



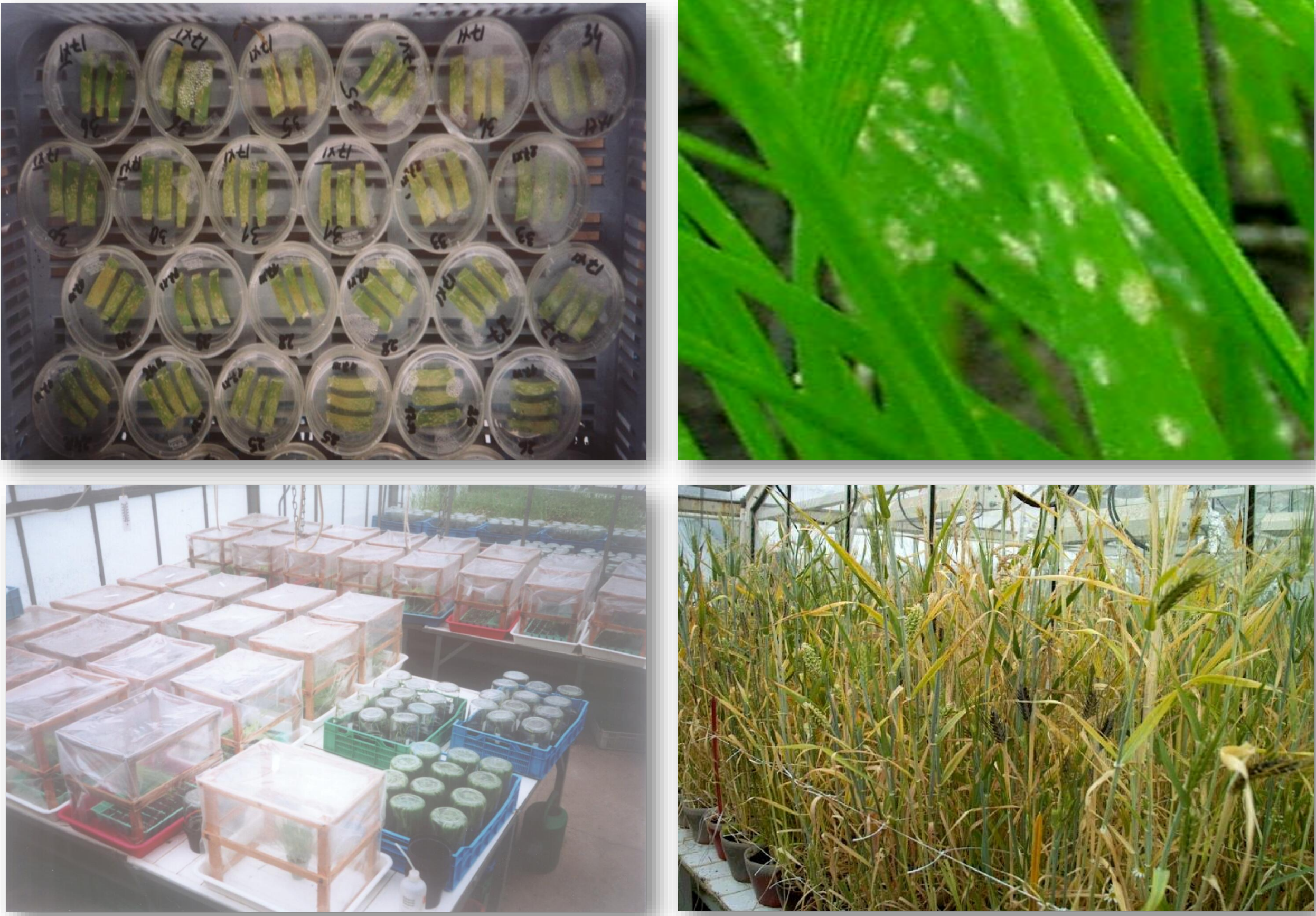
Mlo resistance to powdery mildew in winter barley in Poland

Jerzy H. Czembor, Aleksandra Pietrusińska

Plant Breeding and Acclimatization Institute-NRI IHAR-PIB Radzikow, 05-870 Blonie, Poland

- ❑ Winter barley is an important cereal crop and it is grown in all agricultural regions of Central and Western Poland.
- ❑ The powdery mildew caused by *Blumeria graminis* f. sp. *hordei* is one of the most frequently observed disease on winter barley which can cause considerable yield losses.
- ❑ The disease can be controlled with fungicides but their frequent use speeds up the evolution of fungicide resistance.
- ❑ The use of resistant cultivars is effective method to control powdery mildew and the incorporation of new genes for resistance to powdery mildew into barley cultivars has been very useful in combating powdery mildew.
- ❑ The resistance conferred by most of new resistance genes has not been maintained for more than a few years with some exceptions.

