

Evaluation of Insecticides for the Management of Leaf Folder in Rice Crop

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ABSTRACT: The present study on evaluation of insecticides for the management of leaf folder 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 gall midge with 1.56 % damaged leaves and was at par with treatments Thiamethoxam 25% WG (seed treatment) + Chlorantraniliprole 0.4% GR (main field) (1.58 % damaged leaves), Thiamethoxam 25% WG (seed treatment) (1.62 % damaged leaves), Fipronil 0.3% GR (nursery) + 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: Leaf folder, Capsulated granules, Damaged leaves.

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. The total food grain production in India accounts for 308.65 million tonnes (Anonymous, 2021).

The rice leaf folder *Cnaphalocrocis medinalis* (Lepidoptera: Pyralidae) is a major insect pest of rice. Outbreaks of serious infestations of rice leaf folder have been reported in many Asian countries. 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).

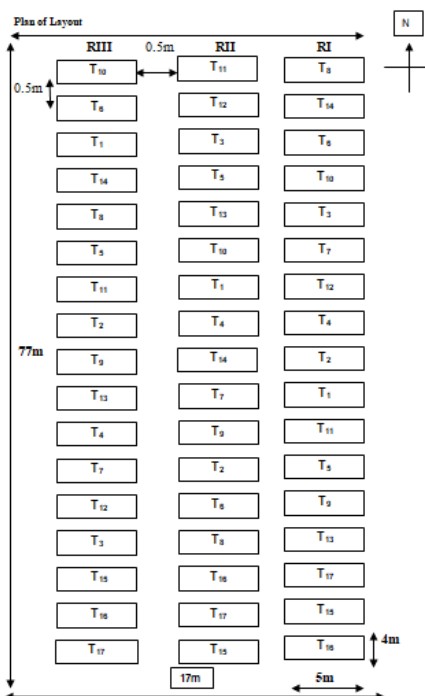
In the past one decade, insecticides use in rice has increased tremendously in this region, as the farmers started growing high yielding rice varieties with greater yield and better profit margin. However, increased use of insecticides does not commensurate with grain production.

Nevertheless, insecticides are the only tool available at present to the farmer to suppress the insect population during epidemics. In view of this, chemical insecticide 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 leaf folder 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 leaf folder. Hence, efforts were made to evaluate the insecticides for management of leaf folder 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, Distt. Bhandara under Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, during *kharif* 2021.

Seed Treatment Method. Soak required quantity of rice seeds in 0.1 percent 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 T₁, T₁₀, T₁₁, T₁₂ and T₁₃.



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 | : <i>kharif</i> 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 1 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)
	T ₅	Carbofuran 3% CG (Check2)	33 Kg per ha (3.3 g per sq. m)
Main field alone (22 DAT)	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 damaged leaves for leaf folder.

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.

% Damage leaf folder =

$$\frac{\text{No. of damaged leaves in 10 hills}}{\text{Total no. of leaves in 10 hills}} \times 100$$

Effect of different treatments on the incidence of leaf folder on paddy. Pooled analysis showed that the treatment of Chlorantraniliprole 0.4% GR (main field) with 1.56 % damaged leaves was found significantly superior over control in reducing the incidence of leaf folder. It was at par with treatment of Thiamethoxam 25% WG (seed treatment) + Chlorantraniliprole 0.4% GR (main field) (1.58 % damaged leaves), Thiamethoxam 25% WG (seed treatment) (1.62 % damaged leaves), Fipronil 0.3% GR (nursery) + Chlorantraniliprole 0.4% GR (main field) (1.73 % damaged leaves), Fipronil 0.3% GR (main field) (1.86 % damaged leaves) and Carbofuran 3% CG (main field) (2.09 % damaged leaves). The next effective treatment was Fipronil 0.3% GR (nursery) + Cartap hydrochloride 4% GR (main field) (2.21 % damaged leaves), Thiamethoxam 25% WG (seed treatment) + Fipronil 0.3% GR (main field) (2.33 % damaged leaves), chlorantraniliprole 0.4% GR (nursery) (2.34 %

