

Sclerotinia head rot:

Improving the methods used to screen sunflowers for resistance
and prospects for using fungicides for management



Michael J. Wunsch¹, Amanda Arens², Scott Halley², Pravin Gautam², Leonard Besemann³,
Walt Albus³, Robert Harveson⁴, and Michael Schaefer¹

¹ **North Dakota State University**, Carrington Research Extension Center, Carrington

² **North Dakota State University**, Langdon Research Extension Center, Langdon

³ **North Dakota State University**, Carrington Research Extension Center Oakes Irrigation Research Site, Oakes

⁴ **University of Nebraska**, Panhandle Research Extension Center, Scottsbluff

(1) Assess the relative susceptibility of sunflowers to head rot during and after bloom

- Results will help guide inoculation methods used in resistance screening nurseries
- Results will inform fungicide efficacy research



(2) Improve the methods used to screen sunflowers for resistance to *Sclerotinia* head rot

- Screening nurseries have not always produced replicable results



(3) Evaluate the potential of modern fungicides for managing *Sclerotinia* head rot

- Several fungicides are known to be effective against head rot when fungicides are applied to the front of heads
- Fungicide efficacy against head rot has not been rigorously tested when fungicides are applied over the top of the canopy



Methods –

Susceptibility of sunflowers to head rot during and after bloom

PLOTS: Minimum 21 to 29 feet of row per plot

DESIGN: Completely randomized split-plot or split-split-plot with minimum 4 replicates

2013: 6 to 16 replicates **2012:** 6 to 7 replicates **2011:** 4 to 6 replicates

INOCULATION: approx. 15,000 ascospores of *S. sclerotiorum* applied to the front and back of heads on two different days



Results –

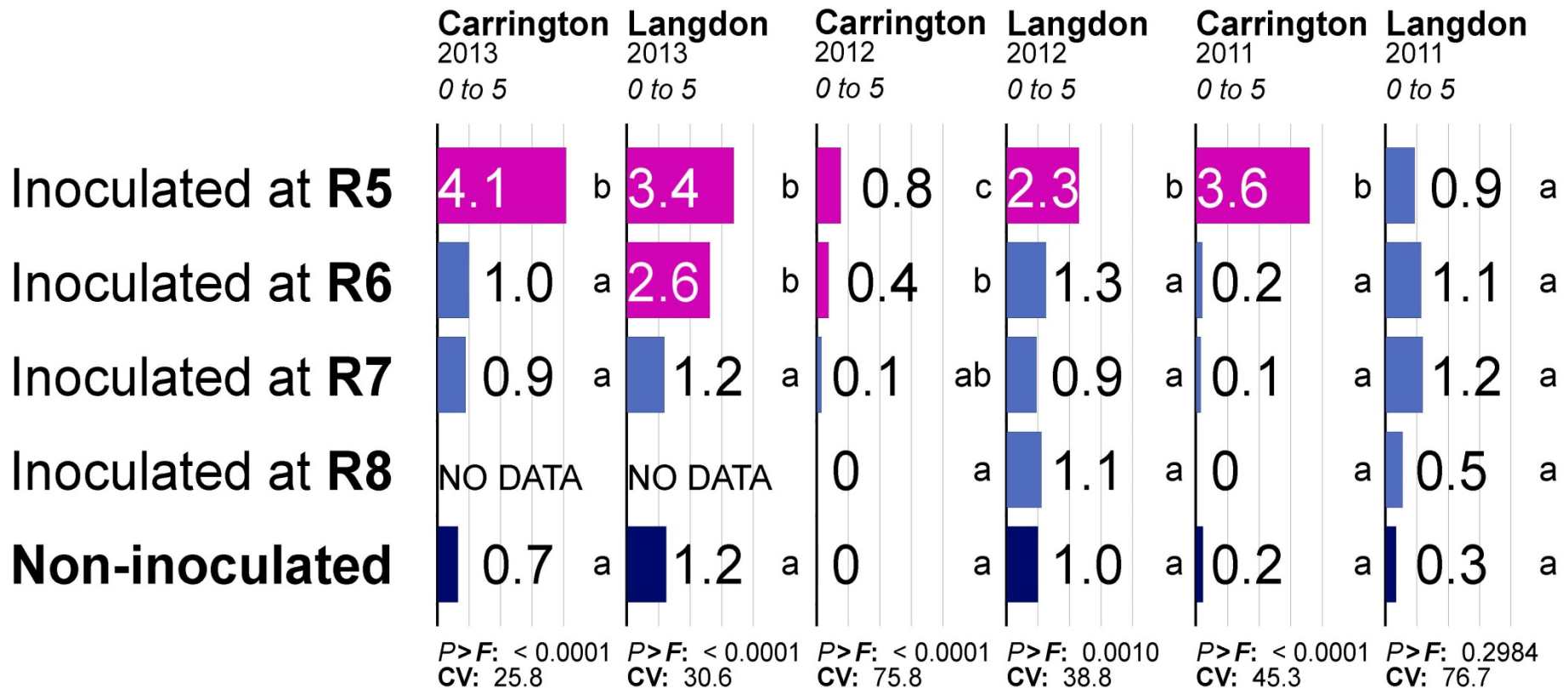
Susceptibility of sunflowers to head rot during and after bloom

SUSCEPTIBLE HYBRID

2012, 2013: Croplan '305 DMR NS'

2011: Mycogen '8H288 CL DM'

Sclerotinia head rot severity (0 to 5) was assessed at physiological maturity.



SUSCEPTIBLE HYBRID

2012, 2013:
Croplan
'305 DMR NS'

2011:
Mycogen
'8H288 CL DM'

