

A combination fungicide for the management of blast and sheath blight disease of paddy

Short Title: Disease management in paddy

Abstract

A new combination fungicide Nativo 75WG composed of Trifloxystrobin 25% (Strobilurin) and Tebuconazole 50% (Triazole) was tested against rice blast and sheath blight diseases under field conditions during *Kharif* 2014 and -2015. The combination fungicide Trifloxystrobin 25% + Tebuconazole 50% (Nativo 75 WG) @ 0.4 g/l was found effective against blast and sheath blight diseases recording least Percent Disease Index (PDI) of 17.02 and 24.7 respectively. Other combination fungicide Tricyclazole 18% + Mancozeb 62% WP @ 1.5 g/l recorded blast PDI of 26.03 which is statistically on par with Kresoxim methyl 44.3 SC @ 1.0 ml/l and Tricyclazole 75 WP @ 0.6 g/l. Other fungicides of the experiment such as Thifluzamide 24 SC @ 0.75 ml/l, Hexaconazole 4% + Zineb 68% @ 2.0g/l and Carbendazim 12% + Mancozeb 63% WP @ 2.0 g/l are on par among themselves but stands next to the Trifloxystrobin 25% + Tebuconazole 50% (Nativo 75 WG) @ 0.4 g/l in reducing sheath blight PDI. Significant increase in the grain yield was observed in the plots treated with test chemical Nativo 75 WG @ 0.4 g/l (55.13 q/h) compare to the other fungicidal treatments which recorded the yield in the range of 40.75-48.12 q/h.

Key words: Rice, Blast, Sheath Blight, Trifloxystrobin 25% + Tebuconazole 50%, PDI

1. Introduction

Rice (*Oryza sativa* L.) is an important food crop of the world including India. Ever growing population in the world particularly in India is further demanding more rice production and

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28 continuous reduction in the availability of cultivable land demanding higher productivity.
29 Under field condition, the productivity of rice is affected by many biotic and abiotic factors.
30 Among the different biotic constraints, diseases caused by fungal pathogens such as blast and
31 sheath blight are more frequent and ferocious disease in irrigated rice of both temperate and
32 subtropical areas and which causes damage at all stages of crop growth [7].

33 Rice blast caused by *Pyricularia oryzae* Cavara [synonym *Pyricularia grisea* Sacc.
34 the anamorph of *Magnaporthe grisea* (Herbert) Yaegashi and Udagawa], is one of the most
35 destructive and wide spread disease of rice [14]. Blast epidemic causes the complete defeat of
36 seedling [9] at the nursery and in field condition [33] and causes up to 80% of total yield
37 reduction [9,17]. Sheath blight, caused by *Rhizoctonia solani* Kunh., is an important
38 destructive disease of rice occurs in all rice growing areas of the world [21,26,27,32]. In
39 India, a modest estimation of losses due to the sheath blight disease alone has been up to
40 54.3% [23,24]. The disease is particularly important in intensive rice production systems
41 [25]. Yield losses of 5-10% have been estimated for tropical lowland rice in Asia [26].

42 Fungicide based management of blast and sheath blight diseases is successful at field
43 level in majority of the cases [5,15,19,36,38]. Fungicidal control is largely practiced for blast
44 disease in temperate or subtropical rice cultivation, primarily in Japan, China, South Korea,
45 Taiwan and, increasingly, Vietnam [19].

46 For the management of blast, fungicides such as Isoprothiolane, Probenazole,
47 Pyroquilon, Tricyclazole [12] and most of the other fungicides like Benomyl, Carbendazim,
48 Chloroneb, Captafol, Mancozeb, Zineb, Edifenphos, Iprobenphos, Thiophanate, Carboxin,
49 Kitazin, Flutolanil, etc. are found to be effective for blast disease management under field
50 conditions [1,10,16,29,37]. For sheath blight, Most of the fungicides like benomyl,
51 carbendazim, chloroneb, captafol, mancozeb, zineb, edifenphos, iprobenphos, thiophanate,
52 carboxin, etc. have been found effective under field conditions [10,16,29].

