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Ultramorphometrics of Sensilla in Maxilla of Honey Bee Apis cerana Fabricius

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ABSTRACT

Olfactory receptors are located in the antennae and maxillae with many sensilla found along the surface. Studies on ultramorphometric sensilla are more commonly found in the antennae. While studies on sensilla in the maxillae in bees are very few. Apis cerna as a local Asian bee has a widespread distribution in Asia and is used as a research object by utilizing the maxillae and maxillae palp. After being collected, preparations were carried out which were then identified with the help of an electron microscope. After observing the distribution, measurements were carried out using Image J. Basiconica type I and II sensilla were found in the maxillae of bees.*A. cerana*. The size of basiconia I sensilla is larger than type II with the most distribution found at the base of the maxilla rather than at the tip of the maxilla and maxilla palp. So that the study shows that the distribution and types of sensilla in the maxilla are more limited. This indicates the characteristics of sensilla in responding to food and their environment.

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1. INTRODUCTION

One type of honey bee that has a dominant distribution in Asia is Apis cerana, so this bee is known as the bee from the east. Apart from that, Apis cerana is also known as Asian Honeybee, Asiatic bee, Asian hive bee, Indian bee, Indian honeybee Chinese bee, Mee bee, Eastern honeybee, and Fly bee which shows that this bee is endemic to Asia. There are four subspecies of the bee A. cerana, namely A. c. cerana that spreads in Afghanistan, Pakistan, North India, China and North Vietnam. Apis cerana indica spreads in India, Sri Lanka, Bangladesh, Burma, Malaysia, Thailand, Indonesia and the Philippines. Apis cerana japonica is distributed in Japan, and A. c. Himalayas are found in the Himalayas (Ruttner, 1988).

Honey bees can choose the taste of food sources, collect resin, find water sources, and for nesting site recognition (DWI, 2023). The taste detectors are located around the hair cuticle where there are receptor cells and mechanoreceptors (Tinungki et al., 2023). Cuticular hairs can be found on the antennae, mouthparts and around the tarsals of the forelimbs (Widowati & Rinata, 2020). In the mouth section which consists of the mandible, maxilla and labium (Irawan, 2013; Setiabudi & Eliyani, 2021). In the maxilla, more types of chaetic sensilla were found to detect types of sugar such as sucrose, fructose and glucose than salt (NaCl) (Sanchez, 2011).

For morphological classification data and genetic differences, along with ecological and behavioral data, the A. cerana bee is very interesting to observe, such as observation data on the types of gustatory sensilla in the mouthparts such as the maxilla and maxilla palp, which are still

very rarely found (Koetz, 2013). In the maxillary palp of the A. florea bee, chaetic sensilla were found. While in the labial palp, variations of sensilla were found, such as chaetic sensilla, basiconic sensilla and cuticular plate-shaped sensilla (Kumar & Kumar, 2016).

Research on olfactory sensilla in A. cerana bees has so far only been found on the antennae. This research shows that the antennae of A. cerana bees have a large distribution of olfactory sensilla so that these bees are sensitive to the scent of flowers. The types of sensilla found were placodea, trichodea types A and B, and basiconica (Jung et al., 2014). Apart from that, types of trichodea C and D sensilla, campaniform sensilla, ampullacea and coeloconica were also found in the antennae of A. cerana bees (Ferawati, 2015).

Most of the sensilla in the mouthparts are associated with chemoreceptors, but in general mechanoreceptors and olfactory sensilla are often found in the palp. Where before starting to eat, insects first touch food using the sensilla at the tip of the maxilla to determine whether or not the food is accepted. This behavior indicates the presence of mechanoreceptor and olfactory sensilla structures. Therefore, it is necessary to identify the types of mouthparts sensilla such as the maxilla and palp maxilla of A. cerana bees (Neagu, 2009).

2. METHOD

The research was conducted at the Integrated Laboratory of IPB, SEM Laboratory of Widyasatyaloka Institute of Sciences (LIPI), Bogor and Animal Husbandry Laboratory, Faculty of Agriculture, Musamus University of Merauke. Apis cerana workers were collected from beehives around the campus of Bogor Agricultural University, Dramaga. Samples were collected as many as 10 individuals to avoid shortage of samples. The captured bees were put into 70% alcohol. A. cerana bees were cut using a scalpel to separate the maxilla from the head and body under a Stereo Microscope. The intact right maxilla was taken to proceed to the cleaning stage and ready for the SEM (Scanning Electrone Microscope) preparation process. After being prepared and gold coated, the sample was ready to be observed for sensilla on the maxilla and maxillary palp using a scanning electron microscope. Measurement of maxillary sensilla using imageJ (rsbweb.nih.gov/ij/download.html)

3. RESULTS AND DISCUSSION

Similar to the heads of other bee species, the head of A. cerana has mouthparts consisting of maxillae and maxillary palps as viewed with a stereo microscope at 40X magnification (Figure 1). In this study, the organ used is the right maxilla of the bee. The following is a picture of the anterior and posterior right maxilla (Figure 2) there is a maxilla palp that has 3 segments.

