Interspecific amphiploids of perennial *Helianthus* species x cultivated sunflower possess valuable genes for resistance to Sclerotinia stem and head

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Abstract

Field evaluation of stem and head rot resistance using artificial inoculation was conducted using interspecific amphiploids of wild perennials *H. grosseserratus, H. hirsutus, H. maximiliani, H. nuttallii, H. strumosus* crossed with P21, intercrossed amphiploids involving an *H. divaracatus* and *H. grosseserratus*, and BC_1F_1 of amphiploid involving *H. strumosus*. All the amphiploids had better stem rot resistance than the most stem rot tolerant check HA 410. Due to the late flowering of most amphiploids, head rot resistance was observed only in an amphiploid of *H. nuttallii* x P21, which segregated 11 resistant and 16 susceptible plants compared to all 17 plants of the tolerant check HA 441 being susceptible. These amphiploids will provide new resistance genes to develop germplasm lines superior to HA 410 and HA 441 for stem rot and head rot resistance, respectively.

Introduction

Sclerotinia sclerotiorum (Lib.) de Bary is a major disease problem in the world's sunflower production. Cultivated sunflower and present-day hybrids lack an acceptable level of resistance to *Sclerotinia*. However, an abundance of wild *Helianthus* species are potential sources of genes for disease resistance, and Sclerotinia is no exception. Interspecific amphiploids of crosses between wild perennial *Helianthus* species and cultivated line P21 have been produced and maintained by sib-pollination (Jan and Fernandez-Martinez, 2002). Selected amphiploids provided new genes for resistance to the newly evolved race F of *Orobanche* in Spain, after an extensive search of resistance among cultivated lines and annual *Helianthus* species failed (Jan and Fernandez-Martinez, 2002). These amphiploids, with their good backcross seed set, could be quickly utilized for the pyramiding of *Sclerotinia* resistance if proven to be resistant. The USDA sunflower breeding program at Fargo has released several inbred lines tolerant to *Sclerotinia* head rot and stalk rot, with HA 410 moderately resistant to stem rot and HA 441 moderately resistant to head rot (Miller and Gulya, 1999). Our objective was to derive Sclerotinia resistance genes from these amphiploids and to pyramid them into the already tolerant HA 410 and HA 441 for stem rot and head rot, respectively.

Materials and Methods

Five interspecific amphiploids, *H. grosseserratus* x P21*, H. hirsutus* x P21 *H. maximiliani* x P21*, H. nuttallii* x P21*, and H. strumosus* x P21, one intercross between amphiploid *H. divaricatus* 830 x P21 and *H. grosseserratus* x P21, and one backcrossed progeny of amphiploid *H. strumosus* x P21 were field evaluated for both stem and head rot at Fargo, ND, and Mapleton, ND in 2005 (Table 1). A single row plot 16-ft long was replicated twice for each entry, with HA 410 and HA 441 as resistant checks for stem rot and head rot, respectively. Stem rot evaluations were conducted with inoculum consisting of *Sclerotinia* mycelium grown on millet grains, which was deposited in the soil beside each plant at the V-10 to R 5.1 stage (Gulya et al., 2004). Head rot evaluations were conducted by spraying 15,000 Sclerotinia oospores in 3 ml of water over each head at the R 5.5 to 5.9 stage in a field equipped with a misting system.

Table 1. Plant survival, chromosome number, and seed set of amphiploids.

Parentage	2*n* Chromosome	Seeds/head			Stem rot		Head rot	
		BC	Sib	Selfed	R	S	R	S
	--------------------------------no.--------------------------------							
H. grosseserratus x P21	66-68	8	26	0	47	1	1	1
H. hirsutus 1126 x P21	96-102	10	17	0	24	3	--	--
(*H. div* 830 x P21) x (*H. gro* x P21)	67-70	17	42	--	14	0	--	--
H. maximiliani x P21	66-69	27	49	0	36	1	--	--
H. nuttallii 730 x P21	66-70	3	19	0	52	4	11	16
H. strumosus 30-002-1 x P21	99-103	12	6	0	27	2	0	1
(*H. strumosus* 30-002-1 x P21) P21	67-68	105	90	--	22	0	--	--
Inbred HA 410	34	--	--	--	**38**	**6**	**0**	**18**
Inbred HA 441	34	--	--	--	**11**	**55**	**0**	**17**

Results and Discussion

The chromosome number, seed set, and reactions of amphiploids to Sclerotinia stem and head rot is presented in Table 1 and Figures 1 to 3. While HA 441 was mostly susceptible, all the four amphiploids, the intercrossed amphiploid, and the $BC_1 F_1$ of the hexaploid amphiploid had better resistance than HA 410 for stem rot. Because P21 is not resistant to stem rot, the resistance genes in these entries are expected to be from the perennial *Helianthus* species involved. Continuing backcrossing with HA 410 and selection for stem rot resistant progenies will ensure the restoration of the HA 410 genotype with possible added resistance genes from the perennial species.

Figure 1. HA 441 (left) and HA 410 (right) with developing head rot.

Figure 2. A head rot susceptible HA 410.

Figure 3. Head rot resistant amphiploid of *H. nuttallii* x P21, amphiploid (center).

Due to the late flowering of most amphiploids, head rot resistance was observed only on the *H. nuttallii* x P21 amphiploid. However, its segregation of 11 resistant and 16 susceptible plants is still far superior compared to all 17 plants of the tolerant check HA 441 being susceptible. Plants resistant to stem rot or to both stem and head rot were moved into the greenhouse for further evaluation, sib-pollination, and backcrossing to HA 410 and HA 441 for stem and head rot resistance gene pyramiding, respectively (Fig. 4).

Figure 4. Amphiploids in the greenhouse.

Our preliminary results provide an optimistic outlook for our future work with these interspecific amphiploids. We feel comfortable at this stage that we are a few steps closer to the successful transfer of new resistance genes from these amphiploids into HA 410 and HA 441 for the production of superior stem rot and head rot resistance germplasms.

References

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