damaged leaves), Thiamethoxam 25% WG (seed treatment) + Cartap hydrochloride 4% G (main field) (2.49% damaged leaves). It was followed by Thiamethoxam 25% WG (seed treatment) + Chlorpyrifos 10% GR (main field) (2.64 % damaged leaves), Cartap hydrochloride 4% GR (main field) (2.67 % damaged leaves), Carbofuran 3% CG (nursery) (2.67 % damaged leaves), Chlorpyrifos 10% GR (main field) (2.83 % damaged leaves), Fipronil 0.3% GR (nursery) (2.83 % damaged leaves) and Fipronil 0.3% GR (nursery) + Chlorpyrifos 10% GR (main field) (3.08 % damaged leaves). However, the highest incidence of leaf folder was recorded in control with 4.15 per cent damaged leaves (Table 3).

Chlorantraniliprole is an anthranilic diamide insecticide in the form of a suspension concentrate. Chlorantraniliprole is particularly active on Lepidopteran insect pests like paddy leaf folder, primarily it acts as a larvicide. Thiamethoxam is a systemic insecticide in the class of neonicotinoids. It has a broad spectrum insecticide. It is absorbed quickly by plants and transported to all of its parts, including pollen, where it acts to deter insect feeding of leaf folder. An insect can absorb in its stomach after feeding or through direct contact, including through its tracheal system. The compound gets in the way of information transfer between nerve cells by interfering with nicotinic acetylcholine receptors in the central nervous system and eventually paralyzes the muscles of the paddy leaf folder (Brunner *et al.*, 1999).

The results of the present investigation are in agreement with Chander and Palta (2008). They reported on the basis of overall effect of insecticides

against leaf folder and on crop yield. The insecticidal treatments Thiamethoxam + λ -Cyhalothrin, Spinosyn and Deltamethrin were observed to be better than other treatments. Sarao and Kaur (2013) conducted field experiments over four doses of Ferterra 0.4% GR (Chlorantraniliprole) a new chemistry @ 20, 30, 40 and 50 g a.i. ha⁻¹ and standard check Cartap hydrochloride 4 G @ 1000 g a.i. ha⁻¹ was tested against stem borers and leaf folder infesting basmati rice. Leaf folder infestation at all the Ferterra doses were at par with standard check at 70 DAT (2.69-3.87 %). Whereas, at 80 DAT, Ferterra doses @ 30, 40, 50 and standard check were at

par (2.95-3.49 %) but significantly better than lower dose. Suri and Brar (2013) reported that leaves damaged by the leaf folder in Chlorantraniliprole @ 40 g a.i. ha⁻¹ (4.12%) was at par with its higher dose of 50 g a.i. ha⁻¹ (3.82%) and Cartap hydrochloride (3.86%) and Chlorantraniliprole (Ferterra 0.4% GR) @ 40 g a.i. ha⁻¹ proved effective against leaf folder and can be recommended for their control on basmati rice. Results of Panse *et al.* (2016) were also comparable with the present findings of leaf damage per cent by leaf folder ranging from 7.05 to 8.30 one day before the spray.

Table 3: Effect of different treatments on incidence of leaf folder on paddy.

