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Compatibility of Insecticides and Fungicides Targeting Major Insect Pests and Diseases of Rice

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Abstract

A field experiment was conducted in the research farm of Regional Research and Technology Transfer Station (OUAT), Chiplima, Odisha, during July to November, 2014 and January to May, 2015. Study was undertaken to determine the compatibility of selected insecticides and fungicides against major pests namely stem borer, plant hopper and diseases; blast and sheath blight of rice. The treatments were; Rynaxypyr 20 SC @ 150 ml ha^{-1}; Dinotefuran 20 SG @ 200 g ha^{-1}; Carbendazim 12% plus mancozeb 63% 75 WP @ 1000 g ha^{-1}; Validamycin 3 SL @ 1250 ml ha^{-1}; their tank mix combination and untreated control. Among the different combinations tested, Rynaxypyr in combination with Carbendazim plus mancozeb recorded less dead heart (1.35%), white ear head (0.92%), blast incidence (0.75%), sheath blight incidence (2.75%) and produced highest yield (43.5 q ha^{-1}) followed by rynaxypyr in combination with validamycin (2.03%, 1.35%, 1.52%, 2.40% and 41.1 q ha^{-1}) and alone rynaxypyr 20 SC (2.2%, 1.23%, 2.66%, 4.2% and 40.3 q ha^{-1}) compared to untreated control. There was no reduction in the efficacy of these insecticides and fungicides when used as tank mix. No phytotoxicity symptoms were observed in treated field. So, all the insecticides and fungicides combinations are compatible with each other and can be safely used as tank mix for the control of simultaneous occurrence of rice pests and diseases, thus, saving the application cost.

Keywords: Compatibility, fungicide, insecticide, insects, diseases, phytotoxicity

1. Introduction

Rice (*Oryza sativa* L.*)* is one of the world's most important cereal crops providing a staple food for nearly half of the global population (Seni and Naik, 2017). In India, it is cultivated almost one-fourth of the total cropped area and providing food to about half of the Indian population. There are about 10,000 varieties of rice are grown in the world out of which almost 4,000 are grown in India (Kulmitra et al., 2017). Introduction and wide adoption of high yielding varieties has led to severe incidence of different insect pests. But, its production is hampers by infestation of a large number of insect pests and pathogens. Among them, yellow stem borer (YSB), *Scirpophaga incerulas* (Walk.), brown plant hopper (BPH), *Nilaparvata lugens* (Stål), Rice blast caused by *Pyricularia oryzae* Cavara and Sheath blight caused by *Rhizoctonia solani* Kunh are the major entities for huge economic crop losses of rice (Seni et al., 2017). 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. Yield losses due to yellow stem borer are estimated 1-19% in early planted and 38-80% in late transplanted rice crops (Catinding and Heong, 2003). 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. Although, average 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 few days (Seni and Naik, 2017). Further this, it may causes damage indirectly by serving as a vector of Rice Grassy Stunt and Ragged Stunt Viruses (Seni and Naik, 2017). Rice blast caused by *Pyricularia oryzae* Cavara is one of the most destructive and wide spread diseases of rice (Jia et al., 2000). In severe cases, it may causes up to 80% of total yield reduction (Seni et al., 2017). Sheath blight, caused by *Rhizoctonia solani* Kunh., is an another important destructive disease of rice occurs in all rice growing areas of the world (Teng et al., 1990). In India, it may cause almost 54% crop losses in rice. Most of the times insect pests and diseases occurs together in rice. In such conditions use of combination of suitable insecticides and fungicides is economical and practicable for their management. Keeping this in mind, the study was undertaken to evaluate the compatibility of selected insecticides and fungicides against major insect pests and diseases of rice under field condition.

