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LATEST RESULTS IN BREEDING WINTER WHEAT FOR RESISTANCE TO FUSARIUM HEAD BLIGHT IN THE ZAGREB BC INSTITUTE

ABSTRACT

Fusarium head blight (*Fusarium graminearum* Schw.) is one of the most dangerous fungal diseases in wheat production decreasing grain yield up to 50% or more what depends on both environmental factors and genotype. Testing of inoculated artificially new Bc winter wheat lines for their resistance to FHB was the objective of the study.

In 2008 and 2009 two and five lines of tested 12 new ones respectively were shown to be more resistant than Sana cultivar used as a standard. Majority of the winter wheat lines exceeded level of resistance standing out by Bc 7 and Bc 1 and Bc Lira variety as the highest yielding variety was registered by CCVR in 2009.

Key words: Bc lines, *Fusarium graminearum*, FHB, resistance, testing, winter wheat

INTRODUCTION

Fusarium head blight (*Fusarium graminearum* Schw.) is one of the most dangerous fungal diseases in wheat production because it can cause considerable reductions in grain yield up to 50 % or more. Yield reductions depend both on environmental factors and the genotype (Korić, Tomasović, 1989; Tomasović, 1981; Tomasović *et al.*, 1993). Breeding for resistance to head blight relies on determining the most effective methods of artificial inoculation, reliable scoring, detection of sources of resistance and their incorporation into the high-yielding genotypes suited to local growing conditions and with favourable agronomic properties.

The objective of the present study is to test the new Bc winter wheat lines for resistance to fusarium head blight under conditions of artificial inoculation with *Fusarium graminearum* Schw., which will then be used in breeding process for development of new lines, later wheat varieties with high resistance to head fusarium.

MATERIALS AND METHODS

Resistance degree of wheat lines to head blight is tested continuously in field trials in Bc Institute's Department of Cereal Crops in Botinec under conditions of artificial inoculation. The aim is to test as many breeding lines as possible. Thus, in 2008 and 2009, field trials were conducted under artificial and natural infections in 4 replications following a randomized block design. Basic plot size was 1,20 m² (1,20 m x 0,25 m x 4 rows). In both years, 16 genotypes were tested for resistance to fusarium head blight and yield capacity. Three standards for resistance were included in testing, i.e. Roazon, (D 48x42x6)₂ and Poncheau, and a standard for yield capacity - Sana. Modified Bilay's liquid substrate was used for inoculum production (Reid et al, 1996). The four most aggressive isolates of *Fusarium graminearum* Schw. were used, tested by means of the Mesterhazy method (1984). Artificial inoculation was made by the "spray-method", with a concentration of 5 x 10⁵ of spores/ml. Inoculation was made by hand with a 5-l sprayer. First artificial inoculation was carried out at anthesis, i.e. when 50 % or more spikes flowered. The inoculation was repeated 3 times at 4-5 days intervals. Assessment of fusarium head blight attack was made 14 days following the second inoculation. The second and the third ratings were taken at late milk and early wax stage at 5-8 day intervals when the infection was clearly visible. The visual rating index (VRI %) was made by using a formula (VRI %) = incidence x severity /100 (Gilbert, Morgan, 2000). Infection severity was rated by using the scale (0 %, 5 %, 25 %, 75 % and 100 %) of spikes infected (Tomasović, 1987; Palaveršić, Tomasović, 2005). *VRI indices were transformed to arc sin √%* after Gomez-Gomez, 1984. Analysis of variance and t-test were made. Data on resistance were statistically processed after Kruger and Weiler, 1975 and genotypes were classified into 5 groups: -- very susceptible, - susceptible, 0 moderately susceptible, + moderately resistant and ++ resistant. Average value of resistance was obtained based on 3 fusarium attack assessments.

RESULTS AND DISCUSSION

In breeding for development of high-yielding wheat varieties resistant to head blight, one of the most important factors for a successful work is application of artificial inoculation. For this purpose, from the genetic point of view, a continuous exchange of sources of resistance is conducted with the breeders from all over the world. These sources are then tested under local conditions and strict criteria of artifi-

cial inoculation. A small number of sources with favourable agronomic traits was screened (Tomasović et al, 2005).

