



## Assessment of biopesticides and insecticide against pseudostem weevil *Odoiporus longicollis* Oliver in red banana

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### ABSTRACT

The pseudostem weevil (*Odoiporus longicollis*) is one of the most dangerous pests in banana crop. On farm and laboratory experiments were carried out at the Krishi Vigyan Kendra, Pechiparai, Kanyakumari District, Tamil Nadu, India during the period 2010-2011 to assess the bio-efficacy of *Beauveria bassiana*, Azadirachtin 10000 ppm and monocrotophos (spray and injection) insecticide against pseudostem weevil, *Odoiporus longicollis* Oliver (Coleoptera : Curculionidae) in Red banana. Injection of monocrotophos @ 4ml/plant registered the highest per cent reduction (76.07%) followed by the injection of Azadirachtin 2ml/plant (70.0%), application of *B. bassiana* @ 25g on the pseudostem trap (56.75%) and monocrotophos spray (38.39%). However, application of monocrotophos (4ml/plant) and Azadirachtin (2ml/plant) by stem injection proved to be more effective than by spraying of monocrotophos. Stem injection of monocrotophos, Azadirachtin and the application of *B. bassiana* recorded the highest per cent mortality of 96.15, 84.74 and 75.36%, respectively, after 96 hrs of application. All the treatments were found to increase the fruit yield with better cost benefit ratio.

**Key words:** Azadirachtin, *Beauveria bassiana*, biopesticides, monocrotophos, pseudostem weevil, stem injection

### INTRODUCTION

Banana is the fourth most important fruit crop and India is the largest producer. Of the 40 million tonnes of fruits produced in India, banana occupies the top position with an annual output of 13.5 MT from an area of 4,00,000 ha. Banana is attacked by different insect pests among which, banana pseudostem weevil (BPW) or banana pseudostem borer, *Odoiporus longicollis* Oliver (Coleoptera: Curculionidae) is a key pest limiting the production and productivity of bananas and plantains (Ostmark, 1974; Gailce *et al.*, 2008). The female weevil lays eggs inside the air chamber of the outer sheath of the pseudostem through holes made by its rostrum. Emerging grubs make extensive tunnels in the pseudostem for feeding and pupate inside the pseudostem to become adults. Owing to the extensive damage to the pseudostem, it often becomes hollow and weak and bears either undersized fruit or no fruit at all depending upon the extent of the damage. The problem is generally noticed only when the damage is in the advanced stage and grubs are fully grown (Padmanaban *et al.*, 2001). Farmers use various control measures, but all have not been evaluated widely for their efficacy or potential integration with other practices (Karamura and Gold, 2000). These measures include cultural controls such as clean planting material, intercropping, destruction of residue after harvest, and pseudostem traps. Other possibilities for control include biological control with

myrmicine ants (Castineiras and Ponce, 1991) or entomopathogens (Pena *et al.*, 1995), botanical or synthetic pesticides (Gold *et al.*, 2001), and mass trapping with pheromone lures (Tinzaara *et al.*, 2003). The pest status of the banana weevil can vary depending on local agro-ecological conditions and *Musa* cultivars (Gold *et al.*, 2001). In this work, attempts have been made to assess the efficacy of biopesticides and insecticides against pseudostem weevil in Red banana.

### MATERIALS AND METHODS

On farm trials were conducted at five locations in Kanyakumari District, Tamil Nadu during 2010 -11 to evaluate the efficacy of bio-pesticides and insecticide against pseudostem weevil in banana. The field experiments were initiated on five-month old red banana plants. All the agronomic practices were adopted uniformly for all the technology options. There were five treatments including an untreated check with five replications in a Randomized Block Design. The treatments were imposed thrice at 30 days interval from 5<sup>th</sup> to 8<sup>th</sup> months. Spraying of monocrotophos (2mL/L.) using a high volume knap sack hand operated sprayer and the quantity of spray fluid used was 500 lit/hectare. Teepol (1%) was added as emulsifier for better spread and adhesion. Monocrotophos 36WSC @ 4 ml (1:7 ratio) (54 ml of monocrotophos with 350 ml of water) and Azadirachtin 10000 ppm (1:4 ratio) @ 2ml/plant were

injected into the stem at two heights *viz.*, 45 and 150 cm through banana pseudostem injector. Application of *B. bassiana* 25g on the pseudostem of banana (pseudostem trap @100/ha) and placing in the ground soil. The symptoms *viz.*, presence of small pin head holes on the stem, fibrous extrusions from bases of leaf petioles, presence of adult weevil and exudation of a gummy substance from the holes on the pseudostem caused by stem borer were observed at monthly intervals.

All the above treatments were evaluated for their efficacy against banana pseudostem borer in the laboratory. The control was maintained separately. Twenty five numbers of weevils were released in the respective treatments and their mortality was noted after 24, 48, 72 and 96 hours after release and the per cent mortality was calculated for each treatment.

**Statistical analysis**

The data on percentage were transformed into corresponding *angle/arc-sine* percentage. The data gathered from field and laboratory experiments were subjected to statistical scrutiny following the methods of Gomez and Gomez (1985) and the means were compared with Duncan Multiple Range Test (DMRT).

