



EVALUATION OF BIOPESTICIDE FORMULATIONS AGAINST BANANA STEM WEEVIL *ODOIPORUS LONGICOLLIS* (OLIVIER)

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ABSTRACT

This study evaluated the laboratory and field efficacy of some biopesticides against the banana pseudostem weevil *Odoiporus longicollis* (Olivier). Sprays were applied five times from 3rd to 11th month at 45 days intervals. The observations such as the oviposition marks, larval galleries, plant death and yield revealed 100% mortality in Avaya and chlorpyrifos and 91.66% in CTCRI-Nanma and neem based product Nimbicidine treatments. The field observations indicated that Nimbicidine and cassava based Nanma significantly reduced the infestation similar to positive control chlorpyrifos, and these were considered under 1st category. The botanicals Zimmu plant extract, gallic acid and Aavya (2nd category) and pongamia and neem soap (3rd category) provided moderate/ less protection. It is concluded that the neem based botanical formulations could be effective and safe to use in banana against stem weevil.

Key words: Banana, *Odoiporus longicollis*, neem based biopesticides, cassava leaf extract, chlorpyrifos, pongamia, neem soap, gallic acid, oviposition marks, larval galleries, plant death, yield

The banana stem weevil (BSW) *Odoiporus longicollis* (Olivier) (Coleoptera: Curculionidae) is an important insect pest of banana (Padmanaban et al., 2001). The commercial varieties are highly susceptible to this and the rhizome weevil *Cosmopolites sordidus* (Germar) that cause yield loss from 10 to 90% (Padmanaban et al., 2020a,b). Stem injection of monocrotophos and swabbing insecticides along with surfactants affect adult interaction with host plants thereby preventing oviposition. Soil application of pesticides against banana weevil is of little success (Dutt and Maiti, 1971; Bujulu et al., 1983; Visalakshi et al., 1989; Padmanaban, 2018). Chemical control provides a short time solution, and its use for a longer period leads to development of resistance (Gokool et al., 2010). Use of botanicals for stem weevil management can be of use to develop ecofriendly IPM. Botanical pesticides are emerging as promising one now (Reddy et al., 2020), as these are environment friendly (Bhagawati et al., 2009; Awasthi et al., 2016). Using neem oil (*Azadirachta indica*), crude extract of *Lantana camera* and *Gliricidia sepium* are known to be effective against *O. longicollis* (Irulandi et al., 2009); also monocrotophos (4ml/ plant) in combination with azadirachtin (2ml/ plant) by stem injection proved to be more effective compared to monocrotophos. Stem injection of monocrotophos, azadirachtin along with *B. bassiana* were effective with increased yield and cost benefits (Awasthi et al.,

2016). Insecticidal activity of cassava extract (contains isothiocyanates) parts such as leaf and tuber rind are known as effective against *O. longicollis* (Krishnan et al., 2016). Aguilar et al. (2014) suggested on-farm trials with botanicals. Hence, the present study to evaluate the laboratory and field efficacy of some biopesticides against *O. longicollis*.

MATERIALS AND METHODS

The field trial was carried out at Kuruvadi, Tiruppanandal, Thanjavur district where the banana weevil infestation is >60%, with cv Poovan (AAB-Mysore). There were nine treatments: two ICAR-IIHR Bengaluru commercial botanical formulations, pongamia soap and neem soap (these formulations were dissolved 10 g/ l- w/v as recommended; ICAR-CTCRI, Thiruvananthapuram biopesticide, Nanma a formulation made out of tapioca leaves. This formulation was prepared using 50 ml in 1 l of water. Zimmu plant extract (an interspecific hybrid of *Allium cepa* x *A. sativum*) was prepared by grinding 100 g of fresh leaves in 1 l of water (w/v) and 30 g of gallic acid was dissolved in 1 l of water (w/v). Nimbicidine (5000 ppm) and chlorpyrifos 20SL (v/v) as commercial formulations were dissolved each 2.5 ml separately in 1 l of water. These two products were used as positive control, and adjutant-Triton-x 100 in water 50 ml/ l as a negative control. Each treatment had 9 replications, and the biopesticide formulations

were applied on the leaf axils and at the cut ends of the already removed senescent leaves, as these areas are identified as targets for adult entry. Spray was given from 3rd month onwards at 45 days' interval until 11th month. After 11th month spray, observations were made on oviposition marks, larval galleries, plant death and bunch yield, regarded as characteristics for identifying the effectiveness of treatments. The data were subjected to ANOVA with Tukey's pairwise comparison analysis using ICAR Software-WASP 2.0.

