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Bio-efficacy of ethiprole 10.7 % + pymetrozine 40 % WG against brown planthopper in rice

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Abstract
Laboratory and field experiments were conducted at Annamalai University, Department of Entomology, Chidambaram during 2018-2020 to evaluate the bio-efficacy of ethiprole 10.7 % + pymetrozine 40 % WG against brown planthopper in rice. The results revealed that ethiprole 10.7 % + pymetrozine 40 % WG @ were effective in the management of brown planthopper. Ethiprole 10.7 % + pymetrozine 40 % WG was found to be safer on natural enemies *viz.*, spiders and mirid bugs. The highest yield were obtained from ethiprole 10.7 % + pymetrozine 40 % WG @ treated plots in both seasons.

Keywords: ethiprole 10.7 % + pymetrozine 40 % wg, brown planthopper, natural enemies, yield

Introduction

Rice (*Oryza sativa* L.) being the staple food for more than 65 per cent of the global population and king of cereals is one of the important cereal crops grown in the tropical and subtropical countries of the world [8],[14]. In India, total rice growing area is around 43.79 million hectares and total annual production is about 116.42 million tonnes in 2018-19[3]. The brown plant hopper, *N. lugens* cause damage to the plants by directly sucking the plant sap and by ovipositing in plant tissue which leads to the wilting of plants or hopper burn [16]. Loss in the grain yield ranges from 10% in fields affected moderately to 70% in those field affected severely [9]. When the insect pest reaches on or beyond ETL insecticide is the most trusted choice by the farmers in their management. Farmers mainly depend on insecticides for their management and nearly half of the insecticides used in rice are aimed at brown planthopper [13]. Indiscriminate use of insecticides, leads to resistance development by insect and ill effect posed on environment opened the new modern era of chemicals having novel mode of action with good bioefficacy, higher selectivity, low mammalian toxicity and safer to environment. So, the introduction of newer insecticide molecules with alternate mode of action against these pests will play a serious role in the pest management programme.

Hence the present investigation was carried out to evaluate the bio-efficacy of ethiprole 10.7 % + pymetrozine 40 % WG against brown planthopper under field and laboratory conditions.

Materials and Methods

1. Laboratory experiment

Fourty days old potted TN -1 rice plants were placed inside a plastic cage and covered by fine mesh nylon cloth with one pair of adult brown planthopper for mass culturing.

Different concentrations of ethiprole 10.7 % + pymetrozine 40 % WG @ 36.91+ 138, 40.13 + 150, 45.47 + 170 g a.i ha^{-1} with the standard checks pymetrozine 50 % WG @ 150 g a.i ha^{-1}, buprofezin 25 % SC @ 200 g a.i ha^{-1} and ethiprole 40 %+ imidacloprid 40 % WG @ 50 + 50 g a.i ha^{-1} were sprayed up to a run- off stage on 30 day old potted TN 1 rice plants.

In each experiment, ten third instar nymphs of brown planthoppers were released per treatment on the treated rice plants and confined with the help of suitable mylar cages. Observations on the mortality were recorded after 1, 4, 24, 48 and 72 hours of exposure and each treatment was replicated thrice [5].

2. Field experiments

Two field experiments were conducted to evaluate the bio-efficacy of ethiprole 10.7 % + pymetrozine 40 % WG against brown planthopper in rice. The first experiment was conducted during Aug 2018 - Dec 2018 and the second experiment was conducted during Aug 2019 - Dec 2019 using the variety ADT- 46 in Annamalai University at Chidambaram.

The experiments were laid out in a randomized block design. The plot size was 20 m^2 with the spacing of 20 X 10 cm in both the seasons. Each treatment was replicated three times. The insecticides with their respective doses used in this investigation were ethiprole 10.7 % + pymetrozine 40 % WG @ 36.91 + 138 g a.i ha^{-1}, ethiprole 10.7 % + pymetrozine 40 % WG @ 40.13 + 150 g a.i ha^{-1}, ethiprole 10.7 % + pymetrozine 40 % WG @ 45.47 + 170 g a.i ha^{-1}, Pymetrozine 50 % WG @ 150 g a.i ha^{-1}, Buprofezin25 % SC @ 200 g a.i ha^{-1}, Ethiprole 40% + Imidacloprid 40% WG @ 50 + 50 g a.i ha^{-1} and untreated control.

