J. Soils and Crops 30 (1) 124-128, June 2020

ISSN 0971-2836 (Print)
ISSN 2582-2756 (Online)
NAAS Rating - 4.46
Scientific Journal Impact Factor - 7.375

EVALUATION OF BIOPESTICIDE, BOTANICALS AND PLANT EXTRACTS AGAINST RICE STEM BORER, *SCRIPOPHAGA INCERTULAS* (WALKER)

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ABSTRACT

The field experiment was undertaken at Agriculture Research Station, Sakoli, Dist. Bhandara (MS) under Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, during *kharif* 2018 to study the performance of herbal against rice stem borer of paddy. This experiment incorporating eight treatments consisting of *Metarhizium anisopliae* ($1x10^8$ cfu ml^{-1}) @ 4 g $litre^{-1}$ of water, neem oil @ 5 ml $litre^{-1}$ of water, 5 % NSKE, 5 % bitter gourd leaf extract, 5 % custard apple leaf extract, 5 % garadi leaf extract, 5 % bitter gourd leaf extract + 5 % garadi leaf extract + 5 % custard apple leaf extract and control. The results revealed that the treatment of 5% NSKE (1.57 % DH) was found significantly superior in reducing the incidence of dead hearts to other treatments and at par with the 5 % bitter gourd leaf extract (2.14 % DH). The next effective treatments in reduction of dead heart were, *M. anisopliae* (3.54 % DH), 5% garadi leaf extract (3.61% DH), 5 % custard apple leaf extract (3.81 % DH), 5 % bitter gourd leaf extract + 5 % garadi leaf extract + 5 % custard apple leaf extract (4.04 % DH) and neem oil (4.05 % DH). However, the highest incidence of dead heart was recorded in control (6.17 % DH). Among the various herbal extracts evaluated for the management of white earheads (stem borer) of paddy, 5 % NSKE (2.81 % WE) was found significantly superior treatment and at par with 5 % garadi leaf extract (4.00 % WE). The next effective treatments for management of white ear heads were *M. anisopliae* (5.93 % WE), 5 % bitter gourd leaf extract (6.33 % WE), neem oil (6.49 % WE), 5 % bitter gourd leaf extract + 5 % garadi leaf extract + 5 % custard apple leaf extract (6.84 % WE), 5 % custard apple leaf extract (8.06 % WE). However, the highest incidence of white earheads was observed in control (11.26 % WE). The treatment of 5 % bitter gourd leaf extract + 5 % garadi leaf extract + 5 % custard apple leaf extract harvested highest grain yield (39.33 q ha^{-1}) and the treatment of *M. anisopliae* recorded highest ICBR (1:12.13) followed by 5 % garadi leaf extract (1:10.29),

(Keywords: Rice, stem borer, botanical, plant extract, biopesticides, efficacy)

INTRODUCTION

Rice (*Oryza sativa* L.) belonging to the family Gramineae is the staple food for one third world's population and occupies almost one fifth of the total land area covered under cereals. Most of the world's rice is cultivated and consumed in Asia, which constitutes more than half of the global population. In India rice cultivated on area 43.57 million hectares with an annual production of 104.32 million tonnes and productivity of about 2.98 tonnes ha^{-1} in 2017 (Anonymous, 2017). Total Indian output of rice was at an all-time high of 166.5 MT (111.0 MT, milled basis). This level would stand 1.2 per cent above the final estimate for the 2016 season and some 2.3 million tonnes above previous FAO expectations, (Anonymous, 2018). Rice is the most important food all over world. Rice is a high energy or high calories food and of high biological value of the proteins.

More than 100 species of insect have been recorded to infest the paddy crop but out of these 20 insect pests are of major economic significance. A few are widely distributed with great potential to create havoc the paddy crop *viz*., stem borer, gall midge, leaf folder, brown plant hopper, white blacked plant hopper and green leaf hopper. The stem borer *Scripophaga incertulas* (Walker) belongs to order Lepidoptera, family Pyranstidae, forms dead hearts in younger plant at the vegetative stages result in destruction of growing point and white ears head bearing panicles at the panicle bearing stage in older plant. The yield losses caused by insect pest in rice have been reported to the tune of 25 per cent (Dhaliwal *et al.,* 2010). The average yield loss

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in rice have been accounted for 30% loss in stem borer (Krishnaiah and Varma, 2015).

Indiscriminate use of synthetic insecticides in crop protection programmes around the world resulted in disturbances of the environment, pest resurgences, pest resistance to pesticides and lethal effect to natural enemies in the agro-ecosystems in addition to direct toxicity to users. Therefore, it has now become necessary to search for the alternative means of pest control, which can minimize the use of synthetic pesticides.

