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Studies on Efficacy of Biopesticides and Neem Based Products against Pink Stem Borer in Finger Millet

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ABSTRACT

The efficacy of biopesticides, neem based products and cartap hydrochloride 50% SP were evaluated against pink stem borer, *Sesamia inferens* (Walker) infesting finger millet under Randomized Block Design in the year *Rabi* 2020 at Agricultural College Farm, Naira. Among the different biopesticides, *Bacillus thuringiensis* var. *kurstaki* @ 2 g/l and *Metarrhizium anisopliae* @ 5 g/l were effective in managing ragi pink borer next to Cartap hydrochloride@ 2 g/l. The maximum grain yield was obtained from cartap hydrochloride 50% SP (30.68 q/ha) followed by *Metarrhizium anisopliae* (24.45 q/ha), *Beauveria bassiana* (23.60 q/ha), azadirachtin 10000 ppm (22.05 q/ha), azadirachtin 3000 ppm (20.65 q/ha), NSKE 5% (20.20 q/ha) and azadirachtin 300 ppm (19.35 q/ha) which are significantly superior over untreated control (14.15 q/ha).The performance of the botanicals remained the same all along the period of experimentation where azadirachtin 10000 ppm was followed by azadirachtin 3000 ppm, NSKE 5% and azadirachtin 300 ppm.

Keywords: *Bacillus thuringiensisvar.kurstaki, Beauveria bassiana and azadirachtin, Cartap hydrochloride 50%SP, Metarrhizium anisopliae and Pink stem borer.*

Finger millet, *Eleusine coracana* (L) Gaertn is the most important crop among the small millet group, is popularly known as "Ragi", widely grown in the arid and semi arid zones of India. Millets are a sustainable food for economically deprived people in rural areas, and they are also more prominent among urban populations owing to its high mineral and vitamin content. In fact, millets are underutilized in developing countries, where food security is becoming increasingly important with a rising human population (Gahukar, 2014).In addition, the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) added finger millet as its sixth mandate crop (Avadhani, 2015). Pests on finger millets were earlier negligible however, efforts to breed high yielding varieties and improved farming techniques such as the application of inorganic fertilizers have progressively led to problems with a few insects assuming pest status.

The pink borer, *Sesamia inferens* (Walker), prominent pest in ragi, causes plant mortality due to dead-heart formation. Considering inadequate research about finger millet insect pests available, the issue of pest fauna that commonly infests the crop has to be tackled by putting more emphasis on the efficacy of biopesticides and neem based chemicals in order to minimize loss and maximize yields.

MATERIAL AND METHODS

A field experiment was conducted to evaluate the efficacy of various biopesticides, botanicals against pink stem borer of finger millet at Agricultural College

Farm, Naira. The finger millet variety VR 847 (Chaitanya) with duration of 110-115 days was grown in net plot of 4 x 5 m at 25 x 10 cm in a Randomized Block Design (RBD) in three replications. Line transplanting was done with a spacing of 25 x 10 cm. The treatments were applied at 10 days interval with knapsack sprayer @ 500 l/ha spray after pink stem borer attaining economic threshold level (5% dead hearts). The observation of pink stem borer was recorded from ten randomly selected hills per treatment per replication before one day and first, third, fifth and seven days after each sprays. The data on finger millet also recorded plot wise and converted in quintals per hectare.