The treatments were sprayed with pneumatic knapsack sprayer using 375 liters of spray fluid per hectare. First application was given at 45 days after transplanting followed by next application in fortnight interval.

3. Method of assessment of *N. lugens*

Observations on the brown planthopper population were recorded in randomly selected 10 hills per plot before and 1, 3, 7, 10 and 14 days after each application.

Total number of insects that fell on the water surface on

tapping vigorously from the plants were counted and expressed as number/hill. Sampling was made by counting their population from ten randomly selected hills from each plot [2].

4. Assessment of natural enemies

In field trials, the population of natural enemies *viz.*, spiders and mirid bugs were recorded in randomly selected ten hills per plot and then the mean population was worked out [15].

5. Yield

Paddy grains were harvested from each plot. The grain yield recorded for individual treatment and computed to per hectare.

6. Statistical analysis

The population of brown planthoppers, spiders and mirid bugs were transformed using square root transformations for statistical analysis. Randomized block design was followed and analysis was done following Panse and Sukhatme [12]. The mean values were compared using Duncan's Multiple Range Test (DMRT).

The corrected percent reduction in field population was worked out by using the formula of Henderson and Tilton [4] as follows.

$$\text{Corrected percent reduction} = 1 - \left[\frac{Ta \times Cb}{Tb \times Ca} \right] \times 100$$

Where

T_a-Number of insects in the treatment after spraying

T_b-Number of insects in the treatment before spraying

C_a-Number of insects in the untreated check after spraying

C_b-Number of insects in the untreated check before spraying

Results & Discussions

1. Laboratory experiment

Various doses of ethiprole 10.7 % + pymetrozine 40 % WG registered 69.67 – 80 per cent mortality and 83.33 – 100 per cent mortality against brown planthopper at 4 and 72 hours of exposure (Table 1).

The standard checks pymetrozine 50 % WG @ 150 g a.i ha^{-1}, buprofezin 25 % SC @ 200 g a.i ha^{-1} and ethiprole 40 % + imidacloprid 40 % WG @ 50 + 50 g a.i ha^{-1} registered 63.33 – 73.33 per cent mortality and 80 – 93.33 per cent mortality against brown planthopper at 4 and 72 hours of exposure.

2. Field experiments

The brown planthopper incidence and the effect of ethiprole 10.7 % + pymetrozine 40 % WG, pymetrozine 50 % WG, buprofezin 25 % SC and ethiprole 40 % + imidacloprid 40 % WG on planthoppers were observed during first season (August – December 2018) and second season (August – December 2019). In first season mean per cent reduction of brown planthopper population were 84.88, 83.54, 75.64, 74.34, 72.52 and 70.86 (Table 2) in ethiprole 10.7 % + pymetrozine 40 % WG, pymetrozine 50 % WG, ethiprole 40 % + imidacloprid 40 % WG, ethiprole 10.7 % + pymetrozine 40 % WG and buprofezin 25 % SC @ 45.47 + 170, 40.13 + 150, 150, 50 + 50, 36.91 + 138 and 200 g a.i ha^{-1} respectively over control.

In second season mean per cent reduction of brown planthopper population were 87.44, 85.89, 78.61, 75.91, 74.48 and 72.80 (Table 3) in ethiprole 10.7 % + pymetrozine 40 % WG, pymetrozine 50 % WG, ethiprole 40 % + imidacloprid 40 % WG, ethiprole 10.7 % + pymetrozine 40 % WG and buprofezin 25 % SC @ 45.47 + 170, 40.13 + 150, 150, 50 + 50, 36.91 + 138 and 200 g a.i ha^{-1} respectively over control.

Pymetrozine 50 % WG @ 350 and 400 g a.i ha^{-1} was found to be more effective against brown planthopper in rice [6]. Pymetrozine 50 WG @ 0.5 g a.i ha^{-1} was found to be more effective against brown planthopper in rice [7]. Pymetrozine 50 WG @ 150 g a.i ha^{-1} recorded high mortality of brown planthoppers in rice [15].

Ethiprole 10 SC @ 50 g a.i ha $^{-1}$ suppressed the brown planthopper population to the tune of 92.05 - 95.03 per cent over control [10], [11].

