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EFFICACY OF BOTANICAL EXTRACTS AGAINST RICE STEM BORER *SCIRPOPHAGA INCERTULAS* (WALKER)

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ABSTRACT

Efficacy of botanical extracts was evaluated against the rice stem borer *Scirpophaga incertulas* (Wlk.) at PAJANCOA and RI, Karaikal during kharif 2019 and rabi 2019-2020. The results revealed that thiamethoxam 25WG @ 100 g/ ha reduced incidence to 4.99% and 4.13% (52.15 and 61.80% reduction, respectively). Among the botanicals, garlic and chilli extract 5% reduced this to 5.69% and 5.48%. The predatory coccinellids and spiders were more in untreated check and it was found at par with garlic and chilli extracts at 5%, followed by five leaf extracts @10% and bitter apple leaf extract 10%. The benefit cost ratio (BCR) was maximum with thiamethoxam 25WG @ 100 g/ ha (1: 1.67 and 1: 2.10), followed by garlic and chilli extract 5% (1: 1.59 and 1:1.91).

Key words: Rice, *Scirpophaga incertulas*, garlic and chilli extract, leaf extracts, bitter apple, ponneem, thiamethoxam, novaluron, predatory coccinellids, spiders, cost benefits

More than 300 species of insect pests damage rice crop, but most of these do not cause economic damage (Pasalu and Katti, 2006). The rice yellow stem borer *S. incertulas* (Walker) attacks the crop right from seedling stage till harvest and causes complete loss of affected tillers (Singh et al., 2015). In Asia, yield losses due to the two most important species, the yellow and striped stem borers ranged from 1-20%. However, during outbreak conditions, yield losses may range from 30 to 100% (Sarwar et al., 2005). The use of insecticides against these is environmentally disruptive and can result in elimination of beneficial insects and accumulation of residues in the harvested produce (Prakash et al., 2008). Botanical insecticides are ecofriendly alternatives to insecticides (Echereobia et al., 2010). These are environmentally safe and economically feasible and do not have negative effects on the natural enemies like coccinellids, spiders, green lacewing, reduviids, mirids, preying mantids, dragonfly, damselfly and parasitoids. Considering the importance of ecofriendly approaches to manage the pests in rice ecosystem, the present study evaluates the effect of botanical extracts against *T. incertulas* and safety to natural enemies.

MATERIALS AND METHODS

Two field experiments I and II were conducted during kharif 2019 and rabi 2019-2020, respectively, in the Eastern farm of PAJANCOA and RI, Karaikal, UT of Puducherry as an irrigated crop (10º95'N, 79º78'E,4 masl). The experiment was laid out in a randomized block design (RBD) with eight treatments replicated thrice with variety ADT 45. The nursery was raised and 25 days after sowing the seedlings were transplanted in the main field with a spacing of 15x 10 cm in 5x 4 m^2 plot. Recommended agronomic practices were followed. The observation on the symptom was made with ten randomly selected plants at weekly intervals from 7 days after transplanting. When the incidence reached the economic threshold level (deadheart- 5% and white earhead-10%), three rounds of treatments were imposed. Assessment of deadheart and white ears infestation at vegetative and reproductive stage was made and % incidence was worked out (Seni and Naik, 2017). The occurrence of predatory coccinellids and spiders were also observed (Sivakumar, 2008). The pretreatment observations at one day before the treatment and post treatment observations at 1, 3, 5, 7, 10 and 14 days after treatment (DAT) were made. The total yield and BCR were computed/ ha and analysed (Seni and Naik, 2017).

Five leaf extracts was prepared by using plant materials viz., leaves of neem (Azadirachta *indica*), giant milkweed (Calotropis *gigantea*), jatropha (*Jatropha curcas*), five leaved chaste (*Vitex negundo*)

and adhathoda (*Justicia adhatoda*). About 2 kg of each plant leaves was cleaned and chopped. The chopped pieces of each plant leaves were macerated individually into paste which was transferred to a wide mouthed bucket (height – 41.5 cm, width – 40 cm) containing 12-15 l of cattle urine (add more if necessary), so that the plant materials were completely immersed in cattle urine and then added 3-5 kg of cow dung (mixed with cattle urine) and 100-250 g of turmeric powder (if available) and it was allowed to ferment for 7-15 days. Fermented solution was filtered for spraying. About 200 g of each garlic and chilli was ground with 1 l of water to obtain juice (Tuan et al., 2014). About 500g of bitter apple, *Citrullus colocynthis* leaves were ground with 500 ml of water in a mixer grinder into fine paste and filtered. The filtered solution was diluted according to the concentration. The data recorded for deadheart and white ear (%) were subjected to angular transformation (arc sine), and the data on the natural enemies were transformed before analysis in "F" test (Panse and Sukhatme, 1958) and subjected to Duncan's multiple range test (DMRT) (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

