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Full Length Research Paper

The comparative study on adult surface ultrastructure of *Harmonia axyridis* Pallas (Coleoptera: Coccinellidae)

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Scanning electron microscopy was used to line scan 7 positions (pronotum, scutellum, elytra, abdominal sternites, head, maxillary palpus and labial palpus) of 11 Harmonia axyridis Pallas with different color patterns to make up for the lack of general morphological observation, and at the same time it was also used to further study the relationship of ultrastructure and predatory behavior of *Harmonia axyridis* Pallas to establish the important research foundation. The results show that the hair on the body of the elytra of the different *H. axyridis* directly stretches out from the surface of the hole and only few hairs on the body of the elytra stretched out from the concave surface of the elytra. Moreover, the hollow on the elytra edge increased significantly, though no two body hairs were produced on one hollow, and the granular material was borne on the first baseline web splices. It was observed that the hair densities of pronotum, scutellum, elytra, and abdominal sternites from the 11 types of *H. axyridis* Pallas showed some diversity. Likewise, the number of sensilla from the head, abdominal sternites, maxillary palpus, and labial palpus showed some differences. These findings highlight the fact that ultrastructure supplement was provided to the morphological aspect of *H. axyridis.*

Key words: *Harmonia axyridis* Pallas, body surface, the scanning electron microscopy (SEM).

INTRODUCTION

Harmonia axyridis Pallas, also called *Ptychanatis axyridis* or *Leis axyridis*, belongs to the Coleoptera Coccinellidae Synonychini *Harmonia*, which is also called *Leis*. This is important natural enemy of various pests, especially of arboreal aphids and scales. We had controlled *Matsucoccus matsumurae* (Kuwana), which damaged seriously *Pinus* spp. and caused major economic losses with *H. axyridis* Pallas in China and had achieved the desired effect (Liu, 1963; Pang et al., 2004). This insect has received increasing attention and it is studied thoroughly by geneticists because of its changing color patterns (Dobzhansky, 1924, 1933; Tan, 1946; Komai et al.. 1950; Geng and Tan, 1980). The argument regarding the difference between *H. axyridis* Pallas and *Harmonia yedoensis* (Takizawa) is manifested mainly on the ridge. Having a horizontal ridge before the end of the elytra is an important feature that distinguishes the *H. axyridis* Pallas from other members of the genera. In China, most *H. axyridis* Pallas have a horizontal ridge on the elytra proximal department. It had been pointed out that those without the ridge are *H. yedoensis* whereas those with the ridge are *H. axyridis* Pallas (Pang, 1984). The presence or absence of the ridge on the elytra end of *H. axyridis* Pallas from different regions is thought to be a geographical variation (Liu, 1963). However, other geneticists think that the presence of the ridge is controlled by Mendelian inheritance, which states that the one with the ridge is dominant whereas the other without the ridge is recessive, and that they are all *H. axyridis* Pallas (Liu, 1963; Geng and Tan, 1980). Mader (1932) classified *H. axyridis* Pallas into 93 varieties, whereas Korshefsky divided them into 105 varieties in the category list that he edited (Korshefsky, 1932). In China, *H. axyridis* Pallas beetles with black background are divided into 2 categories with 62 patterns whereas those with yellow background are divided into 11 categories with 33 patterns (Tan and Li, 1932-1933).

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The varieties amounted to 95 patterns in all (Tan and Li 1932-1933). Research on *H. axyridis* Pallas has currently become very popular. The research done by Chinese scholars focused on finding and naming the color patterns of *H. axyridis* Pallas. Luo (1960) reported that the number of colors and patterns on the elytra of *H. axyridis* Pallas found in Shenyang and Gongzhuling was more than 50. The 1393 *H. axyridis* Pallas collected in Huairou and Yanqing Counties in Beijing were identified and classified into 50 varieties (Wu, 1987). Yuan et al. (1994) not only reported 176 varieties found in Changbai Mountain, but they also named each variant of *H. axyridis* Pallas with yellow background by spot serial numbers and mark nomenclature.

There is little research on the electron microscopic observations of the insects' surface, maxillary palpus, and labial palpus. The form and sensor types of the maxillary palpus and the labial palpus have only been described in *Anoplophora glabripennis* (Motschulsky), *Monochamus alternatus* Hope., *Rammeacris kiangsu* (Tsai) (Zhang et al., 1999, 2001, 2002; Lu et al., 2002; Ning et al., 2004; Xu and Shi, 2004). The fine structure of the surface of *Henosepilachna vigintioctomaculata* (Motschulsky), *Henosepilachna vigintioctopunctat* (Fabricius), and *Coccinella septempunctata* L. were comparatively studied by Zhang et al. (1999, 2002). The study showed that there were minor differences among the fine structures on the body of ladybird beetles. These differences can be used as the auxiliary means for its classification (Zhang et al., 1999, 2001, 2002).

The high resolution and 3D image of the scanning electron microscopy (SEM) clearly shows the subtle structures on the body, which are difficult to observe and describe using general morphological means. The SEM was used to observe the fine surface structures of *H. axyridis* Pallas. This insect is easy to capture and the artificial feeding is simple, thus observing basic biological phenomena like mating, oviposition, hatching and larvae growth, molting, pupation and others is easy. Not only has smooth testing provided certain theoretical and practical evidence for classification research and use of the different color patterns of *H. axyridis* Pallas, but it can also be used to complement shape classification research. In addition, as a pleomorphic insect, *H. axyridis* Pallas is a very important experimental subject in genetics, molecular systematics, and molecular biology research, and has profound significance in basic theoretical exploration.

MATERIALS AND METHODS

Insects

The materials used in the experiment were collected from the MaoEr Mountain experiment forest of the Northeast Forestry University. Eleven different color patterns of *H. axyridis* Pallas were tested according to the classification criteria of Yuan et al. (1994) as shown in Table 1.

One male *H. axyridis* Pallas was chosen from each color pattern. It was first washed with ddH_2O, then 0.4 kg/L NaOH solution, and then 0.2 kg/L NaCl solution. The head, pronotum, scutellum, elytra, abdominal sternites, maxillary palpus, and labial palpus were removed using tweezers under the SMZ-140. These parts were ultrasonically cleaned in 70% ethanol for 10 min, then dehydrated in glutaraldehyde (2.5%) (v/v), and fixed for 12 h. After fixation, the specimens were immersed thrice in phosphoric acid buffer (pH = 7.4) for 20 min. After 3 to 4 times of cleaning with ddH_2O, the specimens were dehydrated using 30, 50, 70, and 90% ethanol for 10 min at each concentration. They were finally dewatered for 20 min with 100% ethanol. After dehydration, the specimens were then cleaned for 20 min in acetone and were left to air dry (Chi et al., 2009). The samples to be scanned were attached to the SEM stage with conductive adhesive, sprayed with gold, and then observed using SEM (QUANTA FEI-200) at an accelerating voltage of 10 kV. The number of hairs of each specimen was observed and the differences between the color patterns of the *H. axyridis* Pallas were compared according to the area statistics.