Sclerotinia head rot
was assessed at
physiological maturity

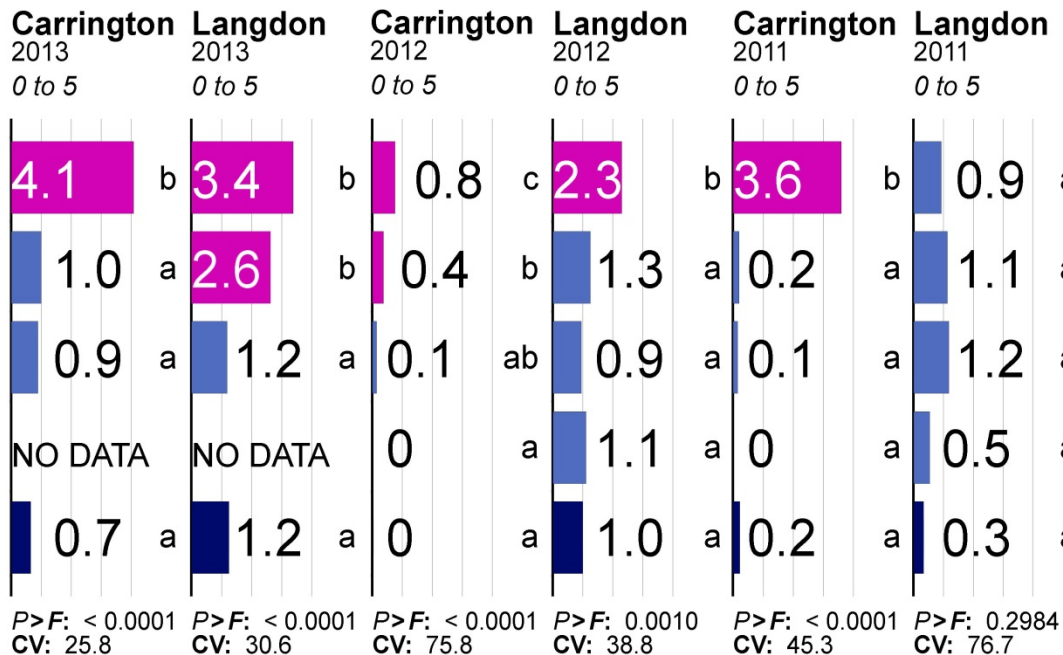
Inoculated at **R5**

Inoculated at **R6**

Inoculated at **R7**

Inoculated at **R8**

Non-inoculated



HEADS BAGGED AFTER INOCULATION

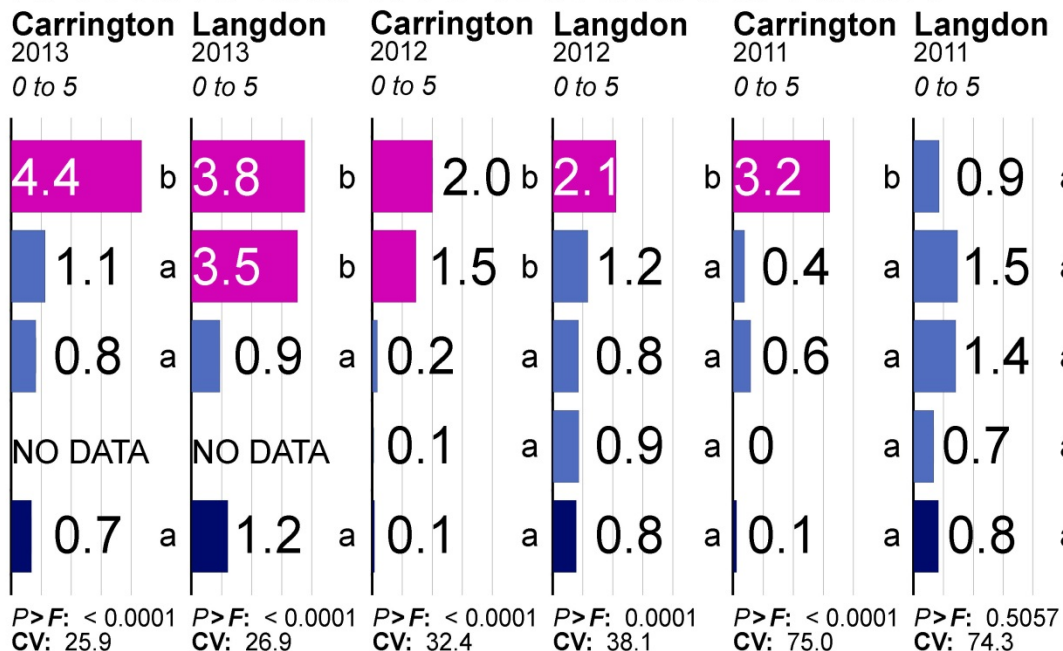
Inoculated at **R5**

Inoculated at **R6**

Inoculated at **R7**

Inoculated at **R8**

Non-inoculated



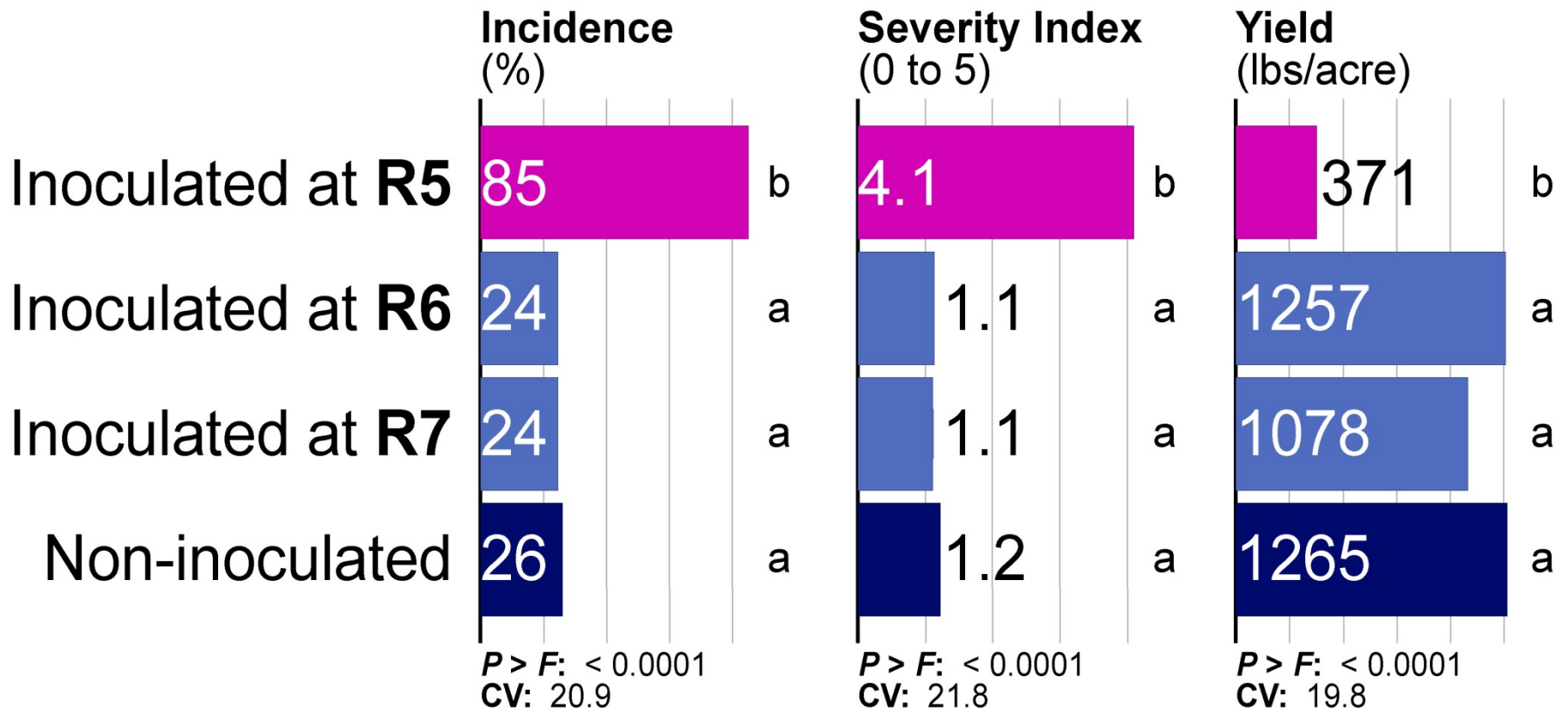
Results –