The results of the field experiment I as given in Table 1 reveal that the incidence of *T. incertulas* was the least with thiamethoxam 25WG @ 100 g/ ha (4.99%); among the botanical treatments, garlic and chilli extract at 5% resulted in 5.69% incidence. Similar results were confirmed in the field experiment II conducted during rabi 2019-2020, with the least incidence being with thiamethoxam followed by that of garlic and chilli extract. These results are in conformity with those of Panse et al. (2016) who reported that thiamethoxam 25WG @ 50g a.i./ ha recorded less deadhearts. Rani (2013) reported that garlic and chilli extract at 5 and 10% did not allow the entry of stem borer larvae in rice stalks up to 6 and after 36 hr of release with a maximum antifeedant efficacy. Baidoo and Mochiah (2016) studied the effectiveness of garlic and hot pepper in controlling the pests of cabbage, *Plutella xylostella, Hellula undalis* and *Trichoplusia ni* and use of these extracts gave best results. Upadhyay et al. (2019) reported that red pumpkin beetles were completely eradicated upon spraying of garlic, ginger and chilli mixture in the ratio 2:1:1 at 10% in water melon. Lakshmanan (2001) observed that garlic bulb extract alone or in combination with kerosene, neem oil, chilli and other extracts effectively managed several lepidopteran borer pests viz., *Earias vittella* and *Chilo partellus.* Panhwar (2002) stated that garlic (70-80%) and chilli pepper (60-70%) are good biocontrol agents of some insect pests of cowpea.

The counts of predatory coccinellids was maximum in the untreated check (2.84/ hill) and was at par with garlic and chilli extract @ 5%, five leaf extracts @ 10% and bitter apple leaf extract @ 10% (2.82, 2.81 and 2.81/hill) (Table 2); maximum occurrence of spiders was observed in untreated check (5.98/ hill) at par with garlic and chilli extract @ 5%, five leaf extracts @ 10% and bitter apple leaf extract @ 10% (5.96, 5.93 and 5.92/ hill). Similar results were also observed in the field experiment II. These results are in accordance with those of Mohapatra (2018) that maximum counts of predators were in untreated plot, closely followed by various ITKs treatments. Saini et al. (2013) observed maximum counts of ladybird beetles with *Jatropha* leaf extract enriched with fermented cow urine. Kunbhar et al. (2018) observed that botanical pesticides particularly *C. collocynthis* extracts were less toxic to the coccinellid predators i.e., *Coccinella septempunctata, Brumus suturalis* and *Menochilus sexmaculatus*. Ravikumar et al. (2012) observed that amalgamated plant extracts caused no adverse effect on spiders and coccinellids. Thiamethoxam 25WG @ 100g/ ha led to the maximum yield (3754.33 and 4505.20 kg/ha) and among the botanical treatments, garlic and chilli extract @ 5% gave 3546.88 and 4256.27 kg/ ha (Table 1). Also, thiamethoxam 25WG @ 100g/ ha gave the maximum benefit cost of 1: 1.67 and 1: 2.10, followed by garlic and chilli extract @ 5% (1: 1.59 and 1:1.91).

