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Field evaluation of profenofos 40% + cypermethrin 4% (44%) ec against lepidopteran pests of rice

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Abstract
A field experiment was conducted to determine the comparative efficacy of combination insecticides with some conventional insecticides against lepidopteran pests of rice. All the tested chemicals are effective for different pests in rice, but among the tested insecticide molecules profenofos 40%+cypermethrin 4% (44%) EC @ 1000 ml per ha, profenofos 40%+cypermethrin 4% (44%) EC @ 750 ml per ha, profenofos 40%+cypermethrin 4% (44%) EC @ 500 ml per ha can be used for the effective management of lepidoperan pests on paddy. With reference to yield the plot treated with these insecticides were shown higher yield compared to untreated check. The higher yield 50.98 q/ha was noticed in the plot treated with profenofos 40%+cypermethrin 4% (44%) EC @ 1000 ml per ha and lowest yield 32.95 q/ha was noticed in untreated plot.

Keywords: Profenofos, cypermethrin, lepidopteran pests, rice, evaluation, stem borer, leaf folder

Introduction
Rice is obtained from paddy grain and it is a staple food for people all over the East, South and Southeast Asia [1]. Rice crop is extremely versatile and adaptive with a temperature range throughout the crop cycle is between 21 ˚C to 37 ˚C. As far as India is concerned it can be grown in almost all agro-climatic zones, soil varieties and altitudes ranging from sea level to 3000 meters above mean sea level. However, current agriculture production practices involving apply of synthetic fertilizers have made rice to attract more insect pests. Over 100 species of insect pests attack rice ecosystem in various stages of the crop, in which Brown planthopper, white-backed planthopper, green leafhopper, yellow stem borer and leaf folder are the major insect pests of paddy [13]. The outbreak of these pests habitually leads to the entire loss of the rice crop, if no effectual control measures are taken up. The loss in grain yield ranges from 10% in moderately affected fields to 70% in those fields which are severely affected [11]. In India, the losses incurred by different insect pests are reported to the tune of 55.12 million rupees which in turn workout to 18.16 percent of total losses. Out of this, 20 to 30 percent damage is alone done by yellow stem borer. In the early seventies and eighties organophosphates like monocrotophos and acephate, carbamate like carbaryl and fenobucarb and other derivatives like ethofenprox have been extensively used in India as well as other countries. Nevertheless, these pests became resistant to these insecticides in most of the countries including India, along with this insecticides have created several environmental problems, as a result, the concept of IPM has gained importance over the years. But still, farmers are showing more reliance on insecticides as they show an immediate result. The indiscriminate use of many insecticides forced the government to impose a ban on many insecticides which ignited the use of newer insecticides with a combined and diversified mode of action. There fore an effort has been made in the present investigation to evaluate the combi insecticide such as Profenofos40%+Cypermethrin 4% (44%) EC against the other insecticides.

Materials and Methods
Field experiment was conducted in randomized block design (RBD) replicating thrice with a plot size of 8.4 X 4.2 m2 and spacing of 20x20cm at Agriculture Research Station, Gangavathi during Kharif, *kharif* 2013-14 and *kharif* 2014-15. The experimental site was located at 76º 32' E longitude and 15º 15' N latitude with an altitude of 419 m above mean sea level. Locally wellknown rice variety BPT-5204 was used as test variety for the experiment.

Experimental details are enlisted in table 1. There was an untreated control in each replication for the comparative evaluation of the efficacy of different treatments. The treatments were applied with the help of a knapsack sprayer and care was taken to avoid spray drift on adjacent plants. All the control plots were sprayed with water.

