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Integrated Disease Management for Zymoseptoria tritici Blotch of Wheat

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Abstract

*The current research conducted to determine the impact of wheat varieties, sowing dates and fungicide spray frequencies on disease development and wheat yield. Two bread wheat varieties, three sowing dates and four fungicide frequencies were evaluated in a factorial RCBD design at Holetta Agricultural Research center during 2020 and 2021 cropping seasons. The highest AUDPC values were recorded in Pavon-76 variety of unsprayed plots at early sowing dates (**2502.5** %-days) and (**1940.3** %-days) in 2020 and 2021 cropping seasons respectively. The lowest AUDPC (**276.3** %-days) value was recorded on the Alidoro variety at late sowing dates with three times fungicide spray frequencies. Highest grain yields were recorded on Alidoro variety (**7.1t/ha**) with three times spray frequencies during late-sowing date. The highest net benefit (245,095.5 ETB) and the lowest net benefit (29,463ETB) were obtained from two times sprayed and unsprayed plots during late and early sowing date planted with Alidoro and pavon-76 varieties, respectively. The present findings confirmed that spray frequencies with appropriate sowing dates play an-important role in managing the disease on partially resistant varieties. We have recommended that **late sowing date with 3 times spray frequencies of systemic fungicides** are very econonical to manage ZSTB disease on susceptible wheat variety and increased grain yield and yield components.*

INTRODUCTION

Bread wheat (*Triticum aestivum* L.), with an annual global production of 778.6 million tons, is a staple food for more than 35% of the world's population. Despite its importance, wheat production and productivity around the globe is hampered by a number of factors including biotic and abiotic stresses as well as low adoption of new agricultural technologies. Among the biotic stresses, diseases caused by fungi are the most important factors constraining wheat production. Overall wheat foliar diseases (STB, FHB and **wheat rusts**) remained an important constraint to wheat production all over the world including in Ethiopia. *Septoria tritici* blotch (STB) caused by the ascomycete *Mycosphaerella graminicola* (asexual stage: *Zymoseptoria tritici*) is the major wheat devastating fungal disease next to rust in Ethiopia and elsewhere in the world. Under favorable growing conditions with high relative humidity (85%) and optimal temperature (22 °C), STB could decrease yield by 30 to 70%. In Ethiopia up to 82% wheat yield loss has been reported. However, effective IDM strategies and sustainable management of the disease is yet to be achieved under Ethiopian condition. As a result there is a need to develop integrated disease management (IDM) strategies and recommended in areas, where the disease is prevalent and economically important.

MATERIALS AND METHODS

The study conducted at Holetta Agricultural Research Center during the main cropping season of 2020 and 2021 on station. Two bread wheat varieties (Pavon-76-Susceptible and Alidoro- Moderately Resistance for STB)and fungicide spray frequency of one time, two times, three times and four times with 14 days interval including control (unsprayed). Sowing dates were Mid-June, Late June and Early July with total treatments of 2x5x3 = 30 arranged in factorial Randomized Complete Block Design (RCBD) with three replications.

RESULT AND DISCUSSION

STB area under disease progress curve (AUDPC) across treatments expressed as AUDPC%-days ranged from 689.5 to 2502.5 during 2020 cropping season; whereas ranged from 276.3 to 1940.3 during 2021 cropping season. AUDPC is a very convenient summary of plant disease epidemics that incorporates initial intensity, the rate parameter, and the duration of the epidemic which determines final disease intensity. The maximum values recorded on unsprayed plots with

mid-June sowing date were 1940.3%-days and 2502.5%-days on variety of Pavon-76; whereas, variety Alidoro sprayed with three times frequencies during early-July sowing date had the lowest (276.3 and 689.5%-days) AUDPC value during 2021 and 2020 cropping season, respectively.

