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RESEARCH NOTE

Field evaluation of fungicides against *Puccinia purpurea* Cooke. causing sorghum rust

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Abstract: Rust of sorghum caused by *Puccinia purpurea* Cooke. is becoming a serious problem in *rabi* sorghum, results in severe losses in grain and fodder yield. The present study was carried out during *rabi* 2020-21 at Main Agricultural Research Station, University of Agricultural sciences, Dharwad on evaluation of fungicides for management of sorghum rust. The results revealed that the minimum rust severity after first spray was recorded in the treatment trifloxystrobin 25 % + tebuconazole 50 % WG (12.10 %) followed by hexaconazole 5 % + validamycin 2.5 % SC (14.07 %) with 65.29 and 59.41per cent reduction in disease over control, respectively. Maximum grain and fodder yield was recorded in trifloxystrobin 25 % + tebuconazole 50 % WG (11.27 q/ha and 61.02 q/ha, respectively) followed by hexaconazole 5 % + validamycin 2.5 % SC (10.83 q/ha and 58.83 q/ha, respectively). However, the highest B:C ratio of 1.72 was recorded in hexaconazole 5 % + validamycin 2.5 % SC followed by hexaconazole 5 % EC (1.63).

Keywords: Management, Rust severity, Sorghum

Sorghum is one of the most important cereal crops grown all over the globe.At present in India, it occupies an area of 4.48 million ha with the production of 4.38 million tonnes and productivityof 995 kg perha(Anon., 2019a).The major sorghum producing states in India are Maharashtra, Karnataka, Madhya Pradesh, Tamil Nadu, Andhra Pradesh and Rajasthan. In Karnataka, it is grown on 9.48 lakh ha of which 1.11 lakh ha in *kharif* season and 8.37 lakh ha in *rabi* season with the production of 7.17 lakh tonnes and productivity of 857 kg ha^{-1} (Anon., 2019b).With the extensive cultivation of crop, problems of disease and pest have resulted in considerable yield losses. Sorghum suffers from many fungal, bacterial and viral diseases.Out of these diseases, sorghum rust caused by *P. purpurea* was a serious problem in *rabi* sorghum in last two years (during 2018-2019) in Dharwad and incurring major losses in both grain and fodder yield. It is a widespread disease in most sorghum growing parts of the world during flowering and grain filling stage. In India rust appears in both *rabi* (early) and *kharif* (late) seasons. Damage caused by rust depends on the time of infection and varieties affected. If infection occurs early, the premature drying of leaves results in reduction in yields and fodder quality.Severe rust infection also contributes to lodging by reducing leaf area and increasing plant stress (Ryley *et al.,* 2002). Such affected plants are more prone to severe foliage infection (*Macrophomina* and *Fusarium*) resulting in poor panicle exertion and grain yield.Under natural rust infection, yield loss as high as 65 per cent was estimated (Bandyopadhyaya, 2000). Keeping these points in view, the present study is aimed at identification of effective fungicide for management of sorghum rust.

A field experiment was conducted during *rabi* 2020-21, at Main Agricultural Research Station, University of Agricultural sciences, Dharwad. The rust susceptible sorghum variety, M 35-1 was sown at 45 cm × 15 cm spacing with RBD design and three replications to evaluate the efficacy of nine different fungicides against sorghum rust. The first spray of fungicides was given soon after the disease appearance (80 days after sowing). Rust severity was recorded at the onset of disease and two times at 15 days interval from first spray of fungicides using 0-9 scale (Ndalira *et al.,* 2020). Further the grades were converted to per cent disease index (PDI) using the formula given by Wheeler (1969) and was transformed to angular values, before the analysis.Later, grain and fodder yield (kg/plot) were recorded and finally converted into q/ha.

The results (Table 1) obtained at 15 days after 1st spray revealed that, minimum rust severity was observed in T_8 (trifloxystrobin 25 % + tebuconazole 50 % WG at 0.05 %)with 9.63 per cent of rust severity which was statistically on par with T_7 (hexaconazole 5 % + validamycin 2.5 % SC at 0.05%)with rust severity of 11.11 per cent.Further two treatments *viz.,*T_5 (hexaconazole 5 % EC at 0.1 %) and T_6 (propiconazole 25 % EC at 0.1 %), with rust severities of 14.81 per cent and 15.06 per cent, respectively were statistically on par with each other. The maximum rust severity was observed in untreated control (24.94 %). Similarly, minimum rust severity at 30 days after 1st spray was recorded in T_8(14.57 %) which was statistically on par with T_7(17.04 %). Further two treatments *viz.,*$T_5$and T_6, with rust severities of 22.96 per cent and 24.20 per cent, respectively were statistically on par with each other. Maximum rust severity was observed in untreated control (41.98 %).