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53 Recently, many combination fungicides such as Trifloxystrobin 25% + Tebuconazole
54 50% 75WG, Azoxystrobin 18.2% + Difenconazole 11.4% SC, Kasugamycin 5% + Copper
55 Oxychloride 45% WP and Kresoxim methyl 40% + Hexaconazole 8% WG have been shown
56 to control the blast and sheath blight disease under field condition [2,5,18]

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57 Fungicides have been used successfully to control blast and sheath blight but, due to
58 continuous development of fungicide tolerance in fungal population, it is inevitable to search
59 for a new group of fungicide with different mode of action so that new information on diverse
60 fungicides with different modes of action can be offered to farmers. In this view, present
61 study was undertaken to appraise the field efficacy of Trifloxystrobin 25% + Tebuconazole
62 50% 75WG, a combination fungicide having strobilurin (Trifloxystrobin 25%) and triazole
63 (Tebuconazole 50%) group of fungicide against blast and sheath blight disease of paddy
64 under field conditions.

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65 2. Material and Methods

66 **Layout, Fungicides and Crop establishment:** A randomized complete block design
67 (RCBD) field experiment was conducted at the experimental fields of Agricultural Research
68 Station, Gangavathi, Karnataka (5.4319° N, 76.5315° E) during 2014 & 2015 *Kharif* seasons.
69 A popular rice variety BPT5204 which is susceptible to blast and sheath blight disease was
70 used for the study. Seeds were sown in the month of July and planted in August. Before
71 sowing, healthy seeds were water soaked overnight and incubated in the gunny bags for
72 better sprouting in the nursery. The land was prepared by puddling method by applying one
73 ploughing followed by two ploughing after one week. The experiment was laid out in RCBD
74 with a plot size of 5 x 4 m each for all treatments. Seedlings of 30 days old were planted in
75 trail plots at 20x10 cm spacing. All standard agronomic practices were followed except using
76 higher nitrogenous (200 kg ha⁻¹) and lower pottasic (50 kg ha⁻¹) fertilizer dose than the
77 normal dose (N₂:P₂O₅:K₂O::150:75:75).

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78 The RCBD experiment comprises nine treatments with three replications each. A new
79 formulations viz., Trifloxystrobin 25% + Tebuconazole 50% (Nativo 75 WG), Kresoxim
80 methyl (Ergon 44.3 SC), Thifluzmide 24 SC (Spencer), Avatar (Hexaconazole 4% + Zineb
81 68%), SAAF 75 WP (Carbendazim 12% + Mancozeb 63% WP) and Merger (Tricyclazole 18
82 % + Mancozeb 62 % WP) were included in the treatment. Commercially available popular
83 fungicides like Tricyclazole 75 WP (Beam) @ 0.6 g/lit and Carbendazim 50 WP @ 1.5 g/lit
84 were used for comparison (Table 1). Bio-efficacy was evaluated by spraying all the test
85 chemicals twice at 15 days interval starting from the initiation of the disease.

86 **Artificial inoculation:** Sheath blight disease was artificially inoculated to all experimental
87 treatments after 45 days of planting. Blast disease was evaluated based on natural disease
88 incidence.

89 **Disease assessment and statistical analysis:** Fourteen days after the fungicide application
90 disease assessment was carried out. The disease was measured using the disease rating scale
91 of 0-9 developed by International Rice Research Institute (IRRI) 1996 for blast and sheath
92 blight disease. Further, the scored data was converted into per cent disease index (PDI) using
93 formula given below. The data on the yield were recorded by marking 3 x 2 m section within
94 each plot using a wire frame as described by [28] and tillers within the frame were cut and
95 harvested in order to determine the yield. Data from *Kharif* 2014 & 2015 seasons were
96 pooled to get the average PDI and yield values. Subsequently, the data on disease severity
97 and yield parameters were subjected to appropriate statistical analysis. Cost to Benefit cost
98 ratio (B:C) was calculated by considering the cost of cultivation (including the cost of test
99 fungicides) and market price of the ~~produce~~product.

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$$PDI = [(Sum\ of\ the\ scores) / (Number\ of\ Observation\ X\ Highest\ Number\ in\ Rating\ Scale)] \times 100$$

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3. Result and Discussion

Field experiment revealed that the treatment Trifloxystrobin 25% + Tebuconazole 50% (Nativo 75 WG) @ 0.4 g/l recorded lowest PDI of blast (17.02) and sheath blight (24.70) (table 1 & 2). There was a significant difference among the treatments with respect to PDI of blast and sheath blight diseases and all treatments recorded significantly lower PDI compare to untreated control in both the seasons. One more Meanwhile, other combination fungicide *i.e.* Tricyclazole 18% + Mancozeb 62% WP (Merger) recorded blast PDI of 26.03 which is statistically on par with Kresoxim methyl 44.3 SC (Ergon) @ 1.0 ml/l and Tricyclazole 75 WP (Beam) @ 0.6 g/l. This report is supported by the previous report [35], where they have reported the effectiveness of Trifloxystrobin 25%+Tebuconazole 50% 75WG in controlling the leaf blast disease of paddy under field condition. Previous workers have also reported the effectiveness strobilurin fungicides in reducing the blast disease compare to other fungicides [11].

