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Search for resistance against *Blumeria graminis* f.sp. *hordei* in barley landraces from Fertile Crescent

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SUMMARY – A collection of 111 barley landraces from the Fertile Crescent was tested for powdery mildew resistance. Two types of resistance were identified. Twelve accessions showed low disease severity with no macroscopically visible necrosis. In additional 19 accessions, segregation was observed, with individual plants showing resistance based on reduction of infection associated with plant necrosis. These individual resistant plants were selected and selfed for future studies.

Keywords: Barley, *Blumeria graminis* f.sp. *hordei*, *Hordeum vulgare*, landraces, powdery mildew.

Introduction

Powdery mildew caused by *Blumeria graminis* f.sp. *hordei* is one of the most important highly variable foliar diseases on barley (*Hordeum vulgare*), which causes severe losses and quality reduction especially for the production of malting barley (Balkema-Boomstra and Mastebroek, 1995; Czembor, 2001).

Many single resistance genes to powdery mildew have been identified and introduced into current barley varieties. Most of these genes originated from barley landraces and from wild relatives (Xu and Kasha, 1992; Czembor and Czembor, 2000). However, these race-specific genes are not durable due to rapid changes in virulence in the pathogen (Dreiseitl and Bockelman, 2003), what reinforce the need of searching new sources of resistance.

The objective of the present study was to determine levels of resistance to powdery mildew present in a collection of barley landraces from the Fertile Crescent.

Materials and methods

Plant material

Seed samples of 111 *H. vulgare* landraces from the Fertile Crescent were kindly provided by the International Centre for Agricultural Research in the Dry Areas - ICARDA, Aleppo, Syria, and United States Department of Agriculture-USDA, USA.

Inoculum

Isolate CO-02 of *B. graminis* f. sp. *hordei* (virulence/avirulence factors *Mla8,a1,a7,a9,a10,a12,a22,a23,k,p,g,La,h/a3,a6,a14,a13,at,o5*) collected at Cordoba, Spain was used in the experiment. The isolate was maintained and increased on young seedlings of the cultivar Vada.

Testing procedure

About 10-15 seeds per accession were sown in 7x7x11 cm boxes. Eleven days after sowing when

the primary leaf was fully expanded, 50 mm of a central leaf segment was excised from each seedling and inoculated as described by Shtaya *et al*. (in press).

Macroscopic observation

Infection type (IT) was recorded five days after inoculation, following the 0-4 scale of Moseman (1965). Infection frequency (IF) was calculated as number of powdery mildew colonies per cm^2.

Results and discussion

The susceptible check Vada showed IF of 69 colonies per cm^2 (Table 1). High susceptibility was common in the collection with average IF of 53 colonies/cm^2. Most of the accessions (83%) displayed compatible interaction (IT 3-4). In remaining 17% of the collection (19 accessions), segregation for IT was observed, with individual plants showing low IT (Table 1). Fourteen accessions (13% of the collection) showed low IF (IF < 40 colonies per cm^2) in spite of a high IT (Table 1).

Table 1. Infection type (IT) and infection frequency (IF), of 19 single-plant barley accessions against powdery mildew

Accessions†	IT	IF	Accessions	IT	IF
IG29088-R	0(4)	4	IG110909-R	1	0
IG29088-S	4	39	IG110909-S	4	55
IG32722-R	2	21	IG115774-R	0	0
IG32722-S	4	53	IG115774-S	4	45
IG32733-R	1	0	IG125770-R	2	0
IG32733-S	4	48	IG125770-S	4	41
IG32799-R	2	29	IG125773-R	2	15
IG32799-S	3-4	61	IG125773-S	3-4	35
IG33094-R	2	12	PI 223142-R	2	15
IG33094-S	4	48	PI 223142-S	4	44
IG35223-R	1	0	PI 253574-R	2	10
IG35223-S	3-4	36	IG110887-R	2	12
IG110851-R	1	0	IG110887-S	4	32
IG110851-S	3-4	45	IG110895-R	0(4)	5
IG110857-R	2	15	PI 253574-S	3-4	46
IG110857-S	4	44	IG27377	4	39
IG110887-R	2	12	IG32580	4	37
IG110887-S	4	32	IG115778	4	36
IG110895-R	0(4)	5	IG125766	4	36
IG110895-S	4	43	IG125767	4	37
IG110899-R	1	0	IG125768	4	37
IG110899-S	4	46	IG125778	4	35
IG110905-R	1	0	IG128167	4	39
IG110905-S	4	40	CIho2623	4	32
IG110906-R	1	0	PI 223145	4	33
IG110906-S	4	47	Vada	4	69

†In accessions in which segregation for IT was observed, individual plants with low IT were recorded separately (accession-R), those with high IT (accession-S).

Barley landraces, especially those originated from centres of origin for cultivated barley, constitute such a gene pool (Czembor and Johnston, 1999; Czembor and Czembor, 2000). However, the presence of landraces with resistance to powdery mildew is lower than observed in other studies (Leur *et al*., 1989).

Seedling test does not necessary predict adult plant resistance and field performance of the selected resistant accessions, but are considered effective and sufficient to postulate race-specific resistance genes and the identification of levels of partial resistance (Backes *et al*., 1996). Some of the accessions of this study showed low IF in spite of a high IT (Table 1). They can be used as an additional source for partial resistance to powdery mildew. This study showed that barley landraces from Fertile Crescent are a valuable source of resistance to powdery mildew.

From the collection, 19 single-plant lines with low IT were derived and grown in the greenhouse to obtain seeds. The presence of reaction types 0, 0(4), 1 and 2 in these lines indicates that they may have alleles for hypersensitive resistance. The resistance gene(s) in each genotype will be postulated on the basis of the gene for gene hypothesis by inoculating them with different isolates of powdery mildew with different virulence spectrum.

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