Susceptibility of sunflowers to head rot during and after bloom

SUSCEPTIBLE HYBRID

2013: Croplan '305 DMR NS'; 145 sq ft plots

Sclerotinia head rot was assessed at physiological maturity.



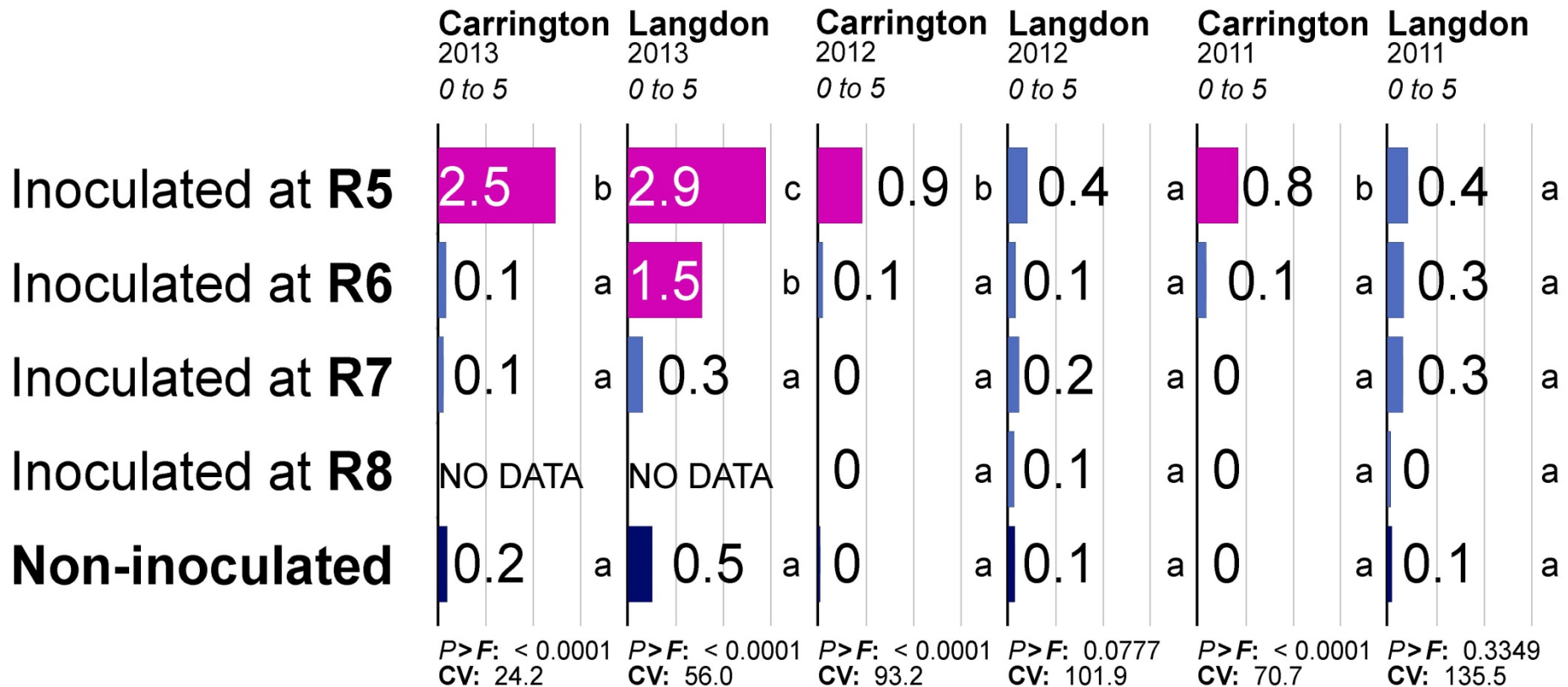
Results –

Susceptibility of sunflowers to head rot during and after bloom

RESISTANT HYBRID

2012, 2013: Croplan '343 DMR HO' 2011: ProSeed 'E8'

Sclerotinia head rot severity (0 to 5) was assessed at physiological maturity.

