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Evaluation of Insecticides for the Management of Brown Plant Hopper and White Backed Plant Hopper in Rice Crop

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ABSTRACT: The present study on evaluation of insecticides for the management of brown plant hopper and white backed plant hopper in rice crop was undertaken at Agriculture Research Station, Sakoli, Bhandara district during *kharif* 2021. The experimental plot was laid out in Randomized Block Design (RBD) incorporating seventeen treatments along with control consisting of seed treatment of Thiamethoxam 25 % WG, nursery application at one week before of Carbofuran 3% CG, Fipronil 0.3 % GR, Chlorantraniliprole 0.4 % GR, main field application at 22 DAT of Carbofuran 3 % CG, Fipronil 0.3% GR, Chlorantraniliprole 0.4% GR, Cartap hydrochloride 4 % GR, Chlorpyrifos 10% GR, Thiamethoxam 25% WG (seed treatment) + Fipronil 0.3 % GR (main field), Thiamethoxam 25% WG (seed treatment) + Chlorantraniliprole 0.4 % GR (main field), Thiamethoxam 25% WG (seed treatment) + Cartap hydrochloride 4 % GR (main field), Thiamethoxam 25% WG (seed treatment) + Chlorpyrifos 10 % GR (main field), Fipronil 0.3% GR (nursery) + Chlorantraniliprole 0.4 GR % (main field), Fipronil 0.3% GR (nursery) + Cartap hydrochloride 4 % GR (main field), Fipronil 0.3 % GR (nursery) + Chlorpyrifos 10 % GR (main field). The results clearly revealed that Chlorantraniliprole 0.4% GR (main field) was most promising in controlling brown plant hopper and at par with treatment Carbofuran 3% CG (nursery), Chlorpyrifos 10% GR (main field), Chlorantraniliprole 0.4% GR (main field) and Carbofuran 3% CG (nursery) was most promising in controlling white backed plant hopper and at par with Chlorantraniliprole 0.4% GR (nursery), Chlorpyrifos 10% GR (main field), Chlorantraniliprole 0.4% GR (main field). Highest yield was noticed in Chlorantraniliprole (main field) (44.33 q/ha) followed by Fipronil 0.3% GR (nursery) + Chlorantraniliprole 0.4% GR (main field) (38.59 q/ha) and Chlorpyrifos 10% GR (main field) (38.22 q/ha). ICBR is highest for Carbofuran 3% CG (nursery) followed by Chlorantraniliprole 0.4% GR (nursery), Fipronil 0.3% GR (nursery), Chlorpyrifos 10% GR (main field) and Thiamethoxam 25% WG (seed treatment).

Keywords: Brown plant hopper, White backed plant hopper, Capsulated granules.

INTRODUCTION

Rice (*Oryza sativa*) is a major field crop of India, covering the large area in the country. In order to meet the growing demand of the ever increasing population, we need to produce more rice every year. But the rice production is limited by both biotic and abiotic stresses of which insect pests alone causes about 25 per cent losses (Katti *et al.,* 2019). India has the largest area of 45 million ha with production of 122 mMT which ranks second in production next to China and contributing 25% of global production of total food grain production and continues to play a vital role in the national food grain supply and the total food grain production in india accounts for 308.65 million tonnes (Anonymous, 2021). Both brown plant hopper (*Nilaparvata lugens*) and white backed plant hopper (*Sogatella furcifera*) are the most notorious pests of rice. Both the nymph and adult stages of this pests cause the direct damage to the crop. The pest sucks the sap from the phloem and xylem

which leads to yellowing, wilting, drying up and ultimately the death of the rice plant. Under severe conditions, the damage spreads in a circular fashion which is termed as "hopper-burn". They also causes indirect damage by transmitting viral diseases. India is the largest rice growing country in the world, but unfortunately the yield of rice per hectare is much less as compared to other countries. The insect pest plays a significant role and accounts for reduction in the yield. It has been estimated that about 31.5% of the production of rice crop in Asia is reduced by insect pests (Cramer, 1967).

