Society for Advancement of Wheat and Barley Research
ICAR-Indian Institute of Wheat & Barley Research
Karnal - 132 001, India

Wheat and Barley Research
10(3): 224-227

Research Article

Homepage: http://epubs.icar.org.in/ejournal/index.php/JWR

Evaluation of Fungicides for the Management of Stripe Rust (*Puccinia striiformis f.sp. hordei*) of Barley

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Article history

Received: 22 Sep., 2018
Revised : 19 Nov., 2018
Accepted: 28 Nov., 2018

Citation

Kanwar H, PS Shekhawat, V Kumar, BDS Nathawat. 2018. Evaluation of fungicides for the management of stripe rust *(Puccinia striformis f.sp. hordei)* of barley. *Wheat and Barley Research* **10**(3): 224-227. doi.org/*10.25174/2249-4065/2018/83425*

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Abstract

The field experiment was conducted to evaluate the efficacy of different chemical fungicides against stripe rust of barley caused by *Puccinia striiformis* f.sp. *hordei* using susceptible cv. RD 2035 for two consecutive rabi seasons (2016-17 & 2017-18) at Rajasthan Agricultural Research Institute, Durgapura, Jaipur. Among the tested fungicides Trifloxystrobin+Tebuconazole @ 0.1% was found best with minimum disease (8.08 PDS) along with highest yield (56.50 q/ha.). It was followed by Tebuconazole @ 0.1% (9.43 PDS), Trifloxystrobin+Tebuconazole @ 0.05 %, (10.35 PDS) and Tebuconazole @ 0.05% (11.68 PDS). The yield performance of Tebuconazole @ 0.1% (42.33 PDS) and Trifloxystrobin+Tebuconazole @ 0.05 % (54.90 q/ha) were at par with Trifloxystrobin +Tebuconazole @ 0.1 (56.59 q/ha). However, highest and equal B:C ratio (2.8) was recorded in Tebuconazole +Trifloxystrobin @ 0.05% and Tebuconazole @ 0.1% followed by Tebuconazole +Trifloxystrobin @ 0.1% (2.7 B:C) Tebuconazole @ 0.05% (2.6 B:C), propiconazole @ 0.1% (2.6 B:C) and propiconazole @ 0.05% (2.3 B:C)

Keywords: Barley, Stripe rust, Fungicides, Puccinia striiformis f.sp. hordei, Percent diseases severity (PDS)

1. Introduction

Barley (*Hordeum vulgare* L.) is adapted to marginal and stress-affected environment and is a source of malt and other products (Devlash *et al.*, 2015). In India, barley crop now emerged as the fourth largest producer with total production of 1.78 million tonnes during (2016-17) in 6.93 million hectare area. In Rajasthan, the area under barley cultivation is 2.81 lac hectares with total production of 0.8 million tonnes which is highest in the country (Anonymous, 2016-17). Barley stripe rust, caused by *Puccinia striiformis* f. sp. *hordei* (PSH), is an important disease of barley in several parts of world (Safavi *et al.*, 2012). The crop is affected by many fungal, bacterial and viral diseases and amongst them the stripe rust (*Puccinia striiformis* f.sp. *hordei*) is a major biotic factor limiting barley production especially in the northwestern plains and northern hills of India (Verma *et al.*, 2018). Vaish *et al.* (2011) reported stripe rust as the most destructive disease resulting in 66% yield loss on susceptible cultivars in the trans-Himalayan region of India. Among various disease management options, stripe rust can be managed effectively by the use of fungicides. Historically stripe rust was commonly observed in cool and moist seasons. But in recent years, stripe rust is emerging as a serious threat in warmer areas where the disease was previously considered unimportant or absent due to movement of new aggressive strains of stripe rust which have ability to adopt higher temperature into non-traditional areas (Hovmoller *et al.*, 2008). Therefore, under epidemic conditions and non availability of resistant varieties, fungicides is the only option in reducing rust severity as a component in integrated management of the disease. Timely and judicious use of effective fungicides for management of stripe rust will be profitable to the farmers. There is very little information published on the use of fungicide to control barley stripe rust in India (Selvakumar *et al.*, 2014). Hence the study was carried out to evaluate various new fungicides to control barley stripe rust.

