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Efficacy of some insecticides against major insect pests of rice, *Oryza sativa* L.

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Abstract
The present experiment in field condition was carried out to assess the relative efficacy of some newer insecticides with some conventional insecticides against major insect pests of rice during *kharif* 2013-14. The treatments include: T1- Acephate 95 SG @ 682 g a.i /ha; T2-Rynaxypyr 20 SC @ 30 g a.i/ha; T3-Dinotefuran 20 SG @ 40 g a.i /ha; T4- Cartap hydrochloride 50 WP @ 375 g a.i/ha; T5- Fipronil 5 SC @ 75 g a.i/ha; T6- Thiamethoxam 25 WG @ 37.50 g a.i /ha; T7-Buprofezin25 SC @ 250 g a.i /ha; T8-Lamda cyhalothrin 5 EC @ 30 g a.i /ha; T9-untreated control. The overall data reveals that the Rynaxypyr 20 SC @ 30 g a.i/ha treated plot recorded significantly lower per-cent of dead heart (0.42%) and white ear- head (1.24%) caused by stem borer and higher grain yield than the other treatments. Thiamethoxam 25 WG @ 37.50 g a.i /ha treated plot recorded significantly higher % reduction of hoppers (>60% over untreated control) and Fipronil 5 SC @ 75 g a.i/ha treated plot had lower number of silver shoot (2.6%) incidence. Among the different treatments the maximum numbers of spiders were found in Rynaxypyr 20 SC @ 30 g a.i/ha treated plot followed by other treatments.

Keywords: stem borer, hoppers, silver shoot, cost benefit ratio, rynaxypyr 20 SC, spiders

1. Introduction

Rice (*Oryza sativa* L.) is one of the world's most important crops providing a staple food for nearly half of the global population [9]. Rice is the most important cereal food crop of India covering about one-fourth of the total cropped area and providing food to about half of the Indian population. Introduction and wide adoption of high yielding varieties has led to sever incidence of different insect pests. Nearly 300 species of insect pests attack the rice crop at different stages and among them only 23 species cause notable damage [17]. Among them, yellow stem borer (YSB), *Scirpophaga incerulas* (Walk.), brown plant hopper (BPH), *Nilaparvata lugens* (Stål) and Asian rice gall midge (GM), *Orseolia oryzae* (Wood-Mason) are the major culprit for huge economic crop losses of rice [13, 20, 22]. The YSB attacks the crop from the seedling stage to the harvesting stage and thus causes complete loss of affected tillers. Dead hearts are produced when the insect attacks at vegetative stage while white heads occur when the stem borer attack at time of heading [22]. Yield losses due to yellow stem borer are estimated 1-19% in early planted and 38-80% in late transplanted rice crops [5]. BPH attacks the crop from late vegetative stage to grains hardening stage. Both the nymphs and adults of this insect suck the sap from the plant resulting in chlorotic, wilting and drying up of rice plant. This feeding damage is commonly known as 'hopper-burn' which begins in patches but spread rapidly as the hoppers move from dying plants to adjacent plants [20]. Generally the yield losses due to hoppers ranges from 10 to 90 percent but if timely control measures are not taken up, there may be possibilty of total crop loss within a very short period. Beside this direct feeding damage, it also serves as the vector of Rice Grassy Stunt and Ragged Stunt Viruses [14]. Gall midge is another important insect which has been prevalent in almost all the rice growing states in India except the Western Uttar Pradesh, Uttaranchal, Punjab, Haryana and Hill states of Himachal Pradesh and Jammu and Kashmir [2]. GM causes an annual yield loss of 0.8% of the total production, amounting to US$80 million [12]. The external symptom of damage caused by gall midge is the production of a silvery-white, tubular leaf sheath gall called a silver shoot or onion shoot. This renders the tiller sterile and do not bear panicle [13]. Chemical insecticides are still effective method to control insect pests particularly in the rice crop. Many conventional insecticides though have been evaluated against these insect, yet, most of the chemicals have failed to provide adequate control. Hence, new molecules are being added for their evaluation with an aim to least disruption of environmental quality [20]. For this,

the present study was carried out to find the efficacy of certain new molecules against major insect pest of rice.