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Table 1. Efficacy of botanical extracts against *S. incertulas*, yield and benefit cost ratio in rice (kharif 2019, rabi 2019-2020)

Treatments	Conc. %/ ml/ g/ ha	Mean % deadheart/hill (kharif 2019) 1st Foliar spray#	2nd Foliar spray#	3rd Foliar spray#	Overall mean	Grain yield (kg / ha)	Benefit cost ratio (BCR)	Mean % deadheart/ hill (rabi 2019-2020) 1st Foliar spray#	2nd Foliar spray#	3rd Foliar spray#	Overall mean	Grain yield (kg / ha)	Benefit cost ratio (BCR)
Five leaf extract	10	8.59 (17.04)^{d}	7.61 (16.02)^{d}	2.48 (9.07)^{d}	6.23	3453.55^{d}	1:1.55	8.74 (17.19)^{d}	7.83 (16.25)^{d}	3.25 (10.38)^{d}	6.61	4144.27^{d}	1:1.86
Garlic and chilli extract	5	8.00 (16.43)^{c}	6.84 (15.17)^{c}	2.20 (8.54)^{c}	5.69	3546.88^{c}	1:1.59	8.05 (16.48)^{c}	6.20 (14.42)^{c}	2.18 (8.49)^{c}	5.48	4256.27^{c}	1:1.91
Bitter apple leaf extract	10	10.08 (18.51)^{f}	9.63 (18.08)^{f}	3.80 (11.24)^{f}	7.84	3121.11^{g}	1:1.39	10.39 (18.81)^{f}	9.34 (17.79)^{f}	4.14 (11.75)^{f}	7.96	3745.33^{g}	1:1.67
Ponneem 45%	3750	8.56 (17.01)^{d}	7.58 (15.98)^{d}	2.46 (9.04)^{d}	6.21	3368.44^{e}	1:1.44	8.73 (17.19)^{d}	7.81 (16.23)^{d}	3.21 (10.33)^{d}	6.59	4042.13^{e}	1:1.73
Azadirachtin 0.03%	2000	9.58 (18.03)^{e}	8.83 (17.29)^{e}	3.09 (10.13)^{e}	7.17	3256.33^{f}	1:1.41	9.66 (18.11)^{e}	8.81 (17.27)^{e}	3.91 (11.41)^{e}	7.47	3907.60^{f}	1:1.70
Thiamethoxam 25WG	100	7.36 (15.74)^{a}	5.99 (14.16)^{a}	1.59 (7.25)^{a}	4.99	3754.33^{a}	1:1.67	5.95 (14.12)^{a}	4.75 (12.59)^{a}	1.68 (7.45)^{a}	4.13	4505.20^{a}	1:2.10
Novaluron 10EC	1000	7.70 (16.11)^{b}	6.27 (14.50)^{b}	1.84 (7.81)^{b}	5.27	3639.33^{b}	1:1.47	6.41 (14.67)^{b}	5.29 (13.30)^{b}	1.94 (8.00)^{b}	4.55	4367.20^{b}	1:1.76
Untreated check	-	12.40 (20.62)^{g}	13.08 (21.20)^{g}	5.76 (13.89)^{g}	10.42	2663.55^{h}	1:1.21	12.39 (20.61)^{g}	14.24 (22.17)^{g}	5.81 (13.95)^{g}	10.82	3234.00^{h}	1:1.47
SEd		0.03	0.03	0.03	-	-	-	0.16	0.06	0.04	-	-	
CD (p=0.05)		0.07*	0.07*	0.06*		39.34*		0.35*	0.12*	0.08*		88.20*	
CV (%)		0.23	0.24	0.38		-		1.16	0.42	0.39		-	-

In a column mean followed by a common letter not significantly different by DMRT (p=0.05); values in parentheses are arc sine transformed values; * - significant at p=0.05; # - observed on pretreatment, 1, 3, 5, 7, 10 and 14 days after treatment

Table. 2 Effect of botanical extracts on predatory coccinellids and spiders in rice (kharif 2019, rabi 2019-2020)