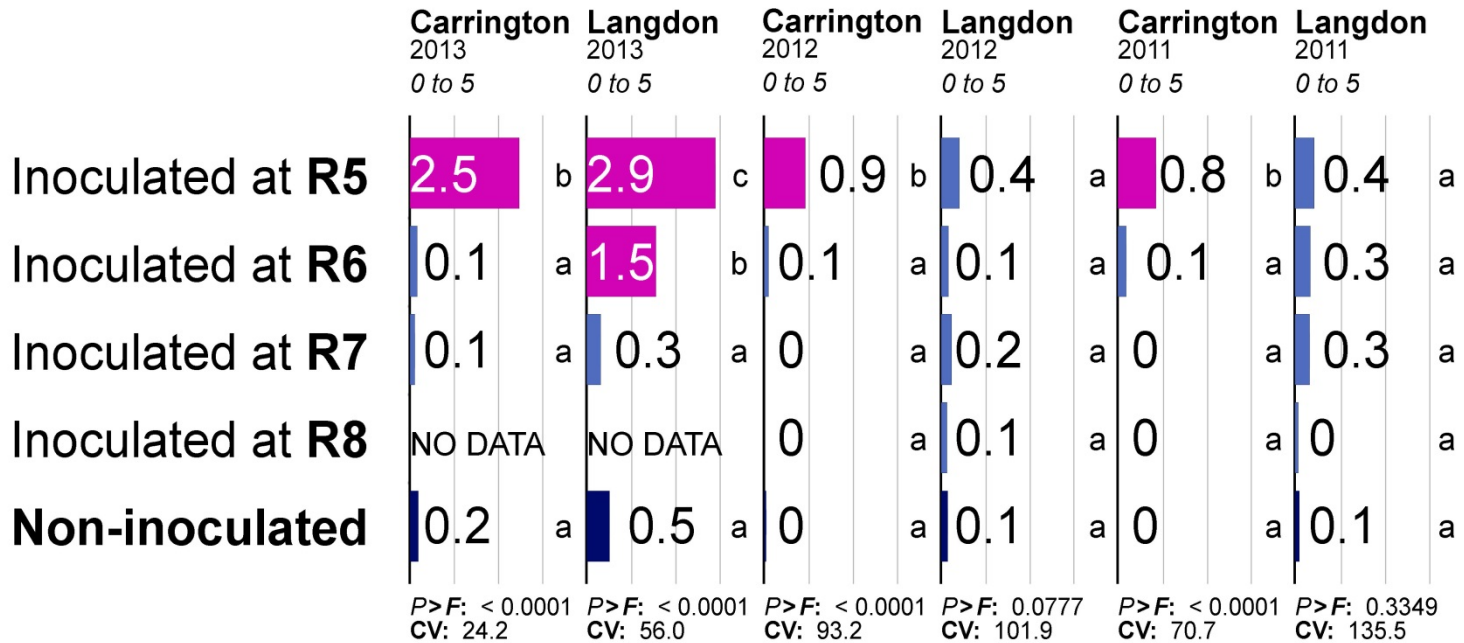


RESISTANT HYBRID

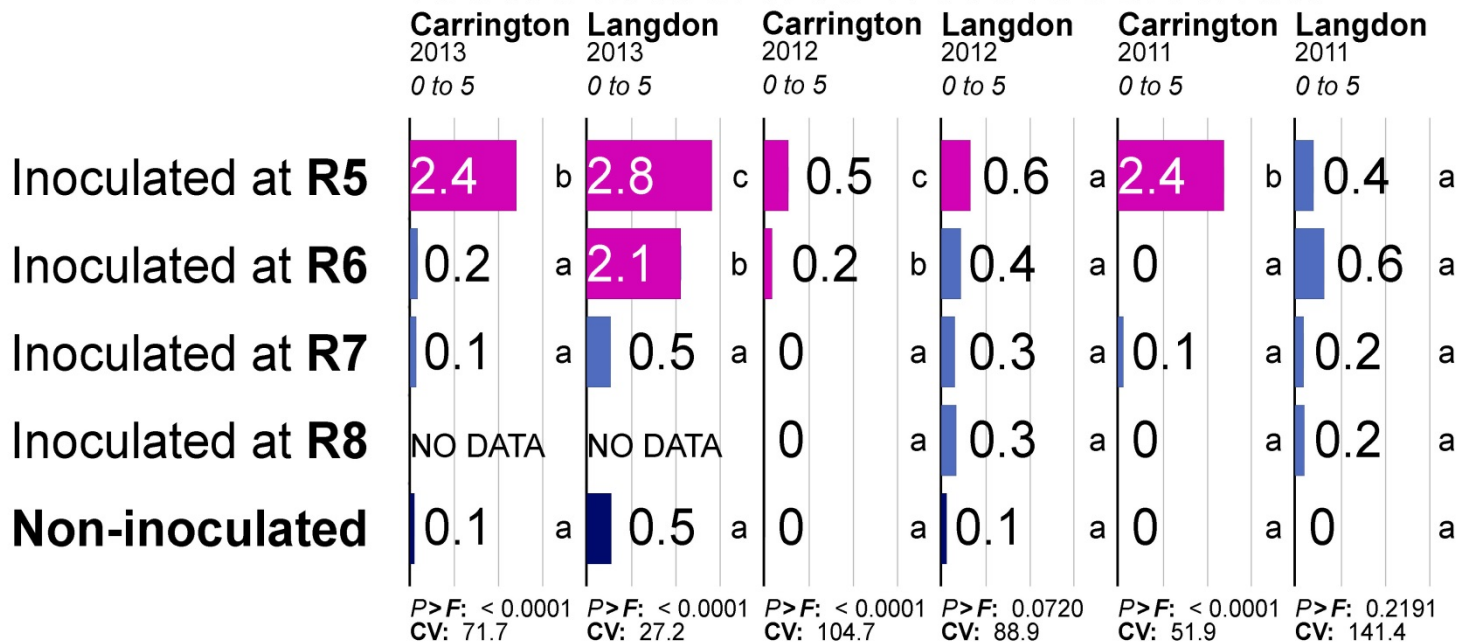
2012, 2013:
Croplan
'343 DMR HO'

2011:
ProSeed
'E8'

