

Sclerotinia Stalk Rot and Head Rot Resistance in Commercial Hybrids and Search for New Sources of Stalk Rot Resistance in USDA Plant Introductions

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Abstract
USDA Plant Introductions were screened at three locations for Sclerotinia stalk rot (SSR) resistance in an effort to discover new sources of SSR resistance and to provide data for association mapping to facilitate future breeding efforts. The 262 entries had SSR levels from 2% to 100%. While only a few entries had high levels of resistance, the wide range of disease will aid the association mapping. USDA inbreds, included for comparison, continued to be among the most resistant entries.

Commercial and experimental hybrids were tested in inoculated field trials for resistance to Sclerotinia head rot and in separate trials for SSR in 2008, in a coordinated manner with participation by multiple entities. The data on 93 hybrids is published in full in the NDSU bulletin A-652 (available online) and also will be posted on the National Sunflower Association website.

Introduction

Two major research efforts are addressed in this report:

- the annual, combined efforts to evaluate commercial sunflower hybrids for resistance to Sclerotinia head rot and stalk rot, and
- a project to evaluate newly available USDA Plant Introductions for stalk rot resistance. This project is aimed at not only identifying new sources of resistance, but also creating a large data set to be used in association mapping to assist in determining which sources are novel Sclerotinia resistant genes.

Materials and Methods

The USDA Plant Introduction sunflower germplasm collection has recently increased a great number of accessions which were previously unavailable for distribution and most of the PIs had not been tested for any traits, including disease resistance. Seeds were obtained from the Ames, IA, collection and planted at three locations: Davenport, ND (CHS), Crookston, MN (Croplan) and Breckenridge, MN (Mycogen), and inoculated with millet-based mycelium as described in previous years. Two replications of single-row plots were planted at each of the three sites.

A coordinated effort to evaluate commercial hybrids for Sclerotinia resistance has been in place for seven years, with participation by researchers from North Dakota State University (Carrington), University of Minnesota (Crookston), USDA (Fargo), and Ag Canada (Morden). Head rot and stalk rot trials are at separate locations, with head rot trials under automated mist irrigation inoculated with ascospores (Figure 1), while stalk rot trials are non-irrigated and inoculated with millet-based Sclerotinia mycelium (Figure 2). Details on inoculation and evaluation procedures have been discussed in previous presentations. Stalk rot trials in 2008 were located in Breckenridge (courtesy of Mycogen Seeds), Davenport (courtesy of CHS), Crookston (courtesy of Croplan), and Carrington (NDSU), while head rot trials were in Carrington (NDSU), Crookston (UMN), and Morden (Ag Canada).

