Olfactory responses of the banana weevil, *Odoiporus longicollis* (Olivier) (Coleoptera: Curculionidae) against pseudostem and its crude extract

K. Sahayaraj* and P. Kombiah

ABSTRACT

Banana pseudostem weevil, *Odoiporus longicollis* (Olivier) (Coleoptera: Curculionidae) is an important pest of banana (*Musa* spp.) plants causing heavy yield reductions throughout the world. Farmers mainly depend upon the synthetic insecticides to manage this pest, but it was more expensive and caused many problems to human being and domestic animals and also to our environment. The present investigation was carried out to study the olfactory responses of the pseudostem weevil *O. longicollis* against the decayed pseudostem and its extract under laboratory conditions. Banana pseudostem were allowed to decay for 1, 3, 5 and 7 days and used for the experiment. Results revealed that both 7 days decayed pseudostem (53.35%) and its extract (75.0%) has more attractant property when compared to other experimental decayed pseudostem and its extracts. The results suggest that decayed pseudostem based attractant can be used as the trapping agent for the management of *O. longicollis.*

Keywords: *Odoiporus longicollis,* attractant, banana weevil, olfactory response, pseudostem extract

INTRODUCTION

Banana (Musaceae) is an important food crop commonly grows in tropical and subtropical parts of the world (Tiwari *et al*., 2006). It is the fourth most important crop after rice, wheat and maize (INIBAB, 2000; Padmanaban *et al.,* 2001). Out of the 40 million tonnes of fruits produced in India, banana occupies the number one position with an annual output of 14.0 MT from an area of 4, 00,000 hectares (Osmark, 1974; Nahif *et al.,* 2003). Among the insect pests of banana, the pseudostem weevil *Odoiporus longicollis* (Olivier) (Coleoptera: Curculionidae) is one of the serious monophagous pest (Padmanaban and Sathiamoorthy, 2001) limiting the production and productivity of bananas and plantains (Visalakshi *et al*., 1989). In recent years, severe incidence of banana pseudostem weevil has been reported from different parts of India and it is becoming very serious in southern India particularly in Tamil Nadu and Kerala (Reghunath *et al.,* 1992; Gailce Leo Justin *et al.,* 2008). The adult *O. longicollis* cause severe damage to the plant by making oviposition punctures on the outer sheath and feeding on the pseudostem (Anitha and Nair, 2004) and the grubs make longitudinal tunnels in the pseudostem for feeding the pupae in the pseudostem become adults (Ravi and Palaniswami, 2002). Due to the larval infestation, the plant pseudostem becomes hollow, weak, premature mortality, shortened plantations life and results in heavy damage (Padmanaban and Sundaraju, 1999; Gold *et al.,* 2001a). It has been estimated that the stem weevil causes 10-90% yield loss depending on the infestation stage and management efficiency (Prasuna *et al.,* 2008).

Use of chemical insecticides causes the long term effects such as pesticide resistance (Gold and Messiaen, 2000), pest resurgence, pest out breaks, ground water contamination (Thapa and GC, 2000, Kannaiyan, 2002) and drastic effects on beneficial insects (Vasantharaj David, 2008). Apart from these impacts, it is being expensive and toxic to the environment, the banana weevil now shows resistance to most classes of chemicals. Therefore, now it is necessary to develop an alternative management method of tackling the pest, that is safe and more ecofriendly for the management of banana pseudostem weevil *O. longicollis*. The aim of the IPM is to combine all the available methods or tools in order to minimize the usage of chemical insecticides and thus to maintain the ecosystem free from pollutants (Chatterjee, 1997). The present investigation was undertaken to evaluate the attractant property of decayed pseudostem and its extracts against the *O. longicollis*.

MATERIAL AND METHODS

Collection of insects

Adult *O. longicollis* were collected from the banana field in and around Kanyakumari district of Tamil Nadu and

were maintained in the laboratory at 28 ± 2°C and 60 ± 10 % RH in plastic containers (10 cm diameter and 20 cm depth) with holes of 1mm diameter for aeration. The fresh pieces of banana pseudostem were provided for their maintenance. Unfed pseudostems were changed once in three days. Laboratory maintained adult weevils were used for the experiment.