**RESULTS AND DISCUSSION**

Among the three technology options tested in which injection of monocrotophos (4mL/plant) was found superior in all the periods of observations and recorded the mean per cent reduction of infestation was 76.07% followed by Azadirachtin 10000ppm @ 2mL/plant (70.05%) and *B. bassiana* 25g on the pseudostem trap (56.75%) as against spraying of monocrotophos (38.39%) (Table 1). This finding gains support from the report of Gailce *et al.* (2006) who stated that

pseudostem injection of monocrotophos or Dimethoate in water (1:5 ratio) @ 4mL/plant significantly reduced the pseudostem weevil. Ogenga-latigo and Masanzam (1996) reported the use of insecticides *viz.*, Dursban, Primicid and Furadan controlled the banana pseudostem weevil more effectively than the fungal pathogen, *B. bassiana*. Sivasubramanian *et al.* (2009) stated that the stem injection of Neem Azal in water (4:4 ratio) was found to be effective in the management of pseudostem weevil in banana. Nankinga (1999) demonstrated that *B. bassiana* formulated with cracked maize and applied to split pseudostem and corm traps caused 50% and 60% mortality respectively of the weevils that were attracted to these traps. The fungus, *B. bassiana* was an effective field delivery system that is both affordable to farmers and ensures effective and persistent activity against the banana weevil (Tumuhaise *et al.*, 2003).

Among the treatments tested in Laboratory, Monocrotophos (4ml/plant) when applied by injection into the stem caused more per cent mortality of the weevil i.e. 84.61 and 96.15 per cent at 72 and 96 hrs of the treatment respectively (Table 2). This treatment was followed by Azadirachtin 10000ppm (1:4, pseudostem injection) and *B. bassiana* (applied on the pseudostem trap) was 84.74 and 75.36 per cent mortality of weevil after 96 hrs of treatment respectively. Sivasubramanian *et al.* (2009) opined that the stem injection of Neem Azal (4:4, stem injection) recorded high per cent mortality of the pseudostem weevil in banana and this is in close agreement with the present investigation.

**Banana fruit yield**

The effect of different technology options in recording higher fruit yield (qtl/ha) was achieved with the stem injection of monocrotophos @ 4mL/plant with 458.34 qtl/ha followed by

**Table 1.** Effect of biopesticides and insecticide against pseudostem weevil, *O. longicollis* in Red banana in the field condition

Treatment	Per cent infestation at different level *						Per cent reduction at different level *					
	Location						Location					
	1	2	3	4	5	Mean (%)	1	2	3	4	5	Mean (%)
Monocrotophos spray @2ml/lit.	15.82 c	14.80 c	16.95 c	15.50 c	16.95 c	16.00 c	39.76 d	44.59 d	29.67 d	40.15 c	37.79 d	38.39 d
Monocrotophos injection @ 4ml/plant	6.50 a	5.75 a	6.30 a	7.10 a	6.20 a	6.37 a	74.16 a	78.47 a	73.86 a	72.59 a	81.27 a	76.07 a
Azadirachtin 10000ppm injection @ 2ml/plant	7.25 a	7.90 a	8.20 a	7.80 a	7.40 a	7.71 a	71.17 b	70.42 b	65.98 b	69.88 a	72.84 b	70.05 b
Application of <i>Beauveria bassiana</i> @25g	11.70 b	11.20 b	10.75 b	11.10 b	11.80 b	11.31 b	53.48 c	58.07 c	55.39 c	57.14 b	59.65 c	56.75 c
Untreated check	25.15 d	26.71 d	24.10 d	25.90 d	27.25 d	25.82 d	-	-	-	-	-	-

\* Each value is the mean of five replications; In a column, means followed by a common letter (s) are not significantly different by DMRT (P=0.05)

**Table 2.** Effect of biopesticides and insecticide against pseudostem weevil, *O. longicollis* in red banana in the laboratory condition

Treatment	Corrected per cent mortality of weevil *				
	24 hours	48 hours	72 hours	96 hours	Mean (%)
Monocrotophos spray @2ml/lit.	6.25 c	9.38 d	15.63 d	18.75 d	12.50 d
Monocrotophos injection @ 4ml/plant	52.82 a	66.66 a	84.61 a	96.15 a	75.06 a
Azadirachtin 10000ppm injection @ 2ml/plant	22.17 b	46.36 b	67.32 b	84.74 b	55.15 b
Application of <i>Beauveria bassiana</i> @ 25g	25.64 b	35.46 c	55.56 c	75.36 c	48.01 c
Untreated check	0.0 d	0.13 e	0.57 e	1.13 e	0.46 e

\* Each value is the mean of five replications; In a column, means followed by a common letter (s) are not significantly different by DMRT (P=0.05)

Azadirachtin 10000ppm @ 2ml/plant (449.68 qtl/ha) and *B. bassiana* @ 25g (443.19 qtl/ha) when compared to 320 quintal per ha in untreated check (Table 3). Stem injection of monocrotophos @ 4ml/plant followed by Azadirachtin 10000ppm @ 2ml/plant and *B. bassiana* @ 25g resulted in an increase of fruit yield over untreated check to an extent of 43.23, 40.53 and 38.49 percent respectively (Table 3).