In the past one decade, insecticides use in rice has increased tremendously in this region, as the farmers started growing high yielding rice varieties with greater yield and better profit margin. However, increased use of insecticides does not commensurate with grain production. Nevertheless, insecticides are the only tool available at present to the farmer to suppress the insect population during epidemics. In view of this, chemical insecticides will remain as a most dependable weapon at present and in future too. Farmers of the eastern Vidarbha region apply insecticides indiscriminately in order to obtain maximum profit. Studies on chemical control of rice brown plant hopper and white backed hopper have been undertaken by many workers. In today's time, there is a need for a pesticide that can reduce pest population while minimizing the environmental damage. Therefore, present studies are needed for the management of brown plant hopper and white backed hopper.

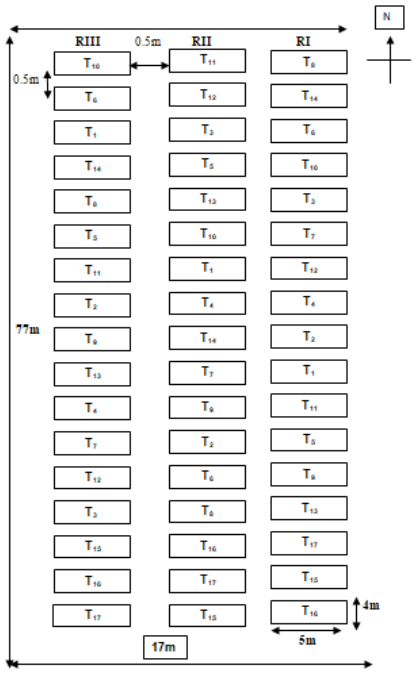
Hence, efforts were made to evaluate the insecticides for management of brown plant hopper and white backed hopper in rice crop.

MATERIALS AND METHODS

Present investigation were carried out to evaluate the effectiveness of insecticides which are used in experiment at Agriculture Research Station, Sakoli, Dist. Bhandara under Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, during kharif 2021.

Seed Treatment Method. Soak required quantity of rice seeds in 0.1 per cent Thiamethoxam 25% WG solution (*i.e.*, 4 g Thiamethoxam 25% WG formulation in one litre of water) @ one litre solution per one kg of rice seeds for about 10 hours and drain excess water. Keep the soaked seed in a gunny bag in dark and leave for 24 hrs for sprouting for the treatments of T_1, T_{10}, T_{11}, T_{12} and T_{13}.

Plan of Layout



Experimental details

1. Name :	Rice crop
2. Family :	Graminae
3. Variety :	PKV HMT
4. Layout :	Randomized Block Design
5. Date of sowing:	01 / 07 / 2021
6. Date of transplanting:	30/ 07 / 2021
7. Season :	*kharif* 2021
8. Treatments:	17
9. Replications:	3
10. Total number of plots:	51
11. Plot size:	Gross = 5.0 m × 4.0 m; Net = 4.40 m × 3.20 m
12. Marginal spacing:	Between replication = 0.5 m Between treatments = 0.5m
13. Spacing :	Row to Row : 20 cm Plant to plant : 15 cm
14. Seedlings/hill:	2 to 3
15. Age of seedlings at planting:	4 weeks
16. Irrigation:	As per requirement
17. Fertilizer dose:	100:50:50 NPK kg/ha
18. Date of Harvesting:	30.11.2021

Insecticides application schedule: As per the list given in table below.

Table 1: Treatment Details.