Table 1: Treatment details

Sl. No.	Treatments	Dose/ha		Dilution in water/ ha
		Technical g a.i. /ha	Formulation g /ha	
T_1	Profenofos 40%+Cypermethrin 4% (44%) EC	200+20	500	500L
T_2	Profenofos 40% + Cypermethrin 4% (44%) EC	200+30	750	500L
T_3	Profenofos 40% + Cypermethrin 4% (44%)EC	400+40	1000	500L
T_4	Profenofos 40% + Cypermethrin 4% (44%) EC	800+80	2000	500L
T_5	Profenofos 50% EC	500	1000	500L
T_6	Cypermethrin 10% EC	50	500	500L
T_7	Acephate75% SP	750	1000	500L
T_8	Lambda cyhalothrin5% EC	12.5	250	500L
T_9	Untreated control	-	-	-

Assessment of number of dead hearts and healthy tillers in ten randomly selected hills in each plot before application and at 10 and 20 days after 1st application and assessment of number of white ear heads and healthy ear heads in ten randomly selected hills in each plot at 20 days after 2nd application. The data collected were converted to percent dead heart analyzed statistically after angular transformation and presented below. The population of natural enemies, mirid bugs and spiders which are considered as important in rice ecosystem were assessed in ten randomly selected hills in each plot before application and at 10 days after 1st and 2nd applications. These data were analyzed statistically after square root transformation. Grain yield was recorded at the time of final harvest plot wise (in kilograms), later was converted to quintals per hectare.

Result and Discussions

Stem borer, *Scirpophaga incertulus* Walker

From the pooled data 2013-15, it was confirmed that the percent dead heart was uniform over the treatment and reached ETL, which is ranged from 5.09 to 5.67 percent dead heart per hill (Table 2). After the insecticide treatment, there was a reduction in the dead heart was found in all the treatment but minimum dead heart (0.29%) was observed in the plot treated with profenofos 40%+cypermethrin 4% (44%) EC @ 1000 ml per ha as compared to 6.08 percent in untreated check at 15 days after the first application, this was followed by profenofos 40%+ cypermethrin 4% (44%) EC @ 750 ml per ha which recorded 0.82 percent dead heart among the chemical treatments highest damage was noticed in the plot treated with acephate 75% SP which have recorded 2.37 percent dead heart per hill (Table 2). The data on percent white ear heads due to stem borer attack was recorded at pre harvesting stage. Significantly lowest percent white earhead was recorded in profenofos 40%+cypermethrin 4% (44%) EC @ 1000 ml per ha (1.51% white ear/hill) as compared to 7.56 percent in untreated check, this was followed by profenofos40%+cypermethrin 4% (44%) EC @ 750 ml per ha which recorded 2.26 percent white ear head per hill.

The present findings of this experiment are in agreement with findings of [14], who evaluated bioefficacy of combination insecticide, Roket- 44% EC (Profenofos- 40% + Cypermethrin- 4%), against stem borer and leaf folder infesting rice. The results revealed that Roket 44% EC (Profenofos 40% + Cypermethrin 4%) @ 1000ml/ha was found significantly superior among all the treatments to control stem borer (*Scripophaga incertulas* Walker) pests of Rice with higher grain yield. Simialrly [7], who reported Acephate 75 SP and Fipronil 50 SC were higly effective in bring down the dead heart and white ear percentage. In another study [17] Fipronil 5 SC and Buprofezin 25 SC proved their efficacy in bringing down the population of stem borers and BPH. [6] observed Fipronil 300EC was promising in suppressing population of leaf folder.