RESULTS

Comparison and observation of the different parts of the surface of *H. axyridis* Pallas

Pronotum

There were many "dots" on the surface of the pronotum of *H. axyridis* Pallas. The results on morphological classification showed that the size and density of the dots are characteristics for morphological classification. There are slender hairy structures with about 60 to 100 μm in the lower part of the leading edge between the pronotum and head capsule. Considering the behavior of ladybirds, this kind of structure can avoid friction between the head capsule and pronotum and acts as a buffer agent when there is prey (Figure 1). There were 2 or 3 rows of structures similar to the styloconic sensillum on the edge of the pronotum (Figure 2). The number of "dot" (body hair) of the different color patterns of *H. axyridis* Pallas were statistically analyzed in the 300 μm × 300 μm area selected from the pronotum center (front, middle, trailing edge) to the pronotum edge (upper, lower) (Table 2). The density of the "dot" in the pronotum edge was more than the density in the pronotum center, and the density of the "dot" in pronotum of *H. axyridis* Pallas on a yellow background was higher than in *H. axyridis* Pallas with black background. Among the samples, the "dot" density in the pronotum of yellow background *H. axyridis* Pallas without spot was maximal, whereas the "dot" density in the pronotum of yellow background *H. axyridis* Pallas with 18 spots was minimal.

Scutellum

Scutellum is the inverted triangle with the bottom edge slightly longer than the side. The scutellum is located below the pronotum and between the two elytra. There is only one kind of body hair on the scutellum, those that

Table 1. Testing various *H. axyridis* Pallas.

Product description	Latin name
2 spots of black background	*H. axyridis* ab. *conspicua* Fald
eye spot of black background	*H. axyridis* ab. *circumscripta* Hem
4 spots of black background	*H. axyridis* var. *spectabilis* Fald
bimonthly spot of black background	*H. axyridis* ab. *lunata* Hem
the band of variant type	*H. axyridis* ab*. transverifascia.* Bar
without spot of yellow background	*H. axyridis* ab. *succinea* Hope
2 spots of yellow background	*H. axyridis* ab.1347-*octosignata* Yuan
16 spots of yellow background	*H. axyridis* ab.12345678- *sedecimsignata* Mls
18 spots of yellow background	*H. axyridis* ab.123456789—*duodevigintisignata* (Mls.) Yuan
19 spots of Yellow background	*H. axyrisdis* ab.½123456789-*undevigintisignata* Fald
name repetition of variant species	*H. axyridis* var. *axyridis* Pallas

Table 2. The density of “dot” on the surface of the pronotum.

Variant	Pronotum center			Pronotum edge		Total
	Front	Middle	Trailing edge	Upper	Lower	
Without spot on a yellow background	68	59	51	59	50	287
2 spots on a yellow background	44	30	48	39	55	216
16 spots on a yellow background	53	49	43	43	55	243
18 spots on a yellow background	21	15	21	21	13	91
19 spots on a yellow background	44	45	32	56	32	209
2 spots on a black background	41	39	27	50	41	198
4 spots on a black background	51	41	32	62	78	264
Bimonthly spot on a black background	36	67	24	46	44	217
Eye spot on a black background	39	40	29	36	26	170
The band of variant type	21	24	36	21	13	115
Name repetition of variant species	53	39	53	60	40	245

stretched out of the holes directly. The body hair in the center of the scutellum is uniformly distributed, whereas the distribution is denser on the sides that connect the elytra (Figures 3 and 4). As shown in Table 3, under SEM, the number of microhairs (dots) on the small scutellum of the band of variant type was highest, the number of microhairs (dots) on the scutellum of the species with 4 spots on a black background was the least (22), and the number of other types of micro-hairs (dot) was between 25 to 33 n. The ratio of the bottom length and the side length was highest in the scutellum of the sample with 16 spots on a yellow background and the ratio was least for the sample with 2 spots on a yellow background.

Elytra

In the preparation of the elytra of the scanning specimens, the necessary parts to be observed were divided into six: upper left, upper right, left, right, lower left, and lower right (Figure 5). The elytra structure was divided into two kinds. One is the micro-hair with a length of 8 μm, which was developed in the depression structure and located in the center (Figures 6 and 7). The other kind is the salient spot. The top of the salient spot mushroomed. There were obvious boundaries on the surrounding epidermal tissue. This was a kind of epidermal salient structure that may be related with the secretion of pheromones of the epidermal tissue (Figure 8). The depressed structure on the edge of the elytra was bigger (Figure 9). The number of “dots” in a 300 μm × 300 μm area on the six parts of the elytra (upper left, upper right, middle left, middle right, lower left, and lower right) is shown in Table 4. The density of the left “dot” (body hair) on the elytra was larger than the right. The density of the “dot” on the upper right of the elytra was the highest, whereas the density of the “dot” on the right was the least. The density of the “dots” on the elytra of *H. axyridis* Pallas with black background was higher than that of the species with the yellow background. Also, the number of the “dot” on the elytra of the eye spot with black background was the largest. The number of “dots” on the elytra of name repetition of variant species was

Table 3. Comparison of the length of each side and number of scutellum on eleven phenotypes.

Variant	Length of the bottom side (μm)	Length of the side (left) (μm)	Length of the side (right) (μm)	Mean of the side (μm)	The ratio of the bottom side and side	The number of microhairs
Without spot on a yellow background	449.32	366.24	374.12	370.18	1.214	25
2 spots on a yellow background	344.34	333.88	319.42	326.65	1.054	30
16 spots on a yellow background	384.14	292.04	273.53	282.79	1.358	25
18 spots on a yellow background	401.81	311.18	329.86	320.52	1.254	28
19 spots on a yellow background	387.33	310.52	300.98	305.75	1.267	33
2 spots on a black background	420.71	353.10	345.32	349.21	1.215	29
4 spot on a black background	449.95	354.74	365.32	360.03	1.249	22
Bimonthly spot on a black background	355.91	289.31	297.86	293.59	1.212	25
Eye spot on a black background	369.68	289.26	286.86	288.06	1.283	31
The band of variant type	439.65	345.21	337.90	341.56	1.287	41
Name repetition of variant species	450.44	344.48	349.80	347.14	1.298	28

Table 4. The density of dot on the surface of elytra.

