravity (Horn, 1985). Sensilla ampullacea (SA) are pegs set at the bottom of a tube internally but appear as small round openings on the cuticular surface externally. Peg set at the bottom of long tube. Fore wings (dorsal & ventral) and hind wing (dorsal) are sparsely distributed by this type of sensilla (Fig. 8, 9; Table 1). However, it is known that pit organs or sensilla ampullacea function as carbon dioxide, temperature and humidity receptors in some Hymenoptera (Lacher, 1964). Similar roles can be assigned to the cuticular pits in the wings.



Figs. 1-9. 1. Adult of *Eurydema dominulus* (Scopoli), 2. Sensilla trichoidea (ST) on the non-membranous parts of fore wing, 3. Sensilla trichoidea on the base of the forewing, 4. Sensilla chaetica (SC) on the dorsal side of the forewing, 5. Sensilla basiconica (SB) on the dorsal side of hindwing, 6. Sensilla campaniformia (SCa) on the base of the dorsal side of fore wing, 7. SCa at higher magnification, 8. Sensilla ampullacea on the dorsal side of fore wing, 9. Spines-like structure (microtrichia) on the dorsal side of fore wing.

Table 1. Sensilla types, location, width and possible function- wings of *E. dominulus*

S. No.	Sensilla	Location	Length (µm)	Width (µm) Basal/ Distal	Possible function
I	Sensilla trichoidea	Forewings (dorsal & ventral)	25–35	1–3 / 0.5–0.8	Mechanoreception and chemoreception
II	Sensilla chaetica	Forewings (dorsal & ventral)	28.8–32.2	2.3–3.6/0.4–2.3	Mechanoreception
III	Sensilla basiconica	Fore & hind wings (dorsal & ventral)	2.3–2.5	1.5–1.8 / 0.2–0.4	Olfaction and Chemoreception
IV	Sensilla campaniformia	Fore & hind wings (dorsal)		5.4–6.3 (diameter)	Directional sensitivity and proprioceptive
V	Sensilla ampullacea	Fore wings (dorsal)		–	Thermo-hygro receptive

The sculpturing pattern of the cuticle in the form of some plates, spines like (microtrichia, Fig. 9) and folds observed in wings may serve to reduce friction between the cuticle and the surface of the plant part. This pattern may also facilitate accumulation of any secretion from the insect's body. It is believed that these cuticular structures are formed at locations on the insect's body where maximum forces of friction are generated (Amrine and Lewis, 1978). In this present study, five types of sensilla were identified, measured and characterized for the first time both the morphology and distribution of sensilla located on the wings of *Eurydema dominulus*. Thus, this study allows us to better understand the possible role and functions of each sensilla. Further studies using transmission electron microscopy coupled with electrophysiological recordings are likely to confirm the specific functions of different sensilla identified in this study.

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