

**OLFACTORY RESPONSES OF *AULACOPHORA FOVEICOLLIS* LUCAS – AN ECOLOGICALLY IMPORTANT PEST - FROM WEST BENGAL, INDIA****Kakali Bhadra***University of Kalyani, Zoology Department, Kalyani, India*

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Abstract

Pumpkin, *Cucurbita maxima*, is severely harmed by *Aulacophora foveicollis* Lucas (Coleoptera: Chrysomelidae), as a major insect pest of the plant. Based on Scanning electron microscopic analysis, compared to mechanosensilla, prevalence of antennal olfactory sensilla, was observed. The number of olfactory sensilla in the circumferential band of IXth antennal segment was higher in female species. Stimulation of the sensilla present on the antennae of *A. foveicollis* was analyzed by electroantennogram (EAG) at four different concentrations viz. 10.0, 5.0, 1.0, and 0.1 mg/ml in both sexes. The male species displayed greatest peak amplitude at 5mg/mL for heneicosane, whereas the female species displayed maximum peak amplitude at 10.0 mg/mL for 2-methyl phenol followed by 5.0 mg/mL for 1,4-dimethoxybenzene. However, pooled EAG data revealed that GLV elicited the strongest reactions, followed by aliphatic chemicals, oxygenated monoterpenes, hydrocarbon monoterpenes, and sesquiterpenes. These findings univocally shows that the pest's antennal responses clearly displayed sexual dimorphism.

Keywords: Electroantennogram, volatile organic compounds VOCs, SEM**Introduction**

Plants interact with insects through release of various allelochemicals or volatile compounds. It is generally the highly developed olfactory sensory system of the antennae of insects, used for the perception of these volatile compounds in the environment. Electroantennogram (EAG) is being used to register these responses to the varied classes of plant odor volatiles (Park et al., 2002).

Previously few studies have been performed on *Aulacophora foveicollis* Lucas that reported the affinity of the pest to alkanes in *Momordica cochinchinensis* floral surface waxes (Mukherjee et al., 2013; 2014a). Host suitability, feeding behavior and food preference of this beetle was studied (Sarkar et al., 2016; Sing et al., 2000). This study emphasizes the ecological relationships between the insect pest, *Aulacophora foveicollis* Lucas (Coleoptera: Chrysomelidae) the red pumpkin beetle, and host plant, *Cucurbita maxima*. *A. foveicollis*, a polyphagous pest, primarily feeds on cucurbits besides a several different fruit crop. Lifespan, fecundity, and survival rates of *A. foveicollis* on *Cucurbita maxima* are comparable to the wide range of variations recorded on other host plant species (Pavlakos, 1943; Al-Ali et al., 1982; Sinha and Krishna, 1971; Alikhan and Yousuf, 1985; Mukherjee and Barik, 2014b; Mukherjee et al., 2015). It has been recorded on several continents, including Asia, some parts of Europe, and Africa. (Doharey, 1983; Butani and Jotwani, 1984; Raman and Annadurai, 1985; Kumar and Nadarajan, 2007; Abe and Matsuda, 2005; Khan et al., 2011; Khan et al., 2012). Young and senescent leaves were less likely to be consumed than mature leaves and blossoms. Flowers and mature leaves showed low sugars, high nitrogen and protein content, narrow C/N ratio and moderately high phenols compared to other parts of plant (Beck, 1956; Hartfield et al., 1982). An individual plant is heterogeneous to any plant eating insect, depending on the nutritional content of the plant parts. Basically, both larval and adult stages of *A. foveicollis* are harmful to the crops, though adult beetles can do greater harm. They feed on flowers, cotyledons and leaves while the grubs mainly feed on plant roots. The pest occurs throughout the year and is capable of causing great

economical loss (Khan et al., 2012). Presently, in the absence of effective ecological sustainable control methods, extensive damage by the pest attracts the use of chemical pesticides which besides their effects on the environment and soil, leave pesticide residues on the crop and increases the pesticide resistance on insect pest. Hence an alternative sustainable control measure is required.

This study is focused on the detail structure of antennal chemosensillae, olfactory stimulation and sensitivity to a wide range of chemicals, applying electroantennogram technique, that have been investigated in both the sexes of *A. foveicollis*. This finding from the understudied North 24 Parganas region of West Bengal aids in understanding the role of olfaction by the pest and its host plant.

Materials

From 2016 to 2019 throughout the months of February to May, adult species of the insect pest were collected from the fields in North 24 Parganas, West Bengal and reared under laboratory condition on leaves of *Cucurbita maxima* (Family: Cucurbitaceae).

Methods

Scanning electron microscopy (SEM)

Antennal sensillum was characterized by SEM. The protocol for SEM were followed as already stated by Bhowmik et al., 2016. It was based on the nomenclature by Zacharuk, 1985, sensilla categorization on the distal segments was determined and illustrated.

Electroantennograms (EAG) and calculation of EAG data

EAG (version 2.6c, 1998, Syntech, Hilversum) analysis were measured as mentioned earlier from adult species of *Aulacophora foveicollis* (Bhowmik et al., 2016, 2017). Total 40 insects, and at a time one antenna for ~ 12 VOCs for 30 min, were used in the experimental procedure for both male and female. The information from EAG was used to calculate the mean values, standard deviation, standard error, and log₁₀ values as well as the relative mean amplitudes in percent. Odorant and air flow were carried out at 0.6 L/min and 1.8m L/min, respectively, using an air stimulation controller for 5 seconds.

