

The Reactions of Bread Wheat Lines Against Stem (Black) Rust (*Puccinia graminis* F. Sp. *tritici*) Population

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Abstract: Quality parameter is very important selection for bread wheat improve programme. Yield trials were evaluated in terms of some physical characteristics, the amount of protein, its quality and some gluten rheological parameters. Stem rust (*Puccinia graminis* f. sp. *tritici*, (*Pgt*) can occur at higher altitudes and coastal areas in Turkey. On the other hand, stem rust is unfavorable for wheat quality to susceptible cultivars. 26 bread wheat genotypes (mixographe class; 3-6, (Bezostaja-1; 5) in yield trials were developed by the Central Research Institute for Field Crops (CRIFC) Department of Quality Assessment and Food. The aim of this study was to determine the reactions of 26 winter bread wheat lines to stem rust disease in adult plant stage. The test materials were sown in a one-meter row with 2 replications in Seydiler, Kastamonu Province. The test materials were screened under natural epidemic condition with *Pgt* (virulent on: *Sr5*, 6, 7b, 8a, 8b, 9b, 9g, 10, 30, *Tmp* and *Mcn* resistance genes). Stem rust developments on each entry were scored using the modified Cobb scale (Susceptible control cv. Little Club 80-100S) in June-August 2015. Coefficients of infections were calculated, and the values below 20 were considered as resistant to disease. Five (14%) genotypes were resistant to *Pgt*. These resistance genotypes can be used in both quality and stem rust resistance breeding programs to stem rust reactions.

Keywords: Bread wheat, stem rust (*Puccinia graminis* f. sp. *tritici*), reaction test, quality

1. INTRODUCTION

Wheat (*Triticum* sp.) is among the strategic crops for the both world and Turkey. Because of the important area of growing, even a slight increase yield for per unit can cause significant increases in total production. On the other hand, the yield and quality of wheat can affect everybody economically from producer to consumer. For this reason, solving the problems of wheat from production to consumption is very important in terms of influencing the country's economy and producer-consumer income levels due to the fact that a certain amount of wheat is being produced, the reactions that have shown against the quality and stress factors of the wheat have started to become an important improvement criterion.

Selection of early generation material with different and reliable methods in breeding programs ensures that the breeder reaches its purpose in a short time and more surely. If the wheat breeding studies are thought to last about 16 years, the earlier the material that is not suitable is removed in the early generations, the more material and detailed work can be done with the other material and the less time, money and labor can be achieved. The quality criteria used in this part of the study; Hectorite weight, zeleny sedimentation and mixograph.

In addition to efforts to improve quality attributes, at every stage, it is desirable in all respects to completely eliminate or partially reduce the production factors and stress that may affect quality. Fungal diseases play an important role in the biotic stress factors that predominate in wheat growing areas. It is reported that the losses that can occur as a result of epidemic of rust disease from rust diseases can reach up to 90% (Aktaş, 2001). Although different methods of struggle for the control of stem rust disease are proposed, the preferences of producers are usually in favor of chemical warfare. Some important disadvantages can be encountered as a result of chemical treatment applications. One of the cheapest and most practical control methods that can be used by producers, is protection of natural environment, genetic resistance (Çetin et al., 2007).

26 bread wheat genotypes (mixographe class; 3-6, (Bezostaja-1; 5) which were developed by the Central Research Institute for Field Crops (CRIFC) Department of Quality Assessment and Food were used in this study. The aim of this study was to determine the reactions of 26 winter bread wheat lines to stem rust disease in adult plant stage.

2. MATERIALS AND METHODS

Quality Studies

Hectoliter weight test: Refers to the weight of 100 liter of wheat in kg. It is a criterion used in the classification of wheat and it is directly related to flour yield. Grain size, density, shape and homogeneity affect the hectoliter weight.

Zeleny sedimentation test: Zeleny sedimentation test was carried out according to Anonymous (1972). The principle of the zeleny sedimentation test is to swell the flour particles in the suspension prepared with the flour and lactic acid

solution according to the gluten quality and measure the amount of these particles at a certain time. In wheat flour, which is high in gluten content and high in quality, the particles are more densely packed and less precipitated in the solution. For this reason, zeleny sedimentation values of high quality wheat flours are higher (Atlı and Koçak, 2004).

Mixographe test: 25 gr flour is mixed with the amount of water calculated according to the moisture contained in the mixer kneader until the maximum dough consistency is obtained. Taking into consideration the peak height and general curve characteristics, a numerical classification is made by comparing with eight reference mixograms. It shows the stronger curve type as the number grows (Anonymous, 2018).

Stem Rust Disease Studies

Reactions test: The test materials were sown in a one-meter row with 2 replications in Seydiler, Kastamonu province in October 2014. The test materials were screened under natural epidemic condition to stem rust (*Puccinia graminis* f. sp. *tritici*). Susceptible control (cv. Little Club) and stem rust differential set, sown in the same method and same date.