3. Toxicity to natural enemies

The effect of ethiprole 10.7 % + pymetrozine 40 % WG, pymetrozine 50 % WG, buprofezin 25 % SC and ethiprole 40 % + imidacloprid 40 % WG on the natural enemies was confirmed by field experiments on spiders *Paradoxa pseudoannulata* Boes and mirid bugs *Cyrtorhinus lividepennis* Reuter in rice ecosystem.

4. Spiders

The effect of ethiprole 10.7 % + pymetrozine 40 % WG on spiders population per ten hills was to an extent of 6.17 - 7.00 nos. in first season (Table 4) and 3.17 – 4.17 nos. in second season (Table 5). The population of spiders in standard checks pymetrozine 50 % WG, buprofezin 25 % SC and ethiprole 40 % + imidacloprid 40 % WG was to an extent of 4.83- 5.83 nos. in first season (Table 4) and 2.17-2.84 nos. in second season (Table 5) @ 150, 50 + 50 and 200 g a.i ha $^{-1}$ respectively over the control (7.50 and 5.17).

Ethiprole 10 EC @ 50 g a.i ha $^{-1}$ was found to be safer to spiders [17] and Pymetrozine 50 WG @ 150 g a.i ha^{-1} did not show any adverse effect on spiders [1].

5. Mirids

The effect of ethiprole 10.7 % + pymetrozine 40 % WG @ 45.47 + 170, 40.13 + 150 and 36.91 + 138 g a.i ha^{-1} on reduction of mirid bug population per ten hills was to an extent of 3.25 – 3.92 nos. in first season (Table 6) and 2.25 – 2.92 in second season (Table 7).The population of mirid bugs in standard checks pymetrozine 50 % WG, buprofezin 25 % SC and ethiprole 40 % + imidacloprid 40 % WG to an extent of 2.25- 2.92 nos. in first season (Table 6) and 1.25 – 1.92 nos. in second season (Table 7) @ 150, 50 + 50 and 200 g a.i ha^{-1} respectively over the control (4.83 and 3.92).

Yield

The data on yield (Table 8) revealed that ethiprole 10.7 % + pymetrozine 40 % WG @ 45.47+ 170 g a.i ha^{-1} treated plots recorded the highest yield of 4123.33 and 4000.67 Kg ha^{-1} of rice, followed by ethiprole 10.7 % + pymetrozine 40 % WG @ 40.13 + 150 g a.i. ha^{-1} treated plots at 4000.00 and 3918.00 Kg ha^{-1}. Both were on par with each other and superior over ethiprole 10.7 % + pymetrozine 40 % WG @ 36.91 + 138 g ha^{-1} (3066.67 & 3183.33 Kg ha^{-1}), pymetrozine 50 % WG 150 g a.i ha^{-1} (2800.00 & 2883.33 Kg ha^{-1}), ethiprole 40 % + imidacloprid 40 % WG 50 + 50 g a.i ha^{-1} (2426.67 & 2516.67 Kg ha^{-1}) and buprofezin 25% SC 200 g a.i ha^{-1} (2033.33 & 2070.00 Kg ha^{-1}) while the lowest yield was recorded from the control plot of 1500.00 and 1400 Kg ha^{-1} in first and second season respectively.

Table 1: Efficacy of ethiprole 10.7 % + pymetrozine 40 % wg on the mortality of *N. lugens*