Botanical pesticides are the important alternatives to minimize or replace the use of synthetic pesticides as they possess an array of properties including toxicity to the pest, repellency, antifeedance, insect growth regulatory activities against pests of agricultural importance. In fact, botanical pesticides are in use in Indian agriculture for over a century to minimize losses caused by pests and diseases. (Prakash and Rao, 1997 and Parmar and Devkumar,1993). Botanical pesticides have many advantages over synthetic pesticides like in general possess low mammalian toxicity thus, constitute least or no health hazards and environmental pollution. There is practically no risk of developing pest resistance to these products, when used in natural forms, these causes less hazards to non-target organisms and pest resistance has not been reported except synthetic pyrethroids. No adverse effect on plant growth, seed viability and cooking quality of the grains and botanical pesticides are less expensive and easily available because of their natural occurrence in agro ecosystem.

MATERIALS AND METHODS

The field experiment was carried at Agriculture Research Station, Sakoli, Dist. Bhandara (MS) under Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, during *kharif* 2018. consisted of eight treatments including *Metarrhizium anisopliae* ($1x10^8$ cfuml^{-1}) @ 4 gm lit^{-1} of water, 5 % neem oil @ 5ml lit^{-1} of water, 5 % NSKE, 5 % bitter gourd (*Momrdica charantia*) leaf extract, 5 % custard apple *(Annona squamosa*) leaf extract, 5 % garadi (*Cleistanthus collinus*) leaf extract, 5 % bitter gourd leaf extract + 5 % garadi leaf extract + 5 % custard apple leaf extract and Control (water spray) with three replications were laid out in Randomized Block Design (RBD). Popular rice variety PKV HMT was transplanted with spacing of 20 cm X 15 cm.

Blanket application of all treatments except *M. anisopliae* was undertaken at 15 DAT, subsequently all treatments application was applied on 30, 50, 70 and 90 DAT. Stem borer infested dead hearts and white ears count on 10 plants based on stratified random sampling were recorded at 15 days after each application along with total tillers.

$$\% \text{ dead haerts} = \frac{\text{No. of dead haerts in 10 hills}}{\text{Total no. of tillers in 10 hills}} \times 100$$

$$\% \text{ White earheads} = \frac{\text{No. of white earheads in 10 hills}}{\text{Total no. of productive tillers in 10 hills}} \times 100$$

The yield data from each treated net plot was recorded and used to calculate for economics and also recorded the ICBR.

RESULTS AND DISCUSSION

First spraying : The results were found non-significant. However, the treatment of 5 % NSKE was found superior in reducing the incidence of stem borer (0.00 % DH) over other treatments. It was followed by 5 % custard apple leaf extract (0.84 % DH), 5 % bitter gourd leaf extract + 5 % garadi leaf extract + 5 % custard apple leaf extract(1.23 % DH), 5 % bitter gourd leaf extract (1.27 % DH) and 5 % garadi leaf extract (2.10 % DH). However, neem oil was found least effective in reducing the incidence of dead hearts with 3.09 per cent dead hearts. In control, the incidence of stem borer was 2.19 per cent dead hearts.

Second spraying : The treatment of 5 % NSKE with 1.54 per cent dead hearts was found significantly superior in reducing the incidence of stem borer over untreated control (6.05 % DH) and at par with all other treatments *viz*., 5 % bitter gourd leaf extract (1.69 % DH), neem oil (2.00 % DH), 5 % bitter gourd leaf extract + 5 % garadi leaf extract + 5 % custard apple leaf extract (2.14 % DH), 5 % garadi leaf extract (2.47 % DH), 5 % custard apple leaf extract (2.83 % DH) and *M. anisopliae* (3.11 % DH).

Third spraying : Among the various treatments evaluated for management of stem borer in paddy, 5 % bitter gourd leaf extract treatment (1.50 % DH) was found significantly superior to other treatments and at par with 5 % NSKE (1.92 % DH). It was followed by 5 % custard apple leaf extract (3.91 % DH), *M. anisopliae* (4.00 % DH), neem oil (4.52 % DH), 5 % bitter gourd leaf extract + 5 % garadi leaf extract + 5 % custard apple leaf extract (5.54 % DH) and 5 % garadi leaf extract (5.98 % DH). However, highest incidence of dead hearts was recorded in control (7.32 % DH).

Fourth spraying : Treatment of 5 % bitter gourd leaf extract (1.78 % DH) was significantly superior in reduction of dead hearts incidence over other treatments and control (4.50 % DH) and at par with 5 % NSKE (1.87 % DH), *M. anisopliae* (1.96 % DH), 5 % garadi leaf extract (2.04 % DH) and 5 % bitter gourd leaf extract + 5 % garadi leaf extract + 5 % custard apple leaf extract (2.85 % DH). It was followed by treatment of 5 % custard apple leaf extract (4.30 % DH) and neem oil (4.45 % DH).