Table1. Effect of bread wheat varieties, sowing dates and fungicide spray frequencies on yield and yield components at Holetta during 2020/21 and 2021/22 Cropping Season

Varieties	Sowing Date	Frequency	2020/2021			2021/2022		
			AUDPC(%-days)	YLD (t/ha)	MRR (%)	AUDPC(%-days)	YLD (t/ha)	MRR (%)
Pavon-76	Mid-June	Unsprayed	2502.5^{a}	1.26^{c}	0	1940.3^{a}	0.91^{p}	0
		Three times	2051^{a-d}	3.24^{a-c}	3,791.89	928^{d-h}	3.36^{i-m}	5,518.2
		Four times	1639.2^{e-g}	**3.9^{a-c}**	3,791.89	1028.7^{d-g}	2.88^{k-o}	3,288.21
	Late June	Unsprayed	2237.7^{a-c}	1.92^{c-e}	0	1564.7^{b}	1.98^{n-p}	0
		Three times	1421^{d-j}	3.15^{a-c}	2,317.69	1133.3^{c-e}	4.3^{d-j}	5,220.06
		Four times	1505^{d-i}	4.2^{ab}	3,261.2	1058.7^{d-f}	4.59^{d-i}	4,388.7
	Early July	Unsprayed	1612.3^{c-h}	1.86^{de}	0	1184.3^{cd}	2.05^{m-p}	0
		Three times	919.3^{jl}	2.86^{a-c}	1,865.61	746.3^{f-k}	5.46^{b-f}	7,719.57
		Four times	535.5^{l}	2.9^{a-c}	1,433.17	676.3^{h-m}	5.01^{c-g}	4,990.91
Alidoro	Mid-June	Unsprayed	2354.3^{ab}	1.46^{de}	0	939^{d-h}	3.57^{h-l}	0
		Three times	1443.2^{d-j}	2.4^{b-c}	1,747.67	364.7^{mn}	5.46^{b-f}	4,234.01
		Four times	1235.5^{e-k}	2.39^{b-c}	1,271.01	490.7^{j-n}	5.3^{b-g}	2,875.43
	Late June	Unsprayed	1862^{a-c}	2.99^{a-c}	0	705.7^{g-l}	5.47^{b-f}	0
		Three times	883.2^{jl}	4.99^{a}	3,831.2	461.7^{j-n}	6.1^{a-c}	1,344.67
		Four times	791^{jl}	4.3^{ab}	1,831.2	473^{j-n}	5.5^{b-e}	-48.40
	Early July	Unsprayed	1516.7^{d-i}	3.15^{a-c}	0	759^{f-k}	4.98^{c-g}	0
		Three times	689.5^{kl}	3.47^{a-c}	528.99	276.3^{n}	6.5^{ab}	3,385.55
		Four times	802.7^{jl}	4.07^{a-c}	1,256.27	290.3^{n}	5.54^{b-d}	863.15
		Mean	1440.4	3.01		798	4.2	
		CV	27.9	16.8		23.2	18.6	
		LSD	657.6	2.27		334.8	1.36	

Yield and Yield Components

The highest yield (7.1 t/ha) was recorded on Alidoro variety four times Rex Duo sprayed plots during early-July sowing date during 2021 cropping season. The lowest yield (0.91) on Pavon-76 variety unsprayed plot during mid-June sowing date.

Partial budget analysis indicated that all fungicide spray frequencies used on the two varieties gave high gross field benefit and marginal rate of return. During 2020 cropping season variety Alidoro had the highest net profit of 145,786.75 Ethiopian Birr per hectare with marginal rate of return (MRR) 3,831.2% with three times spray frequencies during late-June sowing date. The highest marginal rate of return (MRR) 10,160.44% was recorded from Pavon-76 variety with one time spray at early-July sowing dates. During 2021 cropping season variety Alidoro had the highest net profit of 245,095.50 Ethiopian Birr per hectare with marginal rate of return (MRR) 7,192.4% with two times spray frequencies during early-July sowing date. When assessing a crop for risk, it is also necessary to asses it for the potential to cover the cost of application which depends on the potential yield.

CONCLUSION AND RECOMMENDATION

Bread wheat is the most widely cultivated and the major staple food crop in the world consumed by human, providing almost 20% of the total calories and 21% of protein demand globally. All fungicide spray frequency with early-July sowing date have reduced AUDPC compared to the unsprayed plots with mid-June sowing date but only three and four times Rex Duo sprays significantly reduced AUDPC value, respectively. Grain yield showed a significant ($p \leq 0.05$) difference among treatments. The highest yield (7.1 & 6.5 t/ha) was recorded on Alidoro variety with two and three times Rex Duo sprayed plots during late-June sowing date, respectively. The highest marginal rate of return (MRR) 10,160.44%, 7,801.72% & 7,624.82% were recorded from Pavon-76 variety with one time spray at early-July, mid-June and late-June sowing dates, respectively during 2020 cropping season. We have recommended that early-July sowing with 3 times spray frequencies is very economical to manage ZTB disease on susceptible wheat variety.

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