Sclerotinia head rot
was assessed at
physiological maturity



HEADS BAGGED AFTER INOCULATION



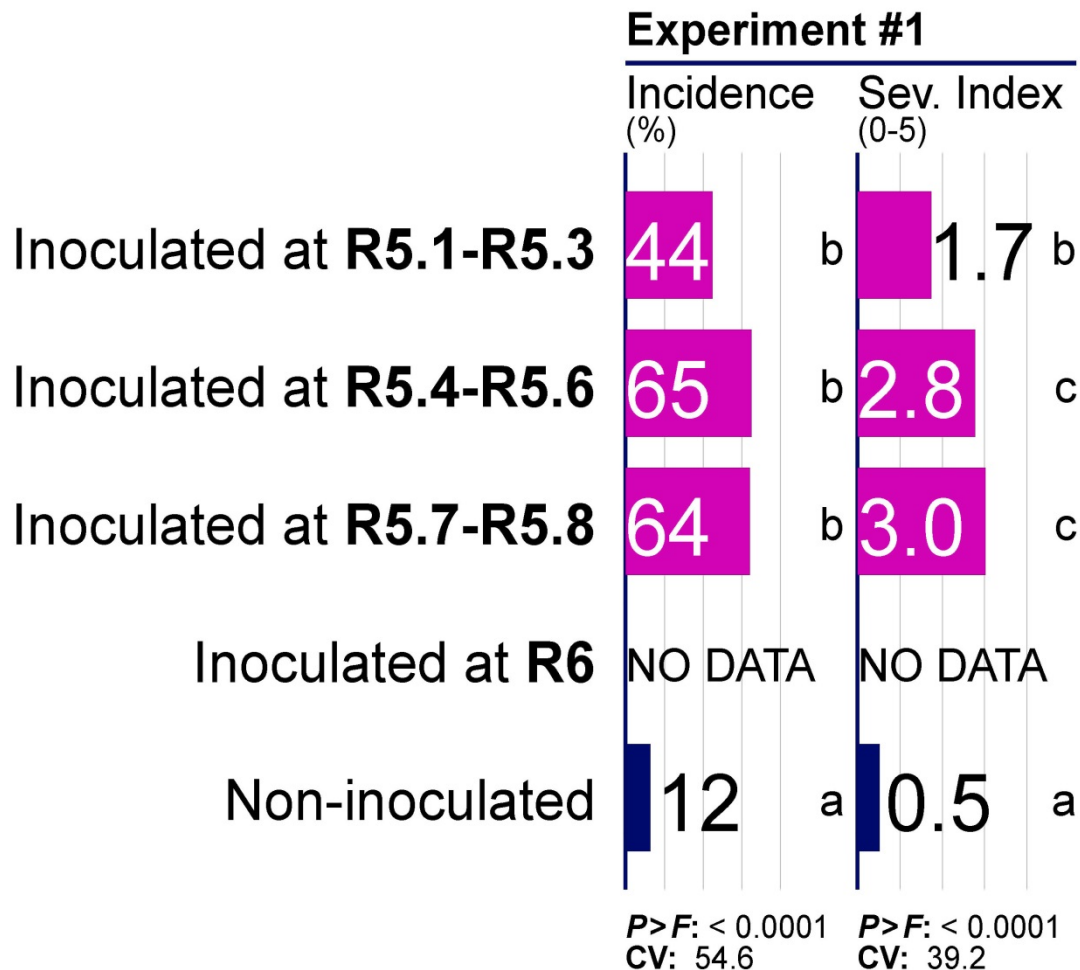
Results –

Susceptibility of sunflowers to head rot during and after bloom

SUSCEPTIBLE HYBRID

2013: Croplan '305 DMR NS'

Sclerotinia head rot severity (0 to 5) was assessed at physiological maturity.



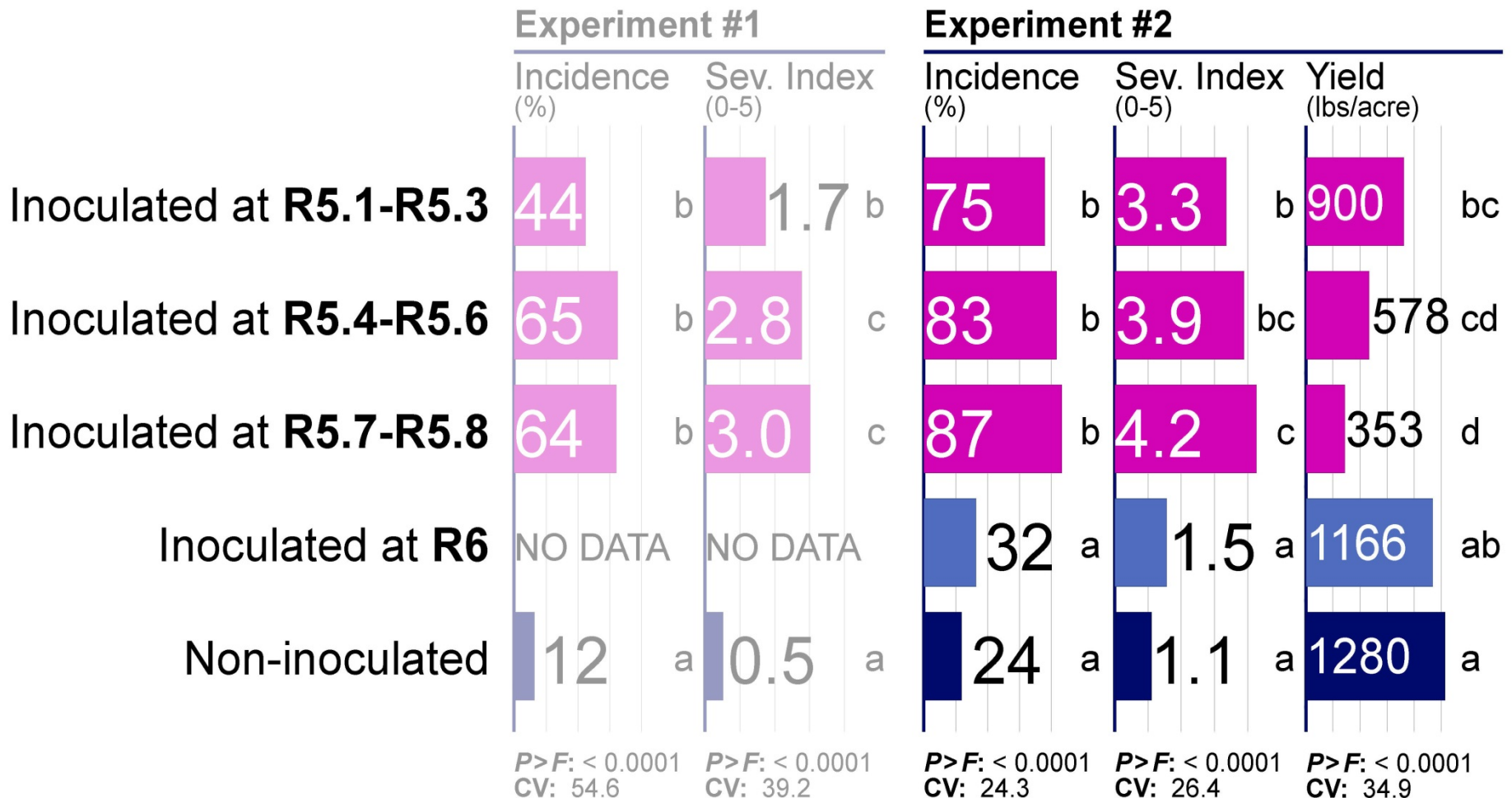
Results –

Susceptibility of sunflowers to head rot during and after bloom

SUSCEPTIBLE HYBRID

2013: Croplan '305 DMR NS'

Sclerotinia head rot severity (0 to 5) was assessed at physiological maturity.