Pseudostem extract preparation

Small pieces (3 x 2 cm) of banana pseudostem were taken in a plastic container and allowed to decay for 1, 3, 5 and 7 days and used for this experiment. For another experiment the 1, 3, 5 and 7 days decayed pseudostem were ground in domestic mixer blender separately. Extract was filtered using filter paper and centrifuged at 5000 rpm for 10 minutes and the supernatant was used as an attractant.

Bioassay

The behavioral response of insects against the decayed pseudostem, and pseudostem extract was evaluated using two way olfactometer as described by Sahayaraj (2008). The olfactometer consists of release chamber in centre and two side arms (one chamber for control and other for the test sample). A small piece of fresh pseudostem (3 x 2 cm) was used as control and one day decayed pseudostem of same size was used as experimental material in chamber of olfactometer. Twelve hours pre-starved twenty banana pseudostem weevils were released separately into the central chamber of the olfactometer and their preference was observed after 30 minutes. Similar procedure was carried out for 3, 5 and 7 days decayed pseudostem and its extract separately. The experiment was replicated three times. The weevils preferred either fresh pseudostem and decayed pseudostem or neither. Weevil chose the decayed pseudostem were considered as attractant. If the weevil chose neither of the chambers then it was considered that weevil made no choice. From the observation recorded the Access proportion Index (API) was performed using the following formula

$$\text{Access Proportion Index} = \frac{NS - NC}{NS + NC}$$

Where NS = Number of insects choosing the sample side and NC = Number of insects choosing the control side.

RESULTS AND DISCUSSION

The olfactory response of *O. longicollis* shows that seven days old decayed pseudostem has more attractant activity (53.35%) when compared to other categories (37.5, 45 and 45.5% for 1, 3 and 5 days old decayed pseudostem, respectively). The percentage of preference was gradually increased when the number of days increased up to seven days. Access Proportion Index (API) also reveals that *O. longicollis* prefers seven days old decayed pseudostem (0.212) than the first day (- 0.210), third day (- 0.100) and fifth day (-0.053) decayed pseudostem (Table 1). Previously Ndiege *et al.* (1991) reported that the volatiles emanating from the banana plant attracts *Cosmopolites sordidus* to banana corms and 1, 8 cineole was responsible for attraction of *Cosmopolites sordidus* (Ndiege *et al.,* 1996). Moreover both male and female *O. longicollis* use the volatile chemicals of banana for locating their mating (Prasuna *et al.*, 2008) and egg laying (Abera, 1997 and Gold *et al.*, 2001).

Similar to that of decayed pseudostem, seven days decayed pseudostem extract significantly ($P < 0.05$) has more attractant property (75.0 %) than other days old pseudostem extracts (35, 40 and 42.5 per cent for 1, 3 and 5 days category respectively). The results of the API were 0.300, -0.150, - 0.105 and 0.666 for 1, 3, 5 and 7 days decayed pseudostem extract respectively (Table 1). The API gradually increased with increased duration of decay of pseudostem. Semiochemicals or insect behavior modifying chemicals, which include pheromones, have been proved to provide better and selective pest control or management in the protection of crops and forests (Welter *et al*., 2005). The use of aggregation pheromones, which attract both male and female insects in association with high volatiles, has led to development of mass trapping as a control strategy for several weevil species (Weissling *et al.*, 1994; Alpizar *et al.*, 2002). Although there

Table 1. Olfactory responses (in %) of *Odoiporus longicollis* in relation to decayed pseudostem and its extract.