Results and Discussion

Antennal chemosensilla distribution and variation in the pest

Adult *A. foveicollis* pest's antennae include nine segments, where each antenna has a scape, a tiny pedicel, and a flagellum, as its three main components. Sensillae of the male and female species did not differ significantly in terms of morphology, rather, the sensilla's distribution (density), notably in the circumferential band, differed, which is the apical band area of IXth segment. The antenna's circumferential band has sensilla on the dorsal and ventral sides that showed varied distribution and subjected to a t-test analysis as collated in Table 1. SEM images showed sensilla of three types *viz.*, Sensilla Basiconica (SB), Sensilla Chaetica (SC), and Sensilla Trichodea (ST). On the dorsal and ventral sides of the antennal segment of female pests, more Sensilla Chaetica Type-I have been seen. While, males have more Sensilla Chaetica Type-I on the ventral side of the circumferential band than females do, and more number of Sensilla Basiconica Type-I on the dorsal side.

EAG Dose –response studies in *Aulacophora foveicollis*

A total of 50 chemicals, obtained from several chemical agencies, were examined for their effects on EAG dose-dependent stimulus in both females and males. Figure 1-4 showed the mean normalized responses in EAG at 0.1, 1.0, 5.0 and 10.0 mg/mL concentrations of plant volatiles in both female and male pest. Compounds were chosen for the EAG study based on their presence in considerable quantities in the cucurbita plant volatile extract, along with a few other normal plant volatiles. SPSS 16.0 software was used to analyse the data in 2-way ANOVA utilising POSTHOC TUKEY ALPHA (0.05).

Table 1. T-test analysis (at $p < 0.05$) for the sensilla distribution in the apical band area of IXth segment in *Aulacophora foveicollis*

		Dorsal side									
		SB-I	SB-II	SB-III	SB-IV	SB-V	SB-VI	SB-VII	SCH-I	SCH-II	ST
Male species		8±0.3	6±0.3	3±0.3	2.2±0.2	4.2±0.5	5±0.3	4±0.3	5.2±0.3	6.2±0.2	4.2±0.3
Female species		7±0.3	6.2±0.2	5±0.3	4±0.3	4±0.3	8±0.3	6±0.4	8±0.3	8±0.3	2.2±0.2
t-test value		2.23	0.53	4.47*	4.81*	0.30	6.7*	3.65*	5.71*	4.81*	4.71*
p-value		0.055	0.6	0.002	0.001	0.77	0.0001	0.006	0.0004	0.001	0.001
		Ventral side									
		SB-I	SB-II	SB-III	SB-IV	SB-V	SB-VI	SB-VII	SCH-I	SCH-II	ST
Male species		4±0.3	5.2±0.3	2.2±0.2	2.2±0.2	3.2±0.2	2.6±0.2	4±0.3	7.2±0.3	5.4±0.2	2.4±0.2
Female species		6±0.4	5.6±0.2	4±0.3	3±0.3	4±0.3	4.6±0.2	6.2±0.4	8.8±0.2	6.2±0.3	3.6±0.2
t-test value		3.65*	0.89	4.81*	2.13*	2.13*	5.7*	3.77*	3.77*	1.78	3.46
p-value		0.006	0.39	0.001	0.06	0.06	0.0004	0.005	0.005	0.11	0.008

Green leaf volatile compounds (GLV)

Females responded to cis-3-hexen-1-ol to 113.4± 1.23% at 10.0 mg/mL, proceeded by 103.32± 1.89% at a dosage of 5.0 mg/mL, 94.45±0.39% at 1.0 mg/mL and 67.06±1.11% at concentration of 0.1 mg/mL. Where as decanal showed minimum responses of 17.80±0.13% at 0.1 mg/mL, while 29.15±2.63%, 68.363±2.46% and 96.84±1.62% relative mean amplitude was shown at 1.0, 5.0 and 10.0 mg/mL. With rest of the GLV molecules like trans-2-Hexenal, relative mean amplitude of 51.95±1.26%, 73.84±2.52%, 61.052±1.64% and 57.59±1.17% were observed at 0.1, 1.0, 5.0 and 10.0 mg/mL concentrations respectively. While trans-2-hexenyl acetate elicited 45.25±1.86% at 0.1 mg/mL, 71.52±2.60% at 1.0 mg/mL, 60.558±1.93% at 5.0 mg/mL and 64.13±1.73% at 10.0 mg/mL. Hexanal showed 82.68±6.95%, 72.80±1.61%, 60.363±1.61% and 68.63±0.56% relative mean amplitude at 0.1, 1.0, 5.0 and 10.0 mg/mL, respectively.

Males had a similar pattern of responses, although their dosage responses varied. Higher responses were induced by cis-3-hexen-1-ol at 10.0 mg/mL, which were 121.702.44%, followed by 94.95±2.46%, 86.5±3.34% and 62.33±3.34% at doses of 1.0, 5.0 and 0.1 mg/mL, while decanal gave minimum responses of 10.96±1.42% at dose of 1.0 mg/mL, while at 0.1, 5.0 and 10.0 mg/mL concentrations it responded 22.97±0.87%, 17.47±0.77% and 33.55±4.84% relative amplitude, respectively. With other GLVs the responses at different doses have been summarized as bar graphs in Fig. 1-4.

