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Research Article

Assessment of Ethiopian Advanced Bread Wheat Genotypes and Varieties to *Septoria tritici* Leaf Blotch

Getnet Muche Abebele*

Department of Agriculture, Kulumsa Agricultural Research Center, Ethiopian Institute of Agricultural Research, P.O. Box. 489, Assela, Ethiopia

ABSTRACT

Wheat production and productivity is significantly constrained by multiple pathogens of which *Septoria tritici* blotch is an economically important foliar disease in the major wheat-growing areas of the world including Ethiopia. Host plant resistance rests the first mark of protection to mitigate this foliar disease, principally in developing countries for economically humble farmers and the most eco-friendly and lucrative strategy for profitable farmers. Thus, the present experiment was executed with the aim of screening of wheat genotypes against *Septoria* leaf blotch. A total of 451 wheat genotypes comprising 436 advanced bread wheat genotypes and 15 commercial released varieties were incorporated in the study. The study shown that none of the genotypes were displayed immune reaction. Close to half (47.1%) of examined wheat genotypes showed good tolerance to the diseases, while the remaining, exceeding half of test genotypes displayed moderately susceptible to susceptible reaction. Therefore, those genotypes which express highly to moderately resistant reaction to *Septoria tritici* could have an imperative role in resistance breeding to *Septoria* leaf blotch which intern play key role for maximizing yield and reduce hunger.

Keywords: Advanced wheat genotypes; Commercial; Wheat; Varieties; *Septoria tritici* blotch

INTRODUCTION

Wheat stands the utmost key food security grain crop with a production of 778.6 million tons (MT) on about 220 million hectares (Mha) worldwide in 2021. Africa contributes more than 3.4% of the entire wheat production globally while; Sub-Sahara Africa (SSA) produced a total of 7.5 MT on a total area of 2.9 Mha accounting for 40% and 1.4% of the wheat production in Africa and at global levels, respectively. In Ethiopia, wheat production is increased year after year dramatically for instance it boosts from 429 thousand tons in 1977 thousand tons thousand tons to 5,100 thousand tons in 2020 (World Data Atlas Ethiopia Tropics Agriculture Crops Production).

Unlike the increments both in area coverage and yield, productivity of wheat in Ethiopia is far less than the global average. This low yield is attributed to multi-faced abiotic and biotic factors such as shortage of upgraded varieties, low and uneven distribution of rainfall, deprived agronomic practices, insect pests and diseases. Of the biotic yield restraining factors, diseases like *Septoria* leaf blotch (*Septiria tritici*), Rusts (*Puccinia* spp), *Fusarium* head blight (*Fusarium gramnearum*), Leaf spot (*Helminthosporium* spp) and Tan spots (*Helminthosporium tritici-repentis*) exists the foremost diseases [1].

Among the biotic restraints, *Septoria tritici* blotch appears around the world in countries as diverse as Argentina, Ethiopia, Iran, the United States, the Netherlands, Russia, New Zealand, and Australia. It is an enormous tricky on durum wheat in Iran, Tunisia and Morocco. Epiphytotic can be particularly overwhelming in rising countries, like those in East Africa. High comparative humidity, regular rains, and modest temperatures are critical for disease development. Moreover, constant wheat cropping, high seeding rates, primary planting and extreme use of nitrogen fertilizers enhanced *Septoria* leaf blotch proliferation.

Under severe epidemics of *Septoria tritici* can decrease wheat harvests by 35% to 50%. In the United States, *Septoria* leaf blotch is second next to wheat rust in terms of importance, and it is the primary disease of wheat in Russia and many countries of Western Europe. The price of fungicides to control the disease can be high, and fungicide treatments may not be cost-effective liable on the price of grain. About 70% of the projected volume of fungicide used on cereals in Europe is used to control STB. In Europe, annual losses from STB are projected to be $400 million dollars, and similar loss

Correspondence to: Getnet Muche Abebele, Department of Agriculture, Kulumsa Agricultural Research Center, Ethiopian Institute of Agricultural Research, P.O. Box. 489, Assela, Ethiopia, E-mail: getnetmuche2014@gmail.com

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estimates for the United States are more than $275 million dollars per year. In Ethiopia, *Septoria tritici* is one of the major constraints of wheat in all wheat-growing areas, causing 82%, 42%, 30% to 39%, crop economic loss annually [2].