Variant	Upper left	Upper right	Left middle	Right middle	Lower left	Lower right	Total
Without spot on a yellow background	40	35	42	22	29	23	191
2 spots on a yellow background	38	37	33	22	34	23	187
16 spots on a yellow background	34	32	28	28	40	30	192
18 spots on a yellow background	21	33	21	20	28	30	153
19 spots on a Yellow background	35	31	29	30	27	28	180
2 spots on a black background	31	39	47	29	35	23	204
4 spot on a black background	36	40	31	27	12	21	167
Bimonthly spot on a black background	37	22	27	26	33	30	175
Eye spot on a black background	23	49	34	39	33	34	212
The band of variant type	31	32	28	30	41	35	197
Name repetition of variant species	24	34	22	12	27	27	146

the fewest among the 11 different color patterns of *H. axyridis* Pallas.

Abdominal sternites

The abdominal sternites of *H. axyridis* Pallas is composed of six sections. Sections 5 and 6 are the most important abdominal sternitess for classification and are often used as a reference feature to differentiate between males and females. The arc on the edge of abdominal sternites 5 and the central semicircle on the edge of abdominal sternites 6 were concave for males. The arcs on the edge of abdominal sternites 5 and on the middle of abdominal sternites 6 were salient for females. Under SEM, there were dense micro-hairs on the surface of the abdominal sternites perforation (Figures 10 and 12). The microhairs on the edges of the abdominal sternites were slightly longer, and when the internal microhairs were short, they were not obvious. In the intermediate department of salience on the first abdominal sternites, some small concave nests replaced the microhairs (Figure 11).

The granular material was also observed using SEM. It could be secretion based on its shape and arrangement (Figure 13). It was found that there were no granular secretions on the surface of the microstructure of the abdominal sternites of female *H. axyridis* Pallas and the micro-hairs were thick types (Figure 14); there were granular structures on the surfaces of the abdominal sternites of the male *H. axyridis* Pallas (Figure 15).

Head

The head of the *H. axyridis* Pallas often retracted below the pronotum. Therefore, the front-end head can only be seen from the back of the insects. There is a pair of compound eyes, a pair of antennae, and a pair of maxillary and labial palpi on the head. The sensor type

Table 5. The density of dot on the head.

Variant	The sensilla chaetica of head front-end	The sensilla chaetica of the sensilla chaetica
Without spot on a yellow background	34	8
2 spots on a yellow background	12	5
16 spots on a yellow background	22	5
18 spots on a yellow background	27	6
19 spots on a Yellow background	24	6
2 spots on a black background	42	5
4 spot on a black background	31	7
Bimonthly spot on a black background	28	7
Eye spot on a black background	20	6
The band of variant type	30	7
Name repetition of variant species	41	7

on the head is one fold, predominantly sensilla chaetica (Figure 16). These were mainly distributed in the head front-end and behind the compound eyes (Figure 17), although a few were found on the side of the compound eyes (Figure 18). In addition, micro-hairs were distributed between the compound eyes (Figure 19). The sensilla of the front-end head and the side of the compound eye of the different *H. axyridis* Pallas are shown in Table 5. The body hair on the front-end head was more than that around the compound eyes. The body hair on the front-end head was the most for the variant with 2 spots on a black background and the least for the variant with 2 spots on a yellow background. The number of body hairs around compound eye was 5 to 8, whereas it was 12 to 42 on the front-end head.

The observation and comparison of maxillary palpus and labial palpus of *H. axyridis* Pallas

Maxillary palpus

The maxillary palpi were divided into four sections in an adult *H. axyridis* Pallas. Ax-shaped, the paratelum is flourishing and flat (Figure 20). There is also a longitudinal groove on top. The width is also different from front to back, with both ends slightly wider while the central part is slightly narrower. There are spine-like protuberances on the groove (Figure 21). Similar to the antenna, the dorsal and ventral sides of the maxillary palpus are not symmetrical. There are also a larger number of ventral sensilla.

Three sensors were observed in this study: sensilla chaetica (ch), sensilla trichodea (tr), and styloconic sensillum (st) (Yan et al., 1987). In addition, some special structures were discovered in the paratelum (Figure 25).

(1) Sensilla chaetica (ch): a sensor mainly distributed on the maxillary palpus, about 40 μm in length (Figure 22).

(2) Sensilla trichodea (tr): distributed on both sides of the groove on the paratelum top, about 2 μm in length (Figure 23).

(3) Styloconic sensilla (st): located on the paratelum top and the groove and was about 1 to 2 μm in length (Figure 24).

The statistical analysis was done on the maxillary palpus sensilla chaetica (ch), sensilla trichodea (tr), and the special structure (Table 6). The number of sensilla in the band of the variant types with 2 spots on a black background, and 16 spots on a yellow background were larger, whereas the number of sensilla in name repetition of variant species, bimonthly spot on a black background, 19 spots on a yellow background, eyespot on a black background was fewer. The difference between the numbers of sensilla chaetica was about 20, whereas the difference in sensilla trichodea was much lower. The number of unknown structures for the 2 spots on a black background, 2 spots on a yellow background, and eye spot on a black background was more (8 to 9), whereas for the bands in the variant type with 16 spots on a yellow background number is less (3 to 4). The styloconic sensillum was not included in the results because of its large number and distribution.

Labial palpi

The labial palpus is divided into three sections. There are also three kinds of sensors: sensilla chaetica (ch), sensilla trichodea (tr), and styloconic sensillum (st) (Yan et al., 1982).

(1) Sensilla chaetica: about 110 to 120 μm in length. There were 3 to 4 sensilla chaetica in the second section located on the abdominal side with an approximately linear arrangement. There was only one in the third section, also located in abdomen side (Figures 26 and 29).

Table 6. The statistic of the sensilla and structure on the maxillary palpi.

Variant	Sensilla chaetica (ch)	Sensilla trichodea (tr)	Special structure	Total
Without spot on a yellow background	70	26	7	103
2 spots on a yellow background	77	10	8	95
16 spots on a yellow background	80	8	3	91
18 spots on a yellow background	70	7	5	82
19 spots on a yellow background	62	8	6	76
2 spots on a black background	82	30	9	121
4 spot on a black background	72	21	6	99
Bimonthly spot on a black background	65	9	7	81
Eye spot on a black background	52	7	8	67
The band of variant type	89	6	4	99
Name repetition of variant species	68	5	6	79

Table 7. The statistics of sensilla on the labial palpus.

