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EFFICACY OF A NEW COMBINATION INSECTICIDE AGAINST RICE BROWN PLANTHOPPER *NILAPARVATA LUGENS* (STAL)

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ABSTRACT

Evaluation of field efficacy of a new combination insecticide buprofezin 24%+ fipronil 40%SC (MAIRM-10) @ 875 ml/ ha against the rice brown plant hopper *Nilaparvata lugens* (Stal) revealed that significantly less incidence (76.91% reduction over control) and higher grain yield (5.37 t/ ha) was obtained. It was at par with its reduced dose of 750 ml/ ha followed by buprofezin 25%SC @ 800 ml/ ha. Though maximum grain yield was obtained with buprofezin+ fipronil @ 875 ml/ ha, maximum cost benefit (ICBR) was observed with the reduced dose of 750 ml/ ha (1: 6.11).

Key words: Rice, *Nilaparvata lugens*, buprofezin 24%+ fipronil 40%SC, neem oil, buprofezin+ fipronil, fipronil, imidacloprid, incidence, grain yield

Rice (*Oryza sativa* L.) is the second largest cultivated crop worldwide, and it's yield is affected by a number of biotic and abiotic stresses, of which insect pests are responsible for 40% reduction (Pathak and Dhaliwal, 1981). The rice plant is attacked by more than hundred insect species throughout the world (Pasalu and Katti, 2006; Heinrichs, 1987). Among them rice brown planthopper (BPH) *Nilaparvata lugens* (Stal) is the most important sucking insect pest. Extensive grain yield losses due to BPH have been reported from several parts of the country (Chandana et al., 2015). Use of insecticides is the most sought-after strategy for BPH management despite drawbacks of insecticide resistance and resurgence (Baehaki et al., 2016) and widespread outbreaks resulting in yield losses (Chander and Palta, 2010; Chander and Husain, 2018). BPH causes severe yield losses due to monoculturing of rice in an extensive area, use of susceptible rice cultivars, availability of irrigation water in addition to indiscriminate use of insecticides. In recent days BPH has developed either resistance or found to be less effective against different groups of insecticides like organophosphate, neonicotinoids, insect growth regulator, feeding inhibitor and phenyl pyrazole compounds. There is a need to assess the efficacy of new insecticidal compounds against BPH, and the present study evaluates the combination of buprofezin with fipronil.

MATERIALS AND METHODS

The field trial was carried out at the Central Research Farm, Gayeshpur, Bidhan Chandra Krishi Viswavidyalaya, Nadia,West Bengal during kharif, 2019 and 2020. Moderately susceptible variety IET-4094 (Khitish) was used with crop raised as per the recommended package of practices, except for plant protection. Experiment was laid on a Randomized Block design with eight treatments including untreated control and each treatment replicated thrice where 25 days old seedlings were transplanted in a spacing of 15x 10 cm with plot size 20 m^2. The treatments evaluated include: T_1– Neem oil 3% @ 2500ml/ ha, T_2– Buprofezin 24% + fipronil 40%SC (MAIRM-10) @ 625 ml/ ha, T_3– Buprofezin 24% + fipronil 40%SC (MAIRM-10) @ 750 ml/ ha, T_4– Buprofezin 24% + fipronil 40%SC (MAIRM-10) @ 875 ml/ ha, T_5– Buprofezin 25%SC @ 800 ml/ ha, T_6– Fipronil 5%SC @ 1500 ml/ ha, T_7– Imidacloprid 17.8%SL @ 125 ml/ ha, and T_8– Untreated control. Three sprays were given at fortnightly intervals starting at 45 days after transplantation (DAT) when the incidence was noticed above economic threshold level. The BPH incidence was recorded one day before and three, seven and ten days after the spraying on randomly selected five hills in each treatment. The yield/ plot was recorded and computed to ha basis. Efficacy of insecticides was calculated on basis of surviving BPH (nymph and adult) / plant after treatment. Data on incidence was subjected to square root transformation, and along with grain yield data were subjected to ANOVA and Tukey HSD. Also, the yield increase in treated plots/ avoidable loss was worked out. To assess the economics, Incremental Cost Benefit-Ratio (ICBR) was worked out, for which net realization was worked out for all treatments by deducting the cost of protection