Taking into account the difficulty of the disease, an integrated approach that incorporates crop rotation, variety selection, stubble management and fungicides (if required) can provide effective suppression of STB where advancement of resistant wheat varieties is the most effective, economic and environmentally-safe strategy to control this disease. CIMMYT's wheat wide crosses program has produced a broad range of resistant germplasm from D genome synthetics and their synthetic derivatives. These materials express high levels of resistance to several leaf pathogens, including *Bipolaris sorokiniana, Pyrenophora tritici-repentis*, and *S. tritici*.

Therefore, genetic diversity is a vital source for selecting various disease resistance and high yielding genes. The dissimilar genetic sources deliver required allelic variation in parental lines to produce new genetic combinations. Thus, the objective of this study was to determine the level of resistance in 453 bread wheat germplasms comprising 436 advanced lines and 17 commercial varieties to *S. tritici* in the field, at different growth stages and under natural environment conditions [3].

MATERIALS AND METHODS

Description of the study area

The experiment was conducted at Bekoji district, experimental station and main hotspot area for *Septoria* disease Kulumsa agricultural research center southeast, Ethiopia in 2020 main cropping season. The site is located at latitude 07°32'37'' N and longitude 39°15'21'' E with an altitude of 2780 meter above sea level. The maximum and minimum temperature was 3.8°C and 20.4°C respectively with annual rain fall 939 mm [4,5].

Experimental wheat genotypes and field design

In the nurseries, a total of 436 advanced spring wheat lines and 15 varieties which were obtained from Kulumsa Agricultural Research center (Ethiopian national bread wheat regional center of Excellency) were included. The test experimental spring wheat lines were arranged in augmented design with standard susceptible check Danda'a. Each test entry was planted in a plot consisting of two rows of 1 m long spaced at 20 cm between rows. A seed rate of 150 kg ha^{-1} and fertilizer rates of 64 kg ha^{-1} N and 46 kg ha^{-1} N and P_2O_5, respectively, were applied on experiment [6-10].

Diseases assessment and data analysis

Disease assessment was executed on plot wise plants to double digit scale (00-99) described by Eyel. The first digit (D1) shows vertical disease progress on the plant and the second digit (D2) states to severity measured as diseased leaf area [11-15].

Percent disease severity is projected relay on the formula: % severity=((D1/Y1) × (D2/Y2) × 100)

Where, D1 and D2 denote the score recorded (00-99 scale) and Y1 and Y2 denote the maximum score on the scale (9 and 9). Then, genotypes were classified in seven categories; immune (00), highly resistant (1-14), resistant (15-34), moderately resistant (35-44), moderately susceptible (45-64), susceptible (65-84) and highly susceptible (85-99).

RESULTS AND DISCUSSION

It is obvious that a wide range of wheat diseases management options are available of which use of resistant variety is the best and fundamental diseases control strategy in general and *Septoria tritici* blotch in particular for resource poor farmers in developing countries and the most environmentally friendly and cost-effective scheme for commercial farmers. According to van Ginkel, in most wheat production environments, although not in all, genetic resistance is the most economical method to control fungal diseases besides to cultural and chemical that may be utilized. Thus, this experiment was executed aiming at selection of wheat genotypes including bread wheat lines, candidate and commercial wheat types for *Septoria tritici* blotch resistance and/or tolerance.