2. Materials and Methods

The experiment was conducted in the experimental farm of Regional Research and Technology Transfer Station (OUAT), Chiplima, Sambalpur, Odisha, during *kharif* 2013 and *Kharif* 2014 in Randomized Block Design (RBD), having 9 treatments which were replicated thrice in a net experimental area of 5 m x 4 m each. The Station is situated at $20^0$21' N latitude and $80^0$55'E longitude in Dhankauda block of Sambalpur district at an altitude of 178.8 m above MSL. The climate of the area is warm/sub humid. Nursery of rice variety Jaya sown in the middle week of July in both the seasons and transplanting was done after 25 days of sowing at 20 cm x 15 cm hill spacing. All the agronomic practices were followed during crop growth period. The treatments were: T1-Acephate 95 SG @ 682 g a.i /ha; T2-Rynaxypyr 20 SC @ 30 g a.i/ha; T3- Dinotefuran 20 SG @ 40 g a.i /ha; T4- Cartap hydrochloride 50 WP @ 375 g a.i/ha; T5- Fipronil 5 SC @ 75 g a.i/ha; T6- Thiamethoxam 25 WG @ 37.50 g a.i /ha; T7-Buprofezin25 SC @ 250 g a.i /ha; T8- Lamda cyhalothrin 5 EC @ 30 g a.i /ha; T9-untreated control. The treatments were applied at 25 DAT, 45 DAT and 65 DAT. The insecticides were applied as high volume sprays @ 500 litres of spray fluid/ha. Observations on the incidence of dead heart (DH) and silver shoot (SS) were taken on 10 randomly selected hills per plot from each replication at 55 and 75 days after transplanting. The white ear head (WEH) was counted on 10 randomly selected hills from each plot just before harvest. Then percentage of dead hearts / white ears / silver shoot was worked out. The hopper population per 10 hills was recorded 7 days after second and third spray. The spider (natural enemies) population per 10 hills was recorded 15 days after last spray.

Statistical Analysis

The Mean value of data obtained from field experiments were analyzed statistically by ANOVA using the package SPSS after converting it to square root transformation value. Finally the grain yield was recorded in plot basis and expressed in quintal/ha. Based on yield, cost benefit ratios of different products were also calculated.

3. Results and Discussion

Stem borer management

The result showed that all the treatments were significantly effective in reducing the infestation of rice yellow stem borer (YSB) and thus, reducing the formation of dead heart and white ear head significantly as compared to the control (Table 1 and 2). In treated plots, in 2013 the yellow stem borer infestation recorded as dead hearts ranged from 0.43 to 4.32% and white ears ranged from 1.10 to 7.02% as against 8.09 and 12.69% in control respectively. Whereas, in 2014 the dead hearts ranged from 0.41 to 4.08% and white ears ranged from 1.38 to 7.72% as against 9.37 and 12.01% in control respectively. Rynaxypyr 20 SC @ 30 g a.i/ha was found most effective against YSB followed by cartap hydrochloride 50 SP @ 375 g a.i/ha, fipronil 5 SC @ 75 g a.i/ha and acephate 95 SG @ 682 g a.i /ha. The effectiveness of cartap hydrochloride was at par with the treatment with fipronil. The present finding in agreement with the Srinivasan *et al.,* [23], who reported that spray with Rynaxypyr @ 30g a.i./ha reduced dead heart incidence with 6.8-7.4% in comparison to control plots (13.8%). Karthikeyan and Christy [11] observed significantly least stem borer damage in chlorantraniliprole 18.5 EC @150 ml/ha treated plot over untreated check. Dhaka *et al.,* [7] and Singh *et al.,* [22], reported about the effectiveness of fipronil 5 SC in reducing the infestation of insect pests in rice. Sachan *et al.,* [19] reported the effectiveness of cartap hydrochloride 50 SP in management of stem borer in rice. Panda *et al* [16] studied the efficacy of Fipronil @ 100 g a.i./ha and 75 g a.i./ha and observed effective control of yellow stem borer in rice.

