Compatibility of Fungicides and Insecticides Targeting Sheath Blight and Major Rice Pests

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Abstract

Three fungicides and six insecticides at recommended concentrations were evaluated as tank mix in various fungicide and insecticide combinations for their efficacy against sheath blight, brown plant-hopper and leaf folder and to investigate their compatibility as tank mix application for the purpose of reducing the application cost in the event of simultaneous occurrence of both diseases and pests during crop growth period. Among the different combinations tested, pymetrozine @ 0.5 g/l in combination with hexaconazole @ 2 ml/l recorded less sheath blight incidence (9.1%) severity (14.8%) and also lesser number of plant-hoppers (0.5/hill) followed by pymetrozine @ 0.5 g/l + validamycin @ 2 ml/l (9.6%, 15.0% and 0.7/hill) and combination product of imidacloprid + ethiprole @ 0.8 g/l + hexaconazole @ 2 ml/l (9.2%, 18.2% and 0.4/hill) compared to untreated check where the incidence and severity of sheath blight was 93.6% and 81.9% respectively. The number of plant-hoppers in untreated check plot was 26/hill. Similarly, chlorantraniliprole @ 0.3 ml/l in combination with hexaconazole @ 2 ml/l (6.3% WE) gave less incidence (8.3%) and severity of sheath blight (12.8%) and also less stem borer and lesser leaf folder damaged leaves per hill (1.9) followed by pymetrozine @ 0.5 g/l + validamycin @ 2 ml/l (9.6%, 15.0% and 1.2/hill, 12.5% WE). There was no reduction in the efficacy of these insecticides and fungicides when used as tank mix and phytotoxicity symptoms were not observed in any of the treatments. Thus, all the insecticides and fungicides combinations used in the present investigation are compatible with each other and can be safely combined as tank mix for the control of rice pests and diseases, thus, saving labour costs.

Key words: Insecticides, fungicides, compatibility, rice, sheath blight, brown plant-hopper and leaf folder.

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Rice (*Oryza sativa* L.) is the primary source of food for more than half of the world's population. Occurrence of diseases and insect pests together in rice demands the necessity of fungicidal and insecticidal application at the same place and time. In many endemic areas, sheath blight, brown planthopper (BPH), leaf folder and stem borer occur at the same stage of the crop growth. Therefore, a combined application of effective fungicides and insecticides is a practical necessity. In Andhra Pradesh, Godavari delta farmers are regularly going for 2-3 sprays in rice crop, and mixed combinations of fungicides and insecticides is a common practice in view of labour shortage at these locations. Keeping this in view, the study was undertaken with effective fungicides like hexaconazole, validamycin and trifloxystrobin 25% + tebuconazole 50% WG @ 2.0 ml/l, 2.0 ml/l and 0.4 g/l, respectively along with the effective insecticides like buprofezin, pymetrozine, acephate, chlorantraniliprole, dinotefuran and imidacloprid + ethiprole 80% WG @ 1.6 ml/l, 0.5 g/l, 1.5 g/l, 0.3 ml/l, 1.8 g/l and 0.8 g/l, respectively to find their efficacy on sheath blight and insect pests like BPH, leaf folder and stem borer as well as the compatibility of the test fungicides and insecticides.

Materials and Methods

The experiments were conducted during the *kharif* 2011 and 2012 seasons in Randomized Block Design. Three fungicides *viz*., hexaconazole 5% EC, validamycin 3% l and trifloxystrobin 25% + tebuconazole 50% (Nativo 75% WG) @ 2 ml/l, 2 ml/l and 0.4 g/l, respectively and six insecticides *viz*., buprofezin 25% SC, pymetrozine 50% WG (Plenum), acephate 75% SP, chlorantraniliprole 18.5% SC (Coragen), dinotefuran 20% SG (Token) and imidacloprid + ethiprole 80% WG (Glamor) @ 1.6 ml/l, 0.5 g/l, 1.5 g/l, 0.3 ml/l, 1.8 g/l, and 0.8 g/l, respectively, were evaluated as tank mix of fungicide and insecticide combinations for their efficacy against sheath blight, brown planthopper and leaf folder and to investigate their compatibility as tank mix application for the purpose of reducing the application cost in the event of simultaneous occurrence of both diseases and pests during crop growth period. An untreated control was also maintained for comparison. Popular susceptible rice variety, MTU-7029 (Swarna) was transplanted during *kharif* 2011 and 2012 seasons in a randomized block design with 10 treatments and three replications. A spacing of 15 x 15 cm was adopted in a gross plot size of 9.945 sq m. A pure culture of a virulent isolate of *Rhizoctonia*