These results were confirmed with the result of [10, 12, 9] testing of the efficacy of a new insecticides combination (flubendiamide + buprofezin) against rice stem borer. [18] support the present findings to confirm that nuvacron (monocrotophos 36 WSC) was observed as the most effective chemical with minimum stem borer infestation (0.50% DH & 0.27% WEH) and also [3] also reported that numerically least damage was noted for imidacloprid 17.8 SL (100 ml/ha), followed by carbofuran 3G (30 kg/ha), fipronil 0.3G (750 ml/ha), monocrotophos 36 WSC (1125 ml/ha), profenophos 50% EC (500 ml/ha), bifenthrin 10% EC (500 ml/ha) and chlorpyriphos 20% EC (1875 ml/ha). Simailar reports were observed by [8], who revealed that the efficacy of premix combination, Acephate 50%+ imidacloprid 1.8% SP at four different doses against insect pests of rice along with Acephate 75% WP (750 g.a.i ha-1), imidacloprid 17.8% SL (25 g.a.i ha-1) and Chlorpyrifos 50% + cypermethrin 5% EC (375+38 g.a.i ha-1). Acephate 50% + imidacloprid 1.8% SP @ 621.6 g.a.i ha-1 was proved to be significantly superior over all other treatments with lowest% dead hearts,% white ear. Acephate 50% + imidacloprid 1.8% SP was found to be effective against both borers and sucking pests.

Contradictory reaults are reported by [4], who carried an experiment to evaluate the efficacy of some insecticides at different doses against the yellow stem borer *scirpophaga incertulas* (Walker) in rice ecosystem. The result shows that among all the insecticides (treatments), profenofos 40 + cypermethrin 4 (44 EC) 880 gm a.i. was most effective against the yellow stem borer, *scirpophaga incertulas* (Walker) (1.25 percent) followed by profenofos 40 + cypermethrin 4 (44 EC) 440 gm a.i. (1.75 percent) and conversely protected the crop. The least efficacy of treatment was found in lambda cyhalothrin 5 EC (3.75 percent) treated plots. All the treatments were found effective and significantly superior over the control.

Leaf folder *Cnaphalocrocis medinalis* Guenee

Leaf folder infestation was severe during the experimental time and it was reached ETL before taking spray. The infestation ranges from 4.86 to 6.14 percent leaf damage per

hill. Treatments were imposed in all the plots, all the insecticides were found to be effective in reducing leaf folder infestation. The observation taken after first spray at 7 days after spraying (DAS), it was found that combination of profenofos 40%+cypermethrin 4% (44%) EC @ 1000 ml per ha was reduced damage significantly than other treatments, at 7 DAS the damage was 1.32 percent leaf damage was observed in plot treated with profenofos 40%+cypermethrin 4% (44%) EC @ 1000 ml per ha it was followed by profenofos 40%+cypermethrin 4% (44%) EC @ 750 ml per ha with 2.61 percent leaf damage per hill. Highest damage was observed in untreated plot with 5.37 percent leaf damage per hill. The same scenario continued even after 15 DAS during first spray (Table 3). After second spray leaf folder damage was reduced in all the treatments except untreated plot which noticed 5.26 percent leaf damage per hill at 15 DAS. The lowest damage was observed in plot treated with profenofos 40%+cypermethrin 4% (44%) EC @ 1000 ml per ha with 0.27 percent leaf folder damage per hill it was followed by profenofos 40%+cypermethrin 4% (44%) EC @ 750 ml per ha with 0.84 percent leaf folder damage per hill and it was followed by profenofos 40%+cypermethrin 4% (44%) EC @ 500 ml per ha with 1.36 percent leaf folder damage per hill (Table 3).

These results are in agreement with [16],who reported that flubendiamide 39.35% SC an anthranilic diamide group, was effective than fipronil 0.3 G and cartap hydrochloride 4% G. However, [2] who reported that the two formulations of flubendiamide *viz*., flubendiamide 20 WDG @ 25 *g.a.i./ha* and flubendiamide 48 SC @ 24 *g.a.i./ha* were effectively controlled the leaf folder. Flubendiamide 20 WDG @ 25 *g.a.i./ha* and flubendiamide 48 SC @ 24 *g.a.i./ha* were effective controlling leaf folder population.