RESULTS AND DISCUSSION

The results of in vitro study for botanical formulations revealed that neem based formulation (Nimbecidine), ICAR-CTCRI-Nanma and Aavya gave maximum mortality after at 72 hr post treatment which was similar to chlorpyrifos (Fig. 1). Similarly, Reddy et al. (2020)

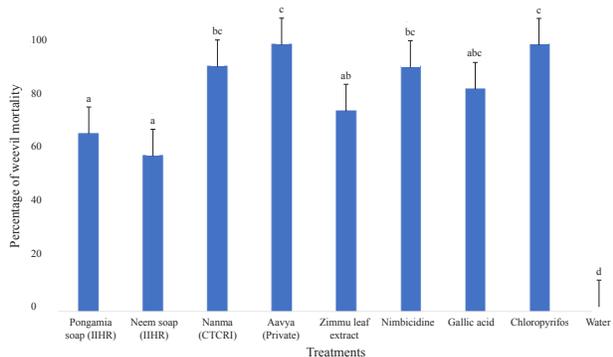


Fig. 1. Efficacy (in vitro) of botanical formulations against *O. longicollis*. Different letters above bar indicate treatments differ significantly (ANOVA- Tukey's pairwise comparison analysis)

also suggested neem-based formulations as effective. The laboratory study extended to the field conditions focused on the larval damage, adult infestation (oviposition) and % plant mortality on post application of last spray. These data given in Table 1 reveal that the plant mortality did not show any significant difference; interestingly, neem based formulations (azadirachtin 5000 ppm- Nimbecidine and ICAR-CTCRI-Nanma) significantly reduced the adult contact due to repellency and reduced larval damage similar to chlorpyrifos. Similarly, Awasthi et al. (2016) studied the effect of leaf extracts from few botanicals including neem oil (3%), on the mortality, repellence and antifeedant properties to adults of *O. longicollis* under laboratory condition; maximum protection score with leaf extract of *Lantana camara* (10% concentration) was observed. In this study, the botanical formulation Aavya gave maximum mortality under in vitro study but not responded well under field conditions. Interestingly, CTCRI Nanma product was found effective under invitro and field conditions. The disadvantage with Nanma is non- availability on commercial basis and the recommended dose is also very high. This study revealed the importance of site of application to prevent the entry of adults, such as through the leaf axil a gap present in between the stem and leaf petiole and through cut ends of senescent leaves. Instead of spraying on the entire plant, spot application at the above said two regions may reduce the requirement of spray solution, labour and provide good control.

The biopesticides from botanicals reveal insecticidal,

Table 1. Efficacy (field) of botanical formulations against *O. longicollis*

S.No.	Treatments	Plants mortality on post spray *	Level of adult infestation*	Level of grub damage*	Fruit yield (kg/plant)	Rank
1	Pongamia soap	0.22	22.67 ^B	1.67 ^B	8.5	8
2	Neem soap	0.11	20.33 ^{BC}	1.11 ^B	10.5	7
3	Nanma	-0.00	1.55 ^{DE}	-0.00 ^B	13.04	2
4	Avaya	-0.00	13.00 ^{BCD}	0.55 ^B	10.88	6
5	Azadiractin	-0.00	2.78 ^{DE}	0.22 ^B	14.38	3
6	Zimmu	0.11	9.33 ^{CDE}	0.55 ^B	11.77	5
7	Gallic acid	0.11	8.67 ^{CDE}	0.55 ^B	11.16	4
8	Chlorpyrifos	-0.00	0.00 ^E	-0.00 ^B	14.77	1
9	Control	0.22	39.33 ^A	8.33 ^A	6.5	9
	General Mean	0.09	13.07	1.44	-	-
	p-Value	0.3919	<.0001	0.0021	-	-
	CV (%)	174.09	54.55	136.60	-	-

*The values arcsin transformed; significant difference between means analyzed by ANOVA with Tukey's pairwise comparison analysis; Different letters within the column indicate significant different between treatments; CV and SE- coefficient of variation and standard error respectively; NS: not significant.

repellent and antifeedant properties which are useful in the ecofriendly weevil management. The available information from the literature and GC-MS analysis of botanicals used in this study indicated the presence of ingredients like karanjin and pongamal in pongamia, azadirachtin in neem, isothiocyanates in nanma; and digitoxin and isothiocyanates in Aavya are responsible for phagorepellent (antifeedant) and insecticidal activity (Gore and Sathyamoorthy, 2000); similarly, cyanoglycosides from cassava plant utilized as a key component in ICAR-CTCRI Menma preparation, can be used for injection for the effective management (Krishnan et al., 2016). Likewise, Sahayaraj et al. (2015) extracted and identified the chemical constituents of *Tephrosia purpurea* and *Ipomoea carnea* by GC-MS and found the presence of hexadecanoic acid as a principal component from stem and root oils. The oils of *T. purpurea* and *I. carnea* showed stronger repellent activity for males than females.

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