

Screening of Sunflower for Resistance to *Sclerotinia* Head Rot

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ABSTRACT

The determination of sunflower hybrids with some level of resistance to sclerotinia head rot consists of a two-phase screening. The first phase includes a larger group of hybrids referenced as the 'initial evaluation' while the second phase represents a four-site evaluation to verify improved resistance identified in the previous year's initial screening. Misting systems were established across the northern sunflower production region near Carrington, Langdon, and Oakes, ND, and Morden, Canada. The misting systems were critically important in providing conditions that favored sclerotinia head rot infections. The overall average head rot infection rate was 42%, while other sunflowers near the test sites had minimal disease. Review of head rot incidence among hybrids in the initial evaluation indicates infection rates ranging from 24% to 79% among 77 hybrids. Hybrids in the repeat evaluation that were previously identified as having improved resistance to head rot had average infection levels that ranged from 20% to 64%. Head rot severity among hybrids differed significantly. Generally, the hybrids with the lower incidence of head rot also trended toward lower severity of infection. Further analysis of the combined head rot data along with data from the similar group of hybrids tested for stalk rot resistance will more clearly identify overall improvements in sunflower hybrid resistance to sclerotinia.

INTRODUCTION

Sclerotinia sclerotiorum infects a broad range of host crops causing serious losses in crop yield and quality. Sunflower has been known to be highly susceptible to sclerotinia infections. This project screens sunflower germplasm, breeding lines and commercial hybrids for resistance to head rot infection from sclerotinia. The overall project provides support to the USDA-ARS sunflower breeding team by establishing and managing extensive misting nurseries at Carrington, ND. Information intended to aid growers in the shorter term is gathered at strategically located research sites within the major sunflower production region. Misting systems specifically designed and managed to induce a favorable environment for sclerotinia head rot infection in sunflower are the foundation of the research. Commercial hybrids and advanced experimental lines are solicited from breeding programs and seed companies to develop tests of hybrids with potential for improved sclerotinia resistance. The determination of resistance consists of a two-phase screening. The first phase includes a larger group of 75 lines referenced as the 'initial evaluation' which is planted at two locations to determine reaction to sclerotinia head rot. The second phase of testing includes a sub-set of 20 hybrids with the best resistance to head rot based on the results of the initial evaluation in the previous year. Sunflower hybrids with the best resistance under the disease pressure provided by misting systems would be expected to perform well under natural field infections.

MATERIALS and METHODS

- ◆ The initial screening evaluation included hybrids submitted to Dr. Tom Gulya by sunflower breeding programs for inclusion in the sclerotinia head and stalk rot trials.
- ◆ The repeat screening evaluation included the best 20 hybrids for resistance to both sclerotinia head and stalk rot from testing in the 2007 evaluations.
- ◆ The trials were planted in late May to early June at Carrington, Langdon, and Oakes, ND, and Morden, Canada. Trial design was a randomized complete block with four replications.
- ◆ Fifteen heads were selected from each row of each plot as individual plants reached about 25% anthesis and were inoculated with an ascospore suspension to ensure the sclerotinia disease-causing organism was present.
- ◆ After inoculation, misting systems were activated and managed to provide a favorable environment for sclerotinia head rot infection.
- ◆ All inoculated plants were scored at multiple times as sunflower matured to determine incidence and severity of the disease.

RESULTS AND DISCUSSION

The project achieved good levels of sclerotinia head rot infection at all misting system sites. The range of infection among hybrids at the four sites was as follows: Carrington 26 to 98%, Langdon 8 to 74%, Morden 11 to 54%, and Oakes 0 to 85%. The misting systems again proved critical to the success of the project since the natural environment around these same locations did not result in significant head rot infection in 2008.

Initial Evaluation:

The initial screening of a new group of sunflower hybrids for resistance to sclerotinia head rot identified a wide range of hybrid susceptibility. Incidence ranged from 24% to 79% infection (Figure 1).

The severity of head rot among hybrids evaluated in the initial screening ranged from a score of 2.9 to 5.0 (Figure 2). Only a limited number of hybrids exhibited a tendency for a reduced level of disease progression across the sunflower head.

The 25 hybrids with the lowest head rot incidence ratings are listed in Table 1. This same group of hybrids represents nearly all hybrids that expressed a reduced level of head rot severity among hybrids in the initial screening.

The sunflower hybrids listed will be compared to the stalk rot ratings from Dr. Tom Gulya's project to determine the group of hybrids that warrant further evaluation in the 2009 repeat screening.