Variant	Sensilla chaetica (ch)	Sensilla trichodea (tr)		Total
		tr1	tr2	
Without spot on a yellow background	4	12	25	41
2 spots on a yellow background	2	14	6	22
16 spots on a yellow background	3	20	4	27
18 spots on a yellow background	5	14	6	25
19 spots on a yellow background	4	10	5	19
2 spots on a black background	5	14	26	45
4 spot on a black background	5	10	23	38
Bimonthly spot on a black background	4	14	3	21
Eye spot on a black background	5	11	4	20
The band of variant type	2	16	4	22
Name repetition of variant species	2	11	4	17

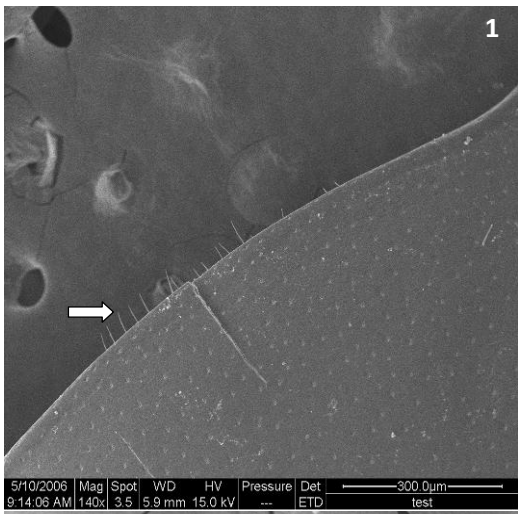

Figure 1. The front edge of pronotum.

(2) Sensilla trichodea: divided into two kinds; sensilla trichodea 1 (tr1), about 10 μm in length, mainly located in the second section of the labial palpus and outside the dorsal (Figure 27), and sensilla trichodea 2 (tr2), about 2 μm in length, distributed in the paratelum of the labial palpus (third section). They are both the dorsal and ventral (Figure 28).

(3) Styloconic sensillum: distributed on the surface and top of the third section of the labial palpus, especially on the top. It was reported that it was a kind of taste sensor (Figure 29).

The statistical analysis of the labial palpus, sensilla trichodea 1 and sensilla trichodea 2 are shown in Table 7. There was no significant difference between the structure of the labial palpi and the sensor types among the 11 different color patterns of *H. axyridis* Pallas. However, there was a slight significant difference between the number of sensilla chaetica and sensilla trichodea. The sensor of the variant with 2 spots on a black background was the most whereas the sensor of the name repetition of variant species distributed was the least. The styloconic sensillum was not included in the

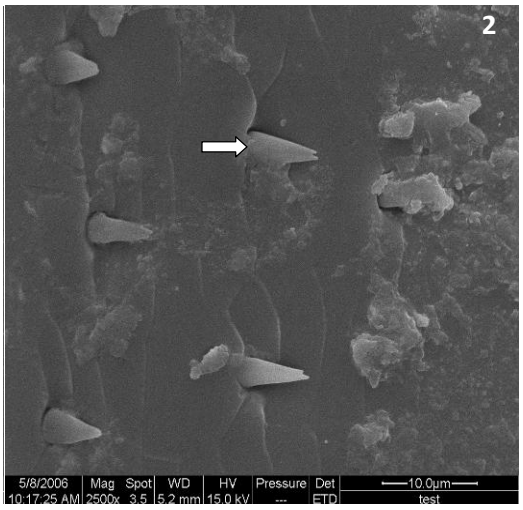

Figure 2. The back edge of pronotum.

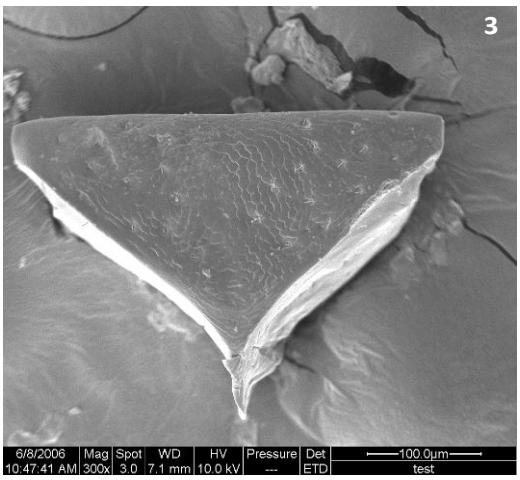

Figure 3. Scutellum.

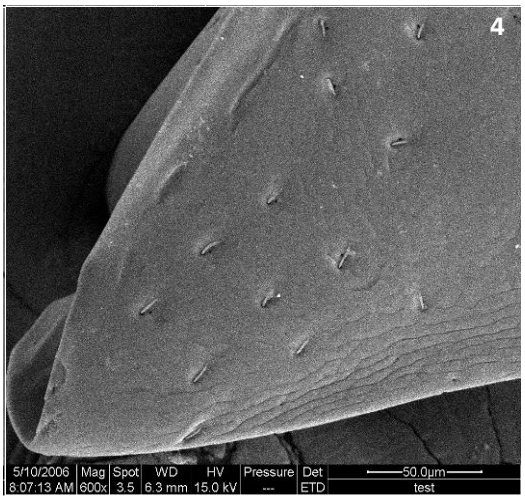

Figure 4. The magnification of scutellum.

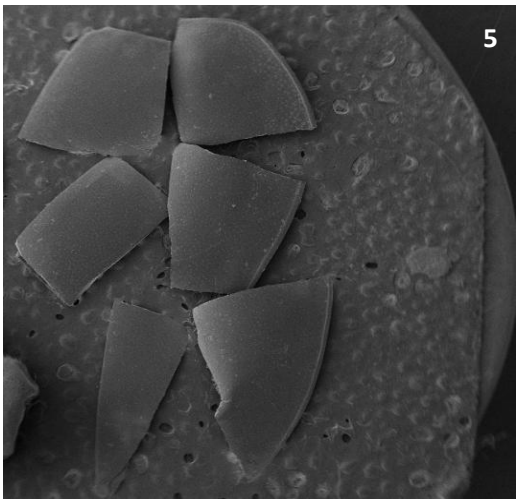

Figure 5. The panorama of elytral.