solani was multiplied on typha leaf bits. Inoculation with *R. solani* was carried out at maximum tillering stage (Bhaktavatsalam *et al*., 1978). The colonized typha bits were placed between the tillers of rice plant, 5-10 cm above the water level. The data on the disease incidence and subsequent spread were collected from the date of first incidence of the disease till 30 days after final spray. The per cent disease incidence and severity was calculated from the data collected from 25 hills of each treatment in each replication as per the Standard Evaluation System for rice (IRRI, 1996). The disease incidence and severity data were transformed into arc sine values before statistical analysis. Similarly natural incidence in these treatments was also recorded. The grain yield was recorded from each gross plot and calculated to kg/ha. The data was subjected to statistical scrutiny, and the results are furnished.

The disease and pests were first noticed in the experimental plots at maximum tillering stage during both seasons. Three fungicidal and insecticidal combination sprays were given at 15 days interval starting from the appearance of initial disease symptoms and pest incidence depending upon the initial disease symptoms/insect damage and the subsequent pest pressure. A spray fluid of 500 L/ha was used to ensure thorough coverage of the plants. Symptoms of phytotoxicity, if any, were also recorded at 5 and 10 days after the imposition of the treatments. Yield data was also recorded.

Results and Discussion

During 2011, the data revealed that among different fungicide and insecticide combinations used for the control of sheath blight, planthoppers and leaf folder, combination product of imidacloprid + ethiprole @ 0.8 g/l + hexaconazole @ 2.0 ml/l has recorded less sheath blight incidence (7.3%) severity (14.4%) and also lesser number of plant-hoppers (0.1 per hill) closely followed by trifloxystrobin 25%+ tebuconazole 50% WG @ 0.4 g/l in combination with buprofezin @ 1.6 ml/l (5.4%, 11.8%, 3/hill), pymetrozine @ 0.5 g/l + validamycin @ 2 ml/l (11.6%, 18.5%, 0.3/hill), pymetrozine @ 0.5 g/l + hexaconazole @ 2 ml/l (13.8%, 19.6%, 0.6/hill) and buprofezin @ 1.6 ml/l + hexaconazole @ 2 ml/l (5.6%, 11.9%, 6.9/hill) compared to untreated check where the incidence and severity of sheath blight was 87.1 and 85.7 per cent respectively. The number of planthoppers per hill in untreated check plot was 38.1 per hill. No significant differences were found among treatments with respect to leaf folder damaged leaves. In 2011, the incidence of leaf folder was very low.

While, chlorantraniliprole @ 0.3 ml/l in combination with hexaconazole @ 2 ml/l gave less disease incidence (12.2%) and severity of sheath blight (18.5%) and also lesser per cent white ears (6.3) closely followed by acephate @ 1.5 g/l + hexaconazole @ 2 ml/l (11.6%, 15.3%, 7.5%) compared to control where the per cent white ears was 19.6 (Tables 1 and 2). This confirms that the fungicides and insecticides involved in the trial are compatible in all fungicide insecticide combination from the point of sheath blight, brown planthopper and stem borer management.

