PATNA WOMEN'S COLLEGE AUTONOMOUS 1940

IRIS
Journal for Young Scientists
ISSN 2278 – 618X **(Print)**
ISSN 2278 – 6384 **(Online)**

http://www.patnawomenscollege.in/journal

Comparative Study of the Antennae of *Solenopsis invicta* from Different Localities of Patna

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Received : November 2018
Accepted : March 2019
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Abstract : *The terminal antennal segment (club) were studied in red imported fire ant (Solenopsis invicta). The worker ants were collected from Gandhi Maidan, College and house in the months of August and September. The size of terminal antennal segment of worker ants collected from Gandhi Maidan were greater in size as compared to those collected from college and house whose size were intermediate and smaller respectively. The difference was significant (p<0.01).*

Keywords: *Red ants, antenna, habitat.*

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Introduction:

Ants are eusocial insects (Crespi and Yanega, 1995) which form colonies that range in size from a few dozen predatory individuals are living in small natural cavities to organised colonies that may occupy large territories and consist of millions of individuals.

Ant communities are headed by a queen, whose function in life is to lay thousands of eggs that will ensure the survival of the colony, whereas workers are sterile females in the ant colony. They are wingless. The queen ant possess large wings but she bites off her wings after egg laying. Workers maintain the colony. They forage for food, care for the offspring, work on the nest, protect the community and perform many other duties. Males who develop from haploid eggs or unfertilised eggs have large wings. After mating they die. The social behaviour of ant depends on communication between individuals. Workers appear red and somewhat yellowish with a brown or completely black gaster (Santschi.F, 1916). Gastric spots are sometimes seen in larger workers, where they are not as brightly coloured as those in *Solenopsis richteri*.

The habitat where they live may determine the food they collect the most; for example, forage success rates for solid foods are highest in lakeshore sites, while high levels of liquid sources were collected from pasture sites. Specific diets can also alter the growth of a colony. Colonies that feed on insects and sugar-water can grow exceptionally large in a short period of time, whereas those that do not feed on sugar-water grow substantially slower.

Therefore, in the Gandhi Maidan area the food sources for ants were insects, food spills whereas in house sugar and sweets may be easily encountered. In the College field they were collected from near the trees where they may have taken more time to detect the source as compared to house. In house food is stored and easily available. There may be leftover packets of sweets or chocolates and other eatable items. Even sugar and milk spilled over may attract these ants easily. They are more over used to the source of food and the location is more or less definite or fixed, such as the kitchen or dining room.

Ants communicate with each other using pheromones, sounds and touch (Jackson et al., 2006). The use of pheromones as chemical signals is more developed in ants.

Like other insects, ants perceive smells with their long, thin and mobile antennae. The paired antennae provide information about the direction intensity of scent. Ants use pheromones for more than just making trials. So the ants are used to the source of food. Detection is not very tedious for them.

Olfactory receptors on the antennae bind to free-floating molecules, such as water vapour and odours including pheromones. The neurons that possess these receptors signal this binding by sending action potentials down the axons to the antennal lobe in the brain. From there, neurons in the antennal lobes connect to mushroom bodies that identify the odour. The sum of the electrical potentials of the antennae to a given odour can be measured using an electro antennogram.

Antennae sometimes referred to as “feelers”, are paired appendages used for sensing in arthropods. Antennae are connected to the first one or two segments of the arthropod head. They vary widely in form but are always made of one or more jointed segments. While they are typically sensory organs. Functions may variously include sensing touch, air motion, heat, vibration (sound), and especially smell or taste. Antennae are sometimes modified for other purposes, such as mating, brooding, swimming, and even anchoring the arthropod to a substrate. The three basic segments of the typical insect antenna are the scape or *scapus* (base), the pedicel or *pedicellus* (stem), and finally the flagellum, which often comprises many units known as flagellomeres. The pedicel (the second segment) contains the Johnston’s organ which is a collection of sensory cells.

Also, the elbow shape of ants antennae make the antennae particularly mobile, rather like our arms. Perhaps, the sensory structure can be thought of, loosely, like our hands and fingers — very sensitive. Although ants don’t use their antennae to manipulate their environment as we use our hands, these structures are key to how the ants interact with their environment.