Thus, a total of 451 bread wheat germplasms comprising 436 advanced lines and 15 commercial varieties were screened during the year 2020 cropping season at Bekoji, main hotspot area to *Septoria tritici*. There were differences among test advanced bread wheat lines and varieties to the disease. However, amazingly, this study confirmed that neither the varieties nor the advanced lines were completely resistance or immune to *Septoria tritici* blotch (Table S1 and Figure 1). For this reason, where resistance is not operative, tolerance can be pursued. Out of 15 bread wheat varieties, only one variety was exhibited highly resistant to the pathogen. Among 436 advanced bread wheat lines tested; 3.4%, 26.8%, 16.9% and 38.9% were found highly resistant, resistant, moderately resistant and moderately susceptible infection types against the disease, respectively. Conversely, 13.5% and 0.23% showed susceptible and highly susceptible infection types in there order. These few genotypes with tolerance attributes could contribute in breeding program and key component in integrated management of *Septoria tritici* blotch in the region. Likewise, about 5.8%, 29.4%, 11.76%, 47.1% and 5.8% of the bread wheat varieties expressed highly resistant, resistant, moderately resistant, moderately susceptible and susceptible reaction to the disease correspondingly, however none of varieties displayed neither immune or nor highly susceptible infection type. Generally, about 52.63% of advanced lines and 52.9% of varieties were within the range of susceptible to highly susceptible reactions. This revealed that *Septoria tritici* blotch is one of the devastating diseases that limit the production and productivity of wheat globally (Table 1).

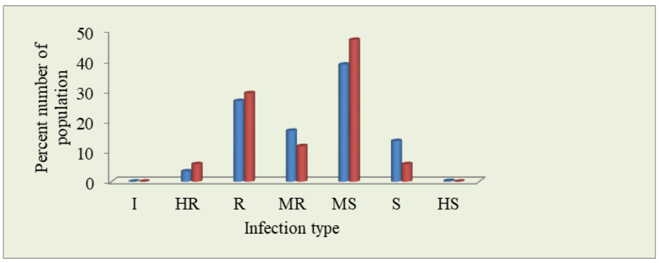

Figure 1: Response of advanced bread wheat lines and varieties to *Septoria tritici* at Bekoji in 2020. **Note:** (■) Advanced lines; (■) Varieties.

Table 1: Severity and host response of wheat genotypes.

Number	Varities	(00-99)	DI	Response
1	Digelu	81	10	HR
2	Kingbird	85	49	MS
3	Tesfa	65	59	MS

4	Atlas	64	29	R
5	Shorima	83	30	R
6	PBW343	85	49	MS
7	Kakaba	85	49	MS
8	Ogolcho	85	49	MS
9	Lemmu	83	30	R
10	Kubsa	76	52	MS
11	Wane	85	49	MS
12	Galama	84	40	MR
13	Alidoro	83	30	R
14	Hidasse	85	49	MS
15	Danda'a	87	69	S

The present study result indicated that there was a wide range of differences among both commercial bread wheat varieties and advanced lines to *Septoria* leaf blotch; reaction score of resistant to susceptible. This finding is in lined with similar works which states that bread wheat varieties showed different response to *Septoria* leaf blotch. The widely cultivated mega cultivar in study area *viz*; Kubsa and Ogolcho were affected by *Septoria* leaf blotch, scored diseases index exceeding 44. Research findings have revealed that *S. nodorum* resistance in wheat is inherited in an intricate manner containing numerous genes. In addition to, field trials genetic mapping, identification of resistant genes on for chromosomes 2A, 3D, and 7D is important. Therefore those genotypes that showed resistance under field conditions should be studied on a single chromosome recombination so as to fully cognize their heritability as well as highlighting linked markers.

CONCLUSION

The current investigation showed that the presence of extensive variability among the tested wheat genotypes for *S. tritici* resistance. Therefore, these traits should be taken into account while choosing superior and appropriate plants for further development of yield and *S. tritici* resistance in the development of high yielding and resistant genotype in bread wheat. Thus, those genotypes that displayed lower disease index might be used as integrated disease management options on wheat.

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CONFLICTS OF INTEREST

The author declares no conflict of interest. The funders had no role in the study design; data collection analysis or interpretation; in writing of the manuscript, or in the decision to publish the result.

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