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Expression of different *Ht* genes to Northern Corn Leaf Blight in Ottawa, Ontario

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Twenty-nine inbred lines with different *Ht* resistance genes for northern corn leaf blight [*Exserohilum turcicum* (Pass.) K.J. Leonard & E.G. Suggs (teleomorph = *Setosphaeria turcica* (Luttrell) K. J. Leonard & E.G. Suggs; syn. = *Helminthosporium turcicum* Pass.] and four susceptible inbred lines (A619, Pa91, CO388, and CO442) were evaluated for the expression of resistance in our leaf blight breeding nursery at Agriculture and Agri-Food Canada (AAFC), Eastern Cereal and Oilseed Research Centre (ECORC), Ottawa, Ontario in 2006 and 2007. Each genotype was planted in a five-row plot with single row plots of 15 plants. All plants were inoculated twice with 0.1 g of ground diseased leaf powder collected from the previous field season. The powder was placed into the whorl of each plant using a Bazooka (Sistrunk Inoculators, Starkville, MS 39759, USA) at 6-8 leaf-stages and again at the 10-12 leaf–stages. If there was no rain after inoculation, the plots were irrigated for 10-15 minutes every day to provide suitable environment for disease to develop.

Specific resistance were observed and recorded first at 15-20 days after the first inoculation (about 12 leaf stage). Five specific resistances were observed, classified as: highly resistant (HR), resistant lesion (R), moderately resistant lesion (MR), moderately susceptible lesion (MS), and susceptible lesion (S). For HR types, there were no typical lesions and the infection point changed color from yellow to brown, sometimes to purple, and had only limited extension. The R types have stripes or narrow elliptical greenish-yellow lesions. MR types have narrow, long, elliptical gray lesions with greenish-yellow or purple margins. MS lesions are long, elliptical, and gray lesion with greenish-yellow or purple margins. The S lesions are long, elliptical, and gray or tan in color. HR, R, and MR plants were selected to self for further resistance breeding to northern leaf blight.

At the soft dough stage (about 3 weeks after silk emergence), plants were observed the specific resistance second time, its classification as above, whereas general resistance were recorded. Based on disease severity, the disease rating scale for general resistance ranges from 1 to 7 where: 1= no symptoms; 2= < 1% of the leaves are symptomatic; 3= 1- 10% of the leaves are symptomatic; 4= 11- 25% of the leaves are symptomatic; 5= > 50% of the lower leaves and < 25% of the mid and upper leaves are symptomatic; 6= lower leaves are dead, > 50% of the mid leaves and < 25% of the upper leaves are symptomatic; 7= plant is dead. The mid leaves refer to the four leaves near the primary ear. Hand-pollinated plants with HR, R, or MR, and disease rating ≤5 were selected continued breeding. Plants with MS or S lesions, or disease rating ≥6, were discarded.

The screening results of inbred lines in 2006 and 2007 were shown in Table 1. Based on these results shown in the table, we made the following conclusions on the expression of the *Ht* genes in Ottawa:

1. Three of the initial sources of blight resistant inbreds [A509N, A553N (orange), and A553N (red)] did not have uniform (pure) resistance since HR or R and S lesions were observed in the 2006 screening. However, self pollination of the HR plants resulted in all HR plants when screened the following year.
2. We observed distinct differences in the expression of the *Ht* genes at early stages (about 12 leaf stage) of plant growth and as expected, symptoms in susceptible genotypes increased as the plants matured. Some specific observations were:
   a. Lesions on *Ht* and *Ht1* plants were very similar. All *Ht* and *Ht1* inbreds were susceptible in Ottawa, Ontario, and are thus not suitable sources of resistance for our region.
   b. All *Ht2* and *Ht3* inbred lines had similar MR type resistance in 2006 and 2007. They all had long lesions with yellow or purple margins. During the later stages of plant development, some of these lesions became larger and developed a gray center thus becoming MS type lesions.
   c. All *Htm1* and *HtN* inbred lines had HR or R type resistance. As the plant developed these either did not change or became slightly larger in size.

64 Table 1. Northern corn leaf blight screening results of inbred lines with different

65 resistance in 2006 and 2007 in Ottawa, Ontario, Canada

Source[†]	Name	*Ht* gene[‡]	2006		2007	
			Specific Resistance	General Resistance	Specific Resistance	General Resistance
Ames23458	A619HT	*Ht1*?	S	5	S	7
Ames23468	A632HT	*Ht1*?	S	5	S	6
Ames27065	B73Htrhm	*Ht1*?	S	5	S	6
PI601079	LH123Ht	*Ht1*?	S	5	S	6
Ames27138	N28Ht	*Ht1*?	S	5	S	7
Ames25219	A619Ht1	*Ht1*	S	5	MR	6
Ames25372	Pa91Ht1	*Ht1*	S	5	S	6
Ames25220	A619Ht2	*Ht2*	MR	4	MR	6
Ames25221	A619Ht3	*Ht2*	MR	4	MR	5
Ames25373	Pa91Ht2	*Ht2*	MR	4	MR	5
Ames25374	Pa91Ht3	*Ht3*	MR	4	MR	5
Cornell University	73353	*Htm1*	R	3	R	3
PI550496	H102	*Htm1*	HR/R	2	HR/R	3
PI406112	A214N	*HtN*	HR/R	2	HR/R	3
PI406118[§]	A509N	*HtN*	95.2HR/R:4.8S	2 or 4	HR/R	3
PI406119[§]	A553N (Orange)	*HtN*	79.7HR/R:20.3S	2 or 4	HR/R	3
PI406120[§]	A553N (Red)	*HtN*	83.3HR/R:16.7S	2 0r 4	HR/R	3
Ames23469	A632HtN	*HtN*	HR/R	2	HR/R	3
PI406126	A661N	*HtN*	HR/R	2	HR/R	3
PI587142	A679	?	--	--	R	5
PI584529	B100	?	--	--	R	3

PI594045	B102	?	--	--	R	3
PI608777	B85	?	--	--	R	3
PI539870	B92	?	--	--	R	3
PI539871	B93	?	--	--	HR/R	2
PI561565	B95	?	--	--	MR	6
AAFC	CO428	?	R/MR	3	R/MR	3
PI587129	H99	?	--	--	R	4
Ames27141	NC290A	?	--	--	R	4
PI587139	A619	N/A	S	7	S	7
PI587174	Pa91	N/A	S	7	S	7
AAFC	CO388	N/A	S	7	S	7
AAFC	CO442	N/A	S	7	S	7
Total				24		33

† Name of organization from which the inbred was obtained or United States Department of Agriculture NC-7 code.

‡ *Ht* resistant gene according to inbred description or pedigree

§ Resistance of these inbred lines was not uniform upon first screening in 2006. The numbers for specific resistance lesion types refer to the percentage observed for each type.

Specific Resistance: HR = highly resistant; R = resistant lesion(s); MR = moderately resistant lesions; MS = moderately susceptible lesions; and S = susceptible lesions.

General Resistance: 1= no symptoms; 2= < 1% of the leaves are symptomatic; 3= 1- 10% of the leaves are symptomatic; 4= 11- 25% of the leaves are symptomatic; 5= > 50% of the lower leaves and < 25% of the mid and upper leaves are symptomatic; 6= lower leaves are dead, > 50% of the mid leaves and < 25% of the upper leaves are symptomatic; 7= plant is dead.