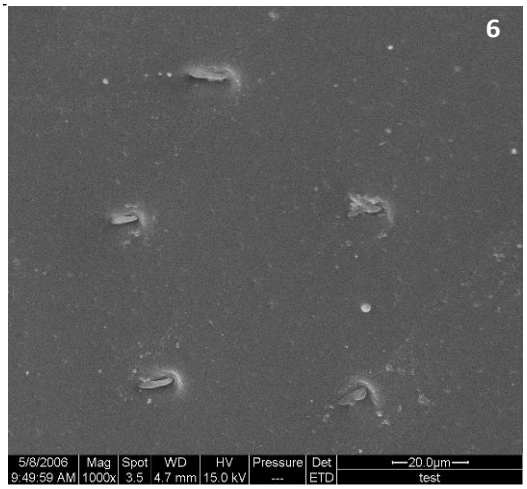

Figure 6. The surface of elytral.

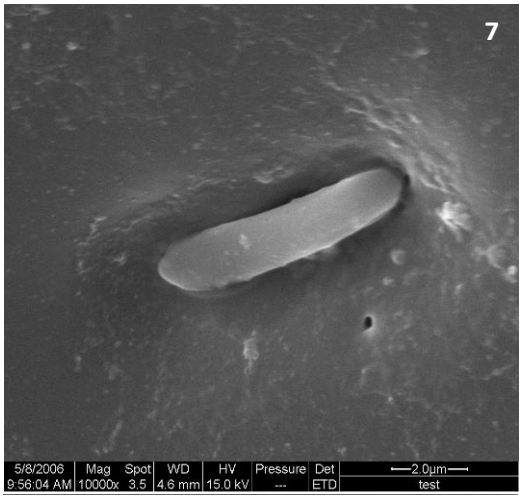

Figure 7. The pilue on the elytral.

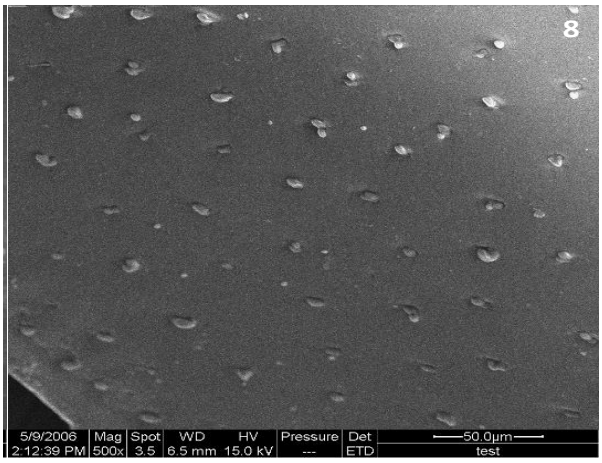

Figure 8. The tumulus.

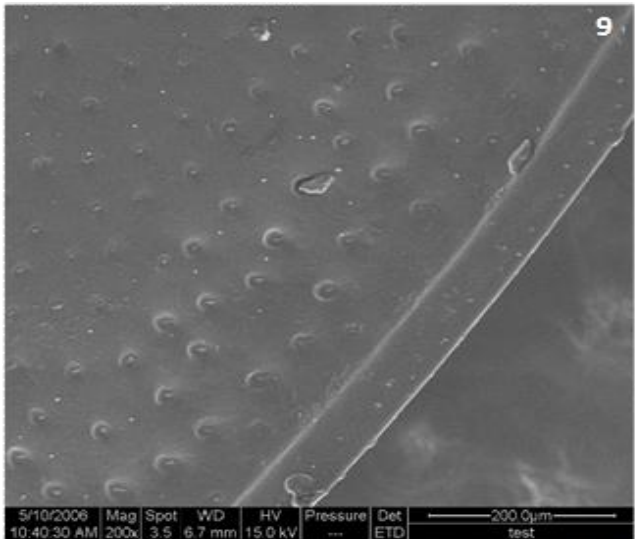

Figure 9. The edge of elytral.

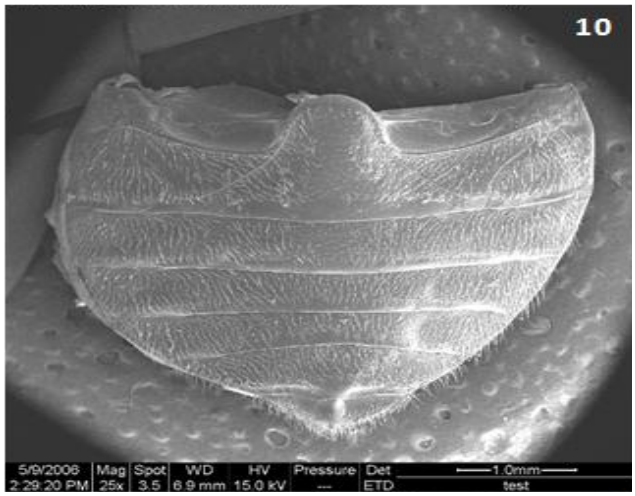

Figure 10. The entire abdominal sternites.

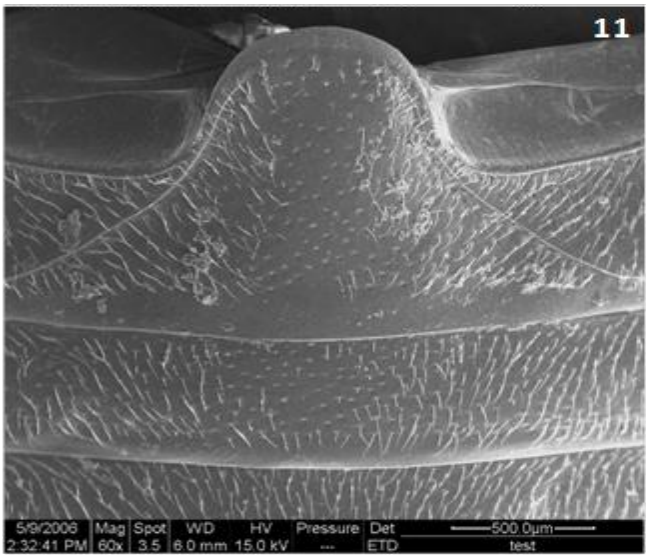

Figure 11. The 1st abdominal sternites.