Similalraly [14] tested bioefficacy of combination insecticide, Roket- 44% EC (Profenofos- 40% + Cypermethrin- 4%), a product of Pesicides Industries Ltd. Gurgaon, Haryana was evaluated at three doses 500, 750 and 1000 ml/ha along with four different insecticides against stem borer and leaf folder infesting rice under irrigated conditions at Agricultural Research Station (Agriculture University), Kota, Rajasthan. The results revealed that Roket 44% EC (Profenofos 40% + Cypermethrin 4%) @ 1000ml/ha was found significantly superior among all the treatments to control leaf folder (*Cnaphalocrocis medinalis* Guenee) and stem borer (*Scripophaga incertulas* Walker) pests of Rice with higher grain yield. The next treatments in order of efficacy were Profenofos 50 EC @ 1000 ml/ha and Acephate 75 SP @ 1000 g/ha.

Simailarly [8] the study revealed that the efficacy of premix combination, Acephate 50%+ imidacloprid 1.8% SP at four different doses against insect pests of rice along with Acephate 75% WP (750 g.a.i ha-1), imidacloprid 17.8% SL (25 g.a.i ha-1) and Chlorpyrifos 50% + cypermethrin 5% EC (375+38 g.a.i ha-1). Acephate 50% + imidacloprid 1.8% SP @ 621.6 g.a.i ha-1 was proved to be significantly superior over all other treatments with lowest%% leaf damage by leaf folder.

Impact on natural enemies

The predators like spiders and mired bugs were observed in paddy ecosystem during cropping season. One day before spray spider and mired bug population were found non significant in all treatments it indicates that predator population was uniformly distributed in all the treatments. However 10 DAS, significantly lowest predators were noticed all the chemical treated plots On 10th and 15th days after treatments there is no significant difference among the treatments (Table 4). Pooled data of 2013-2015 confirms that natural enemy population were reduced by the application of insecticides.

Simailarly the study conducted by [8], revealed that the efficacy of premix combination, Acephate 50%+ imidacloprid 1.8% SP at four different doses against insect pests of rice along with Acephate 75% WP (750 g.a.i ha-1), imidacloprid 17.8% SL (25 g.a.i ha-1) and Chlorpyrifos 50% + cypermethrin 5% EC (375+38 g.a.i ha-1). All the doses of Acephate 50%+ imidacloprid 1.8% SP were found safer to natural enemies in rice ecosystem i.e. *Cyrtorhinus lividipennis* and spiders.

Impact on Yield

From the pooled data 2013-15 it was confirmed that grain yield in all the dosages of insecticides was significantly higher when compared to untreated check (32.95 q/ha). Significantly higher grain yield of 50.98 q/ ha was recorded in profenofos 40%+cypermethrin 4% (44%) EC @ 1000 ml per ha and it was followed by the dosage profenofos 40%+cypermethrin 4% (44%) EC @ 750 ml per ha (47.70 q/ha) and profenofos 40%+cypermethrin 4% (44%) EC @ 500 ml per ha (45.67 q/ha) and among the insecticides the lowest yield was noticed in plot treated with acephate 75%SP (43.42 q/ha) (Table 5).

The result are in line with the reports of [14], who evaluated bioefficacy of combination insecticide, Roket- 44% EC (Profenofos- 40% + Cypermethrin- 4%), against stem borer and leaf folder infesting rice. The results revealed that Roket 44% EC (Profenofos 40% + Cypermethrin 4%) @ 1000ml/ha was found significantly superior among all the treatments to control leaf folder (*Cnaphalocrocis medinalis* Guenee) and stem borer (*Scripophaga incertulas* Walker) pests of Rice with higher grain yield.