In both the observations, the treatment T_8 recorded the least rust severity of 9.63 and 14.57 per cent in the respective week with the maximum disease reduction of 65.29 per cent (Fig. 1). The present results are in acordance with Gorakhanath (2015), who documented that two sprays of hexaconazole (0.1 %) were found to be most effective in controlling rust of sorghum (84.16 %) followed by difenconazole (83.41 %) and propiconazole (82.37 %).Wheat stripe rust was effectively controlled by azoxystrobin 25 EC, which was followed by difenconazole 25 EC (Singh *et al.*, 2016). Combi fungicides contain one contact and one systemic fungicide or two systemic with different mode of action. As strobilurin and triazole group of fungicides vary with respect to mode of action, combination of these two would be best in control of plant diseases andavoid development of fungicide resistance. Fungican develop resistance to one fungicide by point mutation but can't develop resistance to two fungicides with different mode of action at once (Bosch *et al.,* 2014).Thus, from the present study trifloxystrobin 25 % + tebuconazole 50 % WG which is a combi fungicide was proven to be effective against sorghum rust.

Table 1. Effect of different fungicides in management of sorghum rust, grain yield and economics

Treatments	Fungicides	Dosage	PDI			Per cent reduction in disease over control	Grain yield (q/ha)	Per cent increase in grain yield over control	Test weight (g)	Dry fodder yield (q/ha)	Per cent increase in fodder yield over control	B:C ratio
			At the onset of disease	15 days after 1st spray	30 days after 1st spray							
T_1	Mancozeb 75% WP	2.5 g/l	2.22 (8.57)	23.46 (28.97)	39.01 (38.65)	7.06	9.71	10.30	2.44	53.42	11.25	1.47
T_2	Validamycin 3% L	0.5 ml/l	2.96 (9.91)	21.24 (27.44)	32.84 (34.96)	21.76	9.98	13.37	2.67	55.51	15.60	1.62
T_3	Copper oxychloride 50 WP	3 g/l	2.22 (8.57)	24.20 (29.47)	40.25 (39.38)	4.12	9.59	8.98	2.35	53.15	10.68	1.38
T_4	Carbendazim 50% WP	1 g/l	2.71 (9.48)	24.44 (29.63)	40.74 (39.66)	2.94	9.38	6.55	2.32	52.03	8.34	1.43
T_5	Hexaconazole 5% EC	1 ml/l	2.47 (9.04)	14.81 (22.64)	22.96 (28.63)	45.29	10.44	18.60	2.87	57.86	20.49	1.63
T_6	Propiconazole 25% EC	1 ml/l	2.96 (9.91)	15.06 (22.84)	24.20 (29.47)	42.35	10.35	17.61	2.80	57.00	18.70	1.53
T_7	Hexaconazole 5%+ validamycin 2.5% SC	0.5 ml/l	2.22 (8.57)	11.11 (19.47)	17.04 (24.38)	59.41	10.83	23.03	3.07	58.83	22.52	1.72
T_8	Trifloxystrobin 25% + tebuconazole 50% WG	0.5 g/l	2.96 (9.91)	9.63 (18.08)	14.57 (22.44)	65.29	11.27	28.11	3.12	61.02	27.08	1.50
T_9	Captan 70% + hexaconazole 5% WP	1 g/l	2.22 (8.57)	22.47 (28.30)	35.80 (36.75)	14.71	9.89	12.39	2.51	54.32	13.12	1.48
T_{10}	Control		2.96 (9.91)	24.94 (29.96)	41.98 (40.38)	-	8.80	-	2.29	48.02	-	1.45
	S.Em.±		0.419	1.437	1.528		0.376		0.155	2.017		0.060
	C.D. at 5%		NS	4.410	4.576		1.125		0.463	6.040		0.180