Aliphatic compounds

Among the aliphatic compounds, trans-2-hexen-1-ol elicited in females the highest EAG stimulation (119.21.87%) at 5.0 mg/mL, followed by 90.481.16%, 86.622.47% and 65.680.84% at 1.0, 10.0 and 0.1 mg/mL, respectively. The response of female *A. foveicollis* with other aliphatic compounds like 1-Heptanol, maximum response of 102.50±0.85% was observed at 10.0 mg/mL followed by 90.52±1.96%, 88.45±1.07% and 85.75±1.97% at 5.0, 0.1 and 1.0 mg/mL. On the other hand, Hexyl acetate demonstrated 61.50±5.13%, 43.53±1.18%, 48.59±0.99% and 76.09±1.93% relative amplitudes at doses 0.1, 1.0, 5.0 and 10.0 mg/mL, respectively. 1-Octene-3-ol elicited greatest response at 10.0 mg/mL (98.93±6.14%) followed by 77.656±3.08%, 46.89±1.27% and 12.25±0.94% at 5.0, 0.1 and 1.0 mg/mL doses. 1-Pentanol, elicited highest response of 97.68±2.02% at 10mg/mL, while responses at 0.1, 1.0 and 5.0 mg/mL were 57.67±1.04%, 71.45±2.56% and 72.005±2.08%. 2-Nonanone showed highest response of 52.645±1.84% at 5.0 mg/mL while other values read as 41.74±1.02%, 29.65±0.61% and 19.13±0.71% at doses 10.0, 0.1 and 1.0 mg/mL. 1-hepten-3-ol elicited amplitudes of 84.33±0.43%, 76.85±2.39%, 76.05±2.98% and 63.126±2.10% at concentrations 10.0, 0.1, 1.0 and 5.0 mg/mL. Nonanal elicited maximum EAG response of 63.20±2.67% at 0.1 mg/mL followed by 62.22±1.78%, 38.69±2.91% and 31.00±1.83% at 10.0, 5.0 and 0.1 mg/mL. The highest EAG response to nonadecane was at 10.0 mg/mL (96.96±1.82%), followed by 66.21±1.82% at 5.0, 51.72±2.11% at 0.1 and 41.29±2.01% at 1.0 mg/mL of concentration. 2-Heptanone gave 50.165±1.93%, 49.94±1.35%, 45.57±1.05% and 16.53±0.72% responses at 5.0, 10.0, 0.1 and 1.0 mg/mL doses. The greatest response for heptadecane, on the other hand, was 65.101.72% at 10.0 mg/mL, with subsequent results showing 39.721.72%, 41.721.32%, and 63.792.32% at 0.1, 1.0 and 5.0 mg/mL, respectively.

Of all the aliphatic compounds, heneicosane had the highest reaction in males at 5.0 mg/mL ($129.30 \pm 1.9\%$), compared to its responses at 0.1, 1.0 and 10.0 mg/mL ($65.00 \pm 1.72\%$, $101.21 \pm 1.21\%$, and $111.99 \pm 1.81\%$). While maximum stimulation of $126.11 \pm 2.82\%$ at concentration of 10.0 mg/mL followed by $116.01 \pm 1.22\%$, $103.27 \pm 2.865\%$ and $63.28 \pm 1.82\%$ at doses 5.0, 1.0 and 0.1 mg/mL was responded with 1-hepten-3-ol. At 10.0 mg/mL concentration, acetic acid was observed to have a minimum amplitude of $2.48 \pm 1.38\%$. Hexyl acetate showed maximum responses at 0.1 mg/mL ($44.54 \pm 1.71\%$). 1-Pentanol elicited maximum response of $76.87 \pm 1.34\%$ followed by $61.53 \pm 0.39\%$, $57.64 \pm 0.33\%$ and $52.53 \pm 0.43\%$ at 1.0, 0.1 and 5.0 mg/mL concentrations. Trans-2-hexen-1-ol showed highest amplitude of $116.1 \pm 1.60\%$ at 5 mg/mL followed by $111.70 \pm 2.80\%$, $108.46 \pm 2.89\%$ and $65.17 \pm 1.80\%$ at 10.0, 1.0 and 0.1 mg/mL doses, respectively. 1-Octene-3-ol showed maximum response at 0.1 mg/mL dose ($34.84 \pm 2.3\%$). 1-heptanol, on the other hand, displayed the greatest EAG mean amplitude at 5.0 mg/mL ($111.571.22\%$), followed by concentrations at 1.0, 10.0, and 0.1 mg/mL ($102.99 \pm 2.03\%$, $94.82 \pm 3.02\%$, and $68.91 \pm 1.02\%$, respectively). 2-Nonanone elicited maximum stimulation of $66.94 \pm 3.60\%$ at 5.0 mg/mL, while nonanal showed highest stimulation of $45.40 \pm 1.48\%$ at 10.0 mg/mL. 2-Heptanone gave $33.23 \pm 2.31\%$ as maximum stimulus at 10.0 mg/mL dose. Nonadecane produced a maximum stimulation at 5.0 mg/mL ($105.0 \pm 2.11\%$) and a lowest response at 0.1 mg/mL ($66.21 \pm 1.55\%$). Tetradecane showed highest response at 10.0 mg/mL ($106.92 \pm 1.99\%$), while at 0.1, 1.0 and 5.0 mg/mL of doses it responded to $60.72 \pm 0.62\%$, $87.60 \pm 2.11\%$ and $97.32 \pm 1.78\%$, respectively. Pentacosane showed highest response of $100.11 \pm 1.11\%$ at 10.0 mg/mL followed by $90.21 \pm 1.72\%$, $82.32 \pm 2.31\%$ and $62.71 \pm 1.72\%$ at 5.0, 1.0 and 0.1 mg/mL doses, respectively. The largest EAG mean amplitude was seen for heptadecane at a dosage of 5.0 mg/mL, where it was $81.3 \pm 1.98\%$, followed by responses of $78.62 \pm 1.32\%$, $72.89 \pm 0.99\%$, and $50.32 \pm 0.88\%$. 3-Methyl butanol showed maximum amplitude at 5.0 mg/mL ($51.62 \pm 2.62\%$), while at 0.1, 1.0 and 10.0 mg/mL of doses it responded to $42.19 \pm 2.62\%$, $21.28 \pm 2.24\%$ and $40.97 \pm 3.62\%$. With Eicosane highest stimulation was observed at 10.0 mg/mL ($82.40 \pm 1.48\%$) and lowest response was shown at 0.1 mg/mL ($49.99 \pm 2.01\%$). 3-Hydroxy-2-butanone showed maximum response at 0.1 mg/mL ($22.22 \pm 0.56\%$). With rest of the aliphatic compounds, nonanoic acid, hexanoic acid, butyric acid, 2,3-butanedione and Heptane, maximum response of $51.90 \pm 2.82\%$, $55.67 \pm 3.9\%$, $36.27 \pm 2.39\%$, $55.84 \pm 1.78\%$ and $15.41 \pm 3.73\%$, respectively, was elicited at 0.1 mg/mL. Responses with rest of the aliphatic compounds at four different concentrations have been summarized in Fig. 1-4.