Test fungicide Trifloxystrobin 25% + Tebuconazole 50% (Nativo 75 WG) @ 0.4 g/l performed better than the Tricyclazole 75 WP @ 0.6g/h, a widely used fungicide against blast disease in India. This could be due to repeated use of Tricyclazole 75 WP for blast disease management from many years which may have lead to the development of resistant fungal population. This observation is in agreement with the previous researchers [31], where they have recommended the rotation of different groups of fungicide for managing the development of fungicide resistance population.

Data from sheath blight disease suggested that the other fungicides of the experiment (solo/combination) such as Thifluzamide 24 SC (Spenser) @ 0.75 ml/l, Hexaconazole 4% + Zineb 68% (Avatar) @ 2.0g/l and Carbendazim 12% + Mancozeb 63% WP (SAAF) @ 2.0 g/l are on par among themselves but stands next to the Trifloxystrobin 25% + Tebuconazole 50% (Nativo 75 WG) @ 0.4 g/l. This finding is in full agreement with the previous report [2], where Trifloxystrobin 25% + Tebuconazole 50% (Nativo 75 WG) @ 0.4 g/l performed better in

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128 | reducing the sheath blight severity. Similarly, Bhuvaneshwari & Raju, in 2012 [5] reported the
129 better efficacy of a combination fungicide azoxystrobin 18.2% + difenoconazole 11.4% SC
130 (strobilurin + triazole) against sheath blight disease. Our report also confirms the better efficacy
131 of strobilurin derived fungicide (either solo or in combination) against sheath blight disease of
132 rice [3]. Various experimental reports confirmed that strobilurin compounds found to be
133 effective in controlling many rice diseases like grain discoloration [2], sheath rot and brown
134 spot [6].

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135 In our study difference in the disease severity among different treatment was reflected
136 in the final grain yield, a significant increase in the grain yield was observed in the plots treated
137 with test chemical Trifloxystrobin 25% + Tebuconazole 50% (Nativo 75 WG) @ 0.4 g/l (55.13
138 q/h) compare to the other fungicidal treatments which recorded the yield in the range of 40.75-
139 48.12 q/h (Table.3). The lowest yield was recorded in the unsprayed control plots (36.33 q/h).
140 Our results are in conformity with previous reports [3,5,20,22,30,34,35]. Previous workers
141 reported that fungicides application increases the yield of rice. In the present study, the
142 fungicide Trifloxystrobin 25% + Tebuconazole 50% (Nativo 75 WG) @ 0.4 g/l have found
143 superior in reducing the leaf blast and sheath blight disease PDI and therefore increased the
144 grain yield [3].

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145 Due to non availability of location specific resistance varieties for blast disease, the
146 chemical control is an important strategy for the farmers to harvest economic yield. Moreover,
147 poor bio-efficacy of the bio-control agents under the severe epidemic condition makes the
148 chemical control is an inevitable and ultimate means for blast disease management for farmers.
149 For sheath blight, though cultivation of resistant variety is the best option but till date no such
150 variety is available to the farmers. Thus, in present situation cultural practices combined with
151 foliar spray of fungicide is the most common practice to manage the disease and even in

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integrated pest management system need based application of fungicide has been recommended [3].

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Table-1: Effect of Trifloxystrobin 25%+Tebuconazole 50% 75WG on blast disease of rice (Pooled from Kharif – 2014 & 2015)