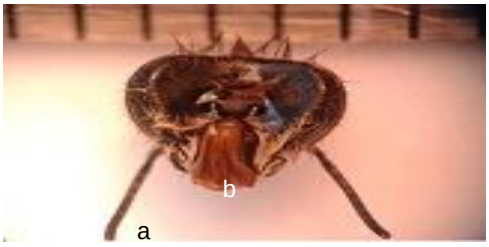

Figure 1. Intact head of A. cerana; a. shows antenna; b. shows the mouthparts of a bee

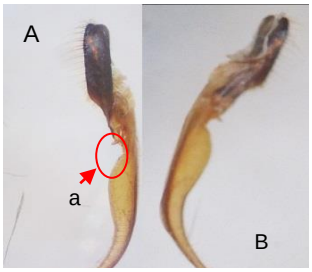

Figure 2. Right maxilla anterior (A) and posterior (B), there is maxillary palp (a)

*Scanning Electron Microscope*able to see the structure of the sensilla on the surface of the maxilla and the maxilla palp of Apis cerana workers. At the tip of the maxilla seen using an electron microscope found the distribution of several basiconica type I sensilla at a magnification of 377um X 350 (Figure 3) and a magnification of 26.4um X 5,000 (Figure 4).

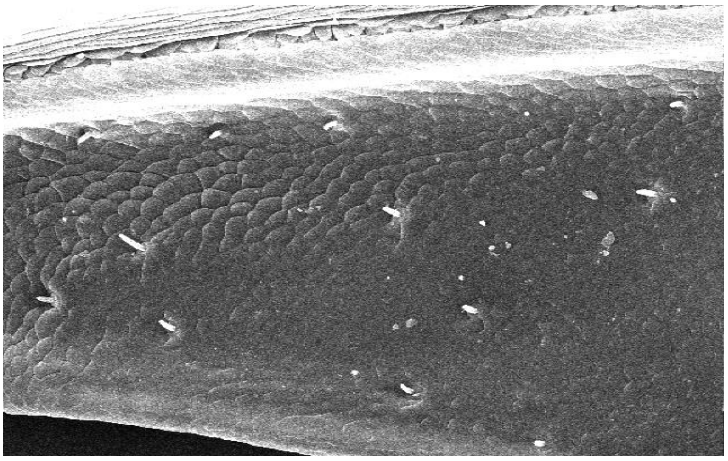

Figure 3. Distribution of sensilla at the tip of the maxilla of A. cerana bees (377µm X 350)

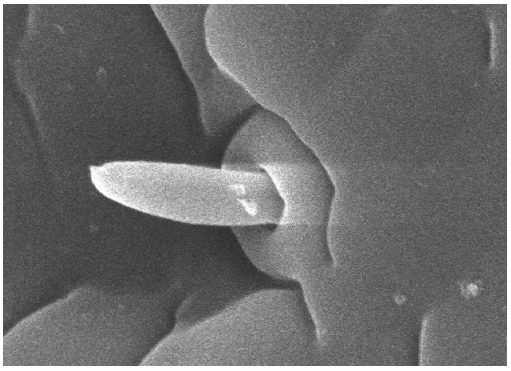

Figure 4. Magnification of Basiconica type I Sensilla (26.4µm X 5,000)

The distribution of sensilla at the base of the maxilla can be seen in the type I basiconica sensilla which are widely distributed (Figure 5). There are also maxillary palps which consist of three segments (red circle).

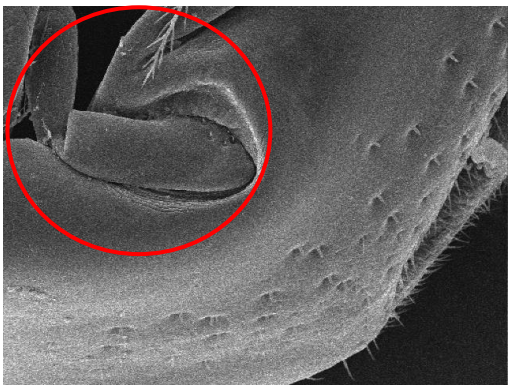

Figure 5. Distribution of sensilla at the base of the maxilla of A. cerana workers (377µm X 350)

Meanwhile, for the maxillary palp region, only basiconica type II sensilla were found at the base of the maxillary palp in small numbers (Figure 6). The series of sensilla in the maxillary palp of the fly (Neobellieria bullata) is very limited, only microtrichia sensilla and basiconica sensilla were found. The largest distribution of basiconica sensilla identifies that the maxillary palp physiologically functions in responding to variations in odor and taste from plants (Wasserman & Itagaki, 2003).