Crop Stage	Treat. No.	Insecticide	Dosage (formulation)
Seed Treatment alone	T_1	Thiamethoxam 25% WG	4g/kg seed
Nursery alone (23 DAS)	T_2	Carbofuran 3% CG (Check1)	33 Kg per ha (3.3 g per sq. m)
	T_3	Fipronil 0.3 GR	25 Kg per ha (2.5 g per sq. m)
	T_4	Chlorantraniliprole 0.4 GR	10 Kg per ha (1.0 g per sq. m)
Main field alone (22 DAT)	T_5	Carbofuran 3% CG (Check2)	33 Kg per ha (3.3 g per sq. m)
	T_6	Fipronil 0.3 GR	25 Kg per ha (2.5 g per sq. m)
	T_7	Chlorantraniliprole 0.4 GR	10 Kg per ha (1.0 g per sq. m)
	T_8	Cartap hydrochloride 4% GR	18.75 kg per ha (1.9 g per sq. m)
	T_9	Chlorpyrifos 10% GR	10 Kg per ha (1.0 g per sq. m)
Seed Treatment + Main field	T_{10}	$T_1 + T_6$	
	T_{11}	$T_1 + T_7$	
	T_{12}	$T_1 + T_8$	
	T_{13}	$T_1 + T_9$	
Nursery + Main field	T_{14}	$T_3 + T_7$	
	T_{15}	$T_3 + T_8$	
	T_{16}	$T_3 + T_9$	
Untreated control	T_{17}	Untreated Control	

Table 2: Application of insecticides.

Sr. No.	Insecticide application number	Date of insecticide application	Insecticide application days after sowing/transplanting
1.	Seed treatment	29.06.2021	2 days before sowing
2.	First	23.07.2021	23 DAS
3.	Second	21.08.2021	22 DAT

Observations:

1. Main field observations were taken from 10 hills at random at each replication at 35, 50 and 65 DAT (per hill).

(i) Number of tillers.

(ii) Number of plant hoppers.

2. Main field at maturity (per hill in 10 hills at random in each replication).

(i) Number of panicle bearing tillers at maturity.

(ii) Grain yield per plot excluding 2 border rows on all sides.

Effect of different treatments on the population of brown plant hopper on paddy. Pooled analysis showed that, the treatment of Chlorantraniliprole 0.4% GR (main field) (6.50 no./hill) was found effective in reducing the incidence of brown plant hopper and followed by Carbofuran 3% CG (nursery) (6.52 no./hill), Chlorantraniliprole 0.4% GR (nursery) (6.55 no./hill), Carbofuran 3% CG (main field) (6.57 no./hill), Thiamethoxam 25% WG (seed treatment) + Fipronil 0.3% GR (main field) (6.60 no./hill), Fipronil 0.3% GR (nursery) + Cartap hydrochloride 4% GR (main field) (6.63 no./hill), Fipronil 0.3% GR (main field) (6.67 no./hill), Cartap hydrochloride 4% GR (main field) (6.75 no./hill), Chlorpyrifos 10% GR (main field) (6.78 no./hill), Thiamethoxam 25% WG (seed treatment) + Chlorpyrifos 10% GR (main field) (6.83 no./hill), Fipronil 0.3% GR (nursery) (6.88 no./hill), Thiamethoxam 25% WG (seed treatment) + Chlorantraniliprole 0.4% GR (main field) (6.90 no./hill), Thiamethoxam 25% WG (seed treatment) (6.92 no./hill), Fipronil 0.3% GR (nursery) + Chlorantraniliprole 0.4% GR (main field) (7.15 no./hill), Fipronil 0.3% GR (nursery) + Chlorpyrifos 10% GR (main field) (7.15 no./hill) and Thiamethoxam 25% WG (seed treatment) + Cartap hydrochloride 4% G (main field) (7.18 no./hill). However, highest incidence of brown plant hopper was recorded in control (7.23 no./hill) (Table 3).

Chlorantraniliprole opens muscular calcium channels (in particular the ryanodine receptor), rapidly causing paralysis and ultimately death of hoppers (Omprakash *et al.*, 2017). Carbofuran (2,3-dihydro-2,2-dimethyl-7-benzofuranyl-N-methylcarbamate) is a broad spectrum N-methyl carbamate insecticide exert their toxicity by reversibly inhibiting acetylcholinesterase (AChE) 10 leading to the persistent action of the otherwise hydrolysed neurotransmitter, acetylcholine on hoppers post synaptic receptors (Jongeneelen *et al.*, 2013). The results are in agreement with the results of Roshan (2011) who studied the effect of some granular insecticides against brown plant hopper in rice under field condition and revealed that among them Cartap hydrochloride 4 G and carbofuran 3 G @ 1.0 kg a.i. ha^{-1} recorded lowest population of these pests upto 35 days after their application. Similarly Renuka *et al.* (2020) revealed that nursery treatment with Fipronil 0.3 G @ 20 kg ha^{-1} + Chlorantraniliprole 0.4 G @ 10 kg ha^{-1} at 40 DAT + spray of Buprofezin 25 % SC @ 825 ml ha^{-1} at 65 DAT were superior with 83% reduction in plant hoppers population.