Table 1. Efficacy of insecticides against rice brown planthopper

	Treatments	Dose (g or ml)/ ha	PTC 3 DAS	Mean BPH incidence/ plant after first spray			Mean BPH incidence/ plant After second spray			Mean BPH incidence/ plant After third spray			Over all Mean	Reduc-tion over control (%)	Yield (ton / ha)	Yield increase over control (%)
				7 DAS	10 DAS	3 DAS	7 DAS	10 DAS	3 DAS	7 DAS	10 DAS					
T_1	Neem oil 3%	2500	36.33	30.46 $(5.56)^{bc}$	33.59 $(5.83)^{c}$	34.81 $(5.94)^{cd}$	27.66 $(5.30)^{d}$	27.07 $(5.25)^{c}$	28.55 $(5.39)^{l}$	23.47 $(4.89)^{c}$	19.23 $(4.44)^{c}$	17.96 $(4.29)^{c}$	26.98 $(5.24)^{c}$	46.52	3.58	13.58
T_2	Buprofezin 24% + fipronil 40% SC (MAIRM 10)	625	35.17	27.67 $(5.31)^{ab}$	30.79 (5.59) b^{c}	32.01 $(5.70)^{b}$	24.87 $(5.04)^{cd}$	24.28 $(4.98)^{c}$	25.76 $(5.12)^{c}$	20.67 $(4.60)^{c}$	16.43 $(4.12)^{c}$	15.17 $(3.96)^{c}$	24.18 $(4.97)^{c}$	52.07	4.02	27.62
T_3	Buprofezin 24% + fipronil 40% SC (MAIRM-10)	750	36.34	22.65 $(4.81)^{ab}$	22.00 $(4.74)^{ab}$	23.22 $(4.87)^{a}$	11.89 $(3.52)^{a}$	11.64 $(3.48)^{a}$	12.58 $(3.62)^{a}$	6.60 $(2.66)^{a}$	3.80 $(2.07)^{a}$	2.41 $(1.71)^{a}$	12.97 $(3.67)^{a}$	74.28	5.29	67.94
T_4	Buprofezin 24% + fipronil 40% SC (MAIRM-10)	875	32.30	20.99 $(4.64)^{a}$	21.28 $(4.67)^{a}$	22.06 $(4.75)^{a}$	10.11 $(3.26)^{b}$	9.59 $(3.18)^{a}$	10.57 $(3.33)^{a}$	5.44 $(2.44)^{a}$	2.83 $(1.82)^{a}$	1.95 $(1.57)^{a}$	11.64 $(3.49)^{a}$	76.91	5.37	70.48
T_5	Buprofezin 25% SC	800	35.37	26.40 $(5.19)^{ab}$	26.66 $(5.21)^{bc}$	28.32 $(5.37)^{b}$	18.66 $(4.38)^{b}$	18.90 $(4.40)^{b}$	20.43 $(4.58)^{b}$	15.40 $(3.99)^{b}$	12.87 $(3.66)^{b}$	11.18 $(3.42)^{b}$	19.86 $(4.51)^{b}$	60.62	4.37	38.73
T_6	Fipronil 5% SC	1500	36.28	27.91 $(5.33)^{abc}$	27.05 $(5.25)^{bc}$	28.69 $(5.40)^{b}$	18.82 $(4.40)^{c}$	18.90 $(4.40)^{b}$	20.30 $(4.56)^{b}$	15.03 $(3.94)^{b}$	12.17 $(3.56)^{b}$	10.17 $(3.27)^{b}$	19.89 $(4.52)^{b}$	60.57	4.17	32.38
T_7	Imidacloprid 17.8% SL	125	35.18	29.34 $(5.46)^{bc}$	29.18 $(5.45)^{cd}$	30.73 $(5.59)^{bc}$	24.39 $(4.98)^{c}$	25.45 $(5.09)^{c}$	26.43 $(5.19)^{c}$	21.09 $(4.65)^{c}$	18.25 $(4.33)^{c}$	16.92 $(4.17)^{c}$	24.64 $(5.01)^{c}$	51.16	3.99	26.67
T_8	Untreated Control		33.89	37.13 $(6.13)^{c}$	37.92 $(6.96)^{e}$	42.48 $(6.56)^{d}$	47.66 $(6.94)^{e}$	52.06 $(7.25)^{d}$	54.32 $(7.40)^{d}$	58.20 $(7.66)^{d}$	61.64 $(7.88)^{d}$	62.72 $(7.95)^{d}$	50.45 $(7.14)^{d}$	-	3.15	-
S. Em. (±)			NS	0.14	0.11	0.09	0.05	0.09	0.06	0.06	0.07	0.06				
CD (p=0.05)			-	0.44	0.34	0.29	0.15	0.27	0.18	0.18	0.21	0.18				

Mean values of three replications represented as mean; Figures in parentheses $\sqrt{(x+0.5)}$ transformed values; Values followed by the same letter not significantly different from each other, Tukey HSD ($p \leq 0.05$); S.Em: Standard Error of mean, CD: Critical Difference.