Gall midge management

Gall midge is one of the major insect pests in rice in Hirakud command area, chiplima. From the experimental result, it is observed that the best treatment was fipronil 5 SC @ 75 g a.i/ha which recorded 3.03 and 2.14 per cent silver shoot during 2013 and 2014, respectively and it was significantly superior to other treatments (Table 1 and 2). The next best treatments were rynaxypyr 20 SC @ 30 g a.i/ha and cartap hydrochloride 50 SP @ 375 g a.i/ha. Other treatments were not significantly varied with each other and they were at par with each other. The present findings corroborated the findings of Archana *et al*., [1] who reported that fipronil 40WG @ 1g/l and was superior to rest of the chemicals by recording least silver shoot incidence (8%) and high % reduction over control (81%). Das and Mukherjee [6] reported that fipronil was effective against rice stem borer and gall midge. Kumar *et al.,* [13] also observed the effectiveness of fipronil in suppression of gall midge in rice.

Hoppers management

From the Table 1 and 2, it is revealed that among different treatments, T6- Thiamethoxam 25 WG @ 37.50 g a.i /ha was recorded significantly superior (>60 % reduction over control) in efficacy against plant hoppers in both years, as I was recorded highest mean % reduction of hoppers over control. T1, T3, T5, T7 and T8 treatments were at par in efficacy for hopper management. All The treatments were superior in hopper management and differed significantly from untreated control plot. Bhavani, [3] also observed the effectiveness of thiamethoxam 25 WG for suppression of plant hoppers population in rice.

Effect on spider

The results on the presence of spiders in different treatments (Table 3) showed that highest number of spiders was found in the un-treated control (10.70/ 10 hills after 15 days of third spray) than the number of spiders recorded in other treatments. Among different insecticide treatments it is found that maximum spider population was present in rynaxypyr 20 SC @ 30 g a.i/ha treated plot followed by buprofezin 25 SC @ 250 g a.i /ha, Cartap hydrochloride 50 WP @ 375 g a.i/ha, Fipronil 5 SC @ 75 g a.i/ha, Thiamethoxam 25 WG @ 37.50 g a.i /ha, Dinotefuran 20 SG @ 40 g a.i /ha, Lamda cyhalothrin 5 EC @ 30 g a.i /ha, and Acephate 95 SG @ 682 g a.i /ha. T4, T5 and T7 treatments were at par in spider numbers per 10 hills after 15 DAT of last spray. The least number of the spiders were recorded in the treatment of Acephate 95 SG @ 682 g a.i /ha treated plot in both the years. Jafar *et al*. [10] also reported that newer insecticide *viz*., chlorantraniliprole 18.5 SC at 30 g a. i./ ha, cartap hydrochloride 50 SP at 500 g a. i. / ha and fipronil 5 SC 625 ml / ha were found to be safe to natural enemies in the rice ecosystem. Misra [15] observed that the rynaxypyr 20 EC at 40 g a. i. / ha was found safe to natural enemies. Shanwei *et al*., [21] also evaluated the newer insecticide, chlorantraniliprole 20

SC at 40 g a. i. / ha and found that it was highly safe to beneficial arthropods in rice field.

Yield

It was found that in Table 4, that rynaxypyr 20 SC @ 30 g a.i/ha treated plot recorded highest yield of 46.10 Qt/ha (>34% yield increase over control) followed by fipronil 5 SC @ 75 g a.i/ha, cartap hydrochloride 50 WP @ 375 g a.i/ha, acephate 95 SG @ 682 g a.i /ha, lamda cyhalothrin 5 EC @ 30 g a.i /ha, thiamethoxam 25 WG @ 37.50 g a.i /ha, dinotefuran 20 SG @ 40 g a.i /ha and buprofezin 25 SC @ 250 g a.i /ha treated plots. All the treatments given plots gave superior yield than untreated control plot.

Cost benefit ratio

From the Table 5, it was found that maximum cost benefit ratio was recorded in acephate 95 SG @ 682 g a.i /ha (1:5.62) followed by cartap hydrochloride 50 WP @ 375 g a.i/ha, lamda cyhalothrin 5 EC @ 30 g a.i /ha, thiamethoxam 25 WG @ 37.50 g a.i /ha, rynaxypyr 20 SC @ 30 g a.i/ha, fipronil 5 SC @ 75 g a.i/ha, dinotefuran 20 SG @ 40 g a.i /ha and buprofezin 25 SC @ 250 g a.i /ha treated plots. Among the different tested insecticides, spraying of conventional organophosphate insecticides, acephate still have good cost benefit ratio. Previously, many scientists also documented the good efficacy of acephate against different insect pests of rice [4, 8, 18, 20].

