Bangladesh J. Bot. **36**(2): 163-166, 2007 (December)

REACTION OF WHEAT LINES TO LEAF RUST (*PUCCINIA TRITICINA*) IN TURKEY

UMIT ARSLAN[*], OZGUR AKGUN KARABULUT AND KOKSAL YAGDI[1]

Uludag University, Gorukle Campus, Faculty of Agriculture, Department of Plant Protection, 16059 Bursa, Turkey

Key words: *Triticum*, Leaf (brown) rust, *Puccinia triticina*, Susceptibility, Resistance

Abstract

The field reactions of 19 bread wheat lines and three durum wheat lines to *Puccinia triticina* showed that the bread wheat lines were susceptible to moderately susceptible while that of three durum wheat lines were resistant, and moderately resistant. The seedling reactions of bread and durum lines against three races, FHTT, PHTT, and PRTT showed that bread lines were susceptible to all the races while durum lines were resistant. All of the tested durum lines were found to be promising for wheat breeding studies carried out against leaf or brown rust of wheat.

Introduction

Leaf or brown rust, caused by *Puccinia triticina* Eriks., (syn. *P. recondita* Rob. Ex Desm. f. sp. *tritici* Eriks. and Henn.), is one of the most severe diseases of wheat (*Triticum* spp.) in many wheat growing regions of the world. Yield losses due to leaf rust on wheat cultivars vary from 5 to 15% (Samborski 1985) or more, depending on the level of resistance, and stages of crop maturity when initial infection occurs (Liu and Kolmer 1997, Kolmer 2001). In some countries, yield losses up to 40 - 50% have been reported (Marshall 1988). Use of resistant cultivars has been preferred to limit losses from rusts for many years (McVey and Long 1993). The use of resistant cultivars is the most effective and environmentally friendly way of protecting them against leaf rust (Singh *et al.* 2001, Wamishe and Milus 2004, Martinez *et al.* 2005).

The objective of present study was to determine the reaction of wheat breeding lines in Turkey to leaf rust and their potential for use in developing resistant cultivars.

Materials and Methods

The 19 bread and 3 durum wheat lines used in this study were developed by one of the authors, Koksal Yagdi, in Department of Field Crops, Agricultural Faculty, Uludag University, Bursa, Turkey. The pedigrees of these advanced breeding lines are shown in Table 1.

Field experiments were conducted in 2002, 2003 and 2004 at the Research and Implementation Area of Department of Field Crops, Faculty of Agriculture, Uludag University. Seeds were sown on the 2 November 2001, 5 November 2002, and 3 November 2003. All field experiments were conducted relying on natural infection since inoculum pressure in the experimental area was high due to the continuous cultivation of wheat and favorable environmental conditions that occur in this area. A randomized complete block design with three replications was used. Each block consisted of 5.0 m length and 1.2 m width and a path of 1.0 m width around each block. The number of plants per m^2 in each block was approximately 500.

The urediniospores were gently dislodged from the surface of rust-infected flag leaves with a spatula, dried in desiccators at room temperature for 12 h, and then kept at 5ºC until use. Ten wheat plants (cv. Saraybosna) were grown separately in 7 cm diameter pot. Seedlings were inoculated with a spatula seven days after the emergence of plants in the pots. Inoculated plants

[*]Corresponding author: E-mail: uarslan@uludag.edu.tr [1]Department of Field Crops, Faculty of Agriculture, Uludag University, Gorukle Campus, 16059 Bursa, Turkey.

were covered with polyethylene bags to initialize the infections at a high rate of humidity. Covered plants were kept at 18ºC for 24 h in darkness, and then kept at 20ºC for 12 days without polyethylene cover. The light intensity inside the growing room was 10000 lux with a 12 h supplemental photoperiod. Seven days after inoculation, the leaves trimmed with a scissor so that a single uredinium remained on the trimmed upper edge of the leaves. Cross contamination was minimized by trimming the leaves before the pustules sporulated and by removing all leaves not used for single pustule isolation. Twenty single uredinium were developed by using this method. Single uredinia of all isolates were increased in the growing room on seedlings cv. Saraybosna.

Table 1. Pedigrees of wheat breeding lines tested for reaction to leaf rust caused by *Puccinia triticina*.

Bread lines	Pedigree
3-42	Kate-A-1/Orso -42
3-70	Kate-A-1/Orso-70
4-9	Kate-A-1/Momtchil-9
4-25	Kate-A-1/Momtchil-25
4-32	Kate-A-1/Momtchil-32
4-83	Kate-A-1/Momtchil-83
5-43	Orso/1435-43
15-4	Sadova/Martonvasari 9-4
15-5	Sadova/Martonvasari 9-5
15-9	Sadova/Martonvasari 9-9
15-10	Sadova/Martonvasari 9-10
17-5	Vratsa/Kate-A-1-5
17-10	Vratsa/Kate-A-1-10
18-2	Martonvasari 9/Bei 2024-2
18-8	Martonvasari 9/Bei 2024-8
18-9	Martonvasari 9/Bei 2024-9
19-2	Sadova/Bei 2032-2
19-4	Sadova/Bei 2032-4
22-2	Martonvasari 9/Sadova-2
Durum Lines	
6-39	Gokgol/Amasya-39
6-70	Gokgol/Amasya-70
11-27	Gokgol/Erzincan-27
Susceptible	Check (Bread Cultivar)
Saraybosna	Osjecka-20/Osk-4.216-2-76

Assessment of the leaf or brown rust disease in the field was carried out by randomly selecting 20 flag leaves from different sides of blocks. Disease severity (the percentage of the total flag leaf surface affected by rust) in each line was assessed in the early milk stage (73 on Zadoks' scale) (Zadoks *et al.* 1974) when the susceptible check Saraybosna had a severity and response rating of 70% susceptible (70 S), using the modified Cobb scale (Stubbs *et al.* 1986). In this scale, the disease severity was assessed from 1 to 100 and the following basic nomenclature was used for the reaction type: 0: no visible infection, R: resistant; necrotic areas with or without small pustules. MR: moderately resistant; small pustules surrounded by necrotic areas. MS: moderately susceptible; medium-sized pustules, no necrosis, but some chlorosis possible. S: susceptible; large pustules, no necrosis or chlorosis (Stubbs *et al.* 1986).