Aromatic compounds

Both the male and female species of *Aulacophora foveicollis* responded to dose-dependent aromatic chemicals in a similar manner that showed varied amplitudes of their EAGs. The EAG amplitude in female was dramatically increased by 2-methyl phenol at 10.0 mg/mL ($136.51 \pm 0.97\%$). While the same for benzoyl alcohol in the female pest at dosages of 10, 5, 1.0 and 0.1 mg/mL was $100.99 \pm 1.83\%$, followed by $92.71 \pm 0.98\%$, $74.59 \pm 2.80\%$, and $66.76 \pm 2.34\%$. The response to 4-methyl phenol on the other hand was greatest at 5mg/mL ($88.90 \pm 0.73\%$), following at 10mg/mL ($66.49 \pm 1.59\%$), 1 mg/mL ($28.18 \pm 0.54\%$), and 0.1 mg/mL ($7.71 \pm 0.75\%$). The highest amplitudes for rest of the aromatic compounds, such as phenethyl alcohol, isoeugenol, 2-methyl phenol, ethyl benzoate, and 3-methyl phenol, were $119.37 \pm 1.09\%$, $40.08 \pm 0.99\%$, $136.51 \pm 0.97\%$ and $120.08 \pm 2.26\%$, respectively, at 10 mg/mL. Another aromatic molecule, ethyl benzene displayed largest EAG response, measuring $100.51 \pm 1.21\%$ at 10 mg/mL, and lowest response of $50.43 \pm 1.29\%$ at 1.0 mg/mL concentration. Furthermore, the female pest showed highly significant EAG response to 1,4 dimethoxybenzene at a concentration of 5.0 mg/mL ($122.4 \pm 1.23\%$), followed by $119.82 \pm 1.89\%$ at 10 mg/mL, and then $95.50 \pm 0.49\%$ and $69.16 \pm 1.11\%$ at 1.0 and 0.1 mg/mL dosages. Other aromatic compounds showed the responses as summarized in Fig. 1-4.

Males elicited maximum changes of $92.07 \pm 5.24\%$ in EAG amplitudes with 2-methyl phenol at 10 mg/mL followed by $78.10 \pm 5.34\%$, $26.90 \pm 3.52\%$ and $20.01 \pm 5.54\%$ at 5.0, 1.0 and 0.1 mg/mL. Acetophenone caused maximum stimulation of $37.62 \pm 4.07\%$ at 0.1 mg/mL. Benzaldehyde showed maximum amplitude of $29.16 \pm 6.84\%$ at 5 mg/mL while phenylacetaldehyde elicited $35.88 \pm 1.05\%$ as maximum EAG amplitude at 10 mg/mL. Benzyl alcohol showed maximum stimulation of $80.25 \pm 1.23\%$ followed by $71.35 \pm 1.43\%$, $64.99 \pm 1.53\%$ and $52.14 \pm 2.61\%$ at 10.0, 5.0, 0.1 and 1.0 mg/mL. Isoeugenol, Phenethyl alcohol, 2 methyl phenol and 3-methyl phenol, all four compounds, produced the highest amplitude of $29.39 \pm 1.08\%$, $81.50 \pm 2.82\%$, $92.07 \pm 5.24\%$ and $86.30 \pm 1.58\%$, respectively, at 10 mg/mL. Ethyl benzoate and 4-methyl phenol on the other hand, at 0.1 mg/mL elicited maximum EAG amplitude of $27.43 \pm 5.90\%$ and $25.81 \pm 2.13\%$. 1,4, dimethoxybenzene caused response of $80.25 \pm 1.11\%$ at 5.0, $69.14 \pm 0.61\%$ at 1.0 and $62.99 \pm 1.02\%$ at 0.1 mg/mL, while highest stimulus was showed at 10 mg/mL ($100.50 \pm 1.25\%$). Furthermore, Ethyl benzene produced the lowest response of $26.40 \pm 1.31\%$ at 10 mg/mL and the maximum EAG stimulus of $69.00 \pm 1.39\%$ at 5 mg/mL.

