

Evaluation of Barley Cultivars for Resistance to Leaf Stripe

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Abstract

A total of 19 Iranian native barley cultivars were in artificial infection experiments tested for resistance against isolate 19 of the leaf stripe fungus, *Pyrenophora graminea*. The cultivar Eram was immune against isolate 19 and the cultivars Jonob, Makoy, C₂, showed high resistance with less than 6% plant infected, the cultivars Zarjo, Valfajr, Reyhan, Karun, Karun × Kavir were the most susceptible cultivars.

Keywords: barley stripe; *Pyrenophora graminea*; resistance; *Hordeum vulgare*

INTRODUCTION

Barley stripe disease caused by the fungus *Pyrenophora graminea* (Died) E. Muller is a common disease of barley where the crops is grown (SIVANESAN 1987). The mean percentage of infection during 2000 was 5.17 in Varamin area of Iran. The disease is most severe when rain and humidity are high during heading or when sprinkler irrigation is used. Barley stripe is a seedborne, single-cycle disease (MATHRE 1987). Although today non-mercurial fungicides can almost completely prevent attack of leaf stripe, the potential danger of the disease and endeavor limit the use of fungicides in agriculture has increased the interest for producing resistant cultivars and utilization of barley stripe resistant cultivars is the most effective measure for controlling barley stripe.

The objective of present investigation is to determine resistance and susceptibility of barley cultivars to barley stripe.

MATERIALS AND METHODS

Three experiments were carried out. In the first, 9 barley cultivars Valfajr, Karun, Reyhan, Roboust, Gorgan, Morex, Aras, Chevron and Jonob were tested in glasshouse condition. The isolates 19 of *Pyrenophora graminea* (Died) E. Muller was grown on potato

dextrose agar plates (9 cm) until they covered with mycelium. The seeds were surface disinfected by soaking in 0.5% sodium hypochlorite for 3 min then rinsed three times in sterile distilled water (SDW). Inoculation was carried out by placing 20 seeds between two mycelium-covered plates (9 cm diam). This sandwich was then incubated at 4–6°C for 10 days (THOMSEN *et al.* 1997). For controls seeds were placed on potato dextrose agar plates. The germinated seeds were sown in autoclaved potting mix in 15 cm diameter plastic pot, 10 seeds per pot. The pots maintained in a glasshouse at a temperature of 12–18°C and normal light condition during December and January in Tehran. Percentage of infected leaves were determined at 10 days intervals. A completely randomized design with three replications was used. Data were analysed by analysis of variance and Duncan's Multiple Range Test at $P < 0.05$ (LITTLE & HILLS 1978).

In the second test 13 barley cultivars, Zarjo, Valfajr, Roboust, Kavir, Karun, Chevron, Excell, Gorgan, Aras, Dasht, Jonob and CI9539 were used.

The isolates 19 of *Pyrenophora graminea* was grown on potato dextrose agar plates (9 cm) until they were covered with mycelium. The seeds of barley cultivars were disinfected as described above and then placed on the plates and allowed to germinate at 4–5°C for 10 days (SMEDEGAARD-PEDERSEN & JORJENSEN 1982). The germinated seeds were then

sown in rows 2 m long in 3 replicates in Abourayhan Campus Research Field in Pakdasht, Iran. Evaluation of disease symptoms were performed 50 days after planting. Percentage of infected leaves and infected stems were determined.

In the third experiment 18 barley cultivars: Gorgan 4, Karun \times Kavir, Goharjo, Aras, Eram, Makoy, C₂, Reyhan, Jonob, Kavir, Dasht, Valfajr, Chevron, Excell, Roboust, CI9539, Morex and Karun were used, the method of seed inoculation is similar to the second experiment and the condition of field was the same. The randomized complete block design was used for both field test. Data were analysed by analysis of variance and Duncan's Multiple Range Test at $P \leq 0.05$ (LITTLE & HILLS 1978).

RESULTS

Results of glasshouse experiments indicated that cultivars Jonob, Chevron and Aras with percentage of infected leaves 3, 4.2 and 5.3, respectively were the most resistant cultivars, and Valfajr and Karun with percentage of infected leaves 20.3 and 15.8 respectively were the susceptible cultivars (Table 1).