During 2012, the data presented in Tables 1 and 2 revealed that among different fungicide and insecticide combinations, dinotefuran @ 1.8 g/l + hexaconazole @ 2 ml/l combination has recorded less sheath blight incidence (3.8%) severity (7.8%) and also lesser number of planthoppers (0.2/hill) closely followed by combination of pymetrozine @ 0.5 g/l + hexaconazole @ 2 ml/l (4.5%, 10.1% and 0.3/hill) and combination of (imidacloprid + ethiprole) @ 0.8 g/l + hexaconazole @ 2 ml/l (11.1%, 22.0% & 0.7/hill) compared to untreated check where the incidence and severity of sheath blight was cent per cent and 78.1 per cent respectively. The number of plant-hoppers per hill in untreated check plot was 13.9 per hill. Similarly chlorantraniliprole @ 0.3 ml/l in combination with hexaconazole @ 2 ml/l gave less disease incidence (4.4%) and severity of sheath blight (7.2%) and also lesser leaf folder affected leaves per hill (3.7), reveal that the combinations did not in any way lower the effectiveness of the fungicides against sheath blight and insecticides against BPH and leaf folder. Phytotoxicity symptoms were not observed in any of the treatments which indicated the positive compatibility of the evaluated chemicals.

The pooled data revealed that among different fungicide and insecticide combinations used for the control of sheath blight, planthoppers and leaf folder, combination of pymetrozine @ 0.5 g/l + hexaconazole @ 2 ml/l has recorded less sheath blight incidence (9.1%) severity (14.8%) and also lesser number of plant hoppers (0.5/hill) closely followed by pymetrozine @ 0.5 g/l + validamycin @ 2 ml/l (9.6%, 15.0%, 0.7/hill) and combination of imidacloprid + ethiprole @ 0.8 g/l + hexaconazole @ 2 ml/l (9.2%, 18.2% and 0.4/hill), compared to untreated check where the incidence and severity of sheath blight was 93.6% and 81.9%, respectively. The number of planthoppers per hill in untreated check plot was 26per hill. The other combinations *viz*., buprofezin @ 1.6 ml/l + trifloxystrobin 25% + tebuconazole 50% WG @ 0.4 g/l (8.3%, 15.7%, 4.2/hill), buprofezin @ 1.6

ml/l + hexaconazole @ 2 ml/l (4.8%, 9.9%, 5.5/hill) and dinotefuran @ 1.8 g/l + hexaconazole @ 2 ml/l (19.4%, 26.8%, 9.5/hill) were also found superior over control. Similarly chlorantraniliprole @ 0.3 ml/l in combination with hexaconazole @ 2 ml/l gave less incidence (8.3%) and severity of sheath blight (12.8%) and also lesser leaf folder infested leaves per hill (1.9) closely followed by pymetrozine @ 0.5 g/l + validamycin @ 2 ml/l (9.6%, 15%, 1.2/hill) compared to control where the number of leaf folder damaged leaves were 4.20 per hill (Tables 1 and 2). The overall results revealed that tank mixing of fungicides with insecticides involved in the present studies did not reduce the efficacy of the fungicides against rice sheath blight and that of insecticides against brown planthopper and leaf folder. Hence, they are compatible with each other for spray application to control the rice pests. These findings are in conformity with the findings of Singh *et al*. (2010), where in it was reported that the 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, respectively during *kharif* 2006 and 2007 along with corresponding grain yield in Taraori Basmati. Similar reports were reported by Prajapati *et al.* (2005) that insecticide triazophos (20% EC @ 0.02%) alone or tank mixed with fungicides carbendazim (50% WP @ 0.05%) and tricyclazole (75% WP @ 0.04%) was found effective in controlling leaf folder damage as well as white backed plant-hoppers as compared to untreated control. 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.

Thus, the effectiveness of the six insecticides *viz*., buprofezin, pymetrozine, acephate, chlorantraniliprole, dinotefuran and imidacloprid + ethiprole did not in any way get hindered by mixing with the fungicides. All the treatments with fungicide-insecticide combinations had significantly higher grain yield as compared to the control.