Table 1: Efficacy of insecticides against major insect pests of rice in Kharif, 2013

T. No.	Treatments	Dose (g a.i/ha)	DH (%)	WEH (%)	SS (%)	No. Hoppers/10 Hills
1	Acephate 95 SG	682.00	1.80 (1.51)	5.74 (2.49)	6.32 (2.61)	47.00
2	Rynaxypyr 20 SC	30.00	0.43 (0.95)	1.10 (1.26)	4.50 (2.23)	56.00
3	Dinotefuran 20 SG	40.00	2.24 (1.65)	6.75 (2.68)	7.79 (2.88)	45.67
4	Cartap hydrochloride 50 WP	375.00	1.08 (1.25)	2.76 (1.79)	5.60 (2.46)	60.00
5	Fipronil 5 SC	75.00	1.30 (1.34)	3.47 (1.99)	3.03 (1.87)	46.00
6	Thiamethoxam 25 WG	37.50	2.64 (1.76)	7.53 (2.82)	5.92 (2.53)	38.67
7	Buprofezin 25 SC	250.00	4.32 (2.19)	9.13 (3.10)	7.76 (2.87)	42.33
8	Lamda cyhalothrin 5EC	30.00	2.50 (1.73)	7.02 (2.74)	5.23 (2.39)	49.67
9	Untreated control	-	8.09 (2.92)	12.69 (3.63)	8.57 (3.01)	103.67
	S.Em		0.09	0.13	0.13	2.63
	CD (5%)		0.28	0.40	0.38	7.87

Figures in parentheses are square root transformed values

Table 2: Efficacy of insecticides against major insect pests of rice in Kharif, 2014

T. No.	Treatments	Dose (g a.i/ha)	DH (%)	WEH (%)	SS (%)	No. Hoppers/10 Hills
1	Acephate 95 SG	682.00	1.59 (1.44)	5.68 (2.48)	5.42 (2.42)	50.67
2	Rynaxypyr 20 SC	30.00	0.41 (0.94)	1.38 (1.36)	4.42 (2.01)	61.33
3	Dinotefuran 20 SG	40.00	2.74 (1.79)	6.87 (2.70)	7.04 (2.75)	44.67
4	Cartap hydrochloride 50 WP	375.00	0.85 (1.16)	2.80 (1.81)	5.12 (2.37)	66.00
5	Fipronil 5 SC	75.00	1.28 (1.34)	3.49 (1.99)	2.14 (1.62)	47.67
6	Thiamethoxam 25 WG	37.50	2.39 (1.70)	6.07 (2.55)	5.00 (2.34)	42.67
7	Buprofezin 25 SC	250.00	4.08 (2.14)	7.72 (2.86)	6.81 (2.70)	44.00
8	Lamda cyhalothrin 5EC	30.00	2.25 (1.66)	6.47 (2.64)	4.73 (2.28)	49.33
9	Untreated control	-	9.37 (3.14)	12.01 (3.53)	8.41 (2.98)	98.67
	S.Em		0.08	0.12	0.09	2.56
	CD (5%)		0.23	0.37	0.26	7.67

Figures in parentheses are square root transformed values

Table 3: Effect of chemicals on spider population after 15 DAT of last spray

T. No.	Treatments	Dose (g a.i/ha)	Spider/10 hill
1	Acephate 95 SG	682.00	2.0
2	Rynaxypyr 20 SC	30.00	8.7
3	Dinotefuran 20 SG	40.00	2.7
4	Cartap hydrochloride 50 WP	375.00	7.0
5	Fipronil 5 SC	75.00	6.3
6	Thiamethoxam 25 WG	37.50	3.3
7	Buprofezin 25 SC	250.00	7.3
8	Lamda cyhalothrin 5EC	30.00	2.3
9	Untreated control	-	10.7
	S.Em		0.65
	CD (5%)		1.95