Tr. no.	Treatments	Per cent mortality of brown planthopper					Mean
		1 hour	4 hours	24 hours	48 hours	72 hours	
T1	Ethiprole 10.7 % + Pymetrozine 40 % WG @ 36.91 + 138 g a.i ha^{-1}	53.33 (46.90)^{cde}	66.67 (54.76)^{bcde}	70.00 (56.98)^{cde}	73.33 (58.98)^{cde}	83.33 (66.12)^{cd}	69.33
T2	Ethiprole 10.7 % + Pymetrozine 40 % WG @ 40.13 + 150 g a.i ha^{-1}	66.67 (54.76)^{ab}	76.67 (61.20)^{ab}	83.33 (66.12)^{ab}	93.33 (77.69)^{b}	100.00 (90.00)^{a}	84.00
T3	Ethiprole 10.7 % + Pymetrozine 40 % WG @ 45.47 + 170 g a.i ha^{-1}	73.33 (59.19)^{a}	80.00 (63.90)^{a}	90.00 (71.54)^{a}	100.00 (90.00)^{a}	100.00 (90.00)^{a}	88.67
T4	Market Std. Check Pymetrozine 50 % WG @ 150 g a.i ha^{-1}	60.00 (50.83)^{bc}	73.33 (58.98)^{abc}	76.67 (61.20)^{bc}	83.33 (66.12)^{c}	93.33 (81.14)^{b}	77.32
T5	Market Std. Check Buprofezin 25 % SC @ 200 g a.i ha^{-1}	46.67 (43.06)^{def}	63.33 (52.84)^{bcdef}	66.67 (54.76)^{cdef}	70.00 (56.98)^{cdef}	80.00 (63.41)^{de}	65.33
T6	Market Std. Check Ethiprole 40 %+ Imidacloprid 40 % WG @ 50 + 50 g a.i ha^{-1}	56.67 (48.83)^{bcd}	70.00 (56.98)^{abcd}	73.33 (58.98)^{cd}	76.70 (61.20)^{cd}	86.67 (68.83)^{c}	72.67
T7	control	0.00 (0.00)^{g}	0.00 (0.00)^{g}	0.00 (0.00)^{g}	0.00 (0.00)^{g}	0.00 (0.00)^{f}	--
	S.Ed	3.57	4.17	3.14	4.42	9.63	-
	CD (P=0.05)	7.72	9.03	6.80	9.57	5.16	

*Mean of three replications; Values in parenthesis are angular transformed values In a column means followed by a common letter are not significantly different by DMRT (P=0.05)

Table 2: Efficacy of ethiprole 10.7 % + pymetrozine 40 % wg against *n. lugens* - i season

Tr.no.	Treatments	Number of brown planthopper per hill* (First application)					Number of brown planthopper per hill* (Second application)				Pooled mean	Per cent reduction over control
		PTC	3 DAT	7 DAT	10 DAT	14 DAT	3 DAT	7 DAT	10 DAT	14 DAT		
1.	Ethiprole 10.7 % +Pymetrozine 40 % WG @ 36.91 + 138 g a.i ha^{-1}	15.67 (4.08)	10.67 (3.42)^{cde}	9.00 (3.16)^{cde}	8.33 (3.05)^{cde}	8.67 (3.11)^{cde}	6.67 (2.77)^{cde}	5.00 (2.44)^{def}	4.33 (2.31)^{cde}	3.00 (1.99)^{cde}	6.96	72.52
2.	Ethiprole 10.7 % + Pymetrozine 40 % WG @ 40.13 + 150 g a.i ha^{-1}	15.33 (4.04)	7.33 (2.89)^{ab}	5.67 (2.58)^{ab}	4.33 (2.31)^{ab}	4.67 (2.38)^{ab}	3.67 (2.16)^{ab}	3.33 (2.08)^{ab}	2.67 (1.91)^{ab}	1.67 (1.63)^{ab}	4.17	83.54
3.	Ethiprole 10.7 % + Pymetrozine 40 % WG @ 45.47 + 170 g a.i ha^{-1}	15.00 (4.00)	7.00 (2.83)^{a}	5.33 (2.52)^{a}	4.00 (2.23)^{a}	4.33 (2.31)^{a}	3.33 (2.08)^{a}	3.00 (2.00)^{a}	2.33 (1.82)^{a}	1.33 (1.52)^{a}	3.83	84.88
4.	Market Std. Check Pymetrozine 50 % WG @ 150 g a.i ha^{-1}	15.33 (4.04)	9.33 (3.21)^{c}	8.33 (3.05)^{c}	7.67 (2.94)^{c}	8.00 (3.00)^{c}	6.00 (2.64)^{c}	4.33 (2.31)^{c}	3.33 (2.08)^{bc}	2.33 (1.82)^{abc}	6.17	75.64
5.	Market Std. Check Buprofezin 25 % SC @ 200 g a.i ha^{-1}	15.67 (4.08)	11.00 (3.46)^{def}	9.67 (3.27)^{def}	8.67 (3.11)^{cdef}	9.00 (3.16)^{cdef}	7.00 (2.83)^{cdef}	5.67 (2.58)^{def}	4.67 (2.38)^{def}	3.33 (2.08)^{cdef}	7.38	70.86
6.	Market Std. Check Ethiprole 40 %+ Imidacloprid 40 % WG @ 50 + 50 g a.i ha^{-1}	15.67 (4.08)	9.67 (3.27)^{cd}	8.67 (3.11)^{cd}	8.00 (3.00)^{cd}	8.33 (3.05)^{cd}	6.33 (2.71)^{cd}	4.67 (2.38)^{cd}	3.67 (2.16)^{bcd}	2.67 (1.91)^{bcd}	6.50	74.34
7.	Un treated control	15.33 (4.04)	20.33 (4.62)^{g}	21.67 (4.76)^{g}	23.33 (4.93)^{g}	25.67 (5.16)^{g}	26.33 (5.23)^{g}	27.33 (5.32)^{g}	28.67 (5.45)^{g}	29.33 (5.51)^{g}	25.33	-
	S.Ed	0.09	0.11	0.09	0.10	0.10	0.12	0.10	0.11	0.15	-	-
	CD (P=0.05)	NS	0.24	0.21	0.23	0.23	0.27	0.22	0.25	0.33	-	-