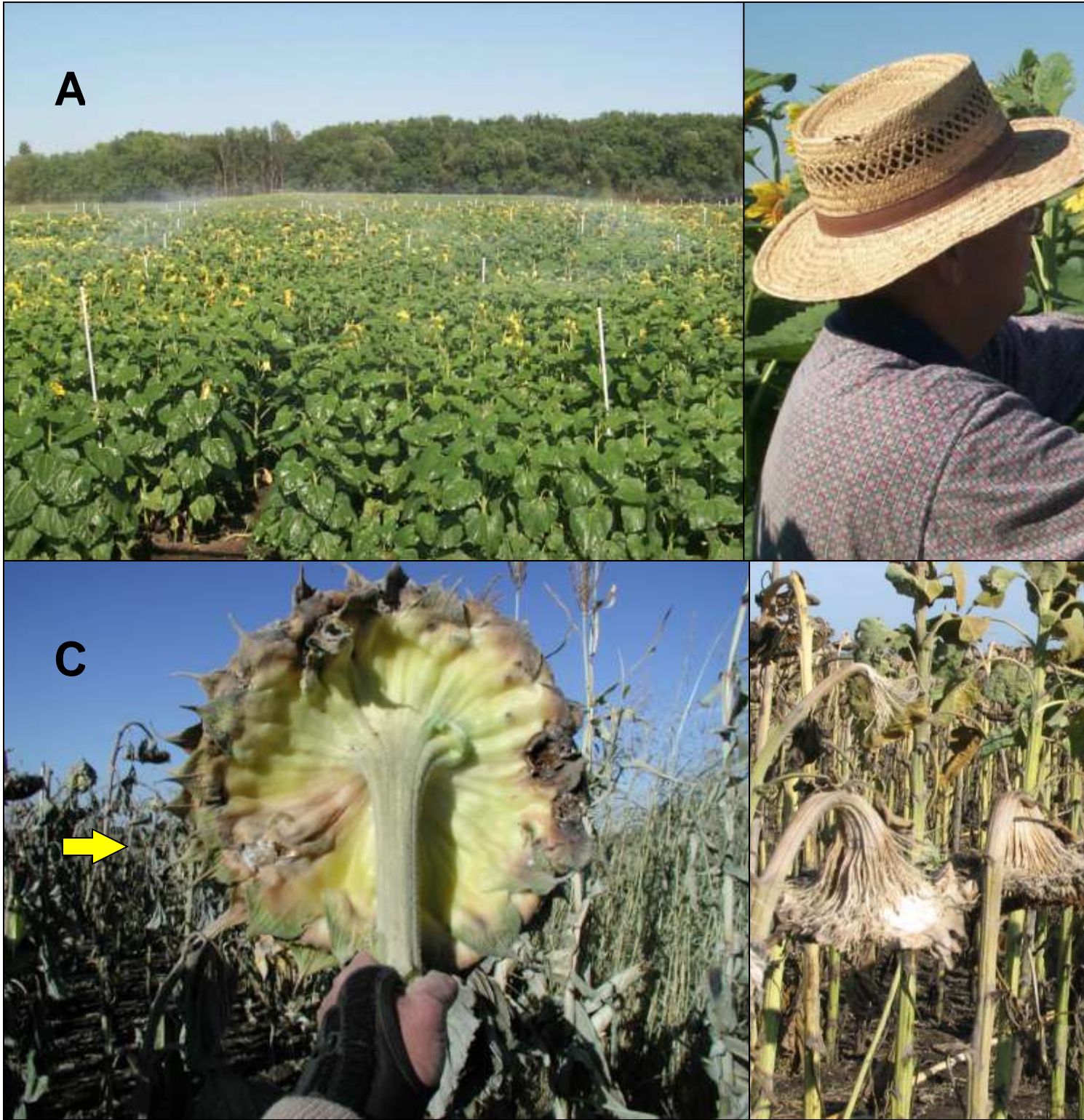


Figure 1. A= Mist irrigation system plot at Carrington
ascospores. C= initial *Sclerotinia* infection two weeks
D= fully susceptible row with heads nearly disintegrated



Figure 2. A. millet-based mycelial inoculum (with

Results and Discussion

Two of the three plantings of the 262 USDA PIs yielded stalk rot data (excess rain at Breckenridge negated stalk rot development). The entries ranged from extremely resistant (2% infection) to total susceptibility, as shown in Figure 3. The most resistant entries are listed in Table 1, and illustrate the diversity of the germplasm. The entire group of 262 entries will be planted again in 2009 at three locations to generate a large dataset for association mapping. Additionally, the best entries will be planted in two head rot nurseries in an attempt to find head rot and stalk rot resistance in the same material. While none of the PIs were more resistant than USDA line HA 441, the more resistant PIs may still have unique genes, and with the development of more precise molecular markers, we hope to be able to identify sources of novel genes.