RESULTS AND DISCUSSION

Dead hearts

The data (Table 1) obtained from the experiment revealed that *Metarrhizium anisopliae* (14.00% dead hearts) along with azadirachtin 10000 ppm (14.59 % dead hearts) followed by *Bacillus thuringiensis* var. *kurstaki*, azadirachtin 3000 ppm, NSKE 5%, *Beauveria bassiana* and azadirachtin 300 ppm with 15.29, 15.43, 16.42 and 17.10 per cent dead heart infestation, respectively, among the biopesticides and botanicals next to cartap hydrochloride 50% SP (6.48%dead hearts) at 1DAS. The biochemicals, *Bacillus thuringiensis* var. *kurstaki* (10.09% DH) and *Metarrhizium anisopliae*(10.74% DH) were observed to be significantly effective at 3DAS next to cartap hydrochloride 50% SP. Whereas *Bacillus thuringiensis* var. *kurstaki* (11.51 % dead hearts) was observed to perform on apar with cartap hydrochloride (10.32 % dead hearts) from 5DAS followed by *Metarrhizium anisopliae*, *Beauveria bassiana*, azadirachtin 10000 ppm, azadirachtin 3000 ppm, NSKE 5% and azadirachtin 300 ppm with 11.09,11.51,12.29,15.58,16.06 and 16.86 per cent dead heart infestation, respectively. The trend of performance contained to be the same even at 7DAS. The results were in commemoration with these studies made by and Balasubramamiam and Kumar(2019). The data pertaining to overall cumulative mean with respect to dead heart incidence revealed that cartap hydrochloride 50% SP (9.36% DH) was significantly superior over all other treatments followed by *Bacillus thuringiensis* var. *kurstaki* (11.94% DH), *Metarrhizium anisopliae* (12.15% DH), *Beauveria bassiana* (13.07% DH) and azadirachtin 10000 ppm (13.20% DH) that were observed to be on a par with each other. The above results are in line with the studies made by Kulagod *et al.* (2011) where it was observed that cartap hydrochloride 50% SP (6.66% DH) was significantly superior over *Bacillus thuringiensis* var. *kurstaki* and azadirachtin 3000 ppm.

The trend in performance of the botanicals, azadirachtin 10000 ppm, azadirachtin 3000 ppm, NSKE 5% and azadirachtin 300 ppm remained the same during 3DAS, 5DAS and 7DAS where the results were in commemoration with these studies made by Balasubramamiam and Kumar(2019). The data pertaining to overall cumulative mean with respect to dead heart incidence revealed that cartap hydrochloride 50% SP (9.36% DH) was significantly superior over all other treatments followed by *Bacillus thuringiensis* var. *kurstaki* (11.94% DH), *Metarrhizium anisopliae* (12.15% DH), *Beauveria bassiana* (13.07% DH) and Azadirachtin 10000 ppm (13.20% DH) that were observed to be on par with each other.

The data presented in the Table 1 with respect to the performance of the botanicals remained the same all along the period of experimentation where azadirachtin 10000 ppm was followed by azadirachtin 3000 ppm, NSKE 5% and azadirachtin 300 ppm. The study made by Choudhary*et al.*(2017) was

Table 1. Cumulative efficacy of biopesticides and neem based products against ragi stem borer (dead hearts)during *rabi*, 2020-21.