*Mean of three replications; Values in parenthesis are angular transformed values In a column means followed by a common letter are not significantly different by DMRT (P=0.05)

Table 3: Efficacy of ethiprole 10.7 % + pymetrozine 40 % wg against *n. lugens* - ii season

Tr.no.	Treatments	Number of brown planthopper per hill* (First application)					Number of brown planthopper per hill* (Second application)				Pooled mean	Per cent reduction over control
		PTC	3 DAT	7 DAT	10 DAT	14 DAT	3 DAT	7 DAT	10 DAT	14 DAT		
1.	Ethiprole 10.7 % + Pymetrozine 40 % WG @ 36.91 + 138 g a.i ha^{-1}	20.33 (4.62)	11.67 (3.56)^{cde}	10.67 (3.42)^{de}	9.67 (3.27)^{de}	10.00 (3.32)^{de}	7.67 (2.94)^{de}	5.67 (2.57)^{cde}	5.33 (2.52)^{c}	5.00 (2.45)^{c}	8.21	74.48

2.	Ethiprole 10.7 % + ymetrozine 40 % WG @ 40.13 + 150 g a.i ha^{-1}	20.67 (4.65)	8.33 (3.05)^{ab}	5.33 (2.52)^{ab}	4.67 (2.38)^{b}	5.00 (2.44)^{ab}	4.33 (2.30)^{ab}	3.67 (2.16)^{ab}	2.67 (1.91)^{ab}	2.33 (1.82)^{ab}	4.54	85.89
3.	Ethiprole 10.7 % + ymetrozine 40 % WG @ 45.47 + 170 g a.i ha^{-1}	21.00 (4.69)	8.00 (3.00)^{a}	4.67 (2.38)^{a}	3.67 (2.16)^{a}	4.33 (2.31)^{a}	4.00 (2.23)^{a}	3.33 (2.07)^{a}	2.33 (1.82)^{a}	2.00 (1.72)^{a}	4.04	87.44
4.	Market Std. Check Pymetrozine 50 % WG @ 150 g a.i ha^{-1}	20.33 (4.62)	11.00 (3.46)^{c}	9.33 (3.21)^{c}	7.33 (2.88)^{c}	7.67 (2.94)^{c}	5.67 (2.58)^{bc}	5.00 (2.44)^{abc}	4.67 (2.38)^{cd}	4.33 (2.31)^{cd}	6.88	78.61
5.	Market Std. Check Buprofezin 25 % SC @ 200 g a.i ha^{-1}	20.00 (4.58)	12.67 (3.70)^{def}	11.33 (3.51)^{def}	10.00 (3.31)^{def}	10.33 (3.37)^{ef}	8.33 (3.05)^{ef}	6.33 (2.70)^{cdef}	5.67 (2.58)^{cdef}	5.33 (2.52)^{cdef}	8.75	72.80
6.	Market Std. Check Ethiprole 40 %+ Imidacloprid 40 % WG @ 50 + 50 g a.i ha^{-1}	20.33 (4.62)	11.33 (3.51)^{cd}	10.33 (3.37)^{d}	9.33 (3.21)^{d}	9.67 (3.27)^{d}	6.33 (2.70)^{cd}	5.33 (2.52)^{cdef}	5.00 (2.44)^{cde}	4.67 (2.38)^{cde}	7.75	75.91
7.	Un treated control	21.33 (4.73)	23.33 (4.93)^{g}	26.67 (5.26)^{g}	31.33 (5.69)^{g}	33.33 (5.86)^{g}	34.33 (5.94)^{g}	35.00 (6.00)^{g}	36.33 (6.11)^{g}	37.00 (6.16)^{g}	32.17	-
	S.Ed	0.09	0.09	0.07	0.09	0.08	0.14	0.18	0.14	0.13	-	-
	CD (P=0.05)	NS	0.19	0.15	0.20	0.18	0.30	0.40	0.32	0.28	-	-