Crop Stage	Tr. No.	Treatments	Leaf folder incidence			
			Damaged leaves (%)			
			35 DAT	50 DAT	65 DAT	Pooled
Seed Treatment alone	T1	Thiamethoxam 25% WG	1.21a (1.27)	1.51a (1.42)	2.04a (1.55)	1.62a (1.45)
Nursery alone (23 DAS)	T2	Carbofuran 3% CG (Check1)	2.04b (1.59)	2.29a (1.66)	3.60b (2.02)	2.67c (1.78)
	T3	Fipronil 0.3% GR	1.61a (1.44)	3.64b (1.85)	3.24b (1.92)	2.99c (1.87)
	T4	Chlorantraniliprole 0.4% GR	2.61b (1.76)	2.19a (1.64)	2.36a (1.66)	2.34b (1.68)
Main field alone (22 DAT)	T5	Carbofuran 3% CG (Check2)	1.01a (1.18)	1.87a (1.54)	3.04b (1.88)	2.09a (1.61)
	T6	Fipronil 0.3% GR	1.33a (1.34)	1.71a (1.49)	2.40a (1.68)	1.86a (1.53)
	T7	Chlorantraniliprole 0.4% GR	1.42a (1.38)	1.81a (1.52)	1.26a (1.32)	1.56a (1.43)
	T8	Cartap hydrochloride 4% GR	1.76a (1.50)	1.74a (1.49)	4.64b (2.26)	2.67c (1.78)
	T9	Chlorpyrifos 10% GR	1.83a (1.52)	2.98a (1.86)	3.42b (1.97)	2.83c (1.82)
Seed Treatment + Main field	T10	T ₁ + T ₆	1.96b (1.55)	2.01a (1.58)	3.07b (1.87)	2.33b (1.67)
	T11	T ₁ + T ₇	0.95a (1.19)	1.68a (1.47)	1.88a (1.51)	1.58a (1.44)
	T12	T ₁ + T ₈	0.91a (1.14)	2.19a (1.64)	4.00b (2.10)	2.49b (1.72)
	T13	T ₁ + T ₉	1.81a (1.49)	2.95a (1.86)	2.87b (1.83)	2.64c (1.77)
Nursery + Main field	T14	T ₃ + T ₇	1.68a (1.47)	1.82a (1.30)	3.17a (1.67)	1.73a (1.49)
	T15	T ₃ + T ₈	1.46a (1.46)	2.94a (1.52)	4.55b (1.90)	2.21b (1.65)
	T16	T ₃ + T ₉	4.28a (1.39)	3.64a (1.85)	4.80b (2.24)	3.08c (1.89)
Untreated control	T17	Untreated Control	4.28c (2.18)	6.09 (2.39)	4.80b (2.30)	4.09c (2.14)
		‘f’ test	Sig.	Sig.	Sig.	Sig.
		SE (+M)	0.14	0.17	0.17	0.07
		CD at 5%	0.4	0.5	0.5	0.19
		CV (%)	16.62	18.2	15.96	6.74

*Sig – Significant, NS- Non Significant

**Figures in parentheses are corresponding values of square root (n+0.5) transformation, n= % Leaf folder

After insecticidal treatment revealed that Thiamethoxam 25 per cent WG 100 g a.i. ha⁻¹ proved to be most effective insecticide showing minimum per

cent leaf damage. The Thiamethoxam 25 per cent WG 50 g a.i./ha recorded similar damage per cent. Balamurugan *et al.* (2017) studied the application of

Virtako 2.4 DT (Chlorantraniliprole 1.2% + Thiamethoxam 1.2%) @ 2.5 kg ha⁻¹ at 20 days after transplantation of rice was found effective in reducing leaf folder (*Cnaphalocrocis medinalis*) with 3.47% leaf damage as compared with untreated check 15.42% leaf damage. Bhardwaj *et al.* (2019) concluded that Chlorantraniliprole being a systemic insecticide is recommended for the management of the leaf folder, *Cnaphalocrocis medinalis*. Its bioefficacy against the

leaf folder is reported for two years (2011-12) in basmati rice at four doses *viz.*, 50, 100, 150, 200 mL ha⁻¹ showed percentage reduction of leaf folder was 71.29, 73.53, 77.42, 80.68, respectively, 15 days after spraying on basmati rice. Karthikeyan and Swathy (2020) revealed that, the Chlorantraniliprole was the most effective insecticide against major pests of rice with leaf folder exhibiting 1.33% leaf damage.