Tr.No.	Treatment Particulars	Dose	Stem borer infestation (%)					Overall mean infestation*
			1 DBS	1 DAS	3 DAS	5 DAS	7 DAS	
			DH	DH	DH	DH	DH	DH
T_1	*Metarhizium anisopliae (1 x 108 CFU/g.)*	5.0 g/l.	7.75	5.86	3.48	3.71	4.29	4.43
			(16.16)	$(14.00)^{b}$	$(10.74)^{bc}$	$(11.09)^{ab}$	$(11.95)^{ab}$	$(12.15)^{b}$
T_2	*Beauveria bassiana (1 x 108 CFU/g.)*	5.0 g/l.	7.99	8.01	4.41	3.99	4.09	5.12
			(16.41)	$(16.42)^{de}$	$(12.11)^{cd}$	$(11.51)^{ab}$	$(11.66)^{ab}$	$(13.07)^{bc}$
T_3	*Bacillus thuringiensis* var. *kurstaki*	2.0 g/l.	7.59	6.96	3.07	3.62	3.34	4.28
			(15.98)	$(15.29)^{cd}$	$(10.09)^{b}$	$(10.96)^{a}$	$(10.52)^{a}$	$(11.94)^{b}$
T_4	NSKE 5%	5.0 ml/l.	8.33	7.98	7.37	7.66	7.57	7.64
			(16.77)	$(16.40)^{de}$	$(15.75)^{ef}$	$(16.06)^{cd}$	$(15.96)^{cd}$	$(16.03)^{d}$
T_5	Azadirachtin 10000 ppm	1.0 ml/l.	7.5	6.35	4.78	4.54	4.84	5.22
			(15.89)	$(14.59)^{bc}$	$(12.62)^{d}$	$(12.29)^{b}$	$(12.70)^{b}$	$(13.20)^{bc}$
T_6	Azadirachtin 3000 ppm	3.0 ml/l.	7.62	7.08	6.88	7.22	7.32	7.01
			(16.01)	$(15.43)^{cd}$	$(15.20)^{e}$	$(15.58)^{c}$	$(15.69)^{c}$	$(15.35)^{cd}$
T_7	Azadirachtin 300 ppm	5.0 ml/l.	8.74	8.65	8.67	8.42	8.71	8.55
			(17.19)	$(17.10)^{e}$	$(17.11)^{f}$	$(16.86)^{d}$	$(17.16)^{d}$	$(16.99)^{d}$
T_8	Cartap hydrochloride 50% SP	2.0 g/l.	8.11	1.28	2	3.21	4.01	2.65
			(16.54)	$(6.48)^{a}$	$(8.13)^{a}$	$(10.32)^{a}$	$(11.55)^{ab}$	$(9.36)^{a}$
T_9	Untreated control		9.39	12.68	15.41	16.63	17.63	7.8
			(17.84)	$(20.85)^{f}$	$(23.10)^{g}$	$(24.05)^{e}$	$(24.81)^{e}$	$(23.24)^{e}$
	F test		NS	Sig.	Sig.	Sig.	Sig.	Sig.
	SEm ±		0.7	0.41	0.63	0.41	0.52	0.78
	CD (p= 0.05)		2.11	1.25	1.86	1.22	1.57	2.33

DAS = Days after spraying; DBS = Day before spraying; DH= Dead heart
Figures in parenthesis are arc sign transformed values
Mean followed by same letter do not differ significantly following DMRT
*-Mean of three sprays

Table 2. Cumulative efficacy of treatments against ragi stem borer (white ear heads) in finger millet during *rabi,* 2020-21.

Tr.No.	Treatment Particulars	Dose	Stem borer infestation (%)			Overall mean infestation
			3 DAS	5 DAS	7 DAS	
			WEH	WEH	WEH	WEH
T_1	*Metarrhizium anisopliae (1 x 108 CFU/g.)*	5.0 g/l.	3.29	3.98	4.78	4.02 (11.56)^{abc}
			(10.44)^{b}	(11.50)^{ab}	(12.62)^{ab}	
T_2	*Beauveria bassiana (1 x 108 CFU/g.)*	5.0 g/l.	4.16	4.06	4.92	4.38
			(11.76)^{bc}	(11.61)^{b}	(12.81)^{ab}	(12.07)^{abc}
T_3	*Bacillus thuringiensis* var. *kurstaki*	2.0 g/l.	3.01	3.9	4.01	3.64
			(9.99)^{b}	(11.38)^{ab}	(11.55)^{a}	(10.99)^{ab}
T_4	NSKE 5%	5.0 ml/l.	6.21	5.81	6.91	6.31
			(14.42)^{d}	(13.94)^{c}	(15.23)^{c}	(14.54)^{d}
T_5	Azadirachtin 10000 ppm	1.0 ml/l.	4.85	4.95	5.32	5.04
			(12.72)^{cd}	(12.85)^{c}	(13.33)^{b}	(12.97)^{bcd}
T_6	Azadirachtin 3000 ppm	3.0 ml/l.	5.21	5.36	6.74	5.77
			(13.19)^{cd}	(13.38)^{c}	(15.04)^{c}	(13.89)^{cd}
T_7	Azadirachtin 300 ppm	5.0 ml/l.	8.56	8.71	9.02	8.76
			(17.01)^{e}	(17.16)^{d}	(17.47)^{d}	(17.21)^{e}
T_8	Cartap hydrochloride 50% SP	2.0 g/l.	1.8	3.21	4.81	3.27
			(7.71)^{a}	(10.32)^{a}	(12.66)^{ab}	(10.42)^{a}
T_9	Untreated control		15.61	16.63	18.46	16.9
			(23.26)^{f}	(24.05)^{e}	(25.44)^{e}	(24.26)^{f}
	F test		Sig.	Sig.	Sig.	Sig.
	SEm $\pm$		0.63	0.38	0.51	0.83
	CD (p= 0.05)		1.86	1.22	1.57	2.43