Responses of several other molecules from oxygenated monoterpenes, sesquiterpenes and hydrocarbon monoterpenes varied in both the sexes of the pest as observed with other compounds and described in the Fig. 1-4 at different concentrations.

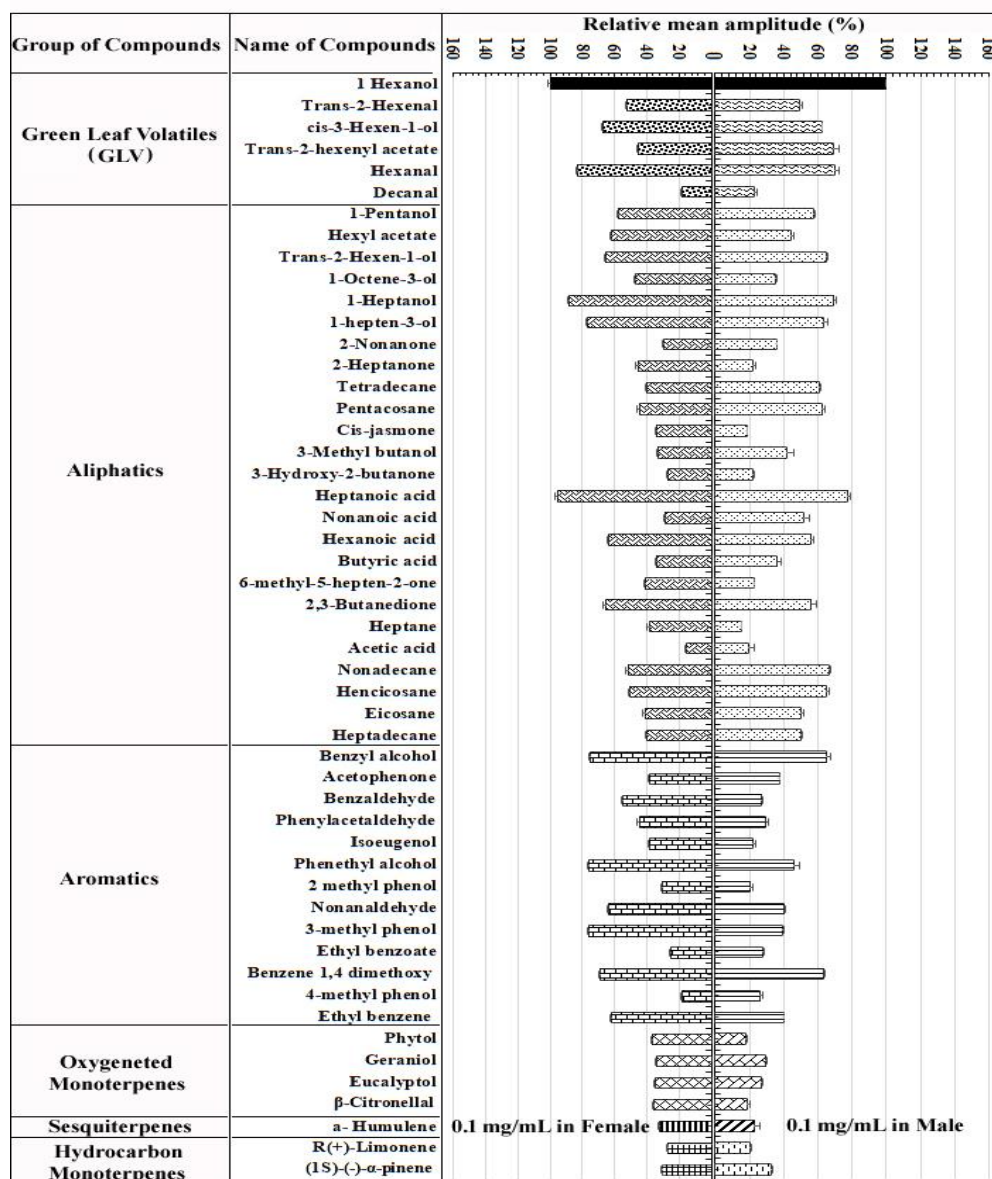


Figure 1. Mean normalized EAG responses of male and female species at 0.1 mg/mL concentration of plant volatiles.