Days	Non responded animals (in %)	Control	Decayed pseudostem preference (in %)	API
Decayed pseudostem				
1	5.0	57.5	37.5	-0.210
3	0	55.0	45.0	-0.100
5	4.5	50.0	45.5	-0.053
7	11.7	35.0	53.4	0.212
Decayed Pseudostem extract				
1	0	65.0	35.0	-0.300
3	5	55.0	40.0	-0.150
5	5	52.5	42.5	-0.105
7	0	25.0	75.0	0.666

API – Access proportion index

are reports on the attraction of the *O. longicollis* by host plant semiochemicals, no one has tried with decayed pseudostem. Prasuna *et al.* (2008) reported that banana sheath extract alone was found to produce considerable influence on weevil olfactory response. In support, our results suggest that irrespective of the *O. longicollis* use decayed pseudostem as cues for food location. In the recent past, the use of pheromones as one of the ecofriendly tactics in the pest management programme has assumed a greater dimension as a novel technique in monitoring and mass trapping insect pests of crop plants (Ravi and Palaniswami, 2002). The results help in chemical identification and planning the synthesis of pheromonal chemicals which could be used as trapping agents for the integrated pest management of banana pseudostem weevil *O. longicollis.*

ACKNOWLEDGEMENT

The authors are grateful to Rev. Dr. Alphonse Manickam, S.J., Principal, St. Xavier's College (Autonomous), Palayamkottai for providing necessary laboratory facilities and encouragements.

REFERENCES

Abera, A. M. K. 1997. Oviposition preferences and timing of attack by the banana weevil *Cosmopolites sordidus* (Germer) in East African highland banana (*Musa* spp). M.Sc., thesis, Makerere University. Kampala, Uganda.

Alpizar, D., Fallus, M., Oehlschlager, A. C., Gonzalez, L. M., Chinchilla, C. M. and Bulgarelli, J. 2002. Pheromone mass trapping of the West Indian sugarcane weevil and the American palmweevil (Coleoptera: Cucculionidae) in palmito palm. *Florida Entomology,* **85**: 426 – 430.

Anitha, N. and Nair, M. 2004. Life table and intrinsic rate of increase rate of pseudostem weevil *Odoiporus longicollis* Oliv. on popular banana clones of Kerala. *Entomon,* **29** (4): 345 - 350.

Chatterjee, P. B. 1997. Plant protection techniques. Bharati bhawan Publishers. Patana, India. 277 - 291 **PP**.

Gailce Leo Justin, C., Leelamathi, M. and Nirmal Johson. 2008. Binomics and management of the pseudostem weevil *Odoiporus longicollis* (Coleoptera: Curculi onidae) in banana – A Review. *Agriculture Review*, **29** (3): 185 - 192.

Gold, C.S. and Messiaen, S. 2000. The banana weevil *Cosmopolites sordidus* Musa pest fact sheet No 4 INIBAP, Montpellier, France.

Gold, C. S., Pena, J. E. and Karamira, E. B. 2001. Biology and Integrated Pest Management for the banana weevil, *Cosmopolites sordidus* (Germar) (Coleoptera: Curculionidae). *Integrated Pest Management Reviews*, **6**: 79 - 155.

Gold, C.S., Peno, J. E. and Karamura, E. B. 2001a. Integrated pest management for the banana weevil *Cosmopolites sordidus* (Germer) (Coleoptera: Curculionidae). *Integrated pest management Review,* **6**: 79-155.

INIBAB. 2000. Bananas. International Network for the Improvement of Banana and plantain. International Plant Genetic Resources Institute, available online at http: // bananas.bioversityinternational.org/files/pdf/ publications/brochure_bananas.pdf.

Kannaiyan, S. 2002. Insect pest management stragies in integrated pest management, (Ignacimuthu, S. and Sen, A. eds). Phenolix publishing house: New Delhi, 1 - 13 **PP**.

Nahif, A.A., Padmanaban, B., Sundararaju, P. and Sathyamoorthy, S. 2003. Ultrastructure of mouth parts, elytra and tarsus of the banana stem weevil, *Odoiporus longicollis* (Coleoptera: Curculionidae). *Entomon*, **28** (1): 45 - 49.

Ndiege, I. O., Budenberg, W. J., Lwande. W. and Hassanali, A. 1991. Volatile components of banana pseudostem of a cultivar susceptible to banana weevil. *Phytochemistry*, 3929 – 3930.