The antennal sensilla are important sensorial organ for insect communication and survial and they are in constant contact with the environment (Iwasaki et al 1995; Nakanishi et al, 2009).

The antennae are sexually dimorphic: the worker antenna has porous sensilla on the two distal segments (the antennal club), whereas the clubless male antenna has porous sensilla on all segments past the pedicel. The major type of porous sensilla on both male and female is sensilla *tricodea curvata*. However, the male *s. tricodea curvata* are rather uniform in size, whereas the female *Solenopsis tricodea curvata* vary considerably in thickness. The number of sensilla

on the distal segment of the worker antenna increases with segment length. This suggests a possible mechanism by which task assignments in *Solenopsis invicta* could be determined by the presence or absence of sensilla sensitive to specific task-related odor or pheromone cues.

Behaviour of insects is largely stereo type and is regulated by sensory input. Sensory capabilities, therefore, are key determinants of insect's behaviour and are well developed. They possess repertoire of chemosensory structures. The sensilla therefore show modification in structure and number according to the requirement for different function like food collection. The antenna may also show change in size according to its habitat.

It is obvious that the antennae are more than chemosensory or smelling structures and this is well documented in many insects. Antennae may have sensory receptors for mechanical force, tactile stimuli, chemo-sensation, smell, humidity, and air flow. This multiplicity of perception is a challenge to understand and to place in the context of behavior.

Materials and Methods :

The red ants were taken from three different localities of Patna. Its right andleft antennae were taken. Antennae were washed in distilled water for atleast 2-3 times, to remove any dust particles adhered to it. After washing, the antennae were dehydrated by putting into 30% alcohol and then into 70% alcohol for 2-3 minutes each. The antennae were then put on a slide and cleared in xylene and mounted using D.P.X. It was observed using compound microscope. The length of the terminal antennal segment was measured. For the measurement ocular micrometer was used. Stage micrometer was used for calibration of the reading of the ocular micrometer. All these measurements were done for comparative study of antennae from three different localities. The data obtained were analysed using statistical method. Standard deviation and mean value were calculated.

Thesewere then subjected to ANOVA one way test for mean effects. Tableandgraph weremadeas perstandard ruleforanalysis.

Result and Discussion :

The antennae is a functional organ and its morphology can be affected by behaviour, habitat and ecology (Wcislo, 1995). Biological information on each type shed light on the relationship between antennal morphology and their habitat.

Control mechanisms that regulate body size and organ size have been sought at both the cellular and organismal level. Cell-level studies have revealed much about the control of cell and cell division, and how these processes are regulated by nutrition (Nijhout, 2003). The size of an organ, or a body, may also be determined by the size of the component cell, and their number (Azevedo, 2002).

Table 1. Showing the mean value and the standard deviation of size of right antennal club of each group

	Worker ants from Gandhi Maidan	Worker ants from College field	Worker ants from house
Mean value ± Standard deviation (in mm)	0.31±0.028	0.22±0.0135	0.19±0.009

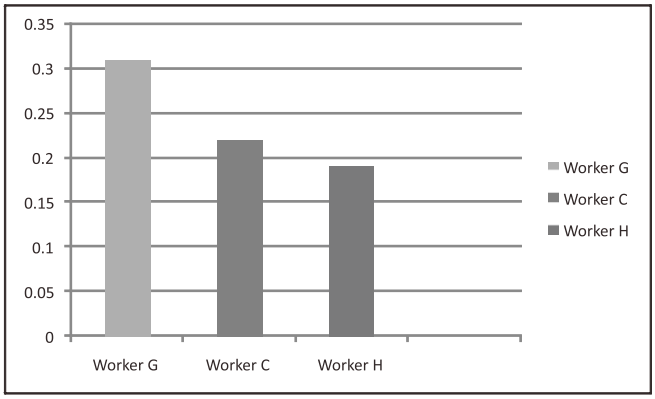

Fig. 1. Showing variation in mean value of right antennal club of worker ants from three different localities

Worker G = Worker ants of Gandhi Maidan
Worker C = Worker ants of College field
Worker H = Worker ants of House

Table 2.Showing the mean value and the standard deviation of size of left antennal club of each group.