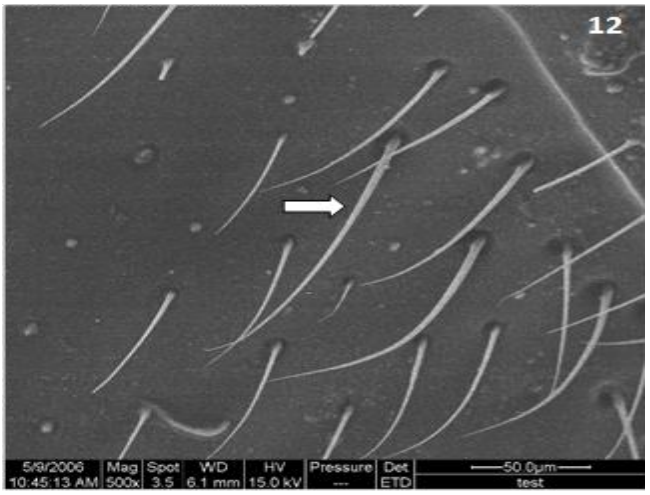

Figure 12. The hair of sternites.

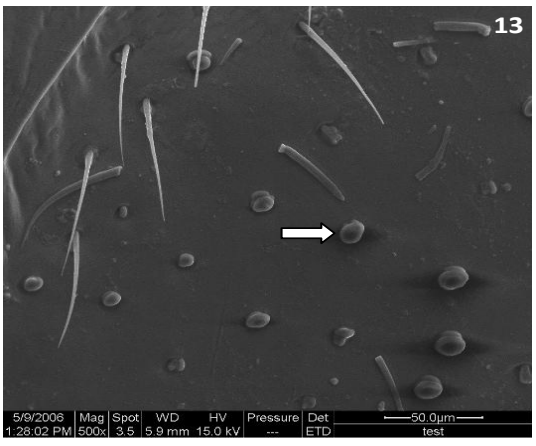

Figure 13. The tumulus of sternites.

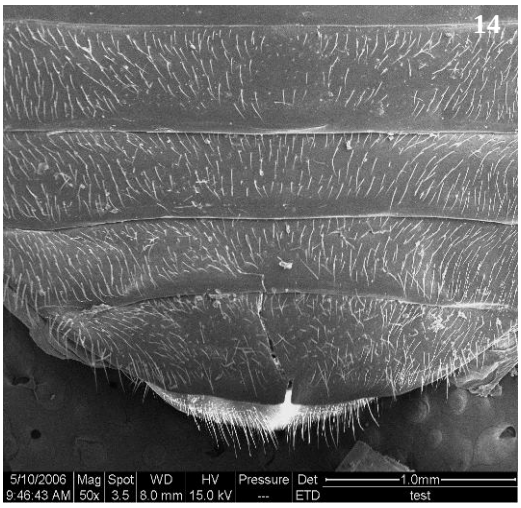

Figure 14. The terminal of abdominal sternites.

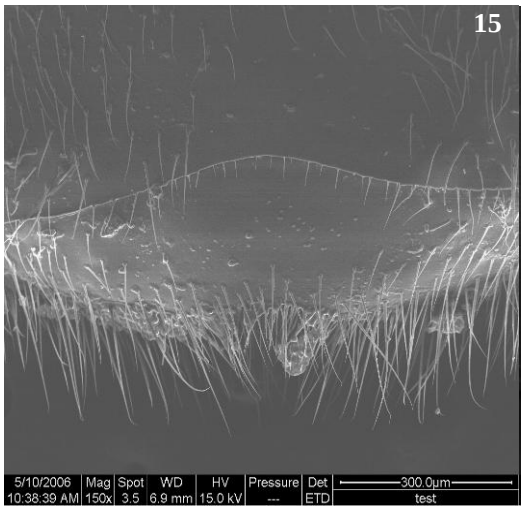

Figure 15. The terminal of abdominal sternites.

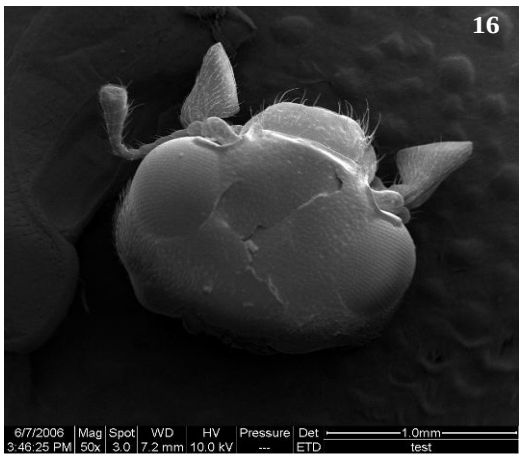

Figure 16. The entire cobbra.

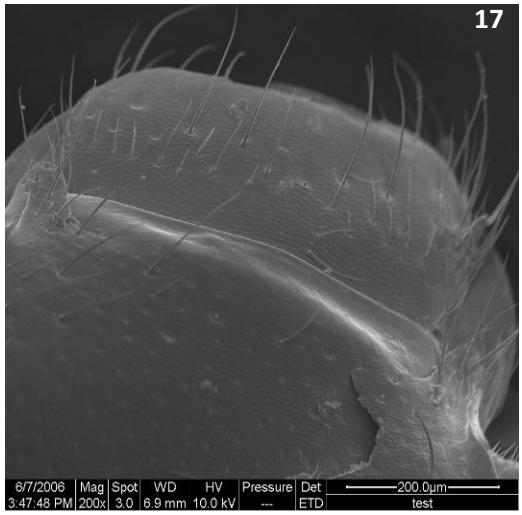

Figure 17. The hair on the front of cobbra.

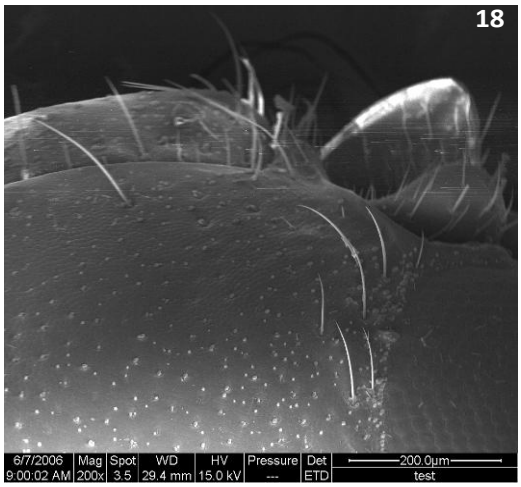

Figure 18. The hair around the eyes.

