International Journal of Advanced Multidisciplinary Research (IJAMR)
ISSN: 2393-8870
www.ijarm.com

Research Article
Efficacy of folier fungicides for controlling wheat rust

Mazher Farid Iqbal[1],[2]Muzzammil Hussain and [3]Masood Qadir Waqar

[1]Adaptive Research Station, Sialkot
[2]Adaptive Research Farm, Gujranwala
[3]Directorate of Agriculture (Adaptive Research) Punjab-Lahore
Corresponding Author : *mazherfareed2004@gmail.com*

Keywords

Efficacy;
fungicides;
Wheat;
Sehar;
control;
Incremental cost;
Punjab-Pakistan

Abstract

The study was conducted to evaluate different foliar fungicides i. e. Propiconazole @ 625 ml/ha; Metiram @ 625 g/ha; Difenaconazole @ 375 ml/ha and Sulpher @ 2500 g/ha for controlling rust of wheat in agro-ecological zone of Adaptive Research, Gujranwala during 2011-2012 and 2012-2013 with Randomized Complete Block Design. Statistically significant (P<0.05) disease control was recorded by difenaconazole (25.50% & 22.91%); compared to followed by Propiconazole (22.5% & 21.11%) and Sulpher (21.19%) compared to control (0%) during two successive years. However the lowest control was recorded by metiram (19.17% & 19.64%).However statistically significant (P<0.05) 1000 grain wt. was recorded by difenaconazole (41.97g& 40.33) compared to all other treatments during 2011-12. However statistically non significant effect (P>0.05) was recorded in all the treated fungicides but showed significant (P<0.05) result over control during 2012-13.Highly significant (P<0.05) result in yield (t/ha) was recorded by difenaconazole (3.48) and propiconazole (3.41) compare to all other treatments during 2011-12. Highly significant (P<0.05) effect in yield (t/ha) was recorded by Sulpher (4.13) compared to difenalconazole (3.67); metiram (3.66) and propiconazole (3.53) compared to control (3.33) during Rabi 2012-13. Maximum BCR was recorded by Sulpher (2.30) with net return of (Rs. 61714/ha) followed by propiconazole (2.13); metiram (2.12); difenaconazole (2.10) with net return of Rs. 55492/ha; Rs. 52779/ha; respectively. However maximum incremental benefit was recorded by Sulpher (Rs. 16784/ha) with BCR (16.67) followed by propiconazole ((Rs. 10562/ha); metitam (Rs. 7849/ha) and difenaconazole (Rs. 7546/ha) with BCR (10.54); (13.04) and (6.28). However low BCR of propiconazole was only due to high price of this product. All the fungicides were effective for controlling the disease; however the farmers are advised to use sulpher, metiram and propiconazole for controlling it in rainfed areas of agro-ecological zone of Gujranwala.

Introduction

Wheat (*Triticum aestivum*) is the most important widely cultivated cereal crop in Pakistan due to its properties, uses of grains and straw. Increment in yield is an important national goal to meet the continuous increasing food's need. In Pakistan wheat was grown on an area of 8693 thousand hectares with production 24.2 million tones (Anonymous, 2012). Wheat is sown on an area of 1051 thousand hectares in Gujranwala division (Anonymous, 2013). Like other crops wheat has major threat to diseases which hindered its quality and decreasing yield.In many diseases Rust of wheat caused huge loss to the crop. Yellow rust is caused by the fungus *Puccinia recondita*. Symptoms are small, orange pustules randomly scattered over leaves. It is common to see a yellowing of the leaf around the rust pustules. During autumn and winter symptoms are usually confined to older leaves. These winter symptoms of yellow rust are sometimes difficult to distinguish from those of brown rust. In the summer yellow rust and brown rust are easier to tell apart. Yellow rust pustules are arranged in stripes, and there is greater differentiation of color. Late in the season yellow rust can become very severe and result in leaf death. Leaf sheaths and ears sometimes become affected. Tiny yellow spore cases