One of these exceptions is the Mlo resistance. Mlo resistance has become a very important source of powdery mildew resistance in barley because there is no known virulence for these genes. Since 1979 (registration of cultivar 'Atem') the Mlo resistance has been deployed in more than 150 cultivars of spring barley in Europe. However, none of barley winter cultivar with mlo resistance to powdery mildew is grown in Poland.

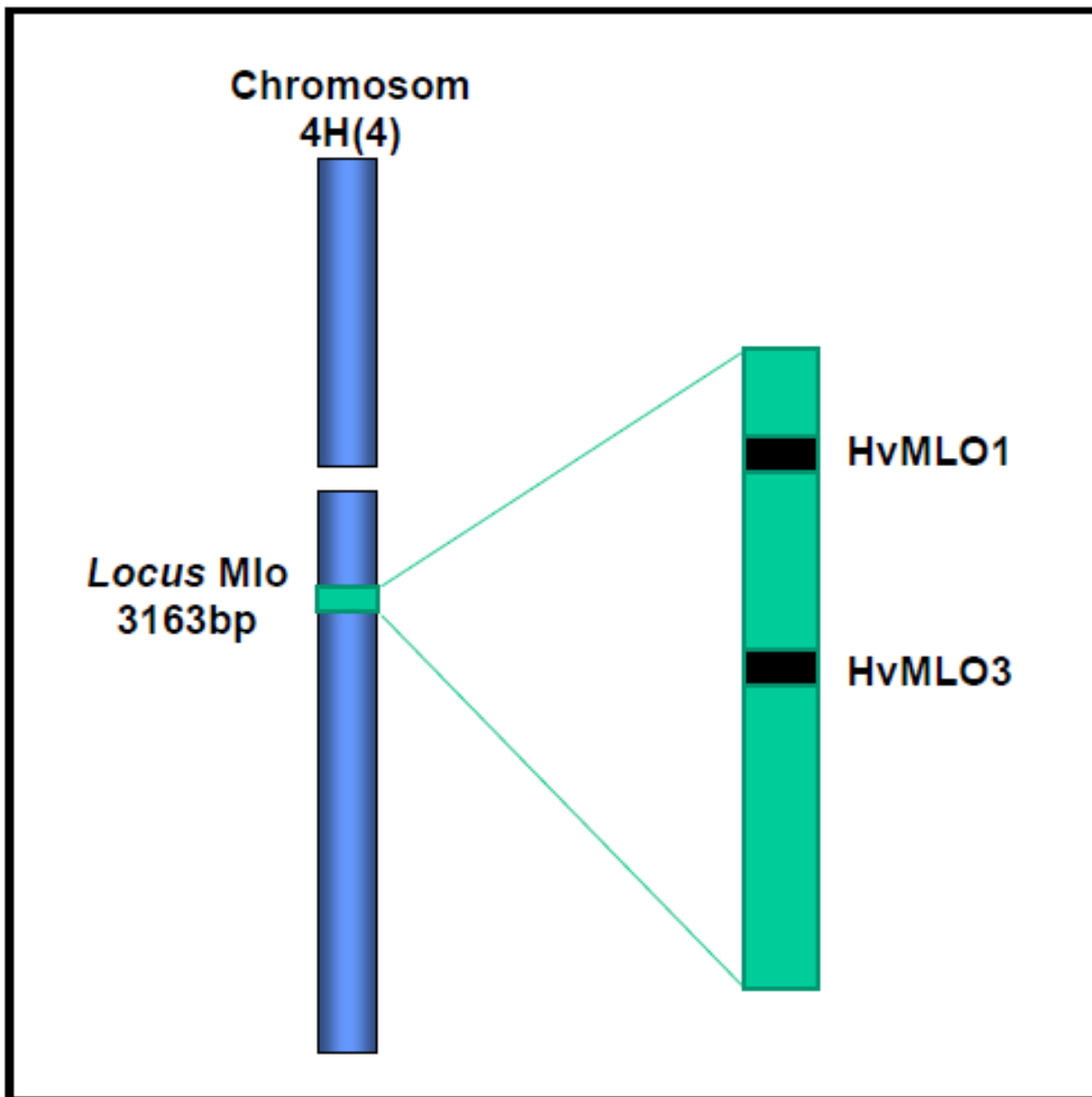


Objective

The aim of presented investigation was to obtain information about agricultural value of F₆BC₂ winter barley lines with the mlo gene for resistance to powdery mildew (*B. graminis* f.sp. *hordei*) under various agricultural conditions in Poland.

Materials and Methods

- ❑ Four cultivars (Souleyka, Titus, SU Vireni and Metaxa) as high yielding parents were used. These lines are characterized by high and stable yield potential under Polish conditions. In addition, existing resistance genes to powdery mildew in these cultivars were preserved.
- ❑ Two lines (BKH 735 and line 42) as parents with mlo resistance were used. Line BKH 735 with resistance mlo was obtained in Laboratory of Applied Genetics IHAR-PIB Radzików in years 2002-2011. This line was selected from population obtained from crosses of cultivars Carola, Danuta and Bazant. Line 42 was obtained from crosses between cultivars Vanesa, Metaxa and Rasbet.
- ❑ Several homogenous F4BC2 lines with *Mlo* resistance type were selected from generated F1, F1BC1, F2BC1, F3BC1 and F4BC1 populations / lines.
- ❑ Selection was conducted under greenhouse conditions, using molecular markers and under field conditions.