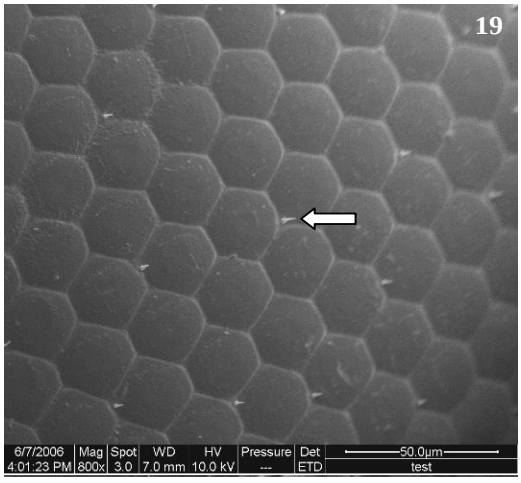

Figure 19. The hair interspace the eyes.

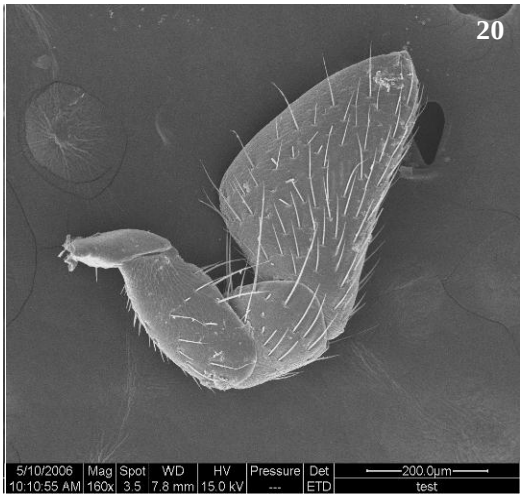

Figure 20. The entire maxillary palpus.

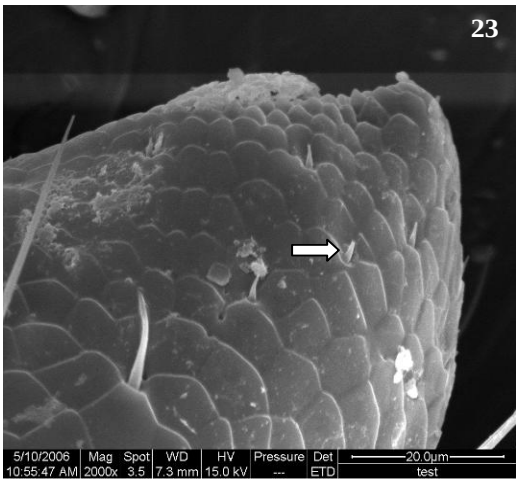

Figure 23. The groove on the apical segment.

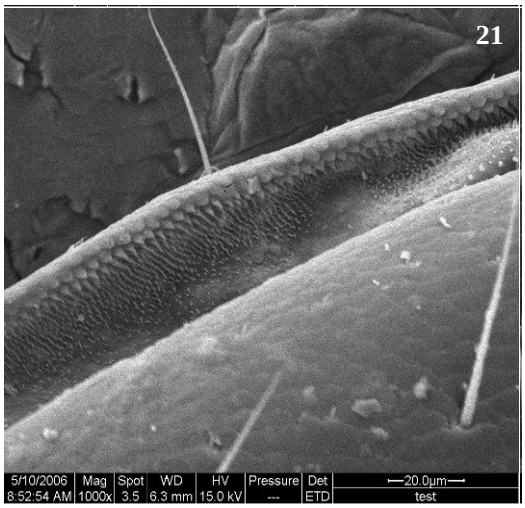

Figure 21. Sensilla trichodea.

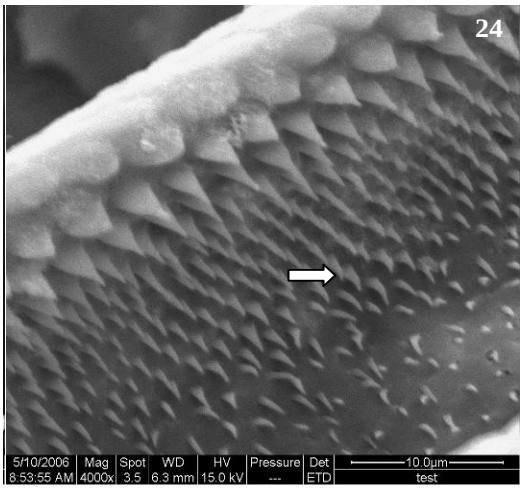

Figure 24. Sensilla styloconic.

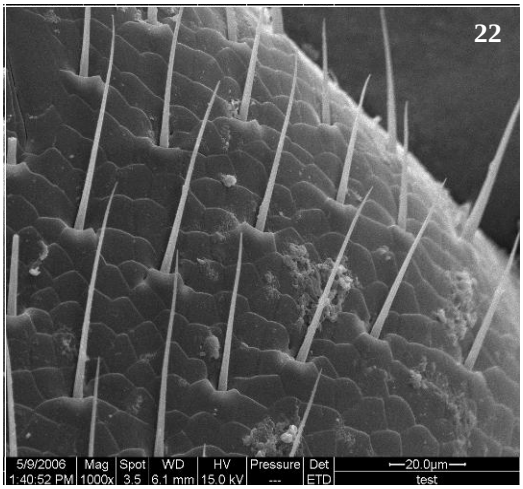

Figure 22. Sensilla chaetica.

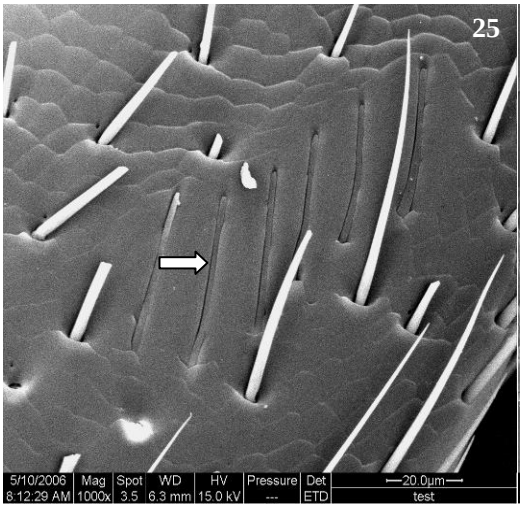

Figure 25. The special structure.