Table 4: Effect of certain chemicals on grain yield of rice

Treatments	Grain yield (qt/ha)		Mean	(%) yield increase over control
	Kharif, 2013	Kharif, 2014		
Acephate 95 SG	42.73	39.17	41.0	26.29
Rynaxypyr 20 SC	45.87	46.37	46.1	34.55
Dinotefuran 20 SG	39.40	37.93	38.7	21.94
Cartap hydrochloride 50 WP	43.23	43.53	43.4	30.42
Fipronil 5 SC	44.57	44.03	44.3	31.86

Thiamethoxam 25 WG	39.47	38.50	39.0	22.57
Buprofezin 25 SC	36.40	37.17	36.8	17.94
Lamda cyhalothrin 5EC	40.53	40.00	40.3	25.04
Untreated control	30.77	29.60	30.2	-
S.Em	0.54	0.54		
CD (5%)	1.61	1.62		

Table 5: Effect of certain chemicals on cost benefit ratio for insect pest management in rice

Treatments	Dose (g a.i/ha)	Input cost (Insecticide and labour cost/ha)	Rice yield (q/ha)	Extra yield over untreated control	Value of additional yield (Rs.)	Cost Benefit Ratio
Acephate 95 SG	682.00	2775	41.0	10.8	15609.25	1: 5.62
Rynaxypyr 20 SC	30.00	6336	46.1	15.9	23103.33	1: 3.65
Dinotefuran 20 SG	40.00	5490	38.7	8.5	12298.42	1: 2.24
Cartap hydrochloride 50 WP	375.00	3450	43.4	13.2	19137.58	1: 5.55
Fipronil 5 SC	75.00	6015	44.3	14.1	20466.75	1: 3.40
Thiamethoxam 25 WG	37.50	3000	39.0	8.8	12757.58	1: 4.25
Buprofezin 25 SC	250.00	4500	36.8	6.6	9567.583	1: 2.13
Lamda cyhalothrin 5EC	30.00	2907	40.3	10.1	14618.42	1:5.03
Untreated control	-	-	30.2	-	-	-

Market rates: Thiamethoxam 25 WG @ Rs. 25/ 5 g; T2- Lamda cyhalothrin 5 EC @ Rs. 1150/litre; Rynaxypyr 20 SC @ RS. 725 / 60 ml; Buprofezin 25 SC @ Rs. 1250/ litre; Cartap hydrochloride 50 WP @ Rs. 300/ 250 g; Dinotefuran 20 SG @ Rs. 395/ 50 g; Acephate 95 SG @ Rs. 450/ 500 g; Fipronil 5 SC @ Rs. 1170/ litre; Price of rice-Rs. 1450/quintal; Labour cost - Rs 250/ha

Conclusion

Thus, the present study revealed that all the tested chemicals were effective for rice insect pests management but among the newer insecticide molecules rynaxypyr 20 SC @ 30 g a.i/ha, cartap hydrochloride 50 WP @ 375 g a.i/ha, fipronil 5 SC @ 75 g a.i/ha, acephate 95 SG @ 682 g a.i /ha were very effective for YSB management, thiamethoxam 25 WG @ 37.50 g a.i /ha, buprofezin 25 SC @ 250 g a.i /ha, dinotefuran 20 SG @ 40 g a.i /ha for hoppers management and fipronil 5 SC @ 75 g a.i/ha for gall midge management. Although rynaxypyr 20 SC @ 30 g a.i/ha treated plot had moderate cost benefit ratio, but if consider the effect on natural enemy point of view it was the best treatment.