Simailarly the study conducted by [8], revealed that the efficacy of premix combination, Acephate 50%+ imidacloprid 1.8% SP at four different doses against insect pests of rice along with Acephate 75% WP (750 g.a.i ha-1), imidacloprid 17.8% SL (25 g.a.i ha-1) and Chlorpyrifos 50% + cypermethrin 5% EC (375+38 g.a.i ha-1). Maximum grain yield (50.14 and 51.02 qha-1) with highest cost benefit ratio (3.1 and 3.3) was observed in Acephate 50% + imidacloprid 1.8% SP @ 621.6 g.a.i ha-1 respectively during *kharif* and *rabi* 2014-15. All the doses of Acephate 50%+ imidacloprid 1.8% SP were found safer to natural enemies in rice ecosystem i.e. *Cyrtorhinus lividipennis* and spiders. Acephate 50% + imidacloprid 1.8% SP was found to be effective against both borers and sucking pests [12]. demonstrated that all the tested doses of fipronil 80 WG gave significantly better yield than control [5]. also reported that yield was at par with different doses of thicyclam hydrogen oxalate 4G and check insecticide.

Conclusion

All the tested chemicals are effective for different pests in rice, but among the tested insecticide molecules profenofos 40%+cypermethrin 4% (44%) EC @ 1000 ml per ha, profenofos 40%+cypermethrin 4% (44%) EC @ 750 ml per ha and profenofos 40%+cypermethrin 4% (44%) EC @ 500 ml per ha can be used for the effective management of stem borer and leaf floder in rice.

Table 2: Bio-Efficacy of Profenofos40%+Cypermethrin 4%(44%) EC against Stem Borer in Rice

Sl. No.	Treatments	Dose (g a.i./ha)	Percent Dead heart at			Percent White ear
			DBS	7 DAS	15 DAS	
T_1	Profenofos40%+Cypermethrin 4% (44%) EC	200+20	5.62 (13.70)	1.73 (7.54)	1.28 (6.48)	3.66 (10.79)
T_2	Profenofos40%+Cypermethrin 4% (44%) EC	300+30	5.21 (13.10)	1.28 (6.49)	0.82 (0.37)	2.26 (8.64)
T_3	Profenofos40%+Cypermethrin 4% (44%) EC	400+40	5.26 (13.25)	0.67 (4.69)	0.29 (3.06)	1.51 (6.99)
T_4	Profenofos 50% EC	500	5.67 (13.69)	2.01 (8.15)	1.53 (7.09)	3.63 (10.83)
T_5	Cypermethrin 10% EC	50	5.09 (13.03)	2.35 (8.82)	1.92 (7.83)	4.15 (11.70)
T_6	Acephate 75%SP	750	5.53 (13.59)	2.47 (8.97)	2.37 (8.79)	4.36 (12.04)
T_7	Lambda cyhalothrin 5% EC 12.5%	12.5	5.26 (13.25)	1.85 (7.80)	1.20 (6.66)	3.82 (11.22)
T_8	Untreated control	-	5.64 (13.72)	5.78 (13.75)	6.08 (14.13)	7.56 (15.76)
	SEm ±		NS	0.68	0.62	0.78
	CD@5%		NS	2.04	1.91	2.32

DBS- Days before sprays; DAS- Days after spray; NS-Non- significant; Figures in parentheses are angular transformed values.

Table 3: Bio-Efficacy of Profenofos 40%+Cypermethrin 4% (44%) EC against leaf folder in rice