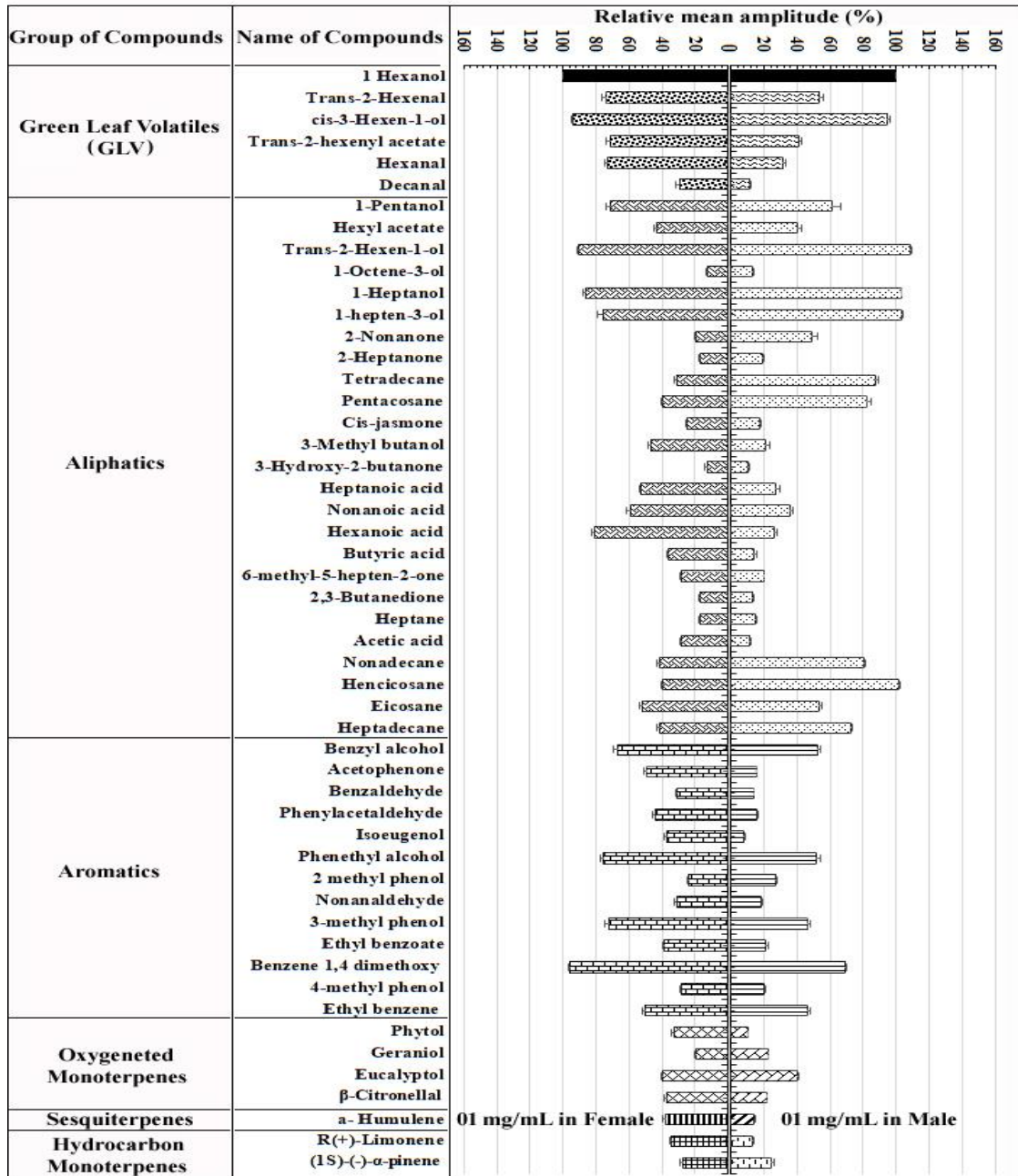


Figure 2. Mean normalized EAG responses of female and male species at 1.0 mg/mL concentration of plant volatiles.