*Mean of three replications; Values in parenthesis are angular transformed values In a column means followed by a common letter are not significantly different by DMRT (P=0.05)

Table 4: Effect of ethiprole 10.7 % + pymetrozine 40 % wg on spiders in rice eco system - i season

Tr.no	Treatments	Spiders population / 10 plants (First application)			Spiders population / 10 plants (Second application)		Mean
		PTC	7 DAT	14 DAT	7 DAT	14 DAT	
T_1	Ethiprole 10.7 % + Pymetrozine 40 % WG @ 36.91 + 138 g a.i ha^{-1}	7.33 (2.89)	6.67 (2.77)	7.00 (2.83)	6.67 (2.77)	7.67 (2.94)	7.00
T_2	Ethiprole 10.7 % + Pymetrozine 40 % WG @ 40.13 + 150 g a.i ha^{-1}	6.67 (2.77)	6.33 (2.70)	6.67 (2.77)	6.00 (2.65)	7.00 (2.83)	6.50
T_3	Ethiprole 10.7 % + Pymetrozine 40 % WG @ 45.47 + 170 g a.i ha^{-1}	7.33 (2.87)	6.00 (2.64)	6.33 (2.71)	5.67 (2.58)	6.67 (2.77)	6.17
T_4	Market Std. Check Pymetrozine 50 % WG @ 150 g a.i ha^{-1}	6.33 (2.70)	5.67 (2.58)	6.00 (2.64)	5.33 (2.52)	6.33 (2.71)	5.83
T_5	Market Std. Check Buprofezin 25 % SC @ 200 g a.i ha^{-1}	7.00 (2.83)	4.67 (2.37)	5.00 (2.44)	4.33 (2.31)	5.33 (2.52)	4.83
T_6	Market Std. Check Ethiprole 40 %+ Imidacloprid 40 % WG @ 50+ 50 g a.i ha^{-1}	6.67 (2.76)	5.00 (2.44)	5.67 (2.58)	5.00 (2.44)	6.00 (2.64)	5.42
T_7	Control	6.67 (2.76)	7.00 (2.83)	7.33 (2.89)	7.67 (2.94)	8.00 (3.00)	7.50
	S.Ed	0.18	0.16	0.12	0.10	0.10	-
	CD (P=0.05)	NS	NS	0.25	0.23	0.22	-

*Mean of three replications; Values in parenthesis are angular transformed values In a column means followed by a common letter are not significantly different by DMRT (P=0.05)

Table 5: Effect of ethiprole 10.7 % + pymetrozine 40 % WG on spiders in rice eco system - ii Season