Table 3: Effect of different treatments on population of brown plant hopper on paddy.

Crop Stage	Tr. No.	Treatments	Brown plant hopper (No./hill)		
			50 DAT	65 DAT	Pooled
Seed Treatment alone	T_1	Thiamethoxam 25% WG	4.20a (2.17)	9.63 (3.18)	6.92a (2.72)
Nursery alone (23 DAS)	T_2	Carbofuran 3% CG (Check1)	4.30a (2.19)	8.73 (3.04)	6.52a (2.65)
	T_3	Fipronil 0.3% GR	4.50a (2.23)	9.27 (3.12)	6.88a (2.72)
	T_4	Chlorantraniliprole 0.4% GR	4.33a (2.20)	8.77 (3.04)	6.55a (2.66)
Main field alone (22 DAT)	T_5	Carbofuran 3% CG (Check2)	**4.07a** **(2.14)**	9.07 (3.09)	6.57a (2.66)
	T_6	Fipronil 0.3% GR	4.67a (2.27)	8.67 (3.03)	6.67a (2.68)
	T_7	Chlorantraniliprole 0.4% GR	4.67a (2.27)	8.33 (2.97)	**6.50a** **(2.65)**
	T_8	Cartap hydrochloride 4% GR	4.47a (2.23)	9.03 (3.09)	6.75a (2.69)
	T_9	Chlorpyrifos 10% GR	4.73b (2.29)	8.83 (3.05)	6.78a (2.70)
Seed Treatment + Main field	T_{10}	$T_1 + T_6$	4.40a (2.21)	8.8 (3.05)	6.60a (2.66)
	T_{11}	$T_1 + T_7$	4.17a (2.16)	9.63 (3.18)	6.90a (2.72)
	T_{12}	$T_1 + T_8$	4.63a (2.27)	9.73 (3.20)	7.18b (2.77)
	T_{13}	$T_1 + T_9$	4.60a (2.26)	9.07 (3.09)	6.83a (2.71)
Nursery + Main field	T_{14}	$T_3 + T_7$	4.77b (2.29)	9.53 (3.17)	7.15b (2.77)
	T_{15}	$T_3 + T_8$	4.40a (2.21)	8.87 (3.06)	6.63a (2.67)
	T_{16}	$T_3 + T_9$	5.07b (2.36)	9.23 (3.12)	7.15b (2.77)
Untreated control	T_{17}	Untreated Control	**5.27b** **(2.40)**	9.2 (3.11)	**7.23b** **(2.78)**
		'f' test	Sig.	NS	Sig.
		SE (+M)	0.05	0.05	0.04
		CD at 5%	0.13	0.16	0.10
		CV (%)	9.57	3.07	8.33

Note: No incidence of brown plant hoppers was noticed during 35 DAT.
*AT- 3 days after treatment, Sig – Significant, NS- Non Significant
**Figures in parentheses are corresponding values of square root (n) transformation, n= Brown plant hoppers (No. /hill).