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Table 1. Efficacy of fungicides and insecticides as tank mix against sheath blight of rice

S. No	Treatments	Dose/L	*Disease incidence (%)			*Disease severity (%)			*Yield (kg/ha)		
			2011	2012	Pooled	2011	2012	Pooled	2011	2012	Pooled
T1	Buprofezin 25% SC (Applaud) + hexaconzole 5% EC	1.6 ml + 2.0 ml	5.6 (13.6)^{a}	4.0 (11.5)^{a}	4.8 (12.6)^{a}	11.9 (20.1)^{a}	8.0 (16.1)^{a}	9.9 (18.3)^{a}	7859^{a}	3776^{a}	5817^{a}
T2	Buprofezin + validamycin 3% L	1.6 ml + 2.0 ml	32.7 (34.9)^{c}	22.3 (27.4)^{b}	27.5 (31.6)^{d}	45.4 (42.3)^{b}	27.4 (30.7)^{c}	36.4 (37.1)^{d}	7196^{ab}	3385^{a}	5291^{b}
T3	Buprofezin + (trifloxystrobin 25% + tebuconazole 50% WG (Nativo 75% WG)	1.6 ml + 0.4 g	5.4 (12.8)^{a}	11.2 (18.7)^{a}	8.3 (16.5)^{a}	11.8 (20.0)^{a}	19.5 (26.0)^{b}	15.7 (23.3)^{b}	7864^{a}	3522^{a}	5693^{a}
T4	Pymetrozine 50% WG (Plenum) + hexaconazole	0.5 g + 2.0 ml	13.8 (21.8)^{b}	4.5 (12.1)^{a}	9.1 (17.5)^{a}	19.6 (26.1)^{a}	10.1 (18.4)^{a}	14.8 (22.6)^{ab}	7615^{a}	3759^{a}	5687^{a}
T5	Pymetrozine + validamycin	0.5 g + 2.0 ml	11.6 (19.7)^{b}	7.5 (14.2)^{a}	9.6 (17.9)^{b}	18.5 (25.5)^{a}	11.4 (18.3)^{a}	15.0 (22.6)^{ab}	7479^{a}	3731^{a}	5605^{a}
T6	Acephate 75% SP + hexaconazole	1.5 g + 2.0 ml	11.6 (19.7) ^{b}	6.6 (14.4) ^{a}	9.1 (17.6)^{ab}	15.3 (22.9)^{a}	12.0 (20.0)^{ab}	13.7 (21.7)^{a}	7954^{a}	3611^{a}	5783^{a}
T7	Chlorantraniliprole 18.5% SC (Coragen) + hexaconazole	0.3 ml + 2.0 ml	12.2 (19.9) ^{b}	4.4 (10.9) ^{a}	8.3 (16.4)^{a}	18.5 (24.9)^{a}	7.2 (13.5)^{a}	12.8 (20.8)^{a}	7458^{a}	3814^{a}	5636^{a}
T8	Dinotefuron 20% SG (Token) + hexaconazole	1.8 g + 2.0 ml	34.9 (36.1)^{c}	3.8 (11.2)^{a}	19.4 (26.0)^{c}	45.8 (42.6)^{b}	7.8 (16.2)^{a}	26.8 (31.1)^{c}	6948^{bc}	3817^{a}	5383^{ab}
T9	(Imidacloprid + ethiprole 80% WG) (Glamor) + hexaconazole	0.8 g + 2.0 ml	7.3 (15.2)^{ab}	11.1 (18.8)^{ab}	9.2 (17.5)^{a}	14.4 (21.8)^{a}	22.0 (27.6)^{bc}	18.2 (25.2)^{b}	8242^{a}	3724^{a}	5983^{a}
T10	Control	--	87.1 (69.0)^{d}	100 (90.0)^{c}	93.6 (75.3)^{e}	85.7 (67.8)^{c}	78.1 (62.2)^{d}	81.9 (64.9)^{e}	6010^{c}	2116^{b}	4063^{c}
		CD(P=0.05)	6.8	9.8	5.0	7.7	8.9	4.3	1180.1	988.1	635.4
		CV	15.1	25.0	11.7	14.3	20.7	8.7	9.2	16.3	6.7

*Mean of three replications

Figures in the parentheses are arc sine transformed values.