Tr.no	Treatments	Spiders population / 10 plants (First application)			Spiders population / 10 plants (Second application)		Mean
		PTC	7 DAT	14 DAT	7 DAT	14 DAT	
T_1	Ethiprole 10.7 % + Pymetrozine 40 % WG @ 36.91 + 138 g a.i ha^{-1}	4.67 (2.38)	3.33 (2.08)	4.33 (2.31)	4.00 (2.24)	5.00 (2.44)	4.17
T_2	Ethiprole 10.7 % + Pymetrozine 40 % WG @ 40.13 + 150 g a.i ha^{-1}	4.00 (2.23)	2.67 (1.91)	4.00 (2.24)	3.67 (2.16)	4.67 (2.38)	3.75
T_3	Ethiprole 10.7 % + Pymetrozine 40 % WG @ 45.47 + 170 g a.i ha^{-1}	4.33 (2.31)	2.00 (1.73)	3.33 (2.08)	3.00 (2.00)	4.33 (2.31)	3.17
T_4	Market Std. Check Pymetrozine 50 % WG @ 150 g a.i ha^{-1}	4.33 (2.31)	1.67 (1.63)	3.00 (2.00)	2.67 (1.91)	4.00 (2.24)	2.84
T_5	Market Std. Check Buprofezin 25 % SC @ 200 g a.i ha^{-1}	4.67 (2.38)	1.00 (1.41)	2.33 (1.82)	2.00 (1.72)	3.33 (2.08)	2.17
T_6	Market Std. Check Ethiprole 40 %+ Imidacloprid 40 % WG @ 50 + 50g a.i ha^{-1}	4.33 (2.30)	1.33 (1.52)	2.67 (1.91)	2.33 (1.82)	3.67 (2.16)	2.50
T_7	Control	4.33 (2.31)	4.67 (2.38)	5.00 (2.44)	5.33 (2.52)	5.67 (2.58)	5.17
	S.Ed	0.14	0.12	0.12	0.12	0.11	-
	CD (P=0.05)	NS	0.25	0.26	0.27	0.24	-

*Mean of three replications; Values in parenthesis are angular transformed values In a column means followed by a common letter are not significantly different by DMRT (P=0.05)

Table 6: Effect of ethiprole 10.7 % + pymetrozine 40 % WG on mirid bugs in rice eco system – i Season

Tr.no	Treatments	Number of mirid bugs / 10 hill (First application)			Number of mirid bugs / 10 hill (Second application)		Mean
		PTC	7 DAT	14 DAT	7 DAT	14 DAT	
T_1	Ethiprole 10.7 % + Pymetrozine 40 % WG @ 36.91 + 138 g a.i ha^{-1}	4.33 (2.31)	3.67 (2.16)	4.00 (2.23)	3.33 (2.08)	4.67 (2.38)	3.92
T_2	Ethiprole 10.7 % + Pymetrozine 40 % WG @ 40.13 + 150 g a.i ha^{-1}	4.00 (2.23)	3.33 (2.08)	3.67 (2.16)	3.00 (2.00)	4.33 (2.31)	3.58
T_3	Ethiprole 10.7 % + Pymetrozine 40 % WG @ 45.47 + 170 g a.i ha^{-1}	4.33 (2.29)	3.00 (2.00)	3.33 (2.08)	2.67 (1.91)	4.00 (2.24)	3.25
T_4	Market Std. Check Pymetrozine 50 % WG @ 150 g a.i ha^{-1}	4.33 (2.31)	2.67 (1.91)	3.00 (2.00)	2.33 (1.82)	3.67 (2.16)	2.92
T_5	Market Std. Check Buprofezin 25 % SC @ 200 g a.i ha^{-1}	4.00 (2.23)	2.00 (1.72)	2.33 (1.82)	1.67 (1.63)	3.00 (2.00)	2.25
T_6	Market Std. Check Ethiprole 40 %+ Imidacloprid 40 % WG @ 50 + 50 g a.i ha^{-1}	4.33 (2.29)	2.33 (1.82)	2.67 (1.91)	2.00 (1.73)	3.33 (2.08)	2.58
T_7	Control	4.00 (2.22)	4.33 (2.31)	4.67 (2.38)	5.00 (2.44)	5.33 (2.52)	4.83
	S.Ed	0.20	0.12	0.12	0.12	0.09	-
	CD (P=0.05)	NS	0.27	0.27	0.27	0.21	-

*Mean of three replications; Values in parenthesis are angular transformed values In a column means followed by a common letter are not significantly different by DMRT (P=0.05)

Table 7: Effect of ethiprole 10.7 % + pymetrozine 40 % WG on mirid bugs in rice eco system – ii Season