#### Cost benefit ratio

Considering the cost of additional yield per ha over untreated check, cost of plant protection and accrued profit per ha in different treatments, mean of cost benefit ratio was higher in

stem injection of monocrotophos (4mL/plant) (3.33) followed by Azadirachtin 10000ppm (2mL/plant) (3.27) and *B. bassiana* @ 25g (3.12) (Table 3).

#### REFERENCES

- Castineiras, A. and Ponce, E. 1991. Efectividad de la utilizacion de *Pheidole megacephala* (Hymenoptera: Formicidae) en la lucha biologica contra *Cosmopolites sordidus* (Coleoptera: Curculionidae). *Protection de Plantas*, 1: 15-21.
- Gailce Leo Justin, C., Rajkumar, D., Nirmalatha, J. D., Prem Joshua, J. and Jayasekhar, M. 2006. Dose optimization of

**Table 3.** Yield and cost benefit relationship for bio-pesticides and insecticide imposed on red banana

Treatment	Yield (Qtl/ha)	Per cent increase over control	Gross cost (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	BCR
Monocrotophos spray @2ml/lit.	414.68	29.58	1,66,000	4,97,280	3,31,280	2.97
Monocrotophos injection @ 4ml/plant	458.34	43.23	1,65,000	5,49,840	3,84,840	3.33
Azadirachtin 10000ppm injection @ 2ml/plant	449.68	40.53	1,65,000	5,39,280	3,74,280	3.27
Application of <i>Beauveria bassiana</i> @ 25g	443.19	38.49	1,70,000	5,31,000	3,61,000	3.12
Untreated check	320.00	-	1,40,000	3,84,000	2,44,000	2.71

\* Each value is the mean of five locations

- insecticides for the management of the pseudostem weevil *Odoiporus longicollis* (Coleoptera: Curculionidae) on banana. *Agricultural Science Digest*, **26**: 117-119.
- Gailce Leo Justin, C., Leelamathi, M. and Nirmal Johson. 2008. Bionomics and management of the pseudostem weevil *Odoiporus longicollis* (Coleoptera: Curculionidae) in banana a review. *Agriculture Review*, **29** (3): 185 - 192.
- 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.
- Gomez, K. A. and Gomez, A. A. 1985. Statistical procedures for agricultural research. John Wiley and Sons. New York. 650P.
- Karamura, E. B. and Gold, C. S. 2000. The elusive banana weevil, *Cosmopolites sordidus* Germar. *Acta Horticulturae*, **540**: 471-485.
- Nankinga, C. M. 1999. Characterization of entomopathogenic fungi and evaluation of delivery systems for the biological control of the banana weevil, *Cosmopolites sordidus*. Ph.D. dissertation. University of Reading, UK. 277 P.
- Ogenga-latigo, M. V. and Masanzam, M. 1996. Comparative control of the banana weevil, *Cosmopolites sordidus*, by the fungal pathogen, *Beauveria bassiana*, and some insecticides when used in combination with pseudostem trapping. *African Crop Science Journal*, **4** (4): 483-489.
- Ostmark, H. E. 1974. Economic insect pests of bananas. *Annual Review of Entomology*, **19**: 161-176.
- Padmanaban, B., Sundararaju, P. and Sathiamoorthy, S. 2001. Incidence of banana pseudostem borer, *O. longicollis* Oliv. (Coleoptera: Curculionidae) in banana peduncle. *Indian Journal of Entomology*, **63**(2): 19-24.
- Pena, J. E., Gilbin-Davis, R. M. and Duncan, R. 1995. Impact of indigenous *Beauveria bassiana* (Balsamo) Vuillemin on banana weevil and rotten sugarcane weevil (Coleoptera: Curculionidae) populations in banana in Florida. *Journal of Agricultural Entomology*, **12**: 163-167.
- Sivasubramanian, P., Zadda Kavitharaghavan, Jayaprabhavathi, S. and Samiayyan, K. 2009. Efficacy of Neem Azal 1.2 EC in the management of banana pseudo stem weevil, *Odoiporus longicollis* Olivier. *Karnataka Journal of Agricultural Sciences*, **22**(3): 561-563.
- Tinzaara, W., Dicke, M., Van Huis, A., Van Loon, J. J. A. and Gold, C. S. 2003. Different bioassays for investigating orientation responses of the banana weevil, *Cosmopolites sordidus*, show additive effects of host plant volatiles and a synthetic male-produced aggregation pheromone. *Entomologia Experimentalis et Applicata*, **106**: 169-175.
- Tumuhaise, V., Nankinga, C. M., Gold, C. S., Kyamanywa, S., Tushemereirwe, W. K., Ragama, P., Moore, D., Gowen, S. R., Moore, D. and Gowen, S. R. 2003. Kairomone trapping for delivery of *Beauveria bassiana* to control the banana weevil, *Cosmopolites sordidus* (Germar). *African Crop Science Conference Proceedings*, **6**: 346-351.

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