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* 2014 and *Rabi* 2014-15 in Randomized Block Design (RBD). There were 9 treatments which were replicated thrice in a net experimental area of 5x4 m^2 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 warming sub humid. The temperature varies from as low as 9 °C to as high as 44.2 °C. The mean maximum and the mean minimum temperatures of 40.5 °C and 13 °C are recorded in the months of May and December, respectively. The cultivar Jaya was transplanted at 25 days old at 20 cm x 15 cm hill spacing. All the agronomic practices were followed during crop growth period. The treatments were: T1- Rynaxypyr 20 SC @ 150 ml ha^{-1}; T2- Dinotefuran 20 SG @ 200 g ha^{-1}; T3- Carbendazim 12% plus mancozeb 63% 75 WP @ 1000 g ha^{-1}; T4- Validamycin 3 SL @ 1250 ml ha^{-1}; T5- Rynaxypyr 20 SC @ 150 ml ha^{-1} plus Carbendazim 12% plus mancozeb 63% 75 WP @ 1000 g ha^{-1}; T6- Rynaxypyr 20 SC @ 150 ml ha^{-1} plus Validamycin 3 SL @ 1250 ml ha^{-1}; T7- Dinotefuran 20 SG @ 200 g ha^{-1} plus Carbendazim 12% plus mancozeb 63% 75 WP @ 1000 g ha^{-1}; T8- Dinotefuran 20 SG @ 200 g ha^{-1} plus Validamycin 3 SL @ 1250 ml ha^{-1}; T9- untreated control. Applications of all the treatments were done at 20, 45 and 65 DAT except untreated control. The insecticides were applied as high volume sprays @ 500 litres of water ha^{-1}. Observations on the incidence of dead heart (DH) 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 was worked out. The BPH population per 10 hills was recorded 1 day before and 7 days after third spray. Percentage disease incidence of blast and sheath blight was recorded 1 day before and 10 days after application of treatments. Symptoms of phytotoxicity were also recorded at 5 and 10 days after application of treatments. Finally the grain yield was recorded in plot basis and expressed in quintal ha^{-1}. The Mean value of data obtained from field experiments were analyzed statistically by ANOVA.

3. Results and Discussion

3.1. 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 significantly as compared to the control (Table 1 and 2). Among the different combinations tested, Rynaxypyr 20 SC @ 150 ml ha^{-1} in combination with Carbendazim 12% plus Mancozeb 63% 75 WP @ 1000 g ha^{-1} recorded less dead heart (1.35%) and white ear head (0.92%) followed by Rynaxypyr 20 SC @ 150 ml ha^{-1} in combination with validamycin 3 SL @ 2 ml l^{-1} (2.03%, 1.35%) and alone Rynaxypyr 20 SC @ 150ml ha^{-1} (2.2%, 1.23%) compared to untreated check where the incidence of DH was 13% and WEH was 11.79%. The present findings are in agreement with the Srinivasan et al., 2012, who

Table 1: Efficacy of insecticides against major insect pests of rice in *kharif*, 2014

Treatment	Dose (g or ml ha^{-1})	Stem borer (% DH) at		WEH (%)	No. Plant hoppers 10 hill^{-1}	
		55DAT	75DAT		BT	AT
Rynaxypyr 20 SC	150	3.35 (1.95)	0.99 (1.21)	1.19 (1.29)	48.00	39.00
Dinotefuran 20 SG	200	7.11 (2.75)	3.89 (2.09)	2.95 (1.84)	35.00	15.00
Carbendazim12% + mancozeb 63% 75 WP	1000	7.45 (2.81)	5.04 (2.35)	7.24 (2.78)	64.00	57.00
Validamycin 3 SL	1250	7.89 (2.90)	5.85 (2.51)	6.15 (2.56)	67.00	62.00
Rynaxypyr 20 SC plus Carbendazim 12%+mancozeb 63% 75 WP	150+1000	1.85 (1.52)	0.56 (1.03)	0.87 (1.17)	45.00	36.00
Rynaxypyr 20 SC plus Validamycin 3 SL	150+1250	3.06 (1.88)	1.43 (1.38)	2.22 (1.63)	42.00	34.00
Dinotefuran 20 SG plus Carbendazim 12%+mancozeb 63% 75 WP	200+1000	6.80 (2.70)	2.73 (1.79)	4.01 (2.11)	28.00	20.00
Dinotefuran 20 SG plus Validamycin 3 SL	200+1250	4.94 (2.33)	3.72 (2.05)	3.13 (1.90)	26.00	12.00
Untreated control	-	12.93 (3.64)	16.83 (4.17)	12.24 (3.56)	89.00	97.00
SEm±		0.08	0.09	0.12	2.28	2.73
CD (p=0.05)		0.24	0.27	0.37	6.85	8.18

Figures in parentheses are square root transformed values

Table 2: Efficacy of insecticides against major insect pests of rice in *rabi*, 2014-15