Repeat Evaluation:

The incidence of head rot shown in Figure 3 represents the infection level of sunflower hybrids averaged across Carrington, Langdon, Oakes, and Morden, locations.

The differences in the severity of head rot among hybrids evaluated in the repeat screening was significant with scores ranging from 2.0 to 4.6 (Figure 3). Generally, the hybrids with the lowest incidence ratings had a corresponding lower level of head rot severity.

The incidence ratings of individual hybrids as evaluated across the four repeat test locations are shown in Table 2. Review of the data across locations will show that hybrids having the best overall resistance to sclerotinia head rot (Figure 3.) were generally among the top hybrids at individual locations. However, this variation in incidence among hybrids across the locations indicates the importance of multiple site evaluations to create more confidence in the overall results.

Table 1. Sunflower sclerotinia head rot incidence and severity of the top 25 hybrids from the 'Initial Screening'.

Brand	Hybrid	Carrington and Morden	
		Combined Incidence	CREC Severity
%			
Dyna-Gro	94C38	24.1	4.4
Seeds2000	X3381	27.2	3.9
Seeds2000	X9466	27.2	3.9
Seeds2000	X4994	27.6	2.9
CHS	CHS08-EX3	28.8	4.0
ProSeed	7016	29.0	3.4
Triumph	TRX8445	29.1	3.9
Mycogen	E88427	29.9	4.2
ProSeed	7207	30.2	4.8
ProSeed	6007	31.2	3.2
Seeds2000	X9714	31.8	3.9
Pioneer	63N82	32.7	3.6
Seeds2000	X9478	33.6	3.9
Interstate	DKL39-80CL	34.9	4.1
ProSeed	7052	37.5	4.4
Seeds2000	X9744	37.9	4.3
Tom Heaton	8TH604	38.9	4.4
Red River	2216	39.9	4.7
Mycogen	E87421	39.9	4.2
PANNAR	PEX 3426	40.3	4.1
Seeds2000	X9766	40.3	3.8
Interstate	MH6640	41.8	4.2
Mycogen	E87355	42.0	4.3
Triumph	TRX8344	42.7	4.1
Dahlgren	95EXP CL	43.5	4.9
Resistant	Croplan 343	29.4	4.3
Resistant	Croplan 305	33.0	3.7
Susceptible	Cargill 270	53.6	4.4

Figure 1. Incidence of sclerotinia head rot among sunflower hybrids in the 'Initial Screening', averaged across Carrington and Morden locations.

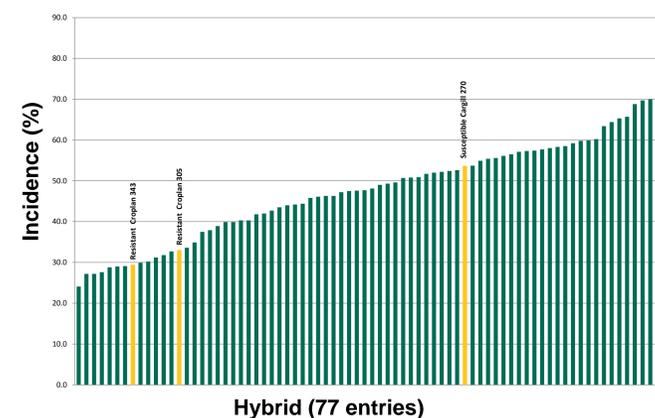


Figure 2. Severity of sclerotinia head rot among sunflower hybrids in the 'Initial Screening' at Carrington.