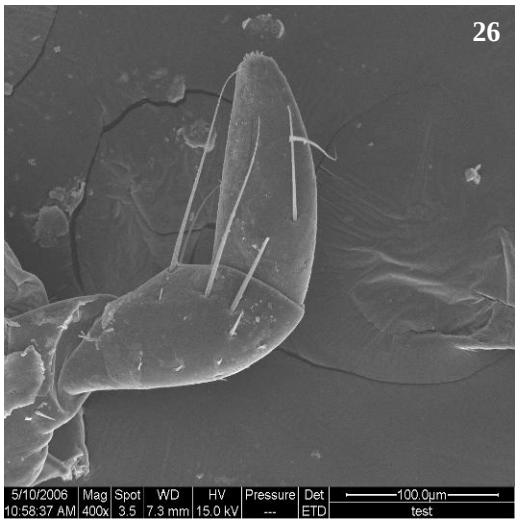

Figure 26. The ventral side of labial palpus and sensilla chaetica.

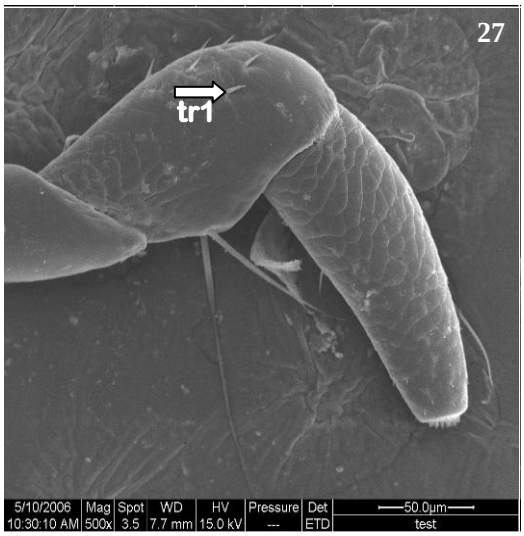

Figure 27. The dorsa side of labial palpus and sensilla trichodea type I.

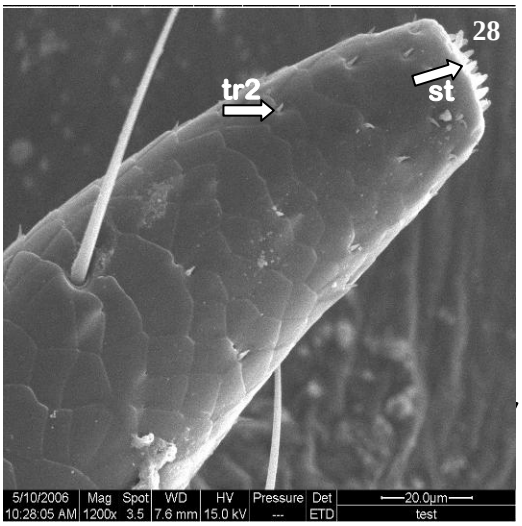

Figure 28. The terminal segment, sensilla styloconic and sensilla trichodea type 2.

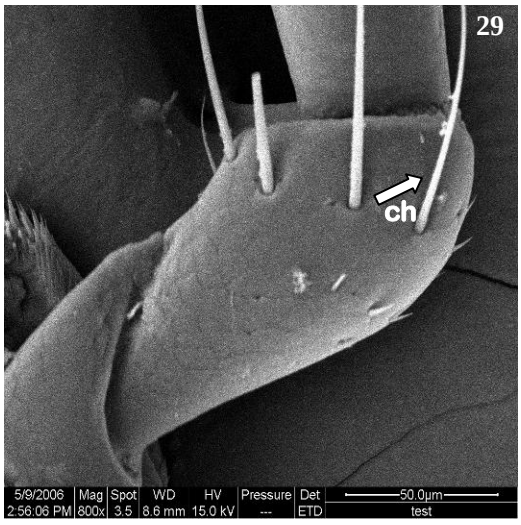

Figure 29. The second segment of labpalpus.

results because of its large number.

DISCUSSION

The magnifier, dissecting microscope, optical microscope, and other tools combined with the general classification of morphological and anatomical structures, both domestic and foreign, were used to study *H. axyridis* Pallas. Tan (1946) thought that the coleopteran colors of *H. axyridis* Pallas are black, khaki, red or orange. After the vivo *H. axyridis* were made into dried specimens, the color of the elytra turned to yellow from red or orange after a month. This is the same as the phenomenon observed when saving the specimens in the testing process. The color of the elytra turned yellow because of the oxidation in the air or the chemical changes in their body. Either way, it showed that the pigment contained in the yellow, orange, or red elytra is of the same kind of material. Therefore, according to the classification, the elytra are sufficient for classification into two-color types: the black and yellow types. This is one of the bases that we followed in our trial for selecting specimens.

At present, there is no documented research on the surface structures of *H. axyridis* Pallas. We observed that the surface fine structures, the labial and maxillary palpi of *H. axyridis* Pallas under SEM were consistent with the previous description. There were two hairs in one depression on the edge of the elytra in two ladybirds used in the comparative study of the surface fine

structure between *H. vigintioctomaculata* and *H. vigintioctopunctat* by Zhang et al. (2002). This result was not found in the scanned observation of *H. axyridis* Pallas. Regarding the insertion of body hairs in the depression of the elytra, Holloway (1985, 1997) had done similar studies with the Anthribidae and Lucanidae families, as well as other insects. They thought that the depth of the grooves and the insertion of the body hairs could be a basis for classification (Holloway, 1985, 1997).

Sensilla trichodea have different functional types; for instance, they are usually responsible for pheromone reception in the antennae of Lepidoptera (Hallberg et al., 1994). Sensilla trichodea are observed in the labial palpi and maxillary palpus of *H. axyridis,* as for the aggregative habit and research prey of *H. axyridis*, we assumed that Sensilla trichodea are responsible for their aggregative and predatory behavior, they may be pheromone receptors.

Functionally, sensilla chaetica have been ascribed to mechano- and chemore-ception in the coccinellids (Broeckling and Salom, 2003). The sensilla chaetica of *Psylliodes chrysocephala* is suggested to be in contact with chemosensilla that responds to chemicals presented in plant surface waxes when it comes in contacts with a leaf having antennae (Isidoro et al., 1998). The sensilla chaetica herein described resembles those of other insects and are abundant in the labial palpi and maxillary palpus of *H. axyridis*. It is premature to assign any particular function to these sensilla.

There was no obvious difference between the depth of the grooves on the elytra and the position of the body hair in all 11 different variants of *H. axyridis* Pallas. Therefore, it could not be used as a basis for classification. Whether the depth of the grooves on the elytra and the insertion of the body hair can be used as the basis of classification remains unclear. In addition, under SEM granular material was observed on the male web splices baseline. These materials are likely secreted substances based on their shape and arrangement. Some material similar to granular secretions with uneven sizes and varying shapes were also found. The composition and the role of these secretions are not known hence, further studies are needed.

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