Treatments	Conc. %/ ml/ g/ ha	Field experiment I (kharif 2019) Mean number of coccinellids/hill				Mean number of spiders/hill				Field experiment II (rabi 2019-2020) Mean number of coccinellids/hill				Mean number of spiders/hill			
		1st Foliar spray#	2nd Foliar spray#	3rd Foliar spray#	Overall mean	1st Foliar spray#	2nd Foliar spray#	3rd Foliar spray#	Overall mean	1st Foliar spray#	2nd Foliar spray#	3rd Foliar spray#	Overall mean	1st Foliar spray#	2nd Foliar spray#	3rd Foliar spray#	Overall mean
Five leaf extract	10	1.71 (1.30)[a]	2.71 (1.64)[a]	4.01 (2.00)[a]	2.81	5.04 (2.24)[a]	5.76 (2.40)[a]	6.96 (2.63)[a]	5.93	1.51 (1.22)[a]	2.61 (1.61)[a]	4.12 (2.03)[a]	2.75	4.80 (2.19)[a]	5.91 (2.43)[a]	6.89 (2.62)[a]	5.87
Garlic and chilli extract	5	1.71 (1.30)[a]	2.72 (1.65)[a]	4.04 (2.01)[a]	2.82	5.09 (2.25)[a]	5.79 (2.40)[a]	6.99 (2.64)[a]	5.96	1.55 (1.24)[a]	2.65 (1.62)[a]	4.18 (2.04)[a]	2.80	4.86 (2.20)[a]	5.95 (2.44)[a]	6.94 (2.63)[a]	5.92
Bitter apple leaf extract	10	1.70 (1.30)[a]	2.70 (1.64)[a]	4.00 (2.00)[a]	2.81	5.04 (2.24)[a]	5.75 (2.39)[a]	6.95 (2.63)[a]	5.92	1.51 (1.23)[a]	2.59 (1.61)[a]	4.14 (2.03)[a]	2.75	4.81 (2.19)[a]	5.91 (2.43)[a]	6.90 (2.62)[a]	5.88
Ponneem 45%	3750	1.41 (1.18)[b]	1.96 (1.40)[b]	2.90 (1.70)[b]	2.10	3.90 (1.97)[b]	4.67 (2.16)[b]	5.64 (2.37)[b]	4.74	1.11 (1.05)[b]	1.71 (1.30)[b]	2.14 (1.46)[b]	1.66	3.96 (1.99)[b]	4.18 (2.04)[b]	4.99 (2.23)[b]	4.38
Azadirachtin 0.03%	2000	1.15 (1.07)[c]	1.75 (1.32)[c]	2.60 (1.61)[c]	1.84	3.62 (1.90)[c]	4.34 (2.08)[c]	5.24 (2.29)[c]	4.40	0.93 (0.96)[c]	1.43 (1.19)[c]	1.76 (1.32)[c]	1.38	3.59 (1.89)[c]	3.68 (1.92)[c]	4.53 (2.13)[c]	3.94
Thiamethoxam 25WG	100	0.79 (0.89)[e]	1.09 (1.04)[e]	1.63 (1.27)[e]	1.18	2.58 (1.60)[e]	3.51 (1.87)[e]	4.20 (2.05)[e]	3.43	0.56 (0.74)[e]	0.80 (0.89)[e]	1.08 (1.04)[e]	0.78	2.92 (1.71)[e]	2.99 (1.73)[e]	3.74 (1.93)[e]	3.22
Novaluron 10EC	1000	0.97 (0.98)[d]	1.35 (1.16)[d]	2.00 (1.41)[d]	1.44	3.21 (1.79)[d]	3.99 (1.99)[d]	4.81 (2.19)[d]	4.01	0.73 (0.85)[d]	1.02 (1.01)[d]	1.42 (1.19)[d]	1.02	3.23 (1.79)[d]	3.32 (1.82)[d]	4.12 (2.03)[d]	3.56
Untreated check	-	1.74 (1.32)[a]	2.73 (1.65)[a]	4.04 (2.01)[a]	2.84	5.11 (2.26)[a]	5.81 (2.41)[a]	7.01 (2.64)[a]	5.98	1.57 (1.25)[a]	2.66 (1.63)[a]	4.20 (2.05)[a]	2.81	4.89 (2.21)[a]	5.98 (2.44)[a]	6.95 (2.63)[a]	5.95
SEd		0.01	0.01	0.01	-	0.01	0.01	0.01	-	0.01	0.01	0.01	-	0.01	0.01	0.01	-
CD (p=0.05)		0.02*	0.02*	0.02*		0.02*	0.02*	0.01*		0.03*	0.03*	0.03*		0.02*	0.02*	0.01*	
CV (%)		0.91	0.53	0.51		0.53	0.51	0.45		1.37	1.00	0.71		0.59	0.41	0.27	

In a column mean followed by a common letter not significantly different by DMRT (p=0.05); values in parentheses are transformed values; * - significant at p=0.05; # - observed on pretreatment, 1, 3, 5, 7, 10 and 14 days after treatment

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