Fifth spraying : Incidence of dead hearts was significantly less in treatment with 5 % NSKE (1.84 % DH) as compared to other treatments followed by treatment with 5% bitter gourd leaf extract (4.48 % DH),5 % garadi leaf extract (5.06 % DH), neem oil (5.86 % DH), *M. anisopliae* (6.24 % DH), 5 % custard apple leaf extract (6.59 % DH) and 5 % bitter gourd leaf extract + 5 % garadi leaf extract + 5 % custard apple leaf extract (7.63 % DH). However, more incidence of dead hearts was observed in control (9.99 % DH).

Pooled : Pooled analysis showed that the treatment of 5 % NSKE (1.57 % DH) was found significantly superior in reducing the incidence of dead hearts to other treatments and at par with 5 % bitter gourd leaf extract (2.14 % DH). The next effective treatments in reduction of dead heart were, *M. anisopliae* (3.54 % DH), 5 % garadi leaf extract (3.61 % DH), 5 % custard apple leaf extract (3.81 % DH), 5% bitter gourd leaf extract + 5 % garadi leaf extract + 5 % custard apple leaf extract (4.04 % DH) and neem oil (4.05 % DH). However, the highest incidence of dead heart was recorded in control (6.17 % DH).

Before harvesting : Among the various herbal extracts evaluated for the management of white earheads (stem borer) of paddy, 5 % NSKE (2.81 % WE) was found significantly superior treatment and at par with 5 % garadi leaf extract (4.00 % WE).The next effective treatments for management of white ear heads were *M. anisopliae* (5.93 % WE), 5 % bitter gourd leaf extract (6.33 % WE), neem oil (6.49 % WE),5 % bitter gourd leaf extract + 5 % garadi leaf extract + 5 % custard apple leaf extract (6.84 % WE) and 5 % custard apple leaf extract (8.06 % WE). However, more incidence of white earheads was observed in control (11.26 % WE).

All the treatments recorded significantly more yield as compared to control plot (23.00 q ha^{-1}). The treatment of 5 % bitter gourd leaf extract + 5 % garadi leaf extract + 5 % custard apple leaf extract harvested highest grain yield (39.33 q ha^{-1}) with an increase of 16.33 q ha^{-1} over control and at par with treatments of *M. anisopliae* (36.26 q ha^{-1}) and 5 % NSKE (35.61 q ha^{-1}). It was followed by treatment of 5 % garadi leaf extract (34.13 q ha^{-1}), 5 % bitter gourd leaf extract (33.10 q ha^{-1}), Neem oil (33.08 q ha^{-1}) and 5 % custard apple leaf extract (31.36 q ha^{-1}). However, the treatment of *M. anisopliae* recorded highest ICBR (1:12.13) followed by 5 % garadi leaf extract (1:10.29), 5 % bitter gourd leaf extract (1:9.98), 5 % custard apple leaf extract (1:9.45), 5 % bitter gourd leaves extract + 5 % garadi leaves extract + 5 % custard apple leaf extract (1:8.76), 5 % NSKE (1:6.89) and neem oil (1:5.72).

In insects, neem is the most active as a feeding deterrent, but in various forms it also serves as a repellent, growth regulator, oviposition (egg deposition) suppressant, sterilant or toxin. As a repellent, neem prevents insects from initiating feeding. As a feeding deterrent, it causes insects to stop feeding (Salama and Sharaby, 1988). The main compound of neem oil, leaves, flowers and fruits with insecticidal properties is azadirachtin. Azadirachtin has two profound effects on insects. At the physiological level, azadirachtin blocks the synthesis and release of molting hormones (ecdysteroids) from the prothoracic gland, leading to incomplete ecdysis in immature insects. In adult female insects, a similar mechanism of action leads to sterility. In addition, azadirachtin is antifeedant to many insects (Schmutterer, 1990). Azadirachtin, along with other related triterpenoid such as Azadirachtin B, Salannin and Nimbin are the active ingredients in neem plant based bioinsecticides and they act disrupting the growth and development of insect and by deterring their feeding. It is considered as a botanical pesticide with exceptional growth regulating and biocidal efficacy along with deterrent effect on the ovipositing and feeding of insect (Morgan, 2009). The results of the present investigation are in accordance with the Dash *et al*. (1990), they also reported that NSKE 5 % has insecticidal property against the yellow stem borer to reduce white ear head. Similarly, Dhuyo and Soomro (2007) conducted a field experiment using NSKE against rice yellow stem borer and found comparable lowest dead heart in comparison to untreated control. Ogah *et al.* (2011) reported that NSKE significantly reduced stem borer damage (number of dead heart) compared to untreated check. Islam *et al.* (2013) found that NSKE caused 38.38 per cent reduction of dead hearts. Choudhary *et al.* (2017) found that NSKE caused 6.36 per cent dead hearts and 14.00 per cent white ear head.