Table 2. Efficacy of insecticides and fungicides as tank mix against major rice pests

S. No	Treatments	Dose/L	*BPH (No./hill)			*Leaf folder infested leaves/hill			White ears (%)
			2011	2012	Pooled	2011	2012	Pooled	2011
T1	Buprofezin 25% SC (Applaud)+ hexaconzole 5% EC	1.6 ml + 2.0 ml	6.9 (2.5)^{b}	4.2 (2.0)^{bc}	5.5 (2.3)^{bc}	0.0 (0.0)	5.5 (2.3)^{b}	2.7 (1.7)^{b}	14.1 (22.0)^{b}
T2	Buprofezin + validamycin 3% L	1.6 ml + 2.0 ml	3.8 (1.9)^{b}	5.6 (2.3)^{c}	4.7 (2.1)^{b}	0.1 (0.2)	4.9 (2.2)^{b}	2.5 (1.6)^{b}	8.5 (16.6)^{a}
T3	Buprofezin + (trifloxystrobin 25% + tebuconazole 50% WG (Nativo 75% WG)	1.6 ml + 0.4 g	3.0 (1.7)^{b}	5.3 (2.1)^{c}	4.2 (2.0)^{b}	0.0 (0.0)	7.2 (2.7)^{c}	3.6 (1.9)^{bc}	20.7 (26.9)^{c}
T4	Pymetrozine 50% WG (Plenum) + hexaconazole 5% EC	0.5 g + 2.0 ml	0.6 (0.7)^{a}	0.3 (0.5)^{a}	0.5 (0.7)^{a}	0.0 (0.0)	4.5 (2.1)^{b}	2.3 (1.5)^{ab}	12.5 (19.4)^{ab}
T5	Pymetrozine + validamycin 3% L	0.5 g + 2.0 ml	0.3 (0.4)^{a}	1.1 (0.8)^{ab}	0.7 (0.7)^{a}	0.0 (0.0)	2.4 (1.5)^{a}	1.2 (1.1)^{a}	14.6 (22.4)^{bc}
T6	Acephate 75% SP + hexaconazole 5% EC	1.5 g + 2.0 ml	28.1 (5.3)^{d}	4.2 (2.0)^{bc}	16.1 (4.0)^{d}	0.1 (0.1)	4.3 (2.1)^{b}	2.2 (1.5)^{ab}	7.5 (15.7)^{a}
T7	Chlorantraniliprole 18.5% SC (Coragen) + hexaconazole 5% EC	0.3 ml + 2.0 ml	80.4 (9.0)^{f}	20.1 (4.3)^{d}	50.2 (7.1)^{f}	0.0 (0.0)	3.7 (1.9)^{ab}	1.9 (1.4)^{a}	6.3 (13.6)^{a}
T8	Dinotefuran 20% SG (Token) + hexaconazole 5% EC	1.8 g + 2.0 ml	18.7 (4.3)^{c}	0.2 (0.4)^{a}	9.5 (3.1)^{c}	0.0 (0.0)	5.5 (2.3)^{b}	2.7 (1.6)^{b}	10.0 (18.2)^{a}
T9	(Imidacloprid + ethiprole 80% WG) (Glamor) + hexaconazole 5% EC	0.8 g + 2.0 ml	0.1 (0.2)^{a}	0.7 (0.7)^{a}	0.4 (0.6)^{a}	0.0 (0.0)	6.0 (2.4)^{bc}	3.0 (1.7)^{b}	10.6 (18.6)^{a}
T10	Control	--	38.1 (6.2)^{e}	13.9 (3.7)^{d}	26.0 (5.1)^{e}	0.1 (0.2)	8.3 (2.8)^{c}	4.2 (2.0)^{c}	19.6 (26.2)^{c}
		CD(0.05)	0.8	1.2	0.8		0.5	0.4	6.7
		CV	14.2	35.9	15.8	NS	12.7	12.8	23.0

*Mean of three replications.

Figures in the parentheses are arc sine transformed values.