	Worker ants from Gandhi Maidan	Worker ants from College field	Worker ants from house
Mean value ± Standard deviation (in mm)	0.31±0.028	0.22±0.0135	0.19±0.009

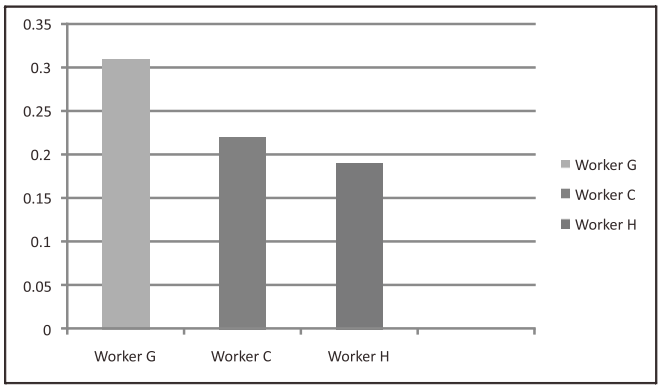

Fig. 2. Showing variation in mean value of left antennal club of worker ants from three different localities

Worker G = Worker ants of Gandhi Maidan
Worker C = Worker ants of College field
Worker H = Worker ants of House

Our experiment was based on the size of the right and left terminal antennal segments of worker ants from three different localities, 25 ants were taken from each localities. Tables (1 and 2) showing mean value and standard deviation of the measurements of size of right and left club in different worker ant groups. When comparedit was noticed that the size of antenna of worker ants obtained from Gandhi Maidan, College field and house are longer, intermediate and shorter in size respectively.

As we have taken worker ants from three different localities, the difference in size of club could be due to their exposure to pollution in environment, temperature and food.The worker ants found in Gandhi Maidan show larger growth in club size compared to other groups, this can be due to availability of food to them. The pollution in Gandhi Maidan may interrupt in the olfaction of food, because of this they may show greater size to increase the number of sensilla to compensate this problem. Whereas in College field there is less pollution and more availability of food which may have led to lesser growth of club size. In the house, being more cleaner place and here also food is easily available which may have led to least growth in club size having less number of sensilla compared to other groups.

Table 3. Showing critical difference

Sl. No.	Worker ants from	Means of club size	Difference of mean club size	Comparison with L.S.D
1.	Gandhi Maidan	$\bar{y}_A$=9.24	$\lvert\bar{y}_A-\bar{y}_B\rvert$=11.102	
2.	College field	$\bar{y}_{YB}$=0.942	$\lvert\bar{y}_A-\bar{y}_C\rvert$=8.298	>0.338
3.	House	$\bar{y}_C$=−1.862	$\lvert\bar{y}_B-\bar{y}_C\rvert$=2.804	

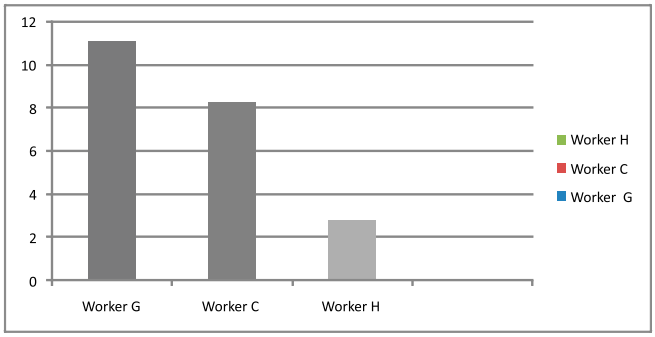

Fig. 3. Showing critical difference of mean of club sizes of worker ants from three different localities.

Worker G = worker ants of Gandhi Maidan.
Worker C = worker ants of the College field.
Worker H = worker ants of the house.

Therefore, the difference in the club size, of worker ant's antenna collectedfrom three different localities is significant.

All three growth of club in three different environmental conditions are significantly different from each other.

From this we can conclude that there is no sampling error. The change is due to environmental conditions prevalent there, especially source and type of foods, since the club and its sensilla plays significant role in the detection of food.

