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Study Of Sense organs of Rhyzoperthadominica With The Help Of Light Microscopy And Scanning Electron Microscopic Technique

Mahure Y.R.,[1] S.K. Zilpe[2], S.M.Pidhekar[3]
Smt. Radhabai Sarda Arts, Commerce And Science College AnjangaonSurji
***Corresponding Author*- Mahure Y.R., S.K. Zilpe**
Email id: yrmahure@gmail.com
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Abstract:
Every year, large quantities of stored products are destroyed or contaminated because of the presence of arthropods, and beetles are by far the most important group of animals attacking these products. *Rhyzoperthadominica*is well known as a pest of stored grain in all warm regions of the world. It also occurs on a wide variety of food, particularly cereals. The damage is done by both adults and larvae.Adults and larvae of *Rhyzoperthadominica* feed primarily on stored cereal seed including wheat, maize, rice, oats, barley, sorghum and millet. They are also found on a wide variety of foodstuffs including beans, dried chillies, turmeric, coriander, ginger, cassava chips, biscuits and wheat flour. The present study is carried out to study the morphological structures with the help of light microscopy and scanning electron microscopy. The present study has identified and characterized six different sensilla types on the body parts of *Rhyzoperthadominica*. External morphology of *Rhyzoperthadominica*is studied under the scanning electron microscope (JEOL/Eo –JSM-6380 PC-SEM scanning electron microscope).Six different types of sensilla are found on the body parts of *Rhyzoperthadominica*. These sensilla are basiconica sensilla, trichoidea sensilla, chaetica, ampullacea sensilla, microtrichia, and filiform sensilla. Based on features of scanning electron microscopy, three types of sensilla were distinguished on the antennal segments of, sensilla chaetica (SC), sensilla trichoidea (ST) and sensilla basiconica (SB). Sensillachaetica (SC) are believed to have a dual function of mechanoreception and contact chemoreception.Sensilla trichoidea 1 (ST1) having putative mechanoreceptive functions Sensilla basiconic suggested to be sex pheromone receptor or olfactory function.

Key Words: Light microscopy, morphological study, Rhyzoperthadominica, and scanning electron microscopy

Introduction:
Lesser grain borer, *Rhyzoperthadominica* (F.) (Coleoptera: Bostrichidae), is hypothesized to have originated in tropical regions of the Indian subcontinent, originally as a wood borer, before expanding its host range to small grains. It is now a cosmopolitan species, occurring in all areas of the world where grain is produced and stored (Potter, 1935;)Two most important Orders of insects are the mostly economically important pest one is Coleoptera and another one is Lepidoptera. Coleoptera includes beetles and weevils which cause most damage to the store grains, are the Lesser Grain Borer: *Rhizoperthadominica* (F.) and the Rice Weevil: *Sitophilus oryzae* (L.) Lepidoptera constitutes moths and butterflies in which Indian Meal Moth: *Plodia interpunctella* causes most damage to the store grins according to Ashworth (1993a, 1993b),Keil (1999) stated that trichoid sensilla may be olfactory, while sensilla found on the pedicel are usually mainly mechanoreceptive. On the other hand, Sensilla trichoidea 2 (ST2) which are common on the antennal flagella of insects.Ochieng *et al.,* (2000) reported that the antennae of adult insects possess various types of sensilla with different functions, and play an important role in various behaviours during adult life. Antennal sensilla are important sensory receptors implicated in host location and discrimination behaviours.Gullan and Cranston, (2010); reported that antennae are mobile, segmented, paired head appendages and are found in nearly all insects groups. Numerous sensilla occurred on antennae in the form of hairs, pegs, pits or cones.

Choate (2003) reported that order Coleoptera comprises beetles with front pair of wings thickened and usually hard to form elytra, many forms with elytra shortened, exposing one or more abdominal segment from above (beetles).The hind legs usually not modified for jumping purpose. Choate (2003) also reported that order Coleoptera may include the largest number of described species of any insect order. They are to be found in almost every habitat, and range in size from 1 – 100mm in length.Insects bear numerous sensory organs used in the sensory perception for smell, taste, sound, touch, vision, and hygroreception. These specialized cuticular structures vary in size and shape.Sensilla has been described in different insects as having mechanoreceptive functions . (Pettersson *et al*., Onagbola).Sensilla chaetica (SC) are believed to have a dual function of mechanoreception and contact chemoreception (Jourdan *et al*., 1995) while, Merivee *et al.,* (1999) suggested that their function are chemoreceptors.Sensillabasiconica 1and 2 (SB1 and SB2) are suggested to be sex pheromone receptor or olfactory function (Hu *et al.,* 2009).The filiform type is a sensillum which is deflected by faint air currents and low-frequency sound, or medium vibration reported by Autrum (1942).