Results of the first field experiment indicated that cultivars Zarjo, Valfajr, Reyhan, Karun, Kavir, Roboust with percentage of infected leaves ranged from 24.5 to 75.5 and percentage of infected stems ranged from 23 to 44 were the most susceptible cultivars, but cultivars Jonob, Chevron, Excell, Dasht with percentage on infected leaves ranged from 5.5 to 11.5 and

Table 1. Reaction of barley cultivars to leaf stripe in glasshouse

Cultivars	Percentage of infected leaves
Valfajr	20.3 a
Karun	15.8 ab
Reyhan	14.1 ab
Roboust	13.5 abc
Gorgan	11.6 abcd
Morex	9.7 bcd
Aras	5.3 cd
Chevron	4.2 d
Jonob	3 d

Significant differences are denoted by different letters at $P < 0.05$ according to Duncan's Multiple Range Test

percentage of infected stems ranged from 8–13 were the most resistant cultivars (Table 2).

Results of second field experiment showed that cultivars Eram, Makoy, C₂, with percentage of infected leaves ranged from 0 to 3 and percentage of infected stems ranged from 0 to 5.5 had the least amount of barley stripe. Cultivar, Karun \times Kavir, Karun, Valfajr, Reyhan and Kavir with percentage of infected leaves ranged from 16.5 to 66 and percentage of infected stems ranged from 19 to 75.7 were severely infected and the other cultivars were intermediate (Table 3).

DISCUSSION

Over the years, many papers have dealt with the resistance of barley against leaf stripe and hundreds of varieties have been tested using different methods and number of isolates. An almost continuous variation in degree of resistance has been found (ARNY 1945; KNUDSEN 1980; TEKAUZ 1990; THOMSEN *et al.* 1997).

This continuity has made it difficult to delineate specific reaction classes. Except for a few varieties that are highly resistant or nearly so (0–2% attack)

Table 2. Reaction of 13 barley cultivars to leaf stripe (1st field experiment)

Cultivars	% infected leaves	% infected stems
Zarjo	74.5 a	52 a
Valfajr	61.0 ab	44 ab
Reyhan	51.0 abc	39 abc
Karun	39.5 bcd	36 abcd
Kavir	34.5 bcde	37 abcd
Roboust	24.5 cde	23 bcd
Aras	22 cde	17 bcd
Gorgan	20.0 cde	18 bcd
CI9539	16.5 de	17 bcd
Dashat	11.5 de	13 cd
Exell	9.5 de	9 d
Chevron	7.5 de	11 cd
Jonob	5.5 e	8 d

Significant differences are denoted by different letters within each column at $P < 0.05$ according to Duncan's Multiple Range Test

Table 3. Reaction of 18 barley cultivars to leaf stripe (2nd field experiment)

Cultivars	% infected stems	% infected leaves
Karun × Kavir	75.7 a	66.0 a
Karun	57.1 a	46.2 b
Valfajr	22.0 bc	18.1 c
Reyhan	19.0 bc	17.5 c
Kavir	34.0 b	16.5 cd
Goharjo	8.0 c	12.0 cde
Morex	5.8 c	10.0 cde
Dasht	11.0 c	8.5 cde
Robust	6.6 c	7.6 cde
CI9539	4.0 c	6.1 cde
Chevron	3.8 c	6.0 cde
Excell	3.0 c	6.0 cde
Aras	7.0 c	5.0 cde
Jonob	6.4 c	5.0 cde
Gorgan 4	4.0 c	4.7 cde
C ₂	5.5 c	3.0 cde
Makoy	2.5 c	1.0 de
Eram	0 c	0 e

Significant differences are denoted by different letters within each column at $P < 0.05$ according to Duncan's Multiple Range Test

and those that are highly susceptible ($> 40\%$ attack). Therefore a study of the genetics of leaf stripe resistance is difficult, and has led to the conclusion that resistance to barley leaf stripe must be based on several genes (KNUDSEN 1980; THOMSEN *et al.* 1997) but evidence of resistance based on single genes has also been reported (NILSSON 1975; SKOU & HAAHR 1987). A conidium of *D. graminea* consists of several cells and their genetic content may differ (CHRISTENSEN & GRAHAM 1934; SHANDS & DICKSON 1934). If the variety is heterogeneous for resistance genes for barley leaf stripe, this may also blur the results.

The results of three experiment indicated that cultivar Jonob, with percentage of infected stem ranged from 6 to 8, and percentage of infected leaves ranged from 3 to 5.5 were the most resistant cultivar. Cultivar

Jonob was also resistant to four isolates of *P. graminea* obtained from different parts of Iran (AGHAKHANI *et al.* unpublished). Cultivar Eram with no infection was immune against the isolate tested.

In conclusion, cultivars Jonob and Eram should be useful as sources for resistance to *P. graminea*. However these cultivars warrant further investigation against the other isolates of *P. graminea* obtained from different parts of the world.

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