Effect of different treatments on the population of white backed plant hopper on paddy. Pooled analysis showed that, the treatment of Carbofuran 3% CG (nursery) was found effective in reducing the incidence of white backed plant hopper (0.93 no./hill) and at par with Chlorantraniliprole 0.4% GR (nursery) (0.97 no./hill), Chlorpyrifos 10% GR (main field) (1.00 no./hill), Chlorantraniliprole 0.4% GR (main field) (1.03 no./hill), Fipronil 0.3% GR (nursery) + Cartap hydrochloride 4% GR (main field) (1.03 no./hill), Thiamethoxam 25% WG (seed treatment) + Chlorpyrifos 10% GR (main field) (1.05 no./hill), Fipronil 0.3% GR (nursery) + Chlorpyrifos 10% GR (main field) (1.07 no./hill), Cartap hydrochloride 4% GR (main field) (1.07 no./hill), Fipronil 0.3% GR (main field) (1.08 no. /hill), Thiamethoxam 25% WG (seed treatment) + Cartap hydrochloride 4% G (main field) (1.10 no./hill), Thiamethoxam 25% WG (seed treatment) + Fipronil 0.3 GR (main field) (1.10 no./hill), Thiamethoxam 25% WG (seed treatment) + Chlorantraniliprole 0.4% GR (main field) (1.18 no./hill) and Carbofuran 3% CG (main field) (1.20 no./hill). It was followed by Fipronil 0.3% GR (nursery) (1.28 no./hill), Thiamethoxam 25% WG (seed treatment) (1.37 no./hill) and Fipronil 0.3% GR (nursery) + Chlorantraniliprole 0.4% GR (main field) (1.43 no./hill). However, highest incidence of white backed plant hopper was recorded in control (1.53 no./hill) (Table 4).

Carbofuran (2,3-dihydro-2,2-dimethyl-7-benzofuranyl-N-methylcarbamate) is a broad spectrum N-methyl carbamate insecticide exert their toxicity by reversibly inhibiting acetylcholinesterase (AChE) 10 leading to the persistent action of the otherwise hydrolysed

neurotransmitter, acetylcholine, on hopper postsynaptic receptors. Chlorantraniliprole opens muscular calcium channels (in particular the ryanodine receptor), rapidly causing paralysis and ultimately death of hoppers (Jongeneelen *et al*., 2013).

Roshan (2011) reported the effect of some granular insecticides against white backed plant hopper in rice under field condition was studied. Among them Cartap hydrochloride 4 G and Carbofuran 3 G @ 1.0 kg a.i. ha^{-1} recorded lowest population of these pests upto 35 days after their application. Baehaki *et al.* (2017) Chlorantranilprole + Thiamethoxam had reduced WBPH population. Renuka *et al*. (2020) revealed that nursery treatment with Fipronil 0.3 G @ 20 kg /ha + Chlorantraniliprole 0.4 G @ 10 kg /ha at 40 DAT + spray of Buprofezin 25 % SC @ 825 ml /ha at 65 DAT were superior with 83% reduction in plant hoppers population.

Table 4: Effect of different treatments on population of white backed plant hopper on paddy.

Crop Stage	Tr. No.	Treatments	White backed plant hopper (No./hill)		
			50 DAT	65 DAT	Pooled
Seed Treatment alone	T_1	Thiamethoxam 25% WG	0.37a (0.93)	2.37a (1.68)	1.37a (1.35)
Nursery alone (23 DAS)	T_2	Carbofuran 3% CG (Check1)	0.37a (0.93)	**1.50a (1.41)**	**0.93a (1.19)**
	T_3	Fipronil 0.3 GR	0.50b (1.00)	2.07a (1.59)	1.28a (1.33)
	T_4	Chlorantraniliprole 0.4 GR	0.37a (0.93)	1.57a (1.43)	0.97a (1.20)
Main field alone (22 DAT)	T_5	Carbofuran 3% CG (Check2)	**0.27a (0.88)**	2.13a (1.61)	1.20a (1.29)
	T_6	Fipronil 0.3 GR	0.40a (0.95)	1.77a (1.49)	1.08a (1.25)
	T_7	Chlorantraniliprole 0.4 GR	0.37a (0.93)	1.70a (1.48)	1.03a (1.23)
	T_8	Cartap hydrochloride 4% GR	0.37a (0.93)	1.77a (1.50)	1.07a (1.24)
	T_9	Chlorpyrifos 10% GR	0.40a (0.95)	1.60a (1.45)	1.00a (1.22)
Seed Treatment + Main field	T_{10}	$T_1 + T_6$	0.50b (1.00)	1.70a (1.48)	1.10a (1.26)
	T_{11}	$T_1 + T_7$	0.37a (0.93)	2.00b (1.58)	1.18a (1.29)
	T_{12}	$T_1 + T_8$	0.40a (0.95)	1.80a (1.51)	1.10a (1.26)
	T_{13}	$T_1 + T_9$	0.33a (0.91)	1.77a (1.50)	1.05a (1.24)
Nursery + Main field	T_{14}	$T_3 + T_7$	0.53b (1.01)	2.33a (1.68)	1.43b (1.38)
	T_{15}	$T_3 + T_8$	0.33a (0.91)	1.73a (1.49)	1.03a (1.23)
	T_{16}	$T_3 + T_9$	0.50b (1.00)	1.63a (1.46)	1.07a (1.24)
Untreated control	T_{17}	Untreated Control	**0.60b (1.05)**	**2.47a (1.72)**	**1.53b (1.42)**
		'f' test	Sig.	Sig.	Sig.
		SE (±M)	0.03	0.09	0.06
		CD at 5%	0.10	0.27	0.17
		CV (%)	6.03	10.47	8.03