Joy *et al.* (1998) reported that leaves and vines of *M. charantia* give tetracyclic triterpenes-momordicines I, II and III (bitter principles) and this might be responsible for its insecticidal activity. The insecticidal effect of the leaf powder could be attributed to one or more of the following: fumigation effect, repellency, stomach poison, effecting case where the weevil feed on admixed grains, mechanical action, starvation or desiccation (Sharby, 1988 and Dales, 1996). *M. charantia* fruit wall acted as an effective bio larvicide against mosquitoes. The decrease in F1 progeny in the treated grains could be result from increased adult mortality, ovicidal and larvicidal properties of the tested plant. The ovicidal and larvicidal properties could have arisen from impairing respiration through blockage of spiracle thereby resulting in suffocation (Dales, 1996).

On the basis of present investigation, it was concluded that the treatments of 5 % NSKE, 5 % bitter gourd leaf extract and 5 % garadi leaf extract were noticed as effective in management of rice stem borer. Neem is the most active as a feeding deterrent, repellent, growth regulator, oviposition (egg deposition) suppressant, sterilant or toxin.

Table 1. Effect of bio-pesticide, botanicals and herbal extracts on incidence of stem borer on paddy

Tr. No.	Treatments	Stem borer incidence							Yield (q ha^{-1})	ICBR
		% Dead heart						% White earhead (Before harvesting)		
		1st Spraying	2nd Spraying	3rd Spraying	4thSpraying	5th Spraying	Pooled			
		30 DAT	45 DAT	65 DAT	85 DAT	105 DAT				
T_1	*Metarhizium anisopliae* ($1x10^8$ cfu/m^{-1}) @ 4 g $litre^{-1}$ of water	2.46 (1.72)	3.11a (1.90)	4.00b (2.12)	1.96a (1.57)	6.24b (2.60)	3.54b (2.01)	5.93b (2.44)	36.26a	12.23
T_2	Neem oil @ 5 ml $litre^{-1}$ of water	3.09 (1.89)	2.00a (1.58)	4.52b (2.24)	4.45b (2.23)	5.86b (2.52)	4.05b (2.13)	6.49a (2.55)	33.08b	5.72
T_3	5 % NSKE	0.00 (0.71)	1.54a (1.43)	1.92a (1.56)	1.87a (1.54)	1.84a (1.53)	1.57a (1.44)	2.81a (1.68)	35.61a	6.89
T_4	5 % bitter gourd (*Momrdica charantia*) leaf extract	1.27 (1.33)	1.69a (1.48)	1.50a (1.42)	1.78a (1.51)	4.48b (2.23)	2.14a (1.63)	6.33b (2.52)	33.10b	9.98
T_5	5 % custard apple *(Annona squamosa*) leaf extract	0.84 (1.16)	2.83a (1.83)	3.91b (2.10)	4.30b (2.19)	6.59b (2.66)	3.81b (2.07)	8.06b (2.84)	31.36b	9.45
T_6	5 % garadi (*Cleistanthus collinus*) leaf extract	2.10 (1.61)	2.47a (1.72)	5.98b (2.55)	2.04a (1.59)	5.06b (2.36)	3.61b (2.03)	4.00a (2.00)	34.13a	10.29
T_7	5 % bitter gourd leaf extract + 5 % garadi leaf extract + 5 % custard apple leaf extract	1.23 (1.31)	2.14a (1.63)	5.54b (2.46)	2.85a (1.83)	7.63c (2.85)	4.04b (2.13)	6.84b (2.61)	39.33a	8.76
T_8	Control (water spray)	2.19 (1.64)	6.05b (2.56)	7.32c (2.80	4.50c (2.24)	9.99c (3.24)	6.17c (2.58)	11.26c (3.36)	23.00c	-
SE (±m)			0.21	0.17	0.17	0.17	0.09	0.25	1.81	
CD at 5%			0.63	0.51	0.50	0.51	0.27	0.74	4.30	

*Observations at 15 Days after treatment, **Sig** – Significant, **NS**- Non-Significant

**Figures in parentheses are corresponding values of square root (n+0.5) transformation for % Dead heart and % White earhead, n=% Dead heart/% White earhead.

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Rec. on 10.07.2019 & Acc. on 20.07.2019