Materials and Methods

Light microscopy study

The beetles are collected from stored cereal sample. The adult beetles were collected from sample and stored in 70% alcohol. Beetle was taken on the slide and observed under the Lyzer "Zoom Stereoscopic Microscopy, Trinocular model (ZSM-3) in the Research laboratory of Zoology Department SGBAU Amravati. The external morphology of adult beetle was studied with the help of identification key and photographs were taken.

Specimen Preparation for scanning electron microscopy

Adults *Rhyzoperthadominica* was collected from stored cerealsample. The adults were stored in 70%alcohol. These beetles were kept out from the 70% alcohol and allow to air dried then put into 90%, absolute alcohol followed by xylene. Whole insect mounted on specimen bronze stub by different views of better observation of sensory organ, with the help of two sided adhesive. Mounted beetle allow to air dry for 1 hour. Platinum coating applying to insects on bronze stub. Then examine sensilla under (JEOL/Eo –JSM-6380 PC-SEM scanning electron microscope). Scanning electron microscopy was done at Department of Metallurgy, Visvesverya National Institute of Technology (VNIT), Nagpur University, and then micrographs were taken for identifying its sensory organs and sensilla present on the sample.

Descriptions and keys to identification of species belonging to the family Bostrichidae can be found by Fisher (1950).

Observations and result of light microscopy:

The external morphological characters of *Rhyzopertha dominica* underLyzer "Zoom Stereoscopic Microscopy, Trinocular model (ZSM-3)*Rhyzopertha Dominica* is found mainly in cereals the Adult *Rhyzoperthadominica* is about 2-3 mm in length and 1 to 1.2 mm in width, small, reddish-brown to black-brown beetle,shape of the body is slim and cylindrical and having biting mouthparts..The head of lesser grain borer is bent downwards and concealed. The head tucked underneath the thorax, is invisible.The antennae consist of 10 segments the scape, pedicel and 8 flagellomeres and 3-segments forming an enlarged antennal club at the terminal end. Antennae inserted in front of eyes.*Rhyzoperthadominica* have well developed thorax. The pronotum (Plate like covering of front segment of the thorax) is tuberculate and saw-toothed appearanceandhaving 3 pairs of legs. The leg is segmented in six parts: Coxa, trochanter, femur, tibia, tarsus and claw .The elytra with punctuate parallel-sided striations. The elytra is covered with curved setae (hairs). End of elytra curved gradually*Rhyzoperthadominica* requires about 27-30 days at 30°C to develop from egg to adult.Larva emerges from eggs between 5-14 days depending on environmental conditions (Chittenden 1911, Crombie 1941).Larva is white to cream coloured, with biting mouthparts and three pairs of legs. The young larva is mobile in grains but become immobile and gradually more C-shaped as they complete their development.

Observations and Result of Scanning electron microscopy

Study of scanning electron microscopic structure of *R.dominica* and its sensilla form on its different part of body,

Antenna of Lesser grain borer having wider scape, small pedicle and eight flagellar segments of antenna. The last three segments form the enlarged club-like structure. The region of antenna is covered by sensilla trichoidea, sensilla basiconica.The filiform type of sensilla having various length and sensilla trichoidea,are found on ventral portion of mouth parts. Six distinctly shaped sensilla are observed on the body and antenna of *Rhyzopertha dominica*.

1) **Sensilla filiform** (F) - It is a thread-like sensillum which is deflect by faint air currents (Dahl, 1883; Gnatzy and Tautz, 1980; Shimozawa and Kanou, 1984a; Tautz, 1977, 1978; reviewed by Autrum, 1942).
2) **Sensilla trichoidea** (**ST1**) - These are hairs which vary greatly in length and are freely moveable. The ST1 are sharp-tipped, nearly straight or slightly curved.They can be solely mechanoreceptor, contact chemoreceptor, thermosensitive, or olfactory in function.
   Sensilla trichoidea (**ST2**) – The ST2 is a blunt-tipped, shorter than ST1.
3) **Sensilla chaetica** (**SC**) – These hairs are similar to the sensilla trichodea, but have thicker cuticular shafts and are not freely moveable. They occur on each antennomere of the antennae, they are characterized by grooved surface and blunt tip. They are mechanoreceptor or contact chemosensitive in function.
4) **Sensilla basiconica** (**SB**) - These are short hairs (pegs) or cones that are innervated by one to several neurons. They can be solely mechanoreceptor, chemoreceptor, olfactory, thermoreceptor and hygrosensitive in function. The SB is characterized by smooth cuticle and blunt tip.
5) **Sensilla microtrichia (Mt)** - These are a fine hair-like non-socketed cuticular structure.
6) **Sensilla ampullacea (Amp)**-These pegs are similar to coeloconic sensilla in structure and function, but are positioned in deep pits with narrow openings and innervated by two to several neurons.