Note: No incidence of white backed plant hopper was noticed during 35 DAT; *AT - 3 days after treatment, Sig – Significant, NS - Non-Significant; **Figures in parentheses are corresponding values of square root (n) transformation, n= White backed plant hoppers (No. /hill).

Table 5: Effect of different treatments on yield of paddy.

Crop Stage	Tr. No.	Treatment	Yield (q /ha)
Seed Treatment alone	T_1	Thiamethoxam 25% WG	23.29b
Nursery alone (23 DAS)	T_2	Carbofuran 3% CG (Check1)	30.47b
	T_3	Fipronil 0.3 GR	20.95b
	T_4	Chlorantraniliprole 0.4 GR	24.89b
Main field alone (22 DAT)	T_5	Carbofuran 3% CG (Check2)	30.29b
	T_6	Fipronil 0.3 GR	24.08b
	T_7	Chlorantraniliprole 0.4 GR	**44.33a**
	T_8	Cartap hydrochloride 4% GR	21.00b
	T_9	Chlorpyrifos 10% GR	38.22a
Seed Treatment + Main field	T_{10}	$T_1 + T_6$	21.00b
	T_{11}	$T_1 + T_7$	32.32b
	T_{12}	$T_1 + T_8$	21.68b
	T_{13}	$T_1 + T_9$	37.78a
Nursery + Main field	T_{14}	$T_3 + T_7$	38.59a
	T_{15}	$T_3 + T_8$	22.26b
	T_{16}	$T_3 + T_9$	37.79a
Untreated control	T_{17}	Untreated Control	**17.13b**
		'f' test	Sig.
		SE (+M)	3.51
		CD at 5%	10.10
		CV (%)	14.24

Table 6: Effect of different treatments on Incremental Cost Benefit Ratio (ICBR).