Disease Assessment: Disease scoring was performed using the Modified Cobb scale. The rust severity and infection type were recorded. Disease evaluations were conducted at least 2 times. The highest score was taken into calculate in the evaluations. The coefficient of infection (CI) was found by multiplying the coefficients determined for rust intensity and type of infection.

3.RESULTS AND DISCUSSION

The genotypes used in this study were selected from different early stage materials used in the different breeding program being run in 2013 growing season. The main selection criterion is; zeleny sedimentation value 54, which is widely used by industrialists and researchers in the final product estimate, and lines with values above were selected.

When the results of the hectoliter and mixograph analyzes of the selected lines are evaluated collectively, Hectoliter values ranged from 76.5 to 80.4 and mostly showed good hectoliter values. If the mixer classes are examined, they variation between 4 and 6. (Table 1).

The test materials were screened under natural epidemic condition with stem rust (virulent on: *Sr5*, *6*, *7b*, *8a*, *8b*, *9b*, *9g*, *10*, *30*, *Tmp* and *Mcn* resistance genes). Stem rust developments on each entry were scored using the modified Cobb scale (Susceptible control cv. Little Club 80-100S) in June-August 2015. Coefficients of infections were calculated, and the values below 20 were considered as resistant to disease. Five (14%) genotypes were resistant to stem rust (Table 1).

Table 1. Hectoliter, zeleny sedimentation and mixogram characteristics of the materials and stem rust reactions

Origin	No	Hectoliter Weight (kg/hl)	Zeleny Sed. (ml)	Mixogram	Stem (Reactions)	Rust
Line	1	78,5	63	6	50 S	
Line	2	76,7	62	5	70 MS	
Line	3	75,4	63	5	40 MS	
Line	4	76,7	59	6	70 S	
Line	5	78,8	62	6	10 MS	
Line	6	76,8	61	4	10 MS	
Line	7	77,7	62	4	70 MS	
Line	8	77,6	59	4	60 MS-S	
Line	9	77,6	61	4	T MS	
Line	10	78,6	63	4	60 MS	
Line	11	76,1	61	4	50 MS	
Line	12	77,7	62	4	60 MS	
Line	13	80,2	59	4	70 S	
Line	14	78,4	61	5	60 MS	
Line	15	78,4	61	4	80 S	
Line	16	77,5	59	6	10 MS	
Line	17	77,3	63	4	60 MS	
Line	18	76,9	62	3	T-10 MS	
Line	19	76,9	62	3	90 S	
Line	20	79,6	63	4	60 MS	
Line	21	76,7	60	4	80 S	
Line	22	78,5	60	6	40 MS	
Line	23	78,1	61	5	40 S	
Line	24	76,7	62	4	60 MS	
Line	25	77,6	61	4	60 MS	
Line	26	79,2	61	5	60 MS	
Standard Cultivars						
Bayraktar 2000	Std 1	77, 8	45	5	60 MS	
Bezostaja 1	Std 2	78,1	56	5	70 MS	
Demir 2000	Std 3	77,9	46	5	90 S	
Konya-2002	Std 4	79,6	47	4	50 MS	
Tosunbey	Std 5	78,8	53	6	40 MS	

The study facilitated identification of stem rust resistant germplasm and their exchange among the quality-diseases resistance breeding programmes. They seem that there are good sources of quality resistance among the bread wheat germplasms of the research programme. Materials seem to be utilized efficiently in bread wheat breeding programmes in winter or facultative wheat growing areas. These resistance genotypes can be used in both quality and stem rust resistance breeding programs to stem rust reactions.

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REFERENCES

- Aktaş, H. 2001. Önemli Hububat Hastalıkları ve Sürvey Yöntemleri Kitapçığı Tarım ve Köyişleri Bakanlığı Tarımsal Araş. Gen. Müd. Bitki Sağlığı Araştırmaları Daire Başkanlığı 80 sayfa Ankara (In Turkish)
- Anonymous, 1972. International Association for Cereal Chemistry, ICC Standard No:116.
- Anonymous, 2018. Wheat and Flour Testing Methods A Guide to Understanding Wheat and Flour Quality (Access date: 28.06.2018)
- Atlı A. and Koçak N., 2003. Islah Programlarında Ekmeklik Buğday Kalitesinin Farklı Sedimentasyon Testleri ile Tahmini. Harran Üniversitesi Ziraat Fakültesi Dergisi, 8 (2):51-57. (In Turkish)
- Çetin, L., Albostan, S., Düşünceli, F., Mert, Z., Akan, K., Braun, H.J. and Morgunov A., 2007. Bazı Uluslararası Buğday Materyalinin Orta Anadolu Tarla Şartlarında Sarı Pasa (*Puccinia striiformis* f.sp. *tritici*) Reaksiyonlarının Belirlenmesi 400- 403 Türkiye VII. Tarla Bitkileri Kongresi, 25–27 Haziran 2007 Erzurum,