Based on shape, size, distribution and cuticular attachment the following types of sensilla are present on the various body parts of *Rhyzoperthadominica*.,Sensilla trichoideathese are hairs which vary greatly in length and are freely moveable and sharp-tipped, nearly straight or slightly curved .Sensilla trichoidea is a blunt-tipped, shorter than ST1.Sensilla filiform is a thread-like sensillum.Sensilla ampullaceathey are similar to coeloconic sensilla in structure and function, but are positioned in deep pits with narrow openings.Sensilla microtrichia are a fine hair-like non-socketed cuticular structure. Sensillabasiconica are short hairs (pegs) or cones.

Thorax Sensilla :Sensilla microtrichia(Mt) are most abundant on thorax region.Sensillabasiconica (SB1) - The SB1 is characterized by smooth cuticle and blunt tip.Sensilla microtrichia (Mt1) - These are the hair-like cuticles slightly straight.Sensilla microtrichia (Mt2) – These are hair-like sensilla but slightly bend at the base.

Antennal Sensilla : Sensilla chaetica (SC) – These hairs are similar to the sensilla trichodea, but have thicker cuticular shafts and are not freely moveable. SC1 are sharp tipped, nearly straight. Sensilla basiconica (SB1) - The SB1 is characterized by smooth cuticle and blunt tip.

Elytral sensilla:Sensilla trichoidea (ST1) - These are hairs which vary greatly in length and are freely moveable. The ST1 are sharp-tipped, nearly straight or slightly curved.Sensillabasiconica (SB1) - The SB1 is characterized by smooth cuticle and blunt tip.

Sensilla on Legs :Sensilla chaetica (SC) – These hairs are similar to the sensilla trichodea, but have thicker cuticular shafts and are not freely moveable.Sensilla trichoidea (ST1) - The ST1 are sharp-tipped, nearly straight or slightly curved.

DISCUSSION

Insects antennae are movable segmented, paired appendages and originated from head. These sensory appendages are found in nearly all insects groups (Gullan and Cranston, 1994). Numerous sensilla occurred on antennae in the form of hairs, pegs, pits or cones. . The possible functions of each sensillum can be discussed according to external shape and distribution of segmentbased on shape, size, distribution and cuticular attachment, two types of sensilla trichoidea (ST1 & ST2), two types of sensilla basiconica (SB1 & SB2) and one type of sensilla chaetica (SC) were observed on the antennae of *Rhyzoperthadominica*.Various workers reported these types of sensilla in various

beetles species (Merivee *et al*., 2002; and Hu *et al*., 2009).

When compared the ultrastructure of these sensilla with those described in other insect species (Altner and Prillinger, 1980; Zacharuk, 1985;), it is found that these sensilla are capable of responding to various stimuli i.e. olfactory, gustatory, and tactile as well as thermoreceptor andor hygroreception. Sensilla chaetica (SC) are present abundantly on last three antennal clubs, whichis having a dual function of mechanoreception and contact chemoreception (Jourdan *et al*., 1995). While, Merivee*et al*., (1999) suggested that their function are chemoreceptor.

Sensilla trichoidea 1 (ST1) has been described in different insects as having putative mechanoreceptive functions, such as in the perception of mechanosensory stimuli (Pettersson *et al*., 2001; Onagbola and Fadamiro, 2008).Keil, (1999) stated that trichoid sensilla may be olfactory, while sensilla found on the pedicel are usually mainly mechanoreceptive.Sensilla trichoidea 2 (ST2) which are common on the antennal flagella of insects, Merivee *et al*., (1999)suggested that they probably function as sex pheromone receptors. ST1 type sensilla are found mostly on elytra, mouth parts, femur of *Rhyzoperthadominica*. ST1 is sharp-tipped, nearly straight or slightly curved.

Sensilla basiconica 1and 2 (SB1 & SB2) are suggested to be sex pheromone receptor or olfactory function (Hu *et al*., 2009).SB1 are found abundantly on third club of antennae and mouth parts on lesser grain borer *Rhyzoperthadominica*. Sensilla microtrichia are most often described as mechanoreceptors associated with antennal structures (Hull and Cribb 1997;).Hu *et al*., (2010) described Mt on the antennae which have a mechanosensory function. But in the present study these sensilla are mostly present on the thorax of *Rhyzoperthadominica*.

There are several types of mouthparts such as chewing, cutting, piercing, sucking and siphoning, there are two general categories- 1) mouthparts adapted for biting and chewing solid food; 2) mouthparts adapted for sucking fluids (Gullan and Cranston, 2010).While most beetles have mouthparts designed for chewing solid food, many beetles of the superfamily Curculionidea have a distinct snout that can bore into wood and chew seeds (Danho *et al*., 2002).*Rhyzoperthadominica* larva having biting mouth parts. Sensilla basiconica and trichoidea are distributed on mouth parts of adult lesser grain borer, *Rhyzoperthadominica*.