Table 2. Economics of insecticide treatments in rice

Treatments		Cost of insecticides Rs/ ha (3 spray)	Total cost (Rs/ ha)	Yield (t/ ha)	Gross realization (Rs/ ha)	Net realization (Rs/ ha)	Net gain (Rs/ ha)	ICBR
T_1	Neem oil 3%	975.00	3927.00	3.58	66874.40	62947.40	4105.40	1:1.04
T_2	Buprofezin 24% + Fipronil 40% SC (MAIRM 10)	2226.56	5178.56	4.02	75093.60	69915.04	11073.04	1:2.14
T_3	Buprofezin 24% + Fipronil 40% SC (MAIRM-10)	2671.87	5623.87	5.29	98817.20	93193.33	34351.33	1:6.11
T_4	Buprofezin 24% + Fipronil 40% SC (MAIRM-10)	3117.18	6069.18	5.37	100311.6	94242.41	35400.41	1:5.83
T_5	Buprofezin 25% SC	3750.00	6702.00	4.37	81631.60	74929.60	16087.60	1:2.40
T_6	Fipronil 5% SC	6581.25	9533.25	4.17	77895.60	68362.35	9520.35	1:0.99
T_7	Imidacloprid 17.8% SL	731.25	3683.25	3.99	74533.20	70849.95	12007.95	1:3.26
T_8	Untreated Control	-	-	3.15	58842.00	58842.00	11073.04	-

Labour cost Rs/ ha (3spray) Rs 2952 and chemical cost and price as per market

from the gross realization of produce. Net gain over control was calculated by deducting the realization of control from realization of each treatment. ICBR from each treatment was calculated by dividing net gain over control by total cost of plant protection measures.

RESULTS AND DISCUSSION

The observations revealed insignificant difference in BPH incidence among treatments before spraying. All the treatments were found significantly superior over control after first spray; buprofezin 24%+ fipronil 40%SC @ 875 ml/ ha (74.28 % reduction in population) was proved to be superior; but at par with its lower dose i.e. 750 ml/ ha (42.20 % reduction) followed by buprofezin 25%SC @800 ml/ ha and fipronil 5%SC @1500 ml/ ha. Neem oil 3% was found to be the least effective, at par with imidacloprid 17.8%SL @ 125 ml/ ha. The data after second spray too revealed the superiority of buprofezin 24%+ fipronil 40%SC @ 875 ml/ ha (80.30% reduction), and at par with its reduced dose of 750 ml/ ha (76.60% reduction). More or less similar trend was observed after third spray; pooled data of three sprays revealed that all the treatments were significantly superior, with maximum reduction in incidence being with buprofezin 24%+ fipronil 40%SC @ 875 ml/ ha (76.91%). It was at par with its dose of 750 ml/ ha (74.28% reduction) (Table 1).

Present results agree with those of Shashank et al. (2012) and Ghosh and Chattarjee (2012), which revealed that buprofezin was the most effective. Buprofezin 24%+ fipronil 40%SC @ 875 ml/ ha gave significantly maximum grain yield (5.37 t/ ha) and it was at par with its lower dose of 750 ml/ ha (5.29 t/ ha; 70.48% yield increase) followed by buprofezin 25%SC (4.37 t/ ha; 67.94% yield increase). Economics of insecticides revealed that maximum net realization (94,242.41 Rs/ ha) was found with buprofezin 24%+ fipronil 40%SC @ 875 ml/ ha followed by its lower dose of 750 ml/ ha (93193.33 Rs/ha). The incremental cost benefit was found to be 1:5.83 and 1:6.11, respectively with these treatments. Neem oil 3% found to be least economic (ICBR 1:1.04) followed by fipronil 5%SC (ICBR 1:0.99) (Table 2). Thus, buprofezin 24%+ fipronil 40%SC (MAIRM-10) @ 875 ml/ha was found to be the most effective, while in terms of cost benefits its lower dose of 750 ml/ ha was the best.

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