may be seen on diseased plant tissue, indicating a second developmental stage of the fungus (HGCA, 2012). First signs are reddish-orangespore masses (pustules) that erupt through leaf surfaces under warm, humid conditions, spread is rapid and leaves turn dull yellow with rust. Losses can be heavy, especially if drought conditions occur (Melvin, 1914).The pathogen survives from one season to the next on volunteer wheat plants or as latent infections in dormant wheat plantings. Mild winters and cool moist spring'sfavors its development, subsequent inoculums that can be wind blown to adjacent fields of wheat. Urediniospores can be blown freely over very long distances so infections in one area can be a result of spore showers. These spore showers are literally spores being washed from the sky in a rainfall or when winds slow and allow spores to settle down to earth and thus inoculate plants in an area where no disease had been observed. Urediniospores are required to infect wheat plant and produce hundredsspores. Free water on leaves and temperatures ranging from 0 to 25 ^{O}C (32-77 ^{O}F) are required for spore germination. Subsequent release of spores from an infected plant can occur in as few as 11 days at optimum temperatures. At near freezing temperatures the time from infection to spore release can be as many as 180 days (Evans et al., 2008). Hot summer temperatures and dry weather are least conducive for the pathogen. Above 25 ^{O}C (77 ^{O}F) the fungus becomes unable to produce spores and above 29 ^{O}C (85 ^{O}F), the pathogen is died. Other grasses are not thought to play any role in the overwintering survival or inoculums production of the pathogen(HGCA, 2012).However the study had been planned to evaluate different foliar fungicides for controlling rust of wheat in agro-ecological zone of Adaptive Research, Gujranwala during 2011-2012 and 2012-2013.

Materials and Methods

The study was conducted to evaluate some foliar fungicides i. e. Propiconazole @ 625 ml/ha; Metiram @ 625 g/ha; Difenaconazole @ 375 ml/ha and Sulpher @ 2500 g/ha sprayed with knapsack sprayer with hollow cone nozzle for controlling wheat rust in agro-ecological zone of Adaptive Research, Gujranwala during 2011-2012 and 2012-2013 with Randomized Complete Block Design. The wheat variety Sehar-2006 was used as medium and it was cultivated on 25th of November each year. The recommended dose of NP i.e. 158:114 kg/ha was applied with seed cum fertilizer till drill after well prepared soil with double usage of disc harrow and one pass of cultivator along with single pass of planking. After 1st irrigation 2.5 bags/ha Urea was broadcasted manually at watter condition. After 2nd irrigation at watter condition suitable herbicides were sprayed with knapsack sprayer with T-Jet/Flat Fan nozzle to control all types of weeds. However the field was irrigated three times with 19 acre inch application of water during the growing season. Before spraying specific plots were laid out each planned fungicide was sprayed in the field just appearance of disease and compared to the control. However data on the yield were recorded by making 3x2 m section within each plot using a wire frame method reported by Seebold etal., (2004). The crop was harvested at its physiological stage when the color of the crop changed from green to yellowish. To prevent the harvested crop from rain, kept in bundles and stocked openly in the field. Threshing was carried out by mini-threshor and cleaned manually. After cleaning, data related to seed yield was recorded. The parameters recorded were disease control (%); 1000 grain weight (g); yield (t/ha)and economic analysis (CBR). For measurements of diseased leaf area tillers/plant were randomly selected, diseasewas rated by using rating scale which was illustrated previously (Chaudary et al., 2009). The collected data wereanalyzedstatistically by applying analysis of variance technique at 5% level of probability (Steel et al., 1997).

Results and Discussion

Disease Control (%)

From table 1 revealed that statistically significant ($P<0.05$) disease control was recorded by difenaconazole (25.50% & 22.91%); compared to followed by Propiconazole (22.5% & 21.11%) and Sulpher (21.19%) compared to control (0%) during two successive years. However the lowest control was recorded by metiram (19.17% & 19.64%).Fungicides (triazoles) were most effective applied before disease infects upper leaves a number of fungicides were affected for the control of rust. These results were agreed with Evans et al., (2008)who reported that Propiconazole fungicide was effective for controlling rust in wheat crop. Efficacy, rates, and timing of fungicide application were most important for controlling rust in wheat (Chenand Wood, 2002).In United State five fungicides, propiconazole, azoxystrobin, propiconazole+trifloxystrobin, strobilurin and azoxystrobin+propiconazole were effective control measures against disease of barley and wheat rust(Chen and Wood 2003). Nevertheless, the use of fungicides added a huge cost to whea tproduction which was a burden formany growers, especially in developing countries (Chen and Wood 2004). The use of fungicides created health problems for users, adversely affect the environment, and resulting in the selection of fungicide resistant strains of the pathogen. To avoid these problems, growing cultivars with adequate level of durable resistance was the best strategy to control rust (Chen, 2005).

Grain/Spike

From table 1 revealed that statistically significant ($P<0.05$) result in grain/spike was recorded by difenaconazole (43.00) followed by propiconazole (42.33) compared to all rest of the treatments during Rabi 2011-12. However statistically significant ($P<0.05$) grain/spike was recorded by Sulpher

(41.33) followed by difenaconazole and metiram (39.67 & 39.67) compared to rest of all treatments. So that lowest grain/spike was recorded by untreated control (36.67 &34.67) during blockwise comparison during both the years.