Treatment	Dose (g or ml ha^{-1})	Stem borer (% DH) at		WEH (%)	No. plant hoppers 10 $hill^{-1}$	
		55DAT	75DAT		BT	AT
Rynaxypyr 20 SC	150	2.9 (1.82)	1.5 (1.37)	1.27 (1.32)	43	17
Dinotefuran 20 SG	200	4.3 (2.18)	3.4 (1.95)	2.70 (1.78)	33	13
Carbendazim12%+mancozeb 63% 75 WP	1000	5.4 (2.43)	7.4 (2.81)	7.02 (2.74)	66	51
Validamycin 3 SL	1250	5.7 (2.50)	8.1 (2.92)	7.59 (2.84)	61	50
Rynaxypyr 20 SC plus Carbendazim 12%+mancozeb 63% 75 WP	150+1000	2.2 (1.62)	0.8 (1.13)	0.97 (1.20)	37	21
Rynaxypyr 20 SC plus Validamycin 3 SL	150+1250	2.4 (1.70)	1.24 (1.32)	1.27 (1.32)	38	23
Dinotefuran 20 SG plus Carbendazim 12%+mancozeb 63% 75 WP	200+1000	4.6 (2.25)	3.21 (1.92)	5.14 (2.37)	32	17
Dinotefuran 20 SG plus Validamycin 3 SL	200+1250	3.81 (2.07)	2.40 (1.70)	3.84 (2.07)	28	15
Untreated control	-	9.95 (3.23)	12.59 (3.62)	11.35 (3.42)	81	104
SEm±		0.09	0.10	0.10	2.62	2.80
CD (p=0.05)		0.27	0.29	0.31	7.94	8.50

Figures in parentheses are square root transformed values

reported that spray with Rynaxypyr @ 30 g a.i. ha^{-1} reduced dead heart incidence with 6.8-7.4% in comparison to control plots (13.8%). Karthikeyan and Christy (2014) observed significantly least stem borer damage in chlorantraniliprole 18.5 EC @150 ml ha^{-1} treated plot over untreated check.

3.2. *Plant hopper management*

Brown plant hopper (BPH) is another major insect pest in rice in Hirakud command area, chiplima. From the experimental result, it is observed that the best treatment was T2-Dinotefuran 20 SG @ 200 g ha^{-1} which recorded 14 numbers of BPH 10 $hills^{-1}$ followed by Dinotefuran 20 SG @ 200 g ha^{-1} in combination with Validamycin 3 SL @ 2 mll^{-1} (13.5 numbers 10 $hills^{-1}$) and Dinotefuran 20 SG @ 200 g ha^{-1} in combination with Carbendazim 12% plus mancozeb 63% 75 WP @ 1000 g ha^{-1} (18.5 numbers 10 $hills^{-1}$). All of these treatments were superior in hopper management than control and differed significantly from untreated control plot (100.5 numbers 10 $hills^{-1}$). Seni and Naik, 2017 also observed the effectiveness of Dinotefuran 20 SG for suppression of plant hoppers population in rice.

3.3. *Effect on blast and sheath blight*

The Field experiment revealed that in both the seasons blast and sheath blight disease incidence was lower in Jaya cultivar and among the treatments, Carbendazim 12% plus Mancozeb 63% 75 WP @ 1000 g ha^{-1} recorded lowest blast incidence (0.93%) whereas Validamycin 3 SL @ 2 ml l^{-1} treated plots had lowest sheath blight incidence (2.6%) (Tables 3). There was a significant difference among the combined treatments with respect to disease incidence of blast and sheath blight diseases and all treatments recorded significantly lower disease incidence compared to untreated control in both the seasons. Maji and Imolehin, 2015 studied the effects of some fungicides on rice blast disease and found that Carbendazim (6.2%)+Mancozeb (73.8%) was effective in suppressing the blast disease of rice. Bhanu et al., 2007 studied the compatibility of Imidacloprid 200 SL with Validamycin 3 SL and found that they were highly compatible and effective in reducing plant hopper and sheath blight incidence. Pal et al., 2015 also reported the effectiveness of Validamycin 3 SL for sheath blight management in rice.

3.4. *Phytotoxicity effect*

As regards to the crop health by visual observation it is observed that no phytotoxic symptoms viz., leaf yellowing, tip necrosis, scorching, epinasty and hyponasty were recorded 5 and 10 days after application of each treatments in both the seasons.

3.5. *Yield*

It is found that in table 4, Rynaxypyr 20 SC @ 150 ml ha^{-1} in combination with Carbendazim 12% plus Mancozeb 63% 75 WP @ 1000 g ha^{-1} treated plot recorded highest yield of 43.50 q ha^{-1} (50% yield increase over control) followed by Rynaxypyr 20 SC @ 150 ml ha^{-1} in combination with Validamycin 3 SL @ 2 ml l^{-1} (41.1 q ha^{-1} and 47% yield increase over control), Rynaxypyr 20 SC @ 150 ml ha^{-1} (40.3 q ha^{-1}), Dinotefuran 20 SG @ 200 g ha^{-1} in combination with Carbendazim 12% plus Mancozeb 63% 75 WP @ 1000 g ha^{-1} (37.9 q ha^{-1}), Dinotefuran 20 SG @ 200 g ha^{-1} in combination with Validamycin 3 SL @ 2 ml l^{-1} (36.6 q ha^{-1}), Dinotefuran 20 SG @ 200 g ha^{-1} (36 q ha^{-1}), Validamycin 3 SL @ 2 ml l^{-1} (34.2 q ha^{-1}), Carbendazim 12% plus Mancozeb 63% 75 WP @ 1000 g ha^{-1} (32.5 q ha^{-1}). All The treatments given plots gave superior yield than