2008 Stalk Rot Test of USDA

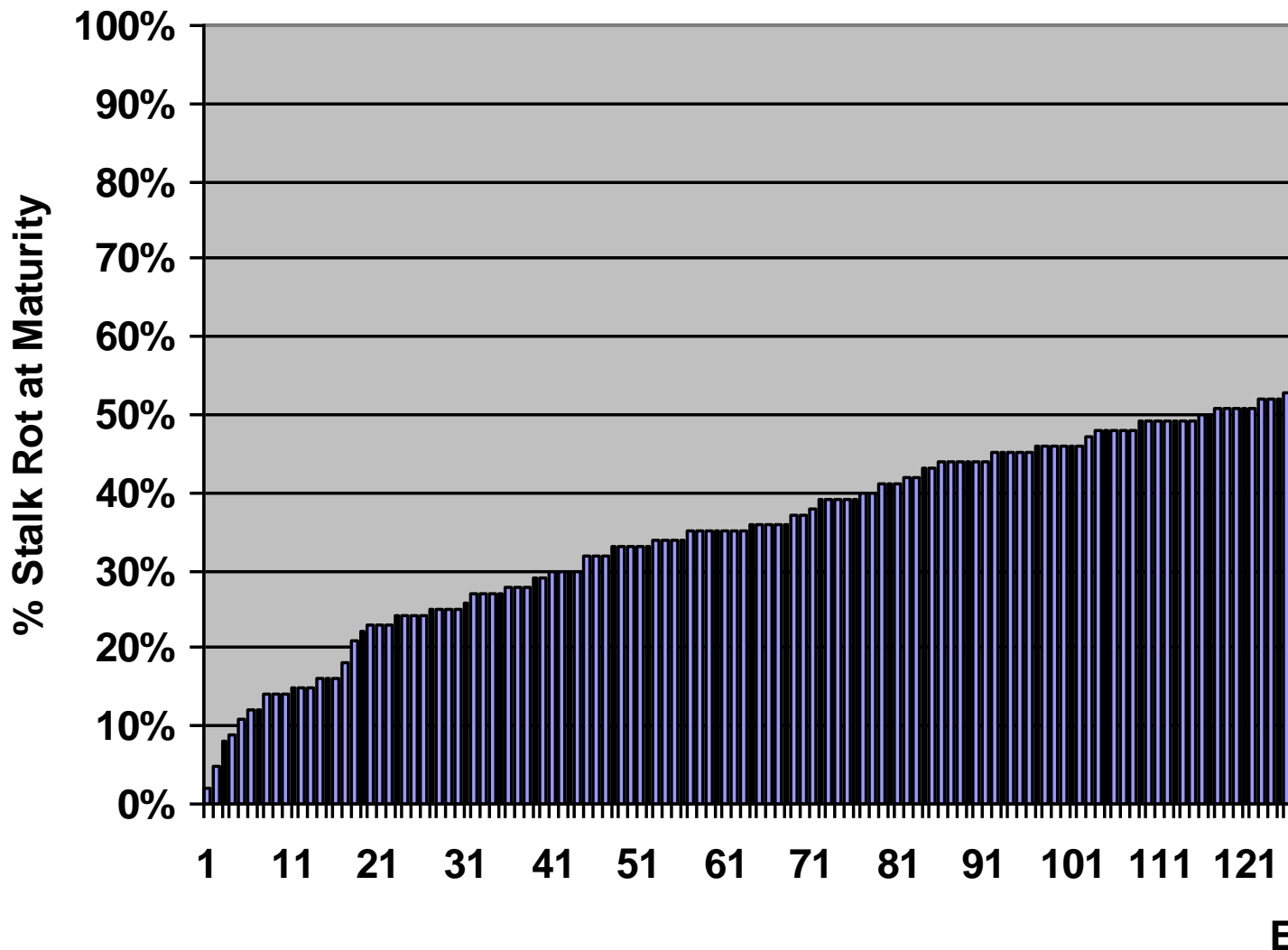


Figure 3. Histogram showing the percent stalk rot at maturity for 262 USDA Plant Introductions tested in two field plots with artificial inoculum.

Table 1. Stalk rot ratings on the best 25 entries of 262 USDA Plant Introductions tested in 2008, along with country of origin to illustrate geographic diversity.

P.I. Number	Stalk Rot % at Maturity	Pedigree	Origin
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HA 441	2%		<i>USDA inbred</i>
600714	5%	<i>CO-PB 105</i>	<i>Spain</i>
650787	8%	<i>Vniimk-1696</i>	<i>Russia (via Bulgaria)</i>
HA 409	9%		<i>USDA inbred</i>
650562	11%	<i>High Oil 74</i>	<i>UDSA/ND</i>
HA 468	12%		<i>USDA inbred</i>
650542	12%	<i>Romsun V-3319B</i>	<i>Romania</i>
535890	14%	<i>Krzynowloski miejscowy</i>	<i>Poland</i>
650613	14%	<i>HIR 34</i>	<i>France</i>
650786	14%	<i>Vniimk-3497</i>	<i>Russia (via Bulgaria)</i>
480471	15%	<i>FS-a-3</i>	<i>Zambia</i>
650525	15%	<i>S8 A9343 2/3-3</i>	<i>Canada</i>
650757	15%	<i>E-3 Normal</i>	<i>Mexico (via VIR)</i>
HA 377	16%		<i>USDA inbred</i>
650778	16%	<i>Harkouski-101</i>	<i>Russia (via Bulgaria)</i>
650801	16%	<i>Ciro-Iran</i>	<i>Iran (via INRA-France)</i>
531389	18%	<i>SLOVENSKA SIVA</i>	<i>Czech Repub (via Hungary)</i>
HA 412	21%		<i>USDA inbred</i>
497936	22%	<i>Rezerv</i>	<i>Russia</i>
650498	23%	<i>Romsun V3355 AC</i>	<i>Romania</i>
650616	23%	<i>11603-4</i>	<i>Uncertain, Shands/Dekalb</i>
650810	23%	<i>Guaran</i>	<i>Paraguay</i>
507903	24%	<i>3100516</i>	<i>Hungary</i>
531361	24%	<i>IREGI HNK 81</i>	<i>Hungary</i>
650386	24%	<i>Vniimk 6540</i>	<i>Russia</i>
Resistant Check	25%	<i>Croplan 305</i>	<i>US</i>
Susceptible Check	56%	<i>Cargill 270</i>	<i>US</i>