Antennal sensilla are important sensory receptors in nestmate communication and discrimination behaviour of ants (Wilson, 1990; Ozaki et al, 2005). Sensilla basiconica are considered as olfactory sensilla because the peg is porous (Martini, 1986). Also the variation in the number of sensilla in response to chemical stimuli and complex chemical environment have been clearly shown by Babu et al (2011) in shaping the antennal organization and development.

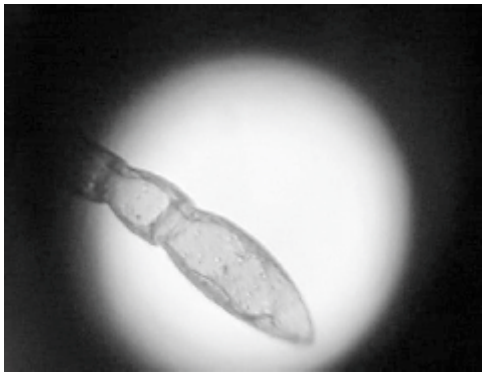

Fig. 1. Worker ant (Gandhi Maidan)

Fig. 2. Worker ant (College field)

Fig. 3. Worker ant (House)

Conclusion :

The antennae of the worker ants (club size) from three different localities were taken and comparative study was done. The club size of the worker ants from Gandhi Maidan were larger as compared to the club size of the worker ants taken from the College field and house. The difference in size of club could be due to the environmental conditions and types of food available to them. Since the mean difference was significant in all three cases and when compared with L.S.D as shown in table (9), from this we can conclude that there is no sampling error, it is the environment and food sources that affects the growth of terminal antennal segment(club size).

Acknowledgement :

We express our deepest gratitude to our respected Principal, Dr. Sister M. Rashmi A.C. for giving us this wonderful opportunity to undertake the project. We are thankful to Dr. Shahla Yasmin, Head, Department of Zoology, who motivated us to take up this project.

References :

Azevedo, R.B.R., French, V., Partridge, L. (2002). Temperature modulates epidermal cell size in *Drosophila melanogaster*. J. Insect Physiol.48, 231-237.

Babu M.J. Ankoekar S.M. and Rajashekhar K.P. (2011). castes of Weaver ant, *Oecophylla smaragdina* (Fabricius) differ in the organization of sensilla on their antennae and mouthparts. *Curr.Sci.* 101(6):755-764.

Crespi B.T., and Yanega D. (1995). Behaviour Ecology, 6(1):109-115.

Detrain,.Deneubourg, J.L., Pasteels, J.M. (1999). Information processing in social, Birkhauser verlag, Basel, Switzerland, pp.69-81.

Iwasaki, M., Itoh, T., Yokohari, F. And Tominage. Y., (1995). Identification of antennal hygroreceptive sensillum and othe sensilla of firefly, *Luciola cruciata. Zoological Science*, 12:725-732.

Jackson, D.E., Ratnieks, F.L. and Primer (2006). Communication in ants. *Current Biol*. 16(15): 570-574.

Martini, R. (1986). Fine structure and development of the large sensillabasiconica of the antennae of sphecid wasps. Tissue and Cell 18:143-151.

Nakanishi, A., Nishino, H., Watanabe,H., Yokohari, F. and Nishikawa (2009). Sex-specific antennal sensory system in the ant *Camponotus japonicas*: structure and distribution of sensilla or the flagellum. Cell tissue Res. 338:79-97.

Nijhout, H.F. (2003). The control of body size in insects, *Development Biology,* 261:1-9.

Ozaki, M., A. Wada-Katsumata, K. Fujikawa, M. Iwahashi, F. Yokohari, Y. Satoji, T. Nishimura & Y. Yamaoka (2005). Ant nestmate and non-nestmate discrimination by a chemosensory sensillum. *Science,* 309: 311-314.

Santschi, F. (1916). “Formicidessudaméricains nouveaux oupeuconnus”. Physis. 2: 365–399.

Wcislo, W.T. (1995). Sensilla numbers and antennal morphology of parasitic and non-parasitic bees (Hymenoptera: Apoidea). *International Journal of Insect Morphology and Embryology,* 24:63-81.