Tr.no	Treatments	Number of mirid bugs / 10 hill (First application)			Number of mirid bugs / 10 hill (Second application)		Mean
		PTC	7 DAT	14 DAT	7 DAT	14 DAT	
T_1	Ethiprole 10.7 % + Pymetrozine 40 % WG @ 36.91 + 138 g a.i ha^{-1}	3.33 (2.08)	2.67 (1.91)	3.00 (2.00)	2.33 (1.82)	3.67 (2.16)	2.92
T_2	Ethiprole 10.7 % + Pymetrozine 40 % WG @ 40.13 + 150 g a.i ha^{-1}	3.00 (1.99)	2.33 (1.82)	2.67 (1.91)	2.00 (1.73)	3.33 (2.08)	2.58
T_3	Ethiprole 10.7 % + Pymetrozine 40 % WG @ 45.47 + 170 g a.i ha^{-1}	3.33 (2.08)	2.00 (1.73)	2.33 (1.82)	1.67 (1.63)	3.00 (2.00)	2.25
T_4	Market Std. Check Pymetrozine 50 % WG @ 150 g a.i ha^{-1}	2.67 (1.91)	1.67 (1.63)	2.00 (1.73)	1.33 (1.52)	2.67 (1.91)	1.92
T_5	Market Std. Check Buprofezin 25 % SC @ 200 g a.i ha^{-1}	3.33 (2.08)	1.00 (1.41)	1.33 (1.52)	0.67 (1.28)	2.00 (1.73)	1.25
T_6	Market Std. Check Ethiprole 40 %+ Imidacloprid 40 % WG @ 50 + 50 g a.i ha^{-1}	2.67 (1.91)	1.33 (1.52)	1.67 (1.63)	1.00 (1.41)	2.33 (1.82)	1.58
T_7	Control	3.00 (1.99)	3.33 (2.08)	3.67 (2.16)	4.00 (2.24)	4.67 (2.38)	3.92
	S.Ed	0.16	0.08	0.12	0.13	0.10	-
	CD (P=0.05)	NS	0.18	0.26	0.28	0.23	-

*Mean of three replications; Values in parenthesis are angular transformed values In a column means followed by a common letter are not significantly different by DMRT(P=0.05)

Table 8: Effect of ethiprole 10.7 % + pymetrozine 40 % wg on rice yield

Tr.no	Treatments	Yield kg ha^{-1}	
		Season I	Season II
T_1	Ethiprole 10.7 % + Pymetrozine 40 % WG @ 36.91 + 138 g a.i ha^{-1}	3066.67 (55.37)^{c}	2883.33 (53.69)^{d}
T_2	Ethiprole 10.7 % + Pymetrozine 40 % WG @ 40.13 + 150 g a.i ha^{-1}	4000.00 (63.22)^{b}	3918.00 (62.60)^{b}
T_3	Ethiprole 10.7 % + Pymetrozine 40 % WG @ 45.47 + 170 g a.i ha^{-1}	4123.33 (64.17)^{a}	4000.67 (63.24)^{a}
T_4	Market Std. Check Pymetrozine 50 % WG @ 150 g a.i ha^{-1}	2800.00 (52.85)^{d}	3183.33 (56.40)^{c}
T_5	Market Std. Check Buprofezin 25 % SC @ 200 g a.i ha^{-1}	2033.33 (44.99)^{f}	2070.00 (45.49)^{f}
T_6	Market Std. Check Ethiprole 40 %+ Imidacloprid 40 % WG @ 50 + 50 g a.i ha^{-1}	2426.67 (49.16)^{e}	2516.67(50.14)^{e}
T_7	Control	1500.00 (38.61)^{g}	1400.00 (37.39)^{g}
	S.Ed	2.75	1.55
	CD (P=0.05)	6.06	3.42

Mean of three replications Values in parentheses are square root transformed values In a column means followed by a common letter are not significantly different by DMRT (P=0.0

Conclusion

From the present investigations, it can be concluded that ethiprole 10.7 % + pymetrozine 40 % WG @ 45.47 + 170 and 40.13 + 150 g a.i ha^{-1} were resulted in effective management when compared with the standard checks pymetrozine 50 % WG, buprofezin 25 % SC and ethiprole 40 % + imidacloprid 40 % WG @ 150, 300 and 50 + 50 g a.i ha^{-1}. Higher doses of ethiprole 10.7 % + pymetrozine 40

% WG @ 45.47 + 170 and 40.13 + 150 g a.i ha^{-1} were effected significant reduction in the population of natural enemies. However repeated application may be avoided to reduce deleterious effects on natural enemies, for fitting into IPM.

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