2. Material and methods

The field experiments were conducted during two consecutive Rabi seasons (2016-17 and 2017-18) at Rajasthan Agricultural Research Institute, Durgapura with susceptible barley variety RD 2035. Sowing was done in 2x2 m plot with three replications in randomize bock design (RBD). In the periphery of the experiment, the susceptible infector rows were grown and artificially inoculated with mixture of races (G, M, 24 & 57) of stripe rust using spray and dusting methods. Observations on per cent disease severity were recorded using modified Cobb scale, suggested by Peterson et al. (1948). The fungicidal spray was started with the appearance of rust and two sprays were applied with ten days interval. The observation on rust was recorded before first spray, 10 days after first and second sprays and finally at dough stage. The data on yield was recorded at harvest. The experimental data were subjected to statistical test by following Analysis of Variance Technique suggested by Panse and Sukhatme (1967) where, variance ratio ("F" Value) was significant, critical difference (CD) value at 5% level of probability were computed for making treatment comparisons. The gross returns, cost of cultivation, net returns and benefit: cost ratio (B: C ratio) were calculated by using prevailing prices of inputs and outputs on the basis of minimum support price (MSP).

$$\textbf{Benefit: cost ration} = \frac{\textit{Gross returns } (₹ ha^{-1})}{\textit{Cost of cultivation } (₹ ha^{-1})}$$

The fungicides and their concentrations are listed below

SN	Common name	Trade name	Active ingredient	concentration (%)	Dose /l
1	Tebuconazole	Folicur	25.9 EC	0.05	0.05ml
2	Tebuconazole	Folicur	25.9 EC	0.1	1ml
3	Propiconazole	Tilt	25 EC	0.05	0.05ml
4	Propiconazole	Tilt	25 EC	0.1	1ml
5	Trifloxystrobin+Tebuconazole	Nativo75WG	25+50%	0.05	0.05ml
6	Trifloxystrobin+Tebuconazole	Nativo75 WG	25+50%	0.1	1ml
7	Difenoconazole	Score	25EC	0.05	0.05ml
8	Difenoconazole	Score	25EC	0.1	1ml
9	Mancozeb	DithaneM-45	75%WP	2 gm	2g

3. Result and discussion

Two years pooled data revealed that there was no significant difference in per cent disease severity (PDS) among the treatments recorded before first spray. Howeaver, all the treatments of different spraying schedules showed significant effect on per cent disease severity over the check at ten days after first spray (TDAFS) (Table-1). The minimum per cent disease severity was recorded in Trifloxystrobin+Tebuconazole @ 0.1% (0.42 PDS) followed by Tebuconazole @ 0.1% (0.55 PDS) Trifloxystrobin+Tebuconazole @ 0.05% (0.88 PDS) and Tebuconazole @ 0.05% (1.27 PDS). The disease severity was highest in control (27.93) at 10DAFS. Similar result was reported by Brown *et al.,* (2002) that the foliar application of tilt, folicur or bayleton applied at the first sign of stripe rust infections were effective in controlling the stripe rust pathogen. The minimum per cent disease severity at TDASS was recorded in treatment Trifloxystrobin+Tebuconazole @ 0.1% (0.03 PDS) followed by Tebuconazole @ 0.1% (0.20 PDS), Trifloxystrobin + Tebuconazole @ 0.05% (0.35 PDS) and Tebuconazole @ 0.5% (0.40 PDS) and these treatments were at par in efficacy with best treatment Trifloxystrobin+Tebuconazole @ 0.1%. Two years pooled data presented in the Table-1 revealed that all the fungicides were found significantly effective over untreated check in reducing the disease and increasing the yield. Among the treatments Tebuconazole +Trifloxystrobin @ 0.1% (8.08 PDS) was found the best with minimum disease severity followed by Tebuconazole @ 0.1% (9.43 PDS), Tebuconazole +Trifloxystrobin @ 0.05% (10.35 PDS) and Tebuconazole @ 0.05% (11.68 PDS). These treatments were at par in efficacy. These were closely followed by propiconazole @ 0.1% (13.82 PDS) in efficacy. Among the tested fungicides there was no significant difference in efficacy with their higher (0.1%) and lower (0.05%) concentrations. Difenoconazole @ 0.05% andmancozeb 75% WP were less effective in managing the disease (Table-1). Similar findings were also reported by Qing Mei *et al.* (2003) that the efficacy of Tebuconazole was 98.17 per cent against the rust which was higher than triadimefon in controlling stripe rust of wheat. Parallel results were reported by Selvakumar et al. (2014) that bayleton and folicur were found to be more effective than tilt for controlling stripe rust of barley. All the treatments gave significantly higher yield as compare to