Crop Stage	Tr. No.	Treatments	No. of insecticidal applications	Qty. Of insecticide req./ha	Rate per Kg or lit.	Cost of treatment (Rs/ha)		Total cost for insecticidal applications (A)	Yield (q/ha)	Increased yield over control (q/ha)	Value of increased yield (Rs./ha) (B)	Increment benefit (C) = (B-A)	ICBR (C/A)	Rank
						Cost of insecticide	Labour charges							
Seed Treatment alone	T_1	Thiamethoxam 25 % WG	1	0.16kg	2200	352	275	627	23.29	6.16	15,400	14,773	23.49	5
Nursery alone (23 DAS)	T_2	Carbofuran 3 % CG (Check1)	1	33kg	130	43	275	318	30.47	13.34	33,350	33,032	103.87	1
	T_3	Fipronil 0.3 % GR	1	25kg	100	25	275	300	20.95	3.82	9,550	9,250	30.83	3
	T_4	Chlorantraniliprole 0.4% GR	1	10kg	200	20	275	295	24.89	7.76	19,400	19,105	64.76	2
Main field alone (22 DAT)	T_5	Carbofuran 3 % CG (Check2)	1	33kg	130	4290	825	5115	30.29	13.16	32,900	27,785	5.43	11
	T_6	Fipronil 0.3 % GR	1	25kg	100	2500	825	3325	24.08	6.95	17,375	14,050	4.22	12
	T_7	Chlorantraniliprole 0.4 % GR	1	10kg	200	2000	825	2825	44.33	27.2	68,000	65,175	23.07	7
	T_8	Cartap hydrochloride 4 % GR	1	18.75kg	125	2344	825	3169	21.00	3.87	9,675	6,506.00	2.05	14
	T_9	Chlorpyrifos 10% GR	1	10kg	100	1000	825	1825	38.22	21.09	52,725	50,900	27.89	4
Seed Treatment + Main field	T_{10}	$T_1 + T_6$	2	30g+25kg	-	2852	1100	3952	21.00	3.87	9,675	5,723	1.44	16
	T_{11}	$T_1 + T_7$	2	30g+10kg	-	2352	1100	3352	32.33	15.2	38,000	34,648	10.33	10
	T_{12}	$T_1 + T_8$	2	30g+18.75kg	-	2696	1100	3796	21.68	4.55	11,375	7,579	1.99	15
	T_{13}	$T_1 + T_9$	2	30g+10kg	-	1352	1100	2452	37.78	20.65	51,625	49,173	20.05	8
Nursery + Main field	T_{14}	$T_3 + T_7$	2	25kg +10kg	-	2025	1100	3125	38.59	21.46	53,650	50,525	16.16	9
	T_{15}	$T_3 + T_8$	2	25kg+18.75 Kg	-	2369	1100	3469	22.26	5.13	12,825	9,356.00	2.69	13
	T_{16}	$T_3 + T_9$	2	25kg+10kg	-	1025	1100	2125	37.79	20.66	51,650	49,525	23.3	6
Untreated control	T_{17}	Untreated Control	-	-	-	-	-	-	17.13	-	-	-	-	-

Cost of insecticides

Sr. No.	Insecticides required /ha	Cost (Rs.)
1.	Thiamethoxam 25 % WG	Rs. 2200/Kg
2.	Fipronil 0.3 % GR	Rs. 100/Kg
3.	Carbofuran 3 % CG (Check1)	Rs. 130/Kg
4.	Chlorantraniliprole 0.4 % GR	Rs. 200/Kg
5.	Cartap hydrochloride 4% GR	Rs. 125/Kg
6.	Chlorpyrifos 10 % GR	Rs. 100/Kg
Labours charges for spray - 4 labour/ha -@ Rs. 275/day. Market value of rice - @ Rs. 2500 /q		

CONCLUSIONS

The brown plant hopper was found to be the serious pest of paddy. Similarly, low incidence of white backed plant hopper was recorded. From the data it can be concluded that Chlorantraniliprole 0.4 % GR (Main Field) was effective in management of brown plant hopper and Carbofuran 3% CG (nursery) was effective in management of white backed plant hopper. Highest grain yield was recorded in plot treated with Chlorantraniliprole 0.4 % GR (Main Field) followed by Fipronil 0.3% GR (nursery) + Chlorantraniliprole 0.4% GR (main field), Chlorpyrifos 10% GR (main field), Fipronil 0.3% GR (nursery) + Chlorpyrifos 10% GR (main field), Thiamethoxam 25% WG (seed treatment) + Chlorpyrifos 10% GR (main field). Among different treatments, incremental cost benefit ratio in Carbofuran 3% CG (Nursery) was found highest followed by Chlorantraniliprole 0.4% GR (nursery), Fipronil 0.3% GR (nursery), Chlorpyrifos 10% GR (main field). Thus, the above insecticides are the better option to manage the brown plant hopper and white backed plant hopper of paddy.

FUTURE SCOPE

The study generates data based on evaluation of insecticides for the management of brown plant hopper and white backed plant hopper in rice crop and to work out the economics of different treatments which will aware farmers to implement the above effective insecticides for managing these pests and to achieve potential yield during *kharif* season in eastern Vidharbha region of Maharashtra.

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