Stalk rot and head rot inoculations on the 93 hybrids were successful at three locations, and the data was statistically significant at all locations (Table 2). Due to early June rains, some plots were planted four weeks later than the earliest plots, but this did not impact stalk rot development. Stalk rot,

averaged over three locations, ranged from 14% infection for the most resistant to 66% for the most susceptible hybrid. With regard to head rot ratings, the most resistant hybrid had 23% infected heads compared to 79% for the most susceptible. As seen in previous years, many hybrids which displayed high levels of resistance to head rot were susceptible to stalk rot, and vice versa. However, there were some entries which displayed high levels of resistance to both forms of Sclerotinia attack.

Table 2. Sclerotinia head rot and stalk rot ratings of the ten best entries from 93 hybrids tested at multiple locations in 2008.

		Stalk Rot					Head Rot				
		Location			Mean across locations	RANK	Location			Mean across locations	Rank
		Davenport	Crookston	Morden			Carrington	Crookston	Morden		
Company	Hybrid										
Triumph	TRX7435HO	12%	19%	12%	14%	1	65	80	33	60	50
Triumph	TRX8344	17%	25%	6%	16%	2	71	88	34	64	70
Heaton	8TH606	11%	11%	30%	17%	3	42	73	15	43	20
Advanta	F30294NS	24%	16%	10%	17%	4	95	75	23	64	69
Resist-2	Crop 343	25%	13%	20%	19%	5	35	NT	11	23	1
ProSeed	6004	27%	17%	13%	19%	6	78	NT	52	65	72
Triumph	7449	9%	36%	13%	20%	7	84	71	29	61	55
ProSeed	6007	29%	15%	22%	22%	8	46	33	14	31	3
PANNAR	PEX 3426	39%	18%	8%	22%	9	62	23	17	34	8
ProSeed	7025	34%	8%	25%	22%	10	77	62	16	52	34
		<i>Davenport</i>	<i>Crookston</i>	<i>Morden</i>	<i>3 loc Av.</i>		<i>Carrington</i>	<i>Crookston</i>	<i>Morden</i>		
c.v.		54	68	59	60		36	19	50		
Isd, 0.05		34	32	24	18		34	20	19		
Min		8	5	6	14		26	23	11	23	
Max		88	68	73	66		97	100	73	79	
average		46	34	29	36		68	75	28	55	
		<i>Davenport</i>	<i>Crookston</i>	<i>Morden</i>	<i>3 loc Av.</i>	<i>Rank</i>	<i>Carrington</i>	<i>Crookston</i>	<i>Morden</i>	<i>3 loc Av.</i>	<i>Rank</i>
Resist-2	Crop 343	25%	13%	20%	19%	6	35	NT	11	23	1
Seeds 2000	X5493	50%	54%	6%	37%	51	39	25	18	27	2
ProSeed	6007	29%	15%	22%	22%	9	46	33	14	31	3
ProSeed	7016	31%	18%	21%	23%	13	39	44	11	31	4
Seeds 2000	X4767	78%	58%	28%	55%	88	47	NT	17	32	5
CHS	CHS08-EX3	45%	9%	22%	25%	19	34	41	25	33	6
Seeds 2000	X9478	59%	35%	36%	43%	68	38	47	16	34	7
PANNAR	PEX 3426	39%	18%	8%	22%	8	62	23	17	34	8
ProSeed	7207	33%	45%	44%	41%	61	48	45	12	35	9
Seeds 2000	X3381	69%	41%	12%	41%	62	59	NT	11	35	10

The results of all 93 hybrids are found in the current printed edition of NDSU bulletin A-652, which is also available online, and the information will also be posted on the NSA website, to include rust ratings on the same hybrids.

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