Sensilla chaetica (SC) they occur on clubs of antennae, they are characterized by grooved surface and blunt tip. These types of sensilla are in great harmony with those reported for other beetles species (Merivee *et al*., 2002; and Hu *et al*., 2009).One type of sensilla chaetica (SC) was observed on the antennae and tibia of *Rhyzoperthadominica*.Sensilla ampullacea- These pegs are similar to coeloconic sensilla in structure and function, but are positioned in deep pits with narrow openings and innervated by two to several neurons.Sensillachaetica- These hairs are similar to the sensilla trichoidea, but have thicker cuticular shafts and are not freely moveable. They are typically innervated by one or more neurons and can be mechanoreceptors or contact chemo-sensitive in function.Sensilla filiform (F) - It is a thread-like sensillum which is deflects by faint air currents.

CONCLUSION : In *Rhyzoperthadominica* short sensory receptors and long sensory receptors are designated according to their morphological structure. The present study has identified and characterized six different sensilla types on the body parts of *Rhyzoperthadominica*. Based on features of scanning electron microscopy, three types of sensilla were distinguished on the antennal segments of, sensilla chaetica (SC), sensilla trichoidea (ST) and sensilla basiconica (SB)Merivee *et al*., 2002; and Hu *et al*., 2009).Sensilla chaetica (SC) are present abundantly on last three antennal clubs, which is having a dual function of mechanoreception and contact chemoreception (Jourdan *et al*., 1995).Sensilla trichoidea 1 (ST1) has been described in different insects as having putative mechanoreceptive functions, such as in the perception of mechanosensory stimuli (Pettersson *et al*., 2001;Onagbola and Fadamiro,2008).Keil, (1999)stated that trichoid sensilla may be olfactory, while sensilla found on the pedicel are usually mainly mechanoreceptive. Sensillachaetica (SC) are believed to have a dual function of mechanoreception and contact chemoreception (Jourdan *et al.,* 1995).

Sensilla basiconic suggested to be sex pheromone receptor or olfactory function (Hu *et al*., 2009). SB1 are found abundantly on third club of antennae and mouth parts on lesser grain borer.

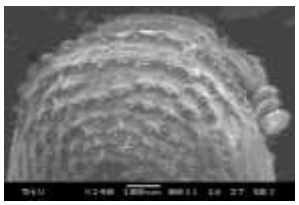
Photograph of Light microscopyPhotograph of Scanning electron microscopy of Rhyzopertha dominof Rhyzopertha dominica

Dorsal view of *Rhyzoperthadominica* (Fabricius)

Ventral view of *Rhyzoperthadominica* (Fabricius)

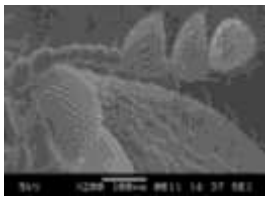
dorsal view of *Rhyzoperthadominica*

ventral view of *Rhyzopertha dominica*

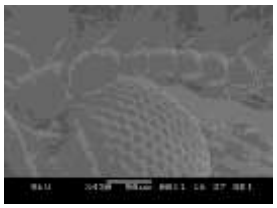


dorsal view of thorax region of *Rhyzoperthadominica*. Sensilla basiconica

Antennae and mouth parts of Rhyzoperthadominica

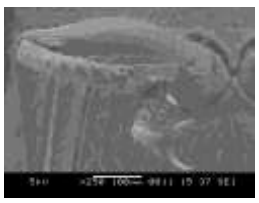


dorsal view of whole antenna of *Rhyzopertha dominica.* Scape (S), pedicel (P), flagellum (Fla)

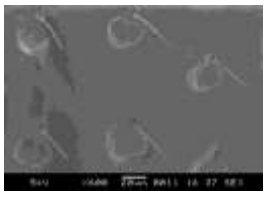


dorsal view of antennal segments and associated sensilla in the adult of *Rhyzopertha dominica* Sensilla trichoidea (ST1 and ST2)

Ventral view of thoracic leg and associated sensilla of *Rhyzopertha dominica*. Sensilla trichoidea(ST1), chaetica(SC)



Dorsal view of prothorasic leg of *Rhyzopertha dominica*



trichoidea(ST1) and basiconica(SB1) type of sensilla on the Elyatra of Rhyzoperthadominica

Ventral view of thoracic leg and associated sensilla of *Rhyzopertha dominica*. Sensilla trichoidea(ST1), chaetica(SC)

Phot ograph of Scanning electron microscopy of *Rhyzopertha dominica of sence organs Sensilla*

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