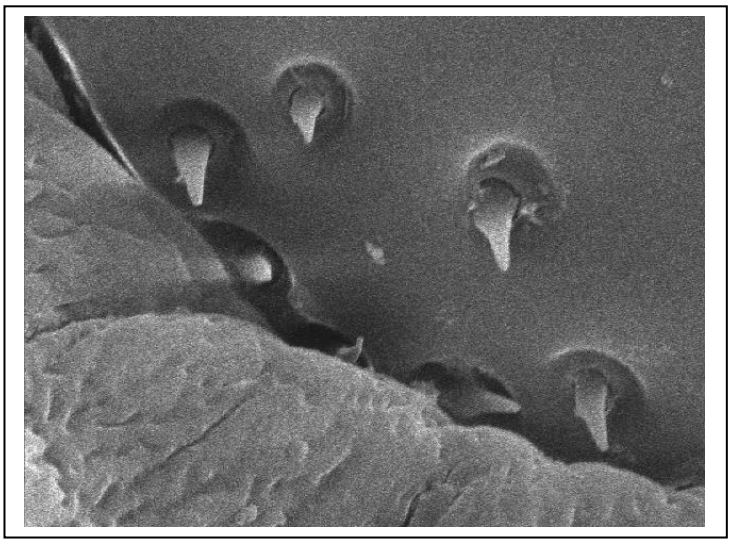

Figure 6. Distribution of sensilla distribution at the base of the Maxilla Palp of A. cerana workers (377µm X 350)

From the results of electron scanning, 2 types of sensilla were found in the maxilla and maxilla palp of A. cerana bees, namely basiconica types I and II. In the ultramorphological study of the mouthparts of A. florea bees, various types of sensilla were found, such as chaetica sensilla (A, B and C), basiconica, trichodea C and plate-shaped cuticular sensilla. The possibility of this type of difference is due to the object of this study not covering the entire mouthparts of A. cerana. However, basiconica sensilla were also found in the palp section which may be used as thermoreceptors and hygroreceptors (Kumar & Kumar, 2016).

After identifying the type of sensilla in the maxilla and maxilla palp, the image (photo) produced by SEM is then continued with sensilla measurement using the imageJ program to obtain data on the length and circumference of the sensilla. Then, the measurement data for the length and circumference of the sensilla from the maxilla and maxilla palp of A. cerana worker bees will be obtained in table 1 below:

Table 1. Ultramorphometrics of sensilla in the maxilla of the worker bee A. cerana

No	Mouth Part	Location	Sensilla Type	Length (µm)	Circumference (µm)
1	maxilla	end	Basiconica type I	15,951 ± 3,340	69,636 ± 27,138
		base	Basiconica type I	12,405±2,302	43,118±17,972
2	Maxillary palp	base	Basiconica type II	7,320 ± 1,717	16,800±9,445

From the table, the size of basiconica in the maxilla palp is smaller than the size of basiconica in the maxilla. This is an indication of the difference in basiconica types into types I and II. The average length of basiconica type II found in the maxilla palp is 7.30 µm which is also within the range of basiconica sensilla size found in A. mellifera bees in the maxilla palp area, namely 6-10µm. This could be an indication of the similarity of bees in responding to the type of food status (Whitehead & Larsen, 1976).

The maxilla of A. cerana has a very small diversity and number of sensilla. Research on sensilla on the maxilla palp found in insects Perla marginata, Dinocras cephalotes, perlodes microcephalus maxilla palp has little variation and the largest distribution at the base of the maxilla

and the base of the maxilla palp. With the type of sensilla in the maxilla of the animal is sensilla basiconica, sensilla chaetica with a very small number. For the size of the small sensilla basiconica is also found in the fly Lucilia cuprina (Hassan et al., 2013). So the types and distribution of sensilla found in the maxilla are fewer when compared to the antennae (Neagu, 2009).

4. CONCLUSION

This study can be concluded that the type of sensilla found in the maxilla and maxilla palp is the type of sensilla basiconica. At the tip and base of the maxilla, the sensilla found are sensilla basiconica type I. While for the maxilla palp area, sensilla basiconica type II was found. From the ultramorphometric calculation, the length and circumference of sensilla basiconica I were the largest with the most distribution found in the maxilla.

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