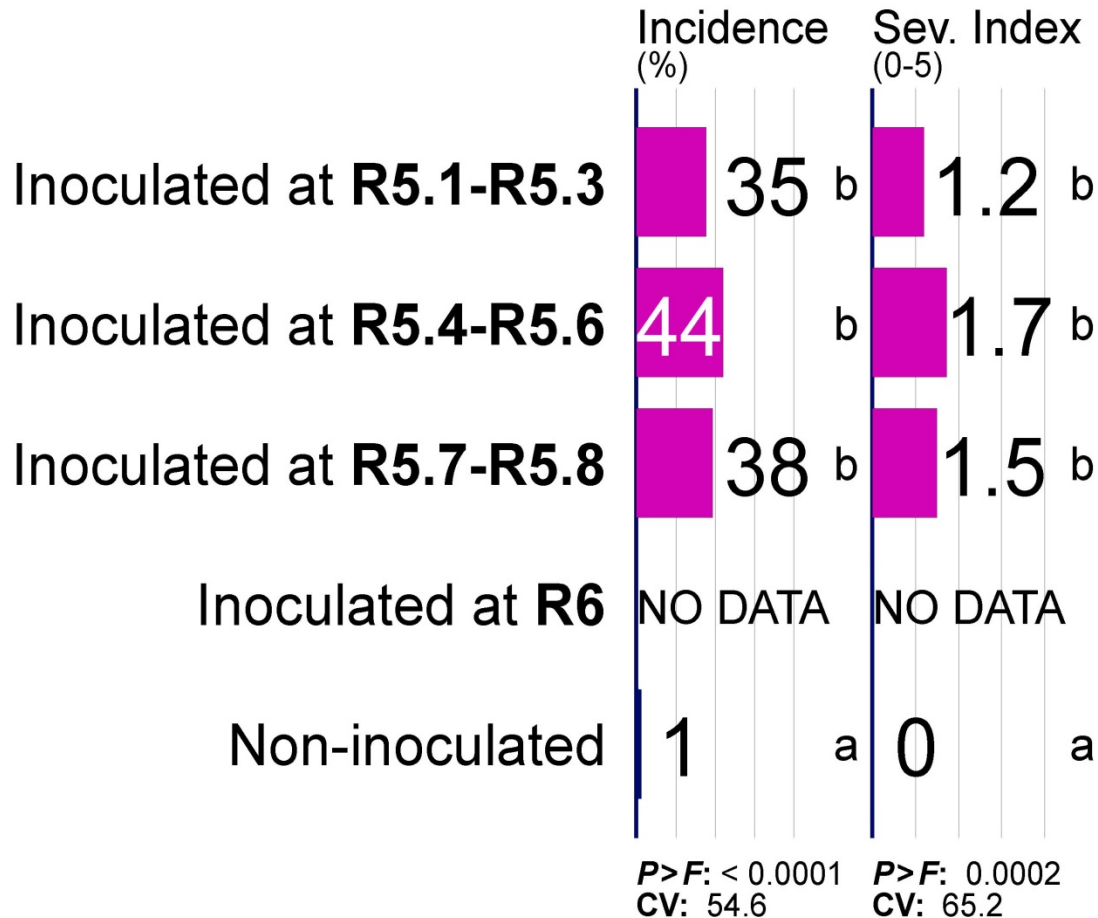
Results –

Susceptibility of sunflowers to head rot during and after bloom

RESISTANT HYBRID

2013: Croplan '343 DMR HO'

Sclerotinia head rot severity (0 to 5) was assessed at physiological maturity.



Conclusions –

Susceptibility of sunflowers to head rot during and after bloom

HEAD ROT RESISTANCE SCREENING NURSERIES:

To produce replicable, unbiased results,
inoculations must be **conducted over multiple dates** such that all heads across all entries are inoculated at the same growth stage.

USING FUNGICIDES TO CONTROL HEAD ROT:

To maximize disease control with foliar fungicides,
fungicides must be applied such that sunflower heads are protected during bloom.



Methods –

Resistance screening nurseries

PLOTS: Minimum 17 feet of row per plot

DESIGN: Completely randomized block, minimum 4 replicates

2013: 4 to 9 replicates

2012: 4 to 6 replicates

2011: 4 replicates

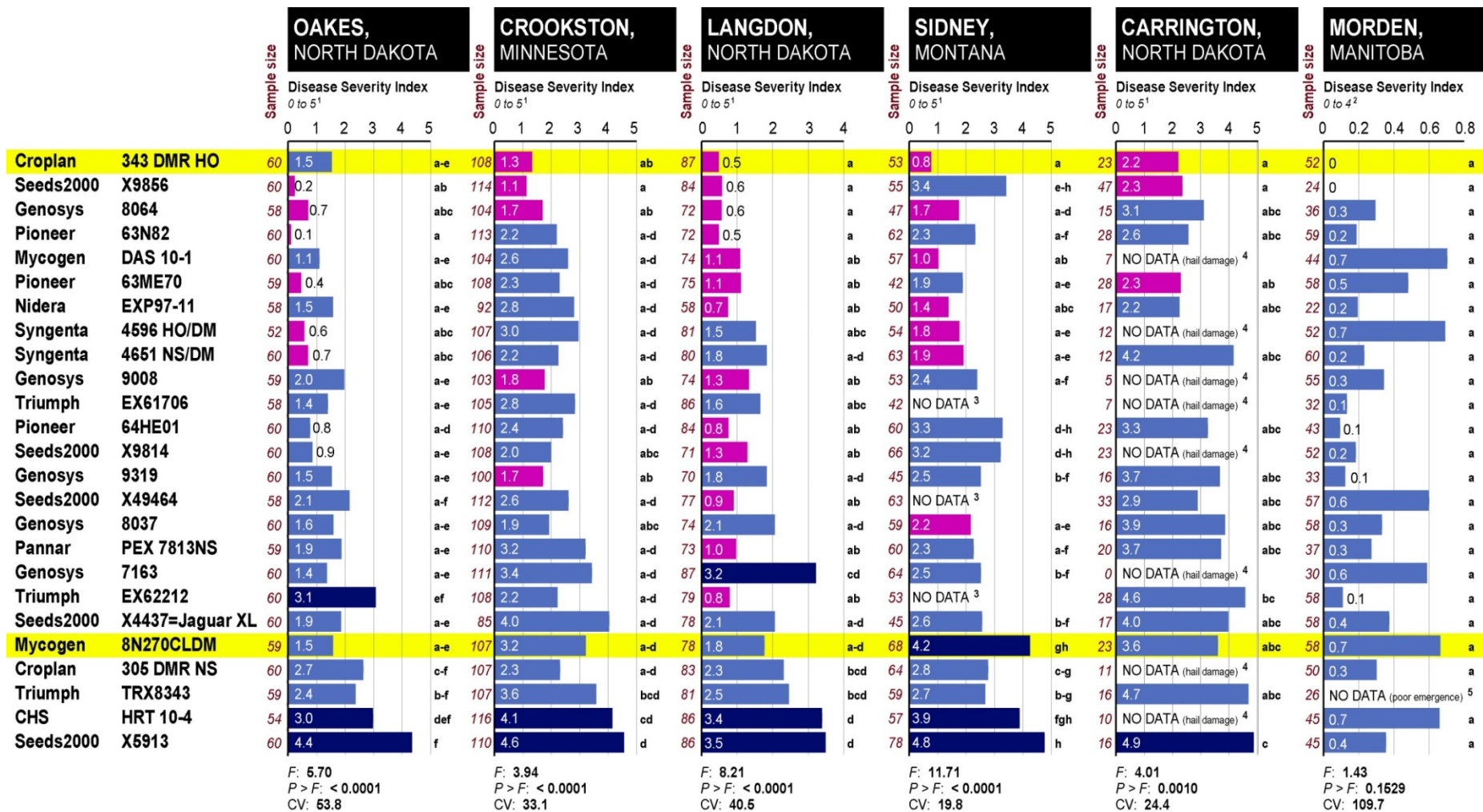
INOCULATION: approx. 15,000 ascospores of *S. sclerotiorum* applied to the front of heads at R5.4 to R5.6 and again 2 to 3 days later