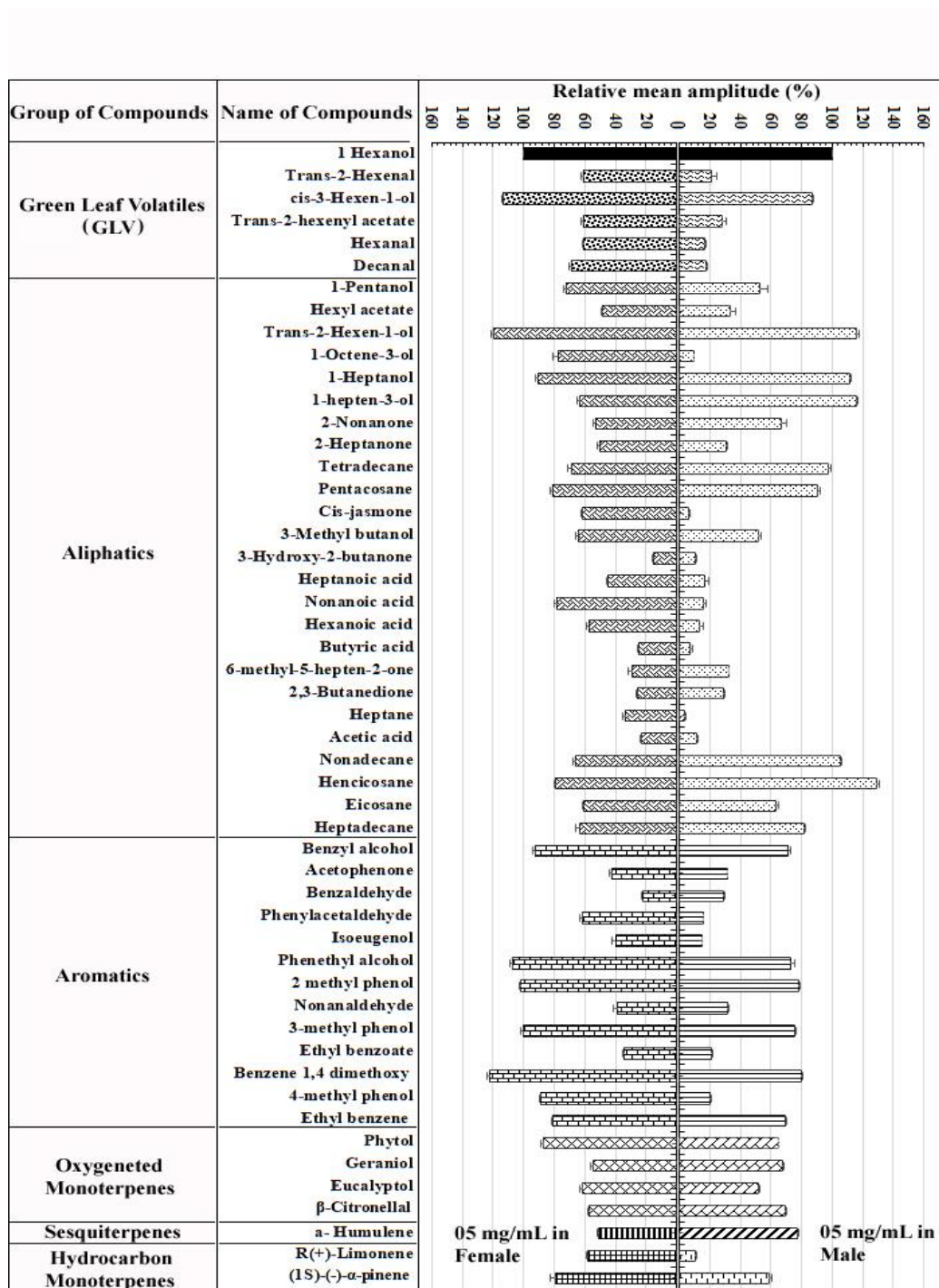


Figure 3. Mean normalized EAG responses at 5.0 mg/mL concentration of plant volatiles in male and female

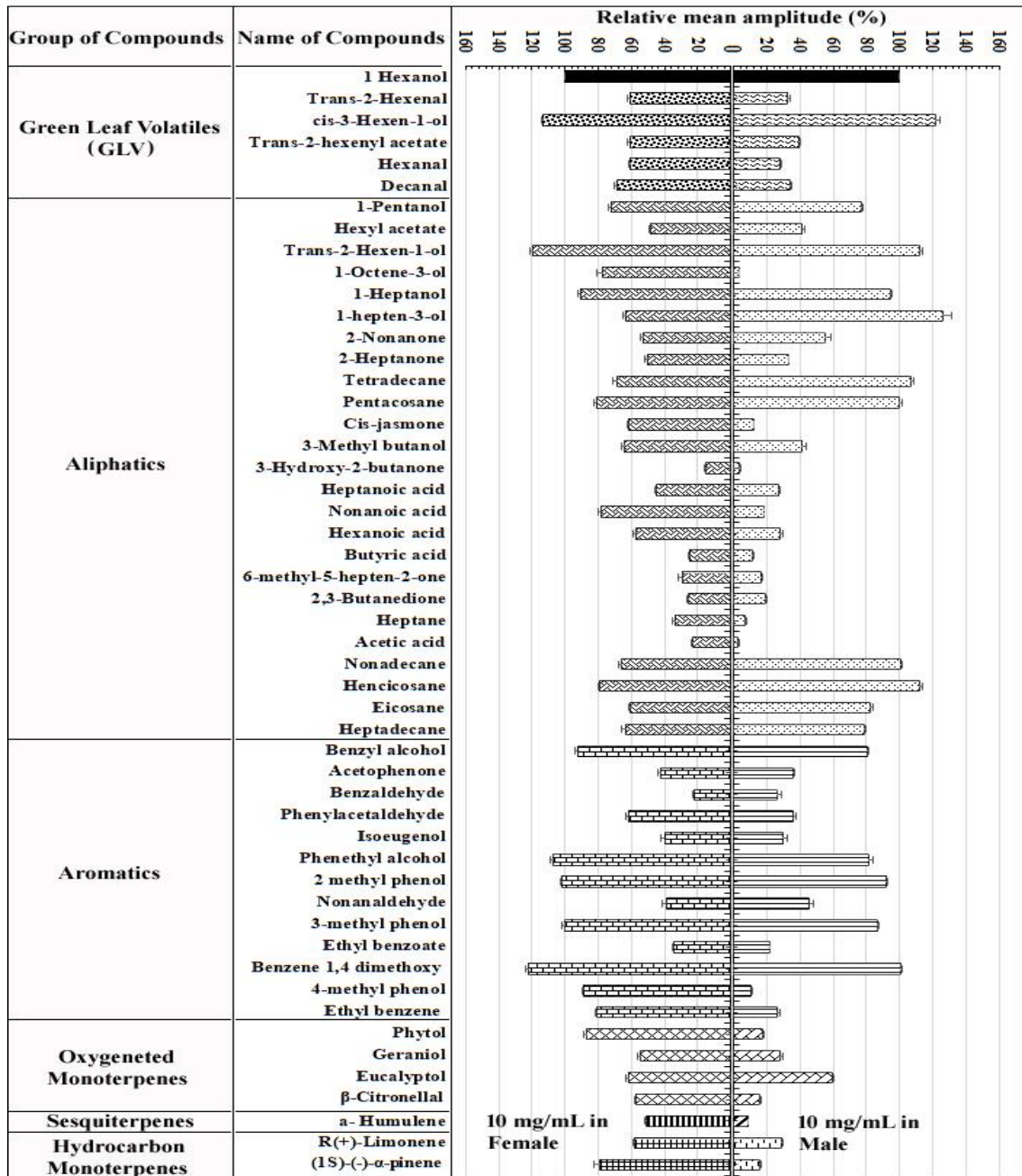


Figure 4. Mean normalized EAG responses at 10.0 mg/mL concentration in *A. foveicollis*

Pooled electroantennogram responses

At the end, individual groups of chemicals were pooled and averaged for comparisons (Fig.5). Responses were, in general, much higher in females than in males. The largest mean EAG amplitudes in both males and females were obtained with GLV, followed by aromatic and aliphatic compounds. The lowest responses were obtained with sesquiterpenes < hydrocarbons monoterpene < oxygenated monoterpenes.