Sl No	Treatments	Dose/l	Leaf Blast Disease Severity (PDI)		
			2014	2015	Pooled
T 1	Trifloxystrobin 25% WP + Tebuconazole 50% WP (Nativo)	0.4 g	17.60 (24.80)	16.44 (23.93)	17.02 (24.35)
T 2	Kresoxim methyl (Ergon 44.3 SC)	1.0 ml	27.21 (31.45)	29.75 (33.05)	28.48 (32.25)
T 3	Thifluzamide 24 SC (Spencer)	0.75 ml	31.10 (33.89)	35.97 (36.85)	33.53 (35.38)
T 4	Hexaconazole 4% + Zineb 68% (Avatar)	2.0 g	33.60 (35.43)	29.28 (32.77)	31.44 (34.10)
T5	Tricyclazole 18%+ Mancozeb 62% WP (Merger)	1.5 g	25.71 (30.46)	26.35 (30.83)	26.03 (30.67)
T6	Tricyclazole 75 WP (Beam)	0.6 g	26.10 (30.72)	25.72 (30.46)	25.91 (30.59)
T7	Carbendazim 50 WP (Bavistin)	1.0 g	36.10 (36.93)	30.28 (33.40)	33.19 (35.11)
T8	Carbendazim 12% + Mancozeb 63% WP (SAAF)	2.0 g	31.12 (33.92)	34.55 (36.01)	32.83 (34.98)
T9	Trifloxystrobin 25% WP + Tebuconazole 50% WP (Nativo)	2.2	46.93 (43.23)	38.28 (38.45)	42.6 (40.74)
Co-efficient of Variance (CV)			10.54	13.56	11.52
Critical Difference (CD)			4.17	5.14	4.01

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* Figures in the parentheses represent arcsine transformed values

Table-2: Effect of Trifloxystrobin 25%+Tebuconazole 50% 75WG on sheath blight disease of rice (Pooled from *Kharif* – 2014 &2015)

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Sl No.	Treatments	Dose/l	Sheath blight (PDI)		
			2014	2015	Pooled
T 1	Trifloxystrobin 25% WP + Tebuconazole 50% WP (Nativo)	0.4 g	23.55 (29.05)	25.86 (30.55)	24.70 (29.80)
T 2	Kresoxim methyl (Ergon 44.3 SC)	1.0 ml	41.38 (40.00)	43.05 (41.00)	42.21 (40.53)
T 3	Thifluzamide 24 SC (Spencer)	0.75 ml	35.82 (36.78)	38.71 (40.87)	37.26 (37.60)
T 4	Hexaconazole 4% + Zineb 68% (Avatar)	2.0 g	33.33 (35.24)	36.55 (37.17)	34.94 (36.25)
T5	Tricyclazole 18%+ Mancozeb 62% WP (Merger)	1.5 g	44.99 (42.12)	42.77 (40.82)	43.88 (41.48)
T6	Tricyclazole 75 WP (Beam)	0.6 g	39.99 (39.22)	45.85 (42.62)	42.92 (40.94)
T7	Carbendazim 50 WP (Bavistin)	1.0 g	37.33 (37.64)	38.88 (38.55)	38.10 (38.09)
T8	Carbendazim 12% + Mancozeb 63% WP (SAAF)	2.0 g	35.55 (36.60)	37.77 (37.90)	36.66 (37.25)
T9	Check	--	47.77 (43.68)	55.68 (48.25)	51.72 (46.01)
Co-efficient of Variance (CV)			10.8	12.42	13.26
Critical Difference (CD)			4.7	5.13	4.98

* Figures in the parentheses represent arcsine transformed values

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Table-3: Effect of Trifloxystrobin 25%+Tebuconazole 50% 75WG on grain yield

SI No.	Treatments	Dose/l	Yield (Q/h)			B:C
			2014	2015	Pooled	
T 1	Trifloxystrobin 25% WP + Tebuconazole 50% WP (Nativo)	0.4 g	56.50	53.75	55.13	2.21
T 2	Kresoxim methyl (Ergon 44.3 SC)	1.0 ml	46.50	47.00	46.75	1.87
T 3	Thifluzamide 24 SC (Spencer)	0.75 ml	50.62	41.50	46.06	1.9
T 4	Hexaconazole 4% + Zineb 68% (Avatar)	2.0 g	50.87	39.12	44.99	1.82
T5	Tricyclazole 18%+ Mancozeb 62% WP (Merger)	1.5 g	48.62	47.15	47.88	1.66
T6	Tricyclazole 75 WP (Beam)	0.6 g	50.25	46.00	48.12	2.0
T7	Carbendazim 50 WP (Bavistin)	1.0 g	41.40	40.75	41.07	1.74
T8	Carbendazim 12% + Mancozeb 63% WP (SAAF)	2.0 g	43.00	38.50	40.75	1.7
T9	Trifloxystrobin 25% WP + Tebuconazole 50% WP (Nativo)	1	37.36	35.30	36.33	1.6
Co-efficient of Variance (CV)			11.06	14.17	10.55	
Critical Difference (CD)			5.6	4.2	6.05	

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