*Figures in parenthesis are arcsine values

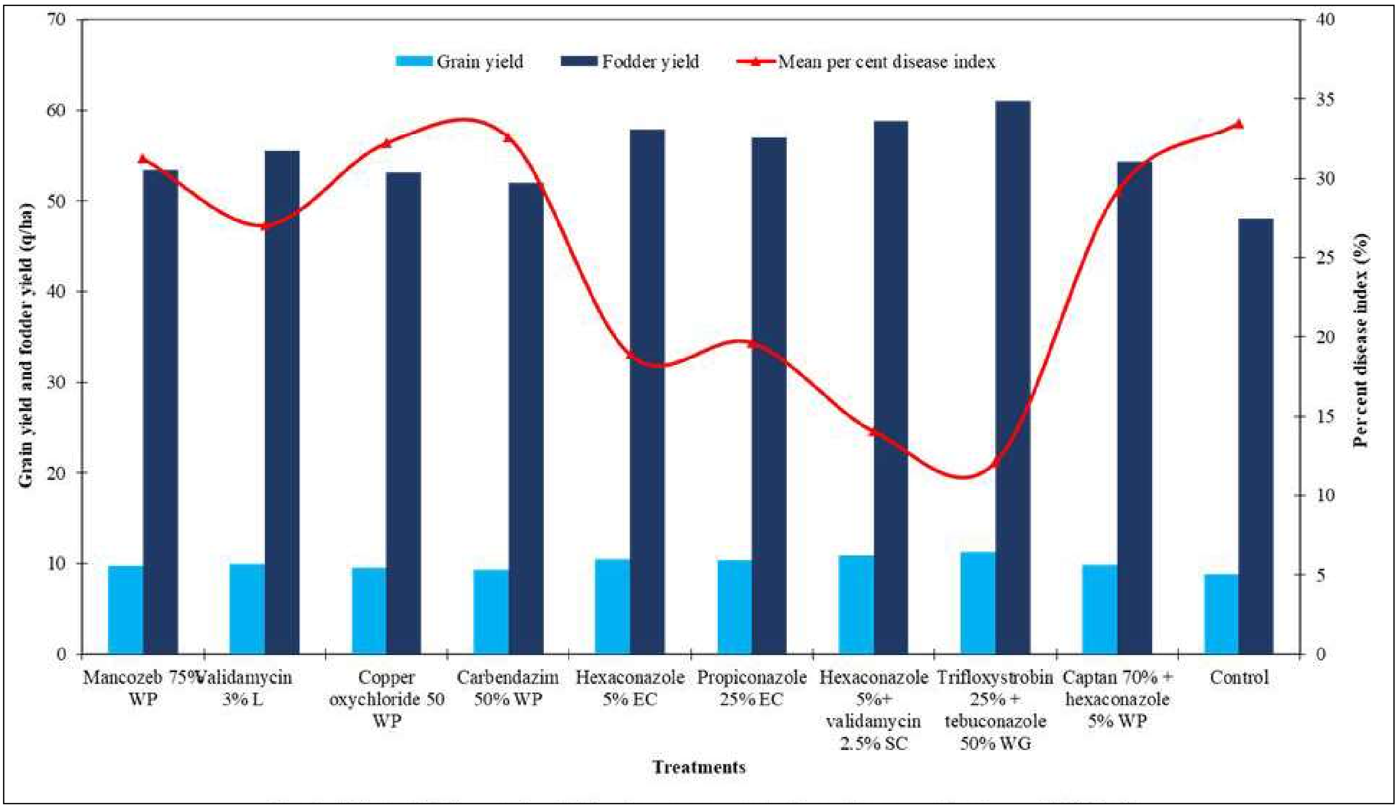

Fig. 1 . Effect of different fungicides in management of sorghum rust and grain & foder yield during *rabi* season – 2020-21

The treatments *viz.,* T_8, T_7, T_5 and T_6 recorded higher grain yield (11.27, 10.83, 10.44 and10.35q/ha, respectively) and fodder yield (61.02, 58.83,57.86 and 57.00 q/ha, respectively). Similarly, the treatments *viz.,* T_8, T_7, T_5 and T_6 recorded higher test weight of 3.12, 3.07, 2.87 and 2.80 g, respectively. The above results revealed that the treatment T_8 was found to be the best in increasing both grain and fodder yield, with the maximum increase of 28.11 per cent and 27.08 per cent respectively, followed by $T_7$with grain yield (23.03 %) and fodder yield (22.52 %). The treatment T_7 which was statistically on par with the best treatment T_8 recorded highest B:C ratio of 1.72, followed by T_5 (1.63).The present results are in agreement with the findings of Singh *et al.* (2016), who reported that azoxystrobin 25 EC effectively controlled wheat stripe rust and showed increased grain yield, fodder yield and grain weight.

It concluded that, the treatment trifloxystrobin 25 % + tebuconazole 50 % WG has reduced rust severity to the maximum extent, increased grain yield and fodder yield. But the highest B: C ratio was observed in fungicide hexaconazole 5 % + validamycin 2.5 % SC which was statistically superior over the best treatment. Thus, Single spray of hexaconazole 5 % + validamycin 2.5 % SC @ 0.5ml/lit was found optimum in reducing rust severity with increase in grain yield and fodder yield of *rabi* sorghum.

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