Both men and females of this insect pest may detect the same fragrance because they use the same signals to locate identical host plants for survival and reproduction in similar environments. It has been established that the choice of a certain host plant depends on the bouquet of chemicals emitted in a specific ratio in different species of phytophagous insects (Visser et al., 1986; Zhang et al., 1999; Das et al., 2007). Based on pooled EAG data, maximum EAG responses was found with green leaf volatile (GLV), aromatic compounds, aliphatic compounds, followed by oxygenated monoterpenes, hydrocarbon monoterpenes and least with sesquiterpenes, that reflected the wide range of feeding habitat of the insect pest. The pumpkin beetle's predilection for GLV chemicals seemed to be a significant determinant in the host plant it chose, pointing to the beetle's polyphagous nature (Das et al., 2007). The species also displayed sexual dimorphism that can be seen based on the variations in responses by EAG at various dosages, in addition to differences in the sensilla distribution in the circumferential bands. Female species showed highest peak amplitude for 2-methyl phenol (at 10mg/mL, 136.51±0.97) followed by 1,4, dimethoxybenzene (at 5mg/mL, 122.4±1.23) and cis 3-hexene-1-ol (at 5 mg/mL, 113.4±1.23) where as males showed maximum amplitude for heneicosane (at 5mg/mL, 129.3±1.99) followed by 1-hepten-3-ol (at 10 mg/mL, 126.11±2.82) and cis 3-hexene-1-ol (at 10 mg/mL, 121.70±2.44). The fact that aromatic chemicals are significant components of pheromones in these insect pests may explain why females respond to them more strongly than aliphatic compounds. Additionally, differences shown in dose-response studies may result from changes in the rates at which various substances are released (Park et al., 2001) and in the sensitivity of olfactory receptor system, which would represent variable tuning of receptors (Visser et al., 1996). Sesquiterpenes, among the group of terpenoids, produced a substantially lower EAG response than oxygenated and hydrocarbon monoterpenes. Previous report by Sinha and Krishna,1971 showed that terpenoid of optimum concentration is an important parameter to stimulate the feeding activity of *A. foveicollis* in cucurbita plant. Higher quantities of these chemicals, however, operate as a feeding deterrent whereas lower concentrations of these compounds will not trigger any feeding activity.

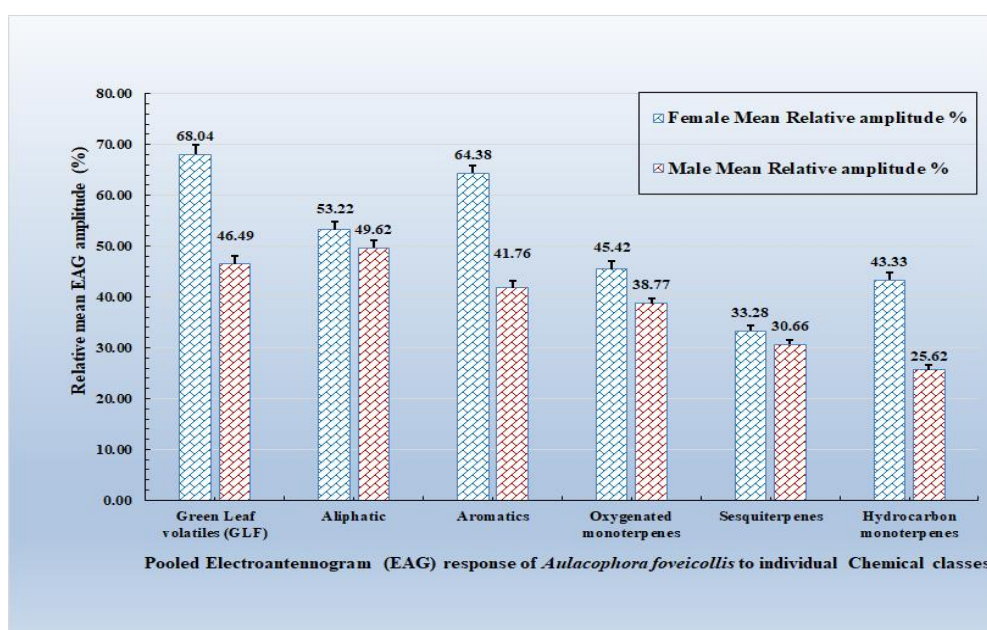


Figure 5. Pooled EAG response of *A. foveicollis* to individual chemical classes

Conclusions

The morphology and olfactory responses of antennal chemosensilla of the pest, examined by SEM and EAG revealed prominent sexual dimorphism in the distribution and responses of the sensilla, the predominance of olfactory sensilla with the presence of few mechanosensilla and greater responses was observed in females for Green leaf volatile GLV followed by aromatic compounds and aliphatic compounds.

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Conflict of interest

No conflict of interest exists.

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