1000 grain Weight

From table 1 revealed that statistically significant (P<0.05) result in 1000 grain weight (g) was recorded by difenaconazole (41.97) compared to all rest of the treatments during 2011-12. However significantly highest (P<0.05) 1000 grain weight was recorded by difenaconazole, Sulpher, Metiram and propiconazole (41.00; 40.33; 39.33 and 38.67g) compared to control but showed non-significant (P>0.05) result with each other.

Table: 1 showing efficacy of foliar fungicides on No. of grain/spike, 1000 grain weight (g) and disease control (%) against wheat rust

Treatments	No. of grain/spike		1000 grain wt. (g)		Disease Control (%)	
	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13
Control	36.67c	34.67c	35.62d	34.67b	0.00d	0.00d
Propiconazole @ 625 ml/ha	42.33ab	37.67b	39.97b	38.67a	22.50b	21.11b
Metiram @ 625 g/ha	40.00b	39.67ab	38.81c	39.33a	19.17c	19.64c
Difenaconazol @ 375 ml/ha	43.00a	39.67ab	41.97a	41.00a	25.50a	22.91a
Sulpher@ 2500 g/ha	42.00b	41.33a	39.46bc	40.33a	21.19b	22.67a
LSD	2.530	2.779	0.776	3.186	1.379	1.226

Yield (t/ha)

From table 1 revealed that statistically significant (P<0.05) yield (t/ha) was recorded by difenaconazole (3.48) and propiconazole (3.41) sulpher (3.23); metiram (3.07) during Rabi 2011-12. However maximum yield (t/ha) was recorded by Sulpher (4.13) followed by difenaconazole (3.67); metiram (3.66) and propiconazole (3.53) during Rabi 2011-2012. The lowest yield was recorded by control (2.83 and 3.33) during both the years.These results were in accordance to Reid and Swart (2004) who reported that yield increased in range between 34%-41% over untreated plots when wheat was treated with foliar fungicides.These results supported by Wiik and Rosenqvist (2010) who found yield increase in several years of study due to a single fungicide treatment during the period 1983-2007.

Table: 2 showing efficacy of foliar fungicides on yield and economics of wheat

Treatments	2011-12	2012-13	Avg. yield (t/ha)	Cost of Cultivation (Rs/ha)	Gross Return (Rs/ha)	Net Return (Rs/ha)	BCR
Control	2.83d	3.33c	3.08	46398	91328	44930	1.97
Propiconazole @ 625 ml/ha	3.41a	3.53bc	3.47	47400	102892	55492	2.13
Metiram @ 625 g/ha	3.07c	3.66b	3.37	47000	99779	52779	2.12
Difenaconazol @ 375 ml/ha	3.48a	3.67b	3.58	47600	100076	52476	2.10
Sulpher@ 2500 g/ha	3.23b	4.13a	3.68	47405	109119	61714	2.30
LSD	0.109	0.226					

Economic analysis

From table 2 maximum BCR was recorded by Sulpher (2.30) with net return of (Rs. 61714/ha) followed by propiconazole (2.13); metiram (2.12); difenaconazole (2.10) with net return of Rs. 55492/ha; Rs. 52779/ha; respectively. These results were supported by the fact that positive net returns was recorded by using high fungicide cost and low wheat prices compared to untreated fungicide observations resulted in positive net returns (Kandy, 2013).

Table: 3 showing efficacy of foliar fungicides on Incremental cost of wheat

Treatments	Incremental Cost (Rs/ha)	Incremental Benefit (Rs/ha)	BCR
Propiconazole @ 625 ml/ha	1002	10562	10.54
Metiram @ 625 g/ha	602	7849	13.04
Difenaconazol @ 375 ml/ha	1202	7546	6.28
Sulpher@ 2500 g/ha	1007	16784	16.67

Incremental Benefit

However maximum incremental benefit was recorded by Sulpher (Rs. 16784/ha) with BCR (16.67) followed by propiconazole (Rs. 10562/ha); metitam (Rs. 7849/ha) and difenaconazole (Rs. 7546/ha) with BCR (10.54); (13.04) and (6.28). However low BCR of propiconazole was only due to high price of this product.

Conclusion

All the fungicides were effective for controlling the disease; however the farmers are advised to use sulpher, metiram and propiconazole for controlling it in rain-fed areas of agro-ecological zone of Gujranwala.

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