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5. References

1. Archana D, Javaregowda, Halappa B. Management of rice gall midge using botanicals and insecticides under rainfed ecosystem. Annals of plant protection Sciences. 2012; 20(1):4-8.
2. Bentur JS, Pasalu IC, Kalode MB. Inheritance of virulence in rice-gall midge (*Orseolia oryzae*). Indian Journal of Agricultural Sciences. 1992; 62:492-493.
3. Bhavani B. Relative efficacy of new insecticide formulations against mixed population of planthoppers and leaf folder in rice. Indian Journal of plant protection. 2006; 34(2):206-209.
4. Bhavani B, Rao PRM. Bioefficacy of certain insecticides against rice plant hoppers Vis-à-Vis Natural enemies under irrigated field condition. Indian Journal of Plant Protection. 2005; 33(1):64-67.
5. Catinding JLA, Heong HL. Rice Doctor©2003, IRRI, Phillipines. 2003, 1-10.
6. Das AN, Mukherjee SK. Insecticidal control of major insect pests of rice. Pest Management and Economic Zoology. 2003; 11:147-151.
7. Dhaka SS, Prajapati CR, Singh DV, Singh R. Field evaluation of insecticides and biopesticides against rice leaf folder, Cnaphalocrosis medinalis. Annals of Plant Protection Sciences. 2011; 19(2):324-326.
8. Fabellar LT, Heinrichs EA. Relative toxicity of insecticides to rice plant hoppers and their predators. Crop Protection. 2003; 5(4):254-258.
9. Food and Agricultural Organization of the United Nations, The state of food security in the world, FAO, Rome, Italy, 2004, 30-31.
10. Jafar WNW, Mazlan N, Adam NA, Omar D. Evaluation on the effects of insecticides on biodiversity of arthropod in rice ecosystem. Acta Biologica Malaysiana. 2013; 2(3):115-123.
11. Karthikeyan K, Christy MM. Efficacy of Chlorantraniliprole 18.5 EC against major pests of rice. Indian Journal of Plant Protection. 2014; 42(4):379-382.
12. Krishnaiah K. Rice gall midge, *Orseolia oryzae*-an overview. In "New approaches to gall midge resistance in rice" Editors: Bennett J, Bentur JS, Pasalu IC, Krishnaiah K., Proceedings of the International Workshop, 22-24 November Hyderabad, India. Los Baños (Philippines): International Rice Research Institute. 1998, 2004, 195.
13. Kumar LV, Patil SU, Prasannakumar MK, Chakravarthy AK. Bioefficacy of insecticides in nursery against Asian rice gall midge, *Orseolia oryzae* (Wood-Mason). Current Biotica. 2011; 5(3):323-329.
14. Ling KC. Rice ragged stunt disease. International Rice Research Newsletter. 1977; 5:6-7.
15. Misra HP. Management of the rice leaf folder, *Cnaphalocrocis medinalis* (Guenee) by newer insecticides. Oryza. 2008; 45(3):252-254.
16. Panda SK, Nayak SK, Behera VK. Bio-efficacy of fipronil 0.4G against insect pests of rice. Oryza. 2004; 41(1, 2):32-34.
17. Pasalu IC, Katti G. Advances in ecofriendly approaches in rice IPM. Journal of Rice Research. 2006; 1(1):83-90.
18. Reddy AV, Devi RS, Reddy DVV. Evaluation of botanical and other extracts against plant hoppers in rice. Journal of Biopesticides. 2012; 5(1):57-61.
19. Sachan SK, Singh DV, Chaudhary AS. Field evaluation of insecticides against rice stem borer and leaf folder. Annals of Plant Protection Sciences. 2006; 14(2):462-

464.
20. Seni A, Naik BS. Evaluation of some insecticides against Brown Plant Hopper, *Nilaparvata lugens* (Stal) in Rice, *Oryza sativa* L. International Journal of Bio-resource and Stress Management. 2017; 8(2):268-271.
21. Shanwei B, Bengui X, Fang L. Control effectiveness of chlorantraniliprole on *Cnaphalocrocis medinalis* and evaluation of its safety to beneficial arthropods in the rice fields. Oryza. 2009; 7:144-157.
22. Singh P, Singh R, Dhaka SS, Kumar D, Kumar H, Kumari N. Bioefficacy of insecticides and bio-pesticides against yellow stem borer, *Scirpophaga incertulus* (walk.) and their effect on spiders in rice crop. South Asian Journal of Food Technology and Environment. 2015; 1(2):179-183.
23. Srinivasan G, Fathima G, Gani AM, Venkataraman NS. Chlorantraniliprole: A novel insecticide for rice ecosystem. Paper presented in 'International symposium on 100 years of rice science and looking' International symposium on 100 years of rice science and looking beyond' 9th to 12th Jan. 2012 held at TNAU, Coimbatore. 2012, 684-685.