- ❑ Greenhouse tests (phenotypic): Families were tested in the seedling stage for resistance under control conditions. Plants were inoculated by *B. graminis* f.sp. *hordei* isolate, iBgh27, with virulence to most powdery mildew genes but avirulent to *mlo* resistance gene.
- ❑ Molecular selection: To confirm the presence of mlo gene the molecular markers assisted selection (MAS) using HVmlo1 and HVmlo3 were used.
- ❑ Field conditions – 3 locations: under field conditions of important economic traits, including disease resistance, yield and yield potential
- ❑ Field trials with 200 F₆BC₂ lines (50 for each combination) were conducted during 2018/19 in 3 locations: Central (Radzików) and Western Poland (Szelejewo, Wiatrowo). The parental lines were used as control. Characteristics for agricultural value of tested lines were obtained.



Parental cultivars and breeding lines and combinations of barley crosses and backcrosses evaluated evaluated in the prent study.																									
Type	Cultivar / line						Powdery mildew resistance																		
							Gene	Effectiveness		6-row						2-row									
6-row	BKH 735						mlo	high																	
	SOULEYKA (d. NORD 03025/3) DE						MI Lv (Laverda	medium																	
	TITUS (d. BE200010170) DE						Mla6, Mla14	medium																	
2-row	line 42						mlo	high																	
	SU VIRENI (d. AC 03/248/15) DE						Mlra (Ragusa)	low																	
	METAXA (d. AC 99/078/23) DE						Mla6, Mla14	medium																	

6-row													2-row												
(BKH 735 x Souleyka) x Souleyka													(linia 42 x SU Vireni) x SU Vireni												
(BKH 735 x Titus) x Titus													(linia 42 x Metaxa) x Metaxa												