Ndiege, I.O., Willam, J., Budenberg Dalmas, Otieno, O. and Ahmed Hassanali, 1996. 1, 8- Cineole: an attractant for the banana weevil, *Cosmopolites sordidus*. *Phytochemistry*, **42** (2): 369 - 371.

Osmark, H. E. 1974. Economic insect pests of bananas. *Annual Reviews of Entomology,* **19:** 161 - 176.

Padmanaban, B. and Sathiamoorthy, S. 2001. International Network for the improvement of banana and plantain, Montpellier Cedex 5.

Padmanaban, B. and Sundararaju, P. 1999. Occurrence of banana weevil borers (Coleoptera: Curculionidae) in Tamil Nadu. *Insect Environment*, **5**: 135.

Padmanaban, B., Sundararaju, P., Velayudhan, K. C. and Sathyamoorthy, S. 2001. Evaluation of Musa germ germplasm against banana weevil borers. *Info Musa*, **10**: 26 - 28.

Prasuna, A. L., Jyothi, K.N., Prasad, A.R., Yadav, J. S and Padmanaban, B. 2008. Olfactory responses of banana pseudostem weevil, *Odoiporus longicollis* Olivier (Coleoptera: Curculionidae) to semiochemicals from consepecifics and host plant. *Current Science*, **94** (7): 896 - 900.

Ravi, G. and Palaniswami, M. S. 2002. Evidence for a female-produced sex pheromone in the banana pseudostem weevil, *Odoiporus longicollis* Olivier. *Current Science*, **83** (7): 893 - 898.

Reghunath, P., Visalakshi, T., Biju Mathew, N., Mohandas, S., Naseema Beevi, S. and Remamoni. 1992. Insecticidal

management of the pseudostem borer *Odoiporus longicollis* Olivier (Coleoptera: Curculionidae) in banana. *Entomon,* **17** (1 - 2): 113 - 115.

Sahayaraj, K. 2008. Approaching behaviour of *Rhynocoris marginatus* (Fab.) (Heteroptera: Reduviidae) on three prey kairomones. *Bulletin of Insectology,* **61** (2): 233 - 237.

Thapa, R. B. and GC. Y. D. 2000. Integrated management of soil insect pests in the mid hill of Nepal. SSMP Documents No. **44**: 1 - 61.

Tiwari, S., Thapa, R. B., Gautam, D. M. and Shrestha, S. K. 2006. Survey of banana stem weevil, *Odoiporus longicollis* (Coleoptera: Curculionidae) in Nepal. *Journal of Insects, Agricultural animal Science,* **27**: 127 - 131.

Vasantharaj David, B. 2008. Biotechnological approaches in IPM and their impact on environment. *Journal of Biopesticides*, **1**: 01 - 05.

Visalakshi, A., Nair, G. M., Beevi, S. N. and Amma, A. M. K. 1989. Occurrence of *Odoiporus longicollis* Oliv. (Coleoptera: Curculionidae) as a pest of banana in kerala. *Entomon,* **14** (3): 367 - 368.

Weissling, T. J., Giblin - Davis, R. M., Gries, G., Gries, R., Perez, A. L., Pierce, H. D. and Oehlshlager, A. C. 1994. Aggregation pheromone of palmetto weevil *Rhynchophorus cruentatus* (F.) (Coleoptera: Cucculionidae). *Journal of Chemical Ecology,* **20**: 505-515.

Welter, S. C., Pickel, C., Miller, J., Cave, F., Van Steenwyk, R. A. and Dunley, J. 2005. Pheromone mating disruption offers selective management options for key pests. *California Agriculture,* **59**: 16 – 22.

K. Sahayaraj* and P. Kombiah

Crop Protection Research Centre, Department of Advanced Zoology and Biotechnology, St. Xavier's College (Autonomous), Palayamkottai – 627 002, Tamil Nadu, India, E-mail: ksraj42@gmail.com.