In 2008 and 2009, 16 winter wheat genotypes were tested for resistance to fusarium head blight under artificial and natural infections. In both years, 12 new genotypes were tested. In the first year of testing two lines were more yielding than the check Sana, while in the second year 5 genotypes were considerably more yielding than the check (Table 1).

Results of testing 16 wheat materials for yield, Botinec 2008, 2009.

Table 1

Genotype	Grain yield (kg/ha)		
	2008.	2009.	Mean
Bc 7	9862.5	9383.3 *	9622.9
Bc 10	10416.7	8133.3 *	9275.0
Bc 4	10137.5	7862.5 *	9000.0
Bc 11	10683.3	7012.5	8847.9
Bc Lira	9625.0	8066.7 *	8845.9
Sana	10379.2	6983.3	8681.3
Bc 3	9683.3	7625.0 *	8654.2
Bc 2	9725.0	7112.5	8418.8
Bc 1	9612.5	7195.8	8404.2
Bc 6	9958.3	6666.7	8312.5
Bc 9	9191.7	7212.5	8202.1
(D 48 x 42 x 6) ₂	9016.7	6708.3	7862.5
Bc 5	7995.8	6866.7	7431.3
Roazon	7866.7	6875.0	7370.9
Bc 12	7862.5	6579.2	7220.9
Poncheau	4929.2	5979.2	5454.2
Mean	9184.1	7266.4	8225.3
LSD (0,05)	437.8	437.8	

Significant differences in resistance to fusarium head blight were obtained among the tested genotypes (Table 2). Based on a visual rating index (VRI %), the highest level of resistance to fusarium head blight was achieved by the genotype Bc Lira (9,16 %) and the lines Bc 1 and Bc 7 (12,23 % and 14,38 % respectively). Average resistance level was $\bar{x} = 26,65$ %. Likewise, the mentioned genotypes achieved high grain yields.

The highest yield was obtained by the line Bc 7 (9622,9 kg/ha), then Bc Lira and Bc 1 (8845,9 kg/ha and 8404,2 kg/ha respectively). Average grain yield was $\langle x \rangle = 8225,3$ kg/ha, and the one achieved by the check Sana was 8681,3 kg/ha. In addition to high yield, Bc Lira expressed the highest resistance level to fusarium head blight. Standards for resistance, Poncheau, Roazon and $(D 48 \times 42 \times 6)_2$ proved their high level of resistance, but had low grain yields.

Table 2
Results of testing 16 wheat materials for resistance to fusarium head blight, Botinec 2008, 2009

Genotype	FHB (VRI%)		
	2008.	2009.	Mean
Bc 7	3.85 ++	24.90	14.38
Bc 10	31.46 -	79.40 --	55.43
Bc 4	14.44 +	33.60	24.02
Bc 11	14.27 +	25.80	20.04
Bc Lira	3.71 ++	14.60 +	9.16
Sana	27.50 -	33.40	30.45
Bc 3	35.62 --	58.20--	46.91
Bc 2	30.31 -	56.90 --	43.61
Bc 1	8.25 +	16.20 +	12.23
Bc 6	18.44	43.30 -	30.87
Bc 9	33.12 -	44.70 -	38.91
$(D 48 \times 42 \times 6)_2$	6.75 ++	34.20	20.48
Bc 5	37.50 --	39.60 -	38.55
Roazon	14.89 +	26.00	20.45
Bc 12	13.77 +	24.30 +	19.04
Poncheau	0.58 ++	3.30 ++	1.94
Mean	18.40	34.90	26.65

CONCLUSION

1. Breeding winter wheat for resistance to fusarium head blight is a permanent process the aim of which is to develop our own material with as good level of resistance to this disease as possible, high yielding capacity and stability in production.
2. Majority of the winter wheat lines tested expressed high resistance level among which Bc 7 and Bc 1 stand out. The variety Bc Lira achieved the highest level of resistance to fusarium head blight during 2008 and 2009. Also, it produced high grain yield. Bc Lira was registered by the Croatian Committee for Variety Registration in 2009 as a new winter wheat variety. Application of artificial infection has proved successful in our winter wheat breeding program.

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