Results

	Plant vigour						Disease resistance															Heading time (days number from 01.01)			Height (cm)		Seed weight (g)	
	fall			spring			powdery mildew			leaf rust			rhynchosporium			BYDV			net blotch									
	RAH	SZD	WTD	RAH	SZD	WTD	RAH	SZD	WTD	RAH	SZD	WTD	RAH	SZD	WTD	RAH	SZD	WTD	RAH	SZD	WTD	RAH	SZD	WTD	RAH	SZD	WTD	
	(BKH 735 x Souleyka) x Souleyka																											
Average	9,0	9,0	9,0	9,0	8,6	9,0	8,8	8,7	8,6	6,7	5,1	9,0	8,8	-	-	9,0	8,8	9,0	8,3	-	9,0	138,4	131,2	141,4	73,6	115,0	47,0	
Min.	9,0	8,0	9,0	9,0	7,0	9,0	7,0	7,0	7,0	3,0	2,0	9,0	7,0	-	-	9,0	7,0	9,0	7,0	-	9,0	132,0	128,0	137,0	65,0	102,0	14,7	
Max.	9,0	9,0	9,0	9,0	9,0	9,0	9,0	9,0	9,0	8,0	8,0	9,0	9,0	-	-	9,0	9,0	9,0	9,0	-	9,0	142,0	136,0	153,0	80,0	128,0	86,0	
	(BKH 735 x Titus) x Titus																											
Average	9,0	9,0	9,0	9,0	8,5	9,0	8,9	8,8	8,6	6,8	6,4	9,0	8,6	-	-	9,0	8,4	9,0	7,9	-	9,0	138,6	133,2	140,5	88,1	116,7	44,3	
Min.	9,0	8,0	9,0	9,0	7,0	9,0	4,0	7,0	6,0	3,0	3,0	8,0	6,0	-	-	9,0	7,0	9,0	6,0	-	9,0	138,0	129,0	137,0	82,0	106,0	5,6	
Max.	9,0	9,0	9,0	9,0	9,0	9,0	9,0	9,0	9,0	9,0	8,0	9,0	9,0	-	-	9,0	9,0	9,0	9,0	-	9,0	142,0	136,0	148,0	92,0	126,0	109,6	
	(L 42 x SU Vireni) x SU Vireni																											
Average	9,0	9,0	9,0	9,0	8,7	9,0	9,0	9,0	8,9	7,1	4,3	9,0	8,7	-	-	9,0	8,6	9,0	8,0	-	9,0	140,4	131,7	141,2	76,6	103,4	38,9	
Min.	9,0	9,0	9,0	9,0	7,0	9,0	9,0	9,0	8,0	5,0	2,0	9,0	7,0	-	-	9,0	6,0	9,0	6,0	-	9,0	138,0	126,0	138,0	70,0	94,0	3,8	
Max.	9,0	9,0	9,0	9,0	9,0	9,0	9,0	9,0	9,0	9,0	7,0	9,0	9,0	-	-	9,0	9,0	9,0	9,0	-	9,0	145,0	136,0	156,0	92,0	116,0	81,7	
	(L 42 x Metaxa)x Metaxa																											
Average	9,0	9,0	9,0	9,0	8,9	9,0	9,0	9,0	9,0	6,4	4,9	9,0	8,8	-	-	9,0	8,6	9,0	7,7	-	9,0	143,6	135,2	142,1	82,8	108,1	34,5	
Min.	9,0	8,0	9,0	9,0	8,0	9,0	9,0	9,0	8,0	3,0	3,0	8,0	7,0	-	-	9,0	7,0	9,0	6,0	-	9,0	139,0	129,0	138,0	75,0	87,0	7,4	
Max.	9,0	9,0	9,0	9,0	9,0	9,0	9,0	9,0	9,0	8,0	6,0	9,0	9,0	-	-	9,0	9,0	9,0	9,0	-	9,0	147,0	137,0	155,0	88,0	125,0	130,5	

Conclusions

The practical outcome of presented investigation is to use of MAS in introduction of Mlo resistance into background of winter barley germplasm with valuable economical characteristics in Polish agricultural conditions. Obtained lines can be used in barley breeding programs for powdery mildew resistance.

Acknowledgements

This work was conducted in project: Interaction between powdery mildew (*Blumeria graminis* f.sp. *hordei*) resistance determined by mlo gene and economical value characteristics in winter barley. 2014-2020. Programme: Basic Research for Biological Progress in Crop Production; Funded by the Ministry of Agriculture and Rural Development Proj. No. 4-1-04-3-01 (27).

Literature

- Higgins, C.M., Hall, R.M., Campbell, P.R., Dietzgen, R.G. 2000. PCR rescue and analysis of transgene sequences directly from crude extracts of transgenic embryos and plants. Plant Molecular Biology Reporter 18: 285a-285g.
- Bilgic, H. Steffenson B.J., Hayes P.M. 2006. Molecular mapping of loci conferring resistance to different pathotypes of the spot blotch pathogen in barley. Phytopathology 96:699-708.
- <http://wheat.pw.usda.gov/cgi-bin/graingenes/report.cgi?class=marker&name=HVMLOH1A>