Results –

Screening commercial sunflower hybrids and breeding lines for resistance

Multi-location screening nurseries, 2011:



Results –

Screening commercial sunflower hybrids and breeding lines for resistance

CORRELATION, DISEASE SEVERITY INDEX

Multi-location head rot resistance screening nurseries, 2011

Below axis: Pearson correlation coefficient Above axis: P-value associated with correlation

	Morden	Sidney	Carrington	Crookston	Oakes	Langdon
Morden		0.4782	0.5257	0.0038	0.5225	0.0245
Sidney	0.13		0.0953	0.0363	0.0879	0.0046
Carrington	0.17	0.42		0.0145	0.002	0.0004
Crookston	0.55	0.41	0.59		0.0026	< 0.0001
Oakes	0.13	0.33	0.68	0.57		0.0015
Langdon	0.44	0.53	0.76	0.71	0.59	

Legend:

- White box = $P > 0.05$
- Light blue box = $P \leq 0.05$
- Dark blue box = $P \leq 0.01$

Morden:

Inoculations conducted on fixed dates with some entries at R5, others at R6

Sidney:

Inoculations conducted on fixed dates with some entries at mid-bloom, others at early bloom

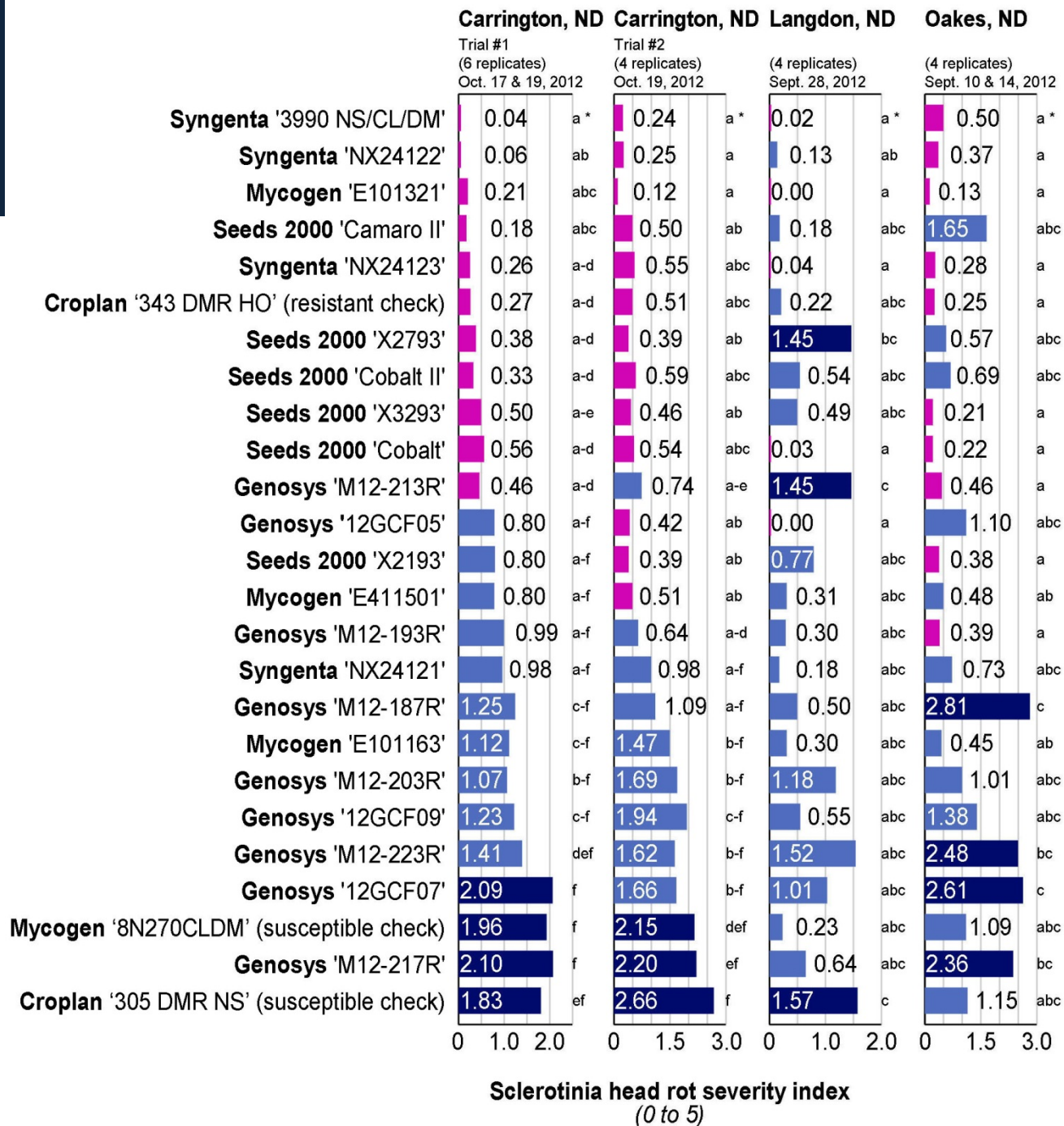
Other sites:

Inoculations conducted on multiple dates such that all entries were at mid- to late bloom

Results –

Screening commercial sunflower hybrids and breeding lines for resistance

Multi-location nurseries, 2012



Sclerotinia head rot severity index (0 to 5)

Results –

Screening commercial sunflower hybrids and breeding lines for resistance

CORRELATION, DISEASE SEVERITY INDEX

Multi-location head rot resistance screening nurseries, 2012

Below axis: Pearson correlation coefficient Above axis: P-value associated with correlation

Carrington, Oakes:

Inoculations conducted on multiple dates such that all entries were at mid- to late bloom.