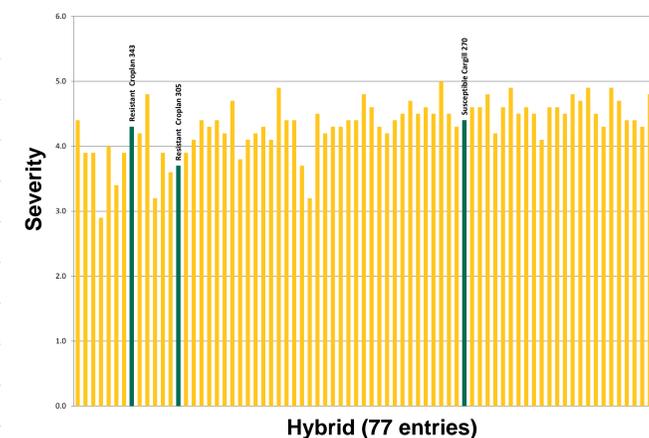
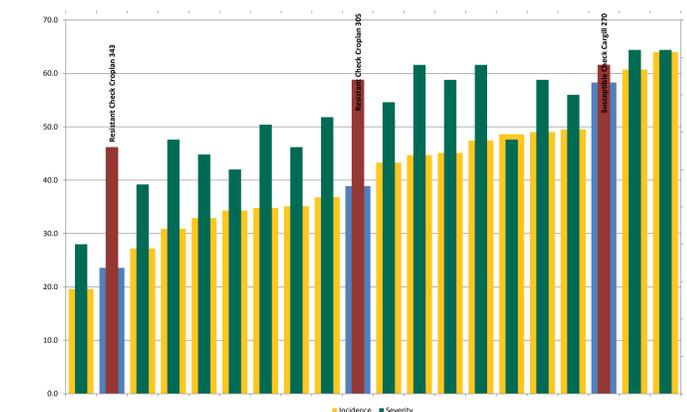


Figure 3. Average incidence and severity of sclerotinia head rot among sunflower hybrids in the 'Repeat Screening'.



Picture 1. The severity rating scale (left to right 1 through 5) for sunflower sclerotinia head rot.



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Table 2. Incidence of sclerotinia head rot among sunflower hybrids tested in the 'Repeat Screening'.

Brand	Hybrid	Incidence				Severity			
		CREC	LRFC	Morden	OIRS	CREC	LRFC	OIRS	
%									
Seeds 2000	X3370	58.6	7.5	10.7	1.7	4.1	0.8	1.0	
Resistant Check	Croplan 343	38.1	19.7	11.8	10.0	4.3	3.1	1.6	
Seeds 2000	X5493	47.4	37.4	24.2	0.0	4.3	4.0	0.0	
Pannar	7924 NS	51.9	43.6	22.9	5.0	4.2	3.6	2.5	
Seeds 2000	X4744	78.9	23.9	25.3	3.3	4.2	3.7	1.8	
Advanta	F51132	57.8	26.2	26.7	26.7	4.0	3.1	2.1	
ProSeed	6004	77.5	25.8	22.4	13.3	4.5	4.2	2.0	
ProSeed	6481	52.8	52.0	23.8	11.7	3.3	4.2	2.5	
Triumph	7449	68.1	36.2	33.1	10.0	4.3	3.7	3.0	
Resistant Check	Croplan 305	40.9	38.2	29.1	76.7	3.7	4.4	4.6	
Croplan	MH 6641(306 DMR)	50.3	46.0	26.7	50.0	3.7	4.6	3.5	
Tom Heaton	H7020	57.1	49.3	32.3	40.0	4.5	4.4	4.2	
Tom Heaton	H7018	54.3	59.5	28.4	38.3	4.1	4.6	3.8	
Interstate	DKF 34-80	71.5	37.9	32.0	48.3	4.5	4.7	4.0	
Mycogen	8H419 DM	76.0	58.8	36.1	23.3	4.3	3.0	3.1	
Croplan	MH 6642 (356 NS)	93.2	49.4	19.8	33.3	4.5	4.0	4.1	
Dahlgren	9519	80.7	73.9	28.3	15.0	4.5	4.7	2.6	
Susceptible Check	Cargill 270	81.5	62.4	25.8	83.3	4.4	4.3	4.8	
Interstate	DKF 34-33	91.4	68.7	34.2	48.3	4.8	4.6	4.5	
Seeds 2000	X4767	83.6	54.2	33.0	85.0	4.7	4.4	4.7	
Mean		67.6		26.6	31.2	4.4	4.0	3.0	
C.V. %		35.8	27	46.6	59.2	10.7	15.7	45.6	
LSD.05		33.5	16.8	NS	26.1	0.6	0.9	1.9	
LSD.01		44.0		NS	34.7	0.9	1.2	2.6	

SUMMARY

Project procedures using misting systems to induce a favorable environment for sclerotinia head rot again were proven critical to gaining new research results.

The initial screening identified numerous sunflower hybrids that show potential for improved resistance to sclerotinia head rot as incidence levels were compared to resistant check hybrids. The projects approach to utilize multiple locations (4) to confirm and gain confidence in sunflower hybrid resistance to sclerotinia head rot was reinforced by the results from the repeat screening.

The screening of sunflower hybrids for resistance to sclerotinia head rot is a component of the broader research effort involving sclerotinia stalk rot evaluations and support of the USDA-ARS breeding program.