untreated check. Although Tebuconazole +Trifloxystrobin @ 0.1% was found best with maximum yield (56.50 q/ha) followed by Tebuconazole + Trifloxystrobin @ 0.05% (54.90 q/ha), Tebuconazole @ 0.1% (53.37 q/ha), propiconazole @ 0.1% (48.98 q/ha), Tebuconazole @ 0.05% (47.55 q/ha) and propiconazole @ 0.05% (42.33 q/ha) (Table-1). Singh *et al.* (2010) observed that foliar sprays of propiconazole (tilt 25 EC) @ 0.1%, reduced the incidence of barley stripe rust with higher 1000-grain weight and grain yield over untreated control. Similar results were found (Devlash *et al.* 2015) that the application of fungicide viz., propiconazole, Tebuconazole and triademefon @ 0.1% resulted in reduction of rust severity ranging from 87.8% to 95.6% and higher grain yield obtained with propiconazole @ 0.1% (26.7 q/ha) followed by Tebuconazole @ 0.1% (25.2 q/ha) and triademefon @ 0.1% (24.5 q/ha). The higher B:C ratio was recorded in Tebuconazole +Trifloxystrobin @ 0.05% (2.8 B:C) and it was same in Tebuconazole @ 0.1 % (2.8 B:C) followed by Tebuconazole +Trifloxystrobin @ 0.1% (2.7 B:C) Tebuconazole @ 0.05% (2.6 B:C), propiconazole @ 0.1% (2.6 B:C), propiconazole @ 0.05% (2.3 B:C). This might be due to higher price of Trifloxystrobin +Tebuconazole (Table-1).

Table-1 Efficacy of different fungicides for the management of Puccinia striiformis f. sp. hordei during Rabi 2016-17 & 2017-18 (Two years pooled data)

SN	Fungicides	Conc. (%)	Percent disease severity				Per cent disease Suppression	Pooled Yield (q/ha)	Percent increase in yield over the control	B:C ratio
			BFS	TDAFS	TDASS	Final				
1	Tebuconazole 25.9%EC	0.05	6.38	1.27	0.4	11.68	87.71	47.55	53	2.6
2	Tebuconazole 25.9%EC	0.1	6.45	0.55	0.2	9.43	90.07	53.37	58.12	2.8
3	Propiconazole25%EC	0.05	5.88	2.18	1.38	16.07	83.08	42.33	47.2	2.3
4	Propiconazole25%EC	0.1	5.92	1.62	1.02	13.82	85.45	48.98	54.37	2.6
5	Trifloxystrobin 25%+Tebuconazole 50%	0.05	6.35	0.88	0.35	10.35	89.11	54.9	59.29	2.8
6	Trifloxystrobin 25%+Tebuconazole 50%	0.1	6.48	0.42	0.03	8.08	91.49	56.5	60.44	2.7
7	Difenoconazole	0.05	6.12	8.02	10.37	41.63	56.18	30.6	26.96	1.6
8	Difenoconazole	0.1	5.53	6.37	10.5	38.87	59.08	34.65	35.5	1.7
9	Mancozeb75%WP	0.2	6.65	10.82	14.15	57.93	39.02	30.02	25.55	1.6
10	Control	0.05	6.35	27.93	47.22	95	0	22.35	0	1.3
			NS	0.83	1.21	4.05		1.35		
			6.51	8.03	8.25	7.8		5.55		

BFS: Before first spray TDAFS: Ten days after first spray TDASS: Ten days after second spray

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