DAS = Days after spraying; WEH=white ear head

Figures in parenthesis are arc sign transformed values;

Mean followed by same letter do not differ significantly following DMRT

similar to the present results where azadirachtin 10000 ppm was significantly superior over azadirachtin 300 ppm.

White ear heads

The data of overall and cumulative mean related to white ear head incidence due to the effectof pinkstem borer, *S. inferens* presented in the Table 2 revealed that *Bacillus thuringiensis* var. *kurstaki*, *Metarrhizium anisopliae* and *Beauveria bassiana* with a cumulative white ear head incidence of 10.99%, 11.56% and 12.07%, respectively, performed on a par with each other next to cartap hydrochloride 50% SP (10.42% cumulative WEH). The present studies were in commemoration with the results arrived by Chormule *et al.*(2014) and Singh

et al.(2015) where it was observed that cartap hydrochloride 50% SP was highly effective (5.09% WEH) in reducing white ear head incidence followed by *Bacillus thuringiensis* var. *kurstaki*and *Metarhizium anisopliae* (8.23% WEH and 8.92% WEH, respectively). Singh *et al.*(2015) and Kulagod *et al.*(2011) concluded that cartap hydrochloride 50% SP always outperformed *Bacillus thuringiensis* var. *kurstaki* in containing white ear head incidence, whose results were in concordance with present studies.

Among the botanicals, azadirachtin 10000 ppm, azadirachtin 3000 ppm and NSKE 5% were observed to be on par with accumulative WEH incidence of 12.97%, 13.89% and 14.54%, respectively, but significantly superior over Azadirachtin 300 ppm (17.21% cumulative WEH). The results obtained from the studies made by Choudhary *et al.* (2017) and Singh (2018) revealed that the performance of Azadirachtin 10000 ppm is significant over to that of azadirachtin 300 ppm. Similarly, the findings of Mishra *et al.* (2020) were in line with the trend in performance of *Bacillus thuringiensis* var. *kurstaki*, NSKE 5% and azadirachtin 300 ppm in the present studies.

Grain Yield

The data on grain yield recorded from different treatments presented in Fig. 1 revealed that *Bacillus thuringiensis* var. *kurstaki, Metarrhizium anisopliae*and *Beauveria bassiana* were effective in recording yield of 25.40 q/ha, 24.45 q/ha, 23.60 q/ha, respectively, which were on a par with each other performing next to cartap hydrochloride (30.68 q/ha). The present results were in accordance with the findings of Rameash *et al.* (2012).

Among the botanicals, azadirachtin 10000 ppm found to be superior by recording 22.05 q/hagrain yield followed by azadirachtin 3000 ppm, NSKE 5% and azadirachtin 300 ppm with 20.65 q/ha, 20.20 q/ha, 19.35 q/ha, respectively, and were observe to be significantly superior over untreated control (14.15 q/ha). The results were similar to the studies made by Balasubramamiam and Kumar(2019).

CONCLUSIONS

The cumulative performance after three sprayings revealed that, the treatments, *Bacillus thuringiensis* var. *kurstaki* @ 5g/l and azadirachtin 10000ppm @ 1 ml/l were observed to be effective among biopesticides and botanicals tested, respectively, preceded by cartap hydrochloride 50% SP @ 2 g/l.Significantly highest yield of 30.68 q/ha was obtained from the plots treated with cartap hydrochloride 50% SP @ 2 g/l followed by *Bacillus thuringiensis* var.*kurstaki, Metarrhizium anisopliae, Beauveria bassiana*, azadirachtin 10000 ppm, azadirachtin 3000 ppm, NSKE 5% and azadirachtin 300 ppm.

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