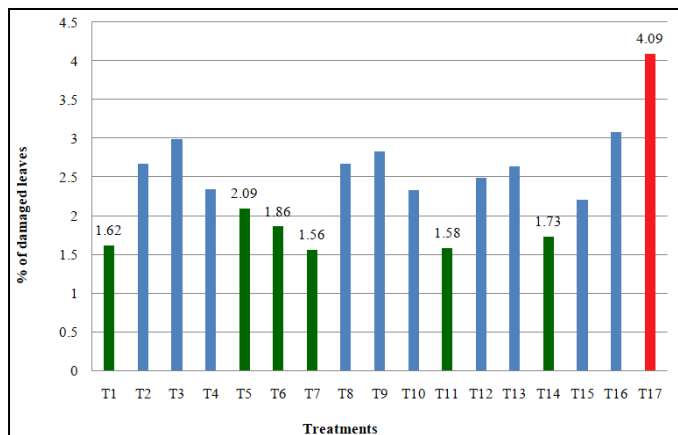


Fig. 1. Effect of different treatments on incidence of leaf folder on paddy.

Table 4: 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
	T ₂	Carbofuran 3% CG (Check1)	30.47b
Nursery alone (23 DAS)	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

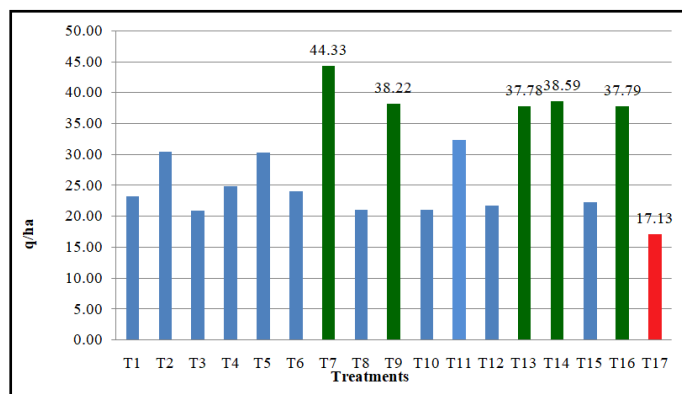


Fig. 2. Effect of different treatments on yield of paddy.

Table 5: 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	-	-	-	-	-

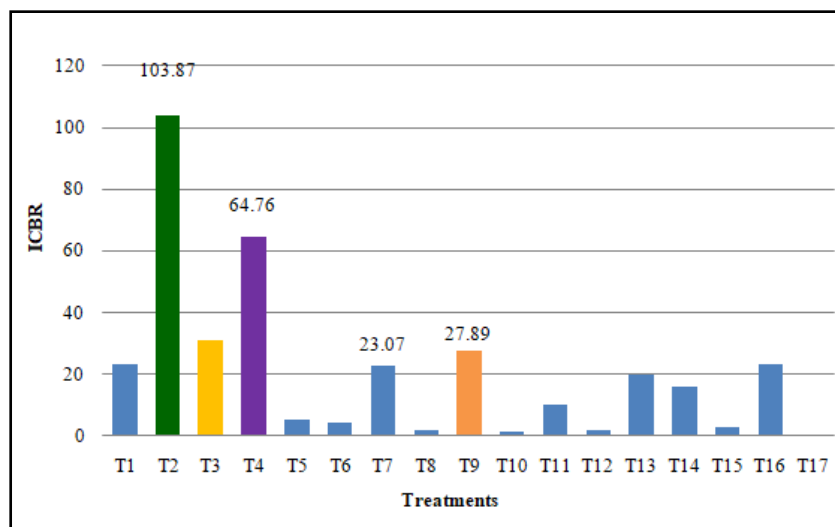


Fig. 3. Effect of different treatments on Incremental Cost Benefit Ratio (ICBR).

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 leaf folder was found to be the serious pests of paddy. From the data it can be concluded that Chlorantraniliprole 0.4 % GR (Main Field) is effective in management of leaf folder. 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 leaf folder of paddy.

FUTURE SCOPE

The study generates data base on to evaluate insecticides for the management of leaf folder in rice crop and to work out the economics of different treatments which will aware farmers to implement the effective insecticides for managing this pest and to achieve potential yield during kharif season in eastern Vidharbha region of Maharashtra.

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Conflict of Interest. None.

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