Table 3: Effect of chemicals on the blast and sheath blight incidence of rice

Treatment	Blast incidence (%)		Sheath blight incidence (%)	
	Kharif' 14	*Rabi'* 14-15	*Kharif'* 14	*Rabi'* 14-15
Rynaxypyr 20 SC	2.72 (1.79)	2.60 (1.76)	4.8 (2.29)	3.6 (2.02)
Dinotefuran 20 SG	3.55 (2.01)	3.30 (1.95)	5.3 (2.41)	3.8 (2.07)
Carbendazim12%+mancozeb 63% 75 WP	1.00 (1.72)	0.86 (1.17)	3.2 (1.92)	2.5 (1.74)
Validamycin 3 SL	2.00 (1.58)	1.03 (1.23)	2.9 (1.85)	2.3 (1.68)
Rynaxypyr 20 SC plus Carbendazim 12%+mancozeb 63% 75 WP	0.75 (1.11)	0.76 (1.12)	3.1 (1.89)	2.4 (1.71)
Rynaxypyr 20 SC plus Validamycin 3 SL	1.75 (1.50)	1.29 (1.33)	2.6 (1.76)	2.2 (1.64)
Dinotefuran 20 SG plus Carbendazim 12%+mancozeb 63% 75 WP	2.00 (1.58)	1.57 (1.44)	3.0 (1.86)	2.6 (1.75)
Dinotefuran 20 SG plus Validamycin 3 SL	2.75 (1.80)	1.17 (1.29)	2.7 (1.79)	2.5 (1.72)
Untreated control	4.55 (2.25)	4.25 (2.18)	5.7 (2.49)	4.3 (2.20)
SEm±	0.05	0.04	0.04	0.03
CD (p=0.05)	0.15	0.13	0.13	0.09

Figures in parentheses are square root transformed values

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

Treatment	Grain yield (q ha^{-1})		Mean	(%) yield increase over control
	Kharif, 2014	*Rabi*, 2014-15		
Rynaxypyr 20 SC	35.81	44.81	40.3	46
Dinotefuran 20 SG	32.48	39.53	36.0	40
Carbendazim12%+mancozeb 63% 75 WP	30.72	34.24	32.5	33
Validamycin 3 SL	31.70	36.79	34.2	37
Rynaxypyr 20 SC plus Carbendazim 12%+mancozeb 63% 75 WP	39.13	47.94	43.5	50
Rynaxypyr 20 SC plus Validamycin 3 SL	36.20	45.98	41.1	47
Dinotefuran 20 SG plus Carbendazim 12%+mancozeb 63% 75 WP	31.89	41.28	36.6	41
Dinotefuran 20 SG plus Validamycin 3 SL	33.07	42.65	37.9	43
Untreated control	19.76	23.48	21.6	-
SEm±	0.66	0.62		
CD (p=0.05)	1.98	1.85		

Figures in parentheses are square root transformed values

untreated control plot. The present findings are in agreement with the findings of Bhuvaneshwari and Krishnam Raju (2013) who reported that the effectiveness of six insecticides viz., buprofezin, pymeterozine, acephate, chlorantraniliprole, dinotefuron, and imidacloprid+ethiprole did not in any way hamper by mixing with different fungicides and they are compatible with each other for spray application to control the insect pests viz., stem borer, brown plant hopper, leaf folder and sheath blight. Bhatnagar, 2004 reported that the combination of cartap (Padan 50% WP) and tricyclazole (Beam 75% WP) was effective in reducing the damage by rice leaf folder and blast, and found to be compatible. Singh et al., 2010 found that combination treatments of fungicides (tricyclazole and iprobenphos) and insecticides (indoxacarb and cartap hydrochloride) were biologically as effective as their individual treatments against neck blast, leaf folder and stem borer of rice. Dodan et al., 1997 studied the compatibility of carbendazim and edifenphos (fungicides) with monocrotophos and phosphamidan (insecticides) at different doses and observed their compatibility as reflected by their effectiveness against stem borer and neck blast under field conditions. They found higher grain yields in combination treatments compared to either insecticide of fungicide treatments alone.

4. Conclusion

Thus, the present study revealed that tank mixing of Rynaxypyr 20 SC or Dinotefuran 20 SG in combination with Carbendazim plus mancozeb 75 WP or Validamycin 3 SL or vice versa did not produce any adverse impact on their efficacy. Thus, all the tested insecticides and fungicides combinations are compatible with each other and can be safely used as tank mix for the time of simultaneous occurrence of rice insect pests and diseases.

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