Flag leaves infected with leaf or brown rust were collected in wheat plots at the experimental station of Uludag University.

Sixteen differential lines were sown as described previously to determine the races and then, inoculated with single pustule of each isolate. A four-letter code describes the low or high infection types of each isolate to the 16 differential lines. Each letter corresponds to the infection types of four differentials. The Thatcher lines with genes Lr1, Lr2a, Lr2c, and Lr3 were the four lines in the first set of differentials; lines with genes Lr9, Lr16, Lr24, and Lr26 were the second set of differentials; lines with genes Lr3ka, Lr11, Lr17, and Lr30 were the third set of differentials; and lines with genes LrB, Lr10, Lr14a, and Lr18 were the fourth set of differentials. Reactions to the differential isolines were rated at 12 days after the inoculation (Long and Kolmer 1989). Isolates that produced infection types 1 (small uredinia surrounded by distinct necrosis), and 2 (small uredinia surrounded by distinct chlorosis) were considered low (resistant) and those that produced infection types 3 (moderate size uredinia without chlorosis) and 4 (very large uredinia without chlorosis) were considered high (susceptible). Designations of '+' indicated larger than normal uredinia and '–' indicated smaller than normal uredinia (Long and Kolmer 1989).

Each wheat line was inoculated only with a race to determine infection type. Inoculations and assessments were made as described previously. Three replicate determinations were made for all seedling experiments and each replicate comprised 3 pots. All seedling tests were conducted twice.

Results and Discussion

Field reactions of the 19 bread lines tested for leaf or brown rust infections were found to be susceptible (S), moderately susceptible (MS) or susceptible to moderately susceptible (S-MS). Among these lines, 18-8 and 18-9 were susceptible to moderately susceptible in 2002, 2003, and 2004. The disease severity of bread lines ranged from 1 to 70, 1 to 80 and 1 to 80 % in 2002, 2003, and 2004, respectively. The highest disease severity was observed on line 15-5 in three years (Table 2). The seedling reactions of tested bread lines showed that all lines were susceptible to FHTT, PHTT, and PRTT races (Table 2).

Table 2. Field and seedling reactions of bread and durum wheat lines to leaf rust in Bursa, Turkey.

	Field reactions leaf rust severity[a] and type of reaction[b]			Seedling reactions[c] races		
	2002	2003	2004	FHTT	PHTT	PRTT
Bread lines						
3-42	20 S	20 S	20 S	3	4	3
3-70	5 S	20 S	30 S	3	3	3
4-9	10 S	60 S	60 S	4	3	4
4-25	40 S	20 S	20 S	3	3	3
4-32	40 S	50 S	60 S	3	3	3
4-83	10 S	70 S	70 S	4	4	4
5-43	20 S	60 S	60 S	3	3	3
15-4	40 S	50 S	40 S	3	3	3
15-5	70 S	80 S	80 S	3	3+	3
15-9	50 S	50 S	50 S	3	3	3
15-10	50 S	60 S	50 S	3	3	3
17-5	10 S	20 S	50 S	3	3	3
17-10	30 MS	10 MS	30 MS	3	3	3
18-2	40 S	60 S	50 S	3	3	3
18-8	20 S-MS	40 S-MS	50 S-MS	3	3+	3
18-9	1 S-MS	1 S-MS	30 S-MS	3	3+	3
19-2	20 S	40 S	40 S	3	3	3
19-4	20 S	30 S	40 S	3	3	3
22-2	20 S	50 S	60 S	3	3	3
Durum lines						
6-39	1 MR	1 R	1 R	1	1	1
6-70	1 R	1 R	1 R	2-	2-	2
11-27	1 R	1 R	1 R	2-	2-	2
Susceptible check (Bread Cultivar)						
Saraybosna	70 S	70 S	70 S	4	4	4

[a]Percentage of the flag leaf area infected by leaf rust. [b]R = resistant. MR = moderately resistant. MS = moderately susceptible. S = susceptible. [c]1 = small uredinia with necrosis. 2 = small uredinia surrounded by distinct chlorosis. 3 = moderate size uredinia without chlorosis. 4 = very large uredinia without chlorosis, + = uredinia larger than normal. – = uredinia smaller than normal.

The field reactions of three durum lines tested for the infections of leaf rust were resistant (R), and moderately resistant (MR). Among the durum lines, line 6-39 was moderately resistant in 2002, while it was resistant in 2003 and 2004. Lines 6-70 and 11-27 were resistant in three years. The disease severity on durum lines was 1 % in three years. The seedling reactions of tested durum lines showed that all lines were resistant to FHTT, PHTT, and PRTT races (Table 2).

It appears that none of the tested bread lines were resistant. Resistant and moderately resistant durum lines could be used in breeding programs. In this regard, all tested durum lines could be used to develop resistant cultivars in wheat breeding programs.

Acknowledgements

The authors thank Dr. J.A. Kolmer, Cereal Disease Laboratory, Minnesota, USA for the differential sets.

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(Manuscript received on 4 November, 2006; revised on 12 March, 2007)