Sl. No.	Treatments	Dose (g a.i./ha)	Percent leaf damage at					
			First Spray			Second spray		
			DBS	7 DAS	15 DAS	DBS	7 DAS	15 DAS
T_1	Profenofos40%+Cypermethrin 4% (44%) EC	200+20	5.89 (13.81)	3.21 (10.27)	2.26 (8.49)	3.31 (10.42)	1.83 (7.76)	1.36 (6.42)
T_2	Profenofos40%+Cypermethrin 4% (44%) EC	300+30	4.86 (12.71)	2.61 (9.23)	0.98 (5.66)	2.66 (9.32)	0.99 (5.69)	0.84 (5.19)
T_3	Profenofos40%+Cypermethrin 4% (44%) EC	400+40	4.92 (12.76)	1.32 (6.58)	0.33 (3.27)	2.47 (8.95)	0.40 (3.50)	0.27 (2.95)
T_4	Profenofos 50% EC	500	5.04 (12.97)	3.27 (10.41)	2.32 (8.68)	3.69 (11.02)	2.16 (8.45)	2.22 (8.48)
T_5	Cypermethrin 10% EC	50	6.14 (14.32)	3.98 (11.51)	2.79 (9.61)	3.80 (11.24)	2.57 (9.16)	2.78 (9.58)
T_6	Acephate 75%SP	750	5.23 (13.17)	3.81 (11.21)	2.85 (9.66)	3.86 (11.30)	2.78 (9.53)	2.86 (9.67)
T_7	Lambda cyhalothrin 5% EC 12.5%	12.5	5.17 (13.13)	3.14 (10.20)	2.33 (8.76)	3.46 (10.70)	2.48 (9.05)	2.71 (9.46)
T_8	Untreated control	-	5.37 (13.37)	6.36 (14.41)	5.57 (13.57)	5.28 (13.18)	5.55 (13.53)	5.26 (13.15)
	SEm ±		-	0.76	0.68	0.52	0.56	0.77
	CD@5%		NS	2.28	2.05	1.56	1.69	2.33

Note: DBS- Day before spray; DAS- Days after spray; NS-Non significant, Figures in parentheses are angular transformed values.

Table 4: Bio-Efficacy of Profenofos 40%+Cypermethrin 4% (44%) EC against Stem Borer in Rice

Sl. No.	Treatments	Dose (g a.i./ha)	Percent Dead heart at			Percent White ear
			DBS	7 DAS	15 DAS	
T_1	Profenofos40%+Cypermethrin 4% (44%) EC	200+20	5.62 (13.70)	1.73 (7.54)	1.28 (6.48)	3.66 (10.79)
T_2	Profenofos40%+Cypermethrin 4% (44%) EC	300+30	5.21 (13.10)	1.28 (6.49)	0.82 (0.37)	2.26 (8.64)
T_3	Profenofos40%+Cypermethrin 4% (44%) EC	400+40	5.26 (13.25)	0.67 (4.69)	0.29 (3.06)	1.51 (6.99)
T_4	Profenofos 50% EC	500	5.67 (13.69)	2.01 (8.15)	1.53 (7.09)	3.63 (10.83)
T_5	Cypermethrin 10% EC	50	5.09 (13.03)	2.35 (8.82)	1.92 (7.83)	4.15 (11.70)
T_6	Acephate 75%SP	750	5.53 (13.59)	2.47 (8.97)	2.37 (8.79)	4.36 (12.04)
T_7	Lambda cyhalothrin 5% EC 12.5%	12.5	5.26 (13.25)	1.85 (7.80)	1.20 (6.66)	3.82 (11.22)
T_8	Untreated control	-	5.64 (13.72)	5.78 (13.75)	6.08 (14.13)	7.56 (15.76)
	SEm ±		NS	0.68	0.62	0.78
	CD@5%		NS	2.04	1.91	2.32

DBS- Days before sprays; DAS- Days after spray; NS-Non- significant; Figures in parentheses are angular transformed values.

Table 5: Impact of different insecticidal treatments on paddy yield

Sl. No.	Treatments	Dosage (g a.i/ha)	Yield (q/ha)
T_1	Profenofos40%+Cypermethrin 4%(44%)EC	200+20	45.67
T_2	Profenofos40%+Cypermethrin 4%(44%)EC	300+30	47.70
T_3	Profenofos40%+Cypermethrin 4%(44%)EC	400+40	50.98
T_4	Profenofos50%EC	500	44.47
T_5	Cypermethrin 10%EC	50	44.61
T_6	Acephate 75%SP	750	43.42
T_7	Lambda cyhalothrin 5%EC12.5%	12.5	44.66
T_8	Untreated control	-	32.95
	SEm ±		1.59
	CD@5%	-	4.76

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