Langdon:

Inoculations conducted on fixed dates with some entries at mid-bloom, others at early bloom

	Carrington - trial 1	Carrington - trial 2	Oakes	Langdon
Carrington - trial 1		<0.0001	0.0002	0.0527
Carrington - trial 2	0.8866		0.0024	0.0167
Oakes	0.6704	0.5794		0.0839
Langdon	0.3917	0.4739	0.3526	

Results – Multi-location screening nurseries, 2013

Company	Entry	Type	Status	Carrington, ND		Oakes, ND		Langdon, ND	
				9 REPLICATES	R9 growth stage 0 to 5	4 REPLICATES	R9 growth stage 0 to 5	4 REPLICATES	R9 growth stage 0 to 5
NuSeed Global	NHW11915	Confection	experimental	0.8	ab	1.6	ab	1.7	ab
Mycogen	246321	Oil	experimental	0.5	a	1.7	ab	2.3	a-d
NuSeed Global	NHW11917	Confection	experimental	1.1	a-d	1.7	ab	2.5	a-d
Mycogen	101321	Oil	experimental	1.0	abc	2.4	a-e	2.0	abc
Croplan	343 DRM HO	Oil	resistant check	1.9	b-h	2.2	a-d	1.5	a
NuSeed Global	NHW12706	Confection	experimental	1.7	a-f	1.1	a	3.1	a-d
NuSeed Global	NHW12806	Confection	experimental	1.9	b-h	1.7	ab	2.3	a-d
NuSeed / Seeds 2000	NLK12M008	Oil	experimental	1.4	a-e	2.0	abc	2.6	a-d
Genosys	12GCF05	Confection	commercially available	1.4	a-e	2.0	abc	3.0	a-d
NuSeed / Seeds 2000	NHK12S076	Oil	experimental	1.7	a-g	NOT TESTED	NOT TESTED	NOT TESTED	
Genosys	12G20	Oil	commercially available	2.0	b-i	NOT TESTED	NOT TESTED	NOT TESTED	
Mycogen	303321	Oil	experimental	3.0	g-n	2.6	a-e	2.9	a-d
Genosys	12GCF18	Confection	commercially available	2.9	f-m	2.6	a-f	3.1	a-d
Genosys	12GCF07	Confection	commercially available	2.4	d-k	2.9	a-f	3.5	a-d
NuSeed / Seeds 2000	NHK12M010	Oil	experimental	2.3	c-i	3.4	b-f	3.7	a-d
Genosys	11G08	Oil	commercially available	2.3	c-i	NOT TESTED	NOT TESTED	NOT TESTED	
NuSeed Global	NHW11929	Confection	experimental	2.5	e-l	NOT TESTED	NOT TESTED	NOT TESTED	
Croplan	305 DMR NS	Oil	susceptible check	3.1	h-o	4.6	ef	2.0	abc
Genosys	12GCF12	Confection	commercially available	3.7	k-o	2.7	a-f	3.4	a-d
NuSeed / Seeds 2000	NHK12S075	Oil	experimental	2.5	e-l	3.5	b-f	4.0	bcd
NuSeed / Seeds 2000	NHK12S029	Oil	experimental	3.2	i-o	NOT TESTED	NOT TESTED	NOT TESTED	
NuSeed / Seeds 2000	Camaro II	Oil	commercially available	3.5	j-o	3.3	a-f	3.4	a-d
NuSeed / Seeds 2000	Cobalt II	Oil	commercially available	3.6	k-o	3.9	c-f	3.2	a-d
Mycogen	8N270CLDM	Oil	susceptible check	4.1	mno	4.0	c-f	3.1	a-d
NuSeed / Seeds 2000	NLK12S069	Oil	experimental	3.5	j-o	4.3	def	3.6	a-d
NuSeed / Seeds 2000	NSK13M305	Confection	experimental	4.1	mno	3.8	b-f	3.4	a-d
NuSeed / Seeds 2000	NSK13M302	Confection	experimental	3.7	k-o	4.1	c-f	4.0	bcd
NuSeed / Seeds 2000	X4216	Oil	experimental	3.7	l-o	NOT TESTED	NOT TESTED	NOT TESTED	
NuSeed / Seeds 2000	NSK13M301	Confection	experimental	4.1	mno	4.0	c-f	4.4	cd
NuSeed / Seeds 2000	NSK13M304	Confection	experimental	3.9	mno	4.4	def	4.3	cd
Genosys	12GCF15	Confection	commercially available	4.3	no	4.8	f	3.7	a-d
NuSeed / Seeds 2000	NLK12S070	Oil	experimental	3.9	mno	4.5	def	4.5	d
NuSeed / Seeds 2000	NSK13M303	Confection	experimental	4.4	o	NOT TESTED	NOT TESTED	NOT TESTED	

P>F: < 0.0001
CV: 26.3

P>F: < 0.0001
CV: 26.1

P>F: < 0.0001
CV: 27.5

Results –

Screening commercial sunflower hybrids and breeding lines for resistance

CORRELATION, DISEASE SEVERITY INDEX

Multi-location head rot resistance screening nurseries, 2013

Below axis: Pearson correlation coefficient Above axis: P-value associated with correlation

All sites:

Inoculations conducted on multiple dates such that all entries were at mid- to late bloom.

	Carrington	Oakes	Langdon
Carrington		<0.0001	<0.0001
Oakes	0.8542		0.0006
Langdon	0.6998	0.6288	

Conclusions –

Screening commercial sunflower hybrids and breeding lines for resistance

TO PRODUCE REPLICABLE, UNBIASED RESULTS:

inoculations must be **conducted over multiple dates** such that all heads across all entries are inoculated at the same growth stage.



Blaine Schatz



Sam Markell

Methods – Fungicide efficacy testing

PLOT SIZE:

2012, 2013: 127.5-130 sq ft (Oakes, Langdon), 145-150 sq ft (Carrington, Scottsbluff)

2011: 55 sq ft (Langdon), 100 sq ft (Carrington)

DESIGN: Completely randomized block with 4 replicates

INOCULATION: approx. 15,000 ascospores of *S. sclerotiorum* applied to the front of heads two to three times during bloom

FUNGICIDE APPLICATIONS:

- Flat-fan 8001 or 8002 nozzles
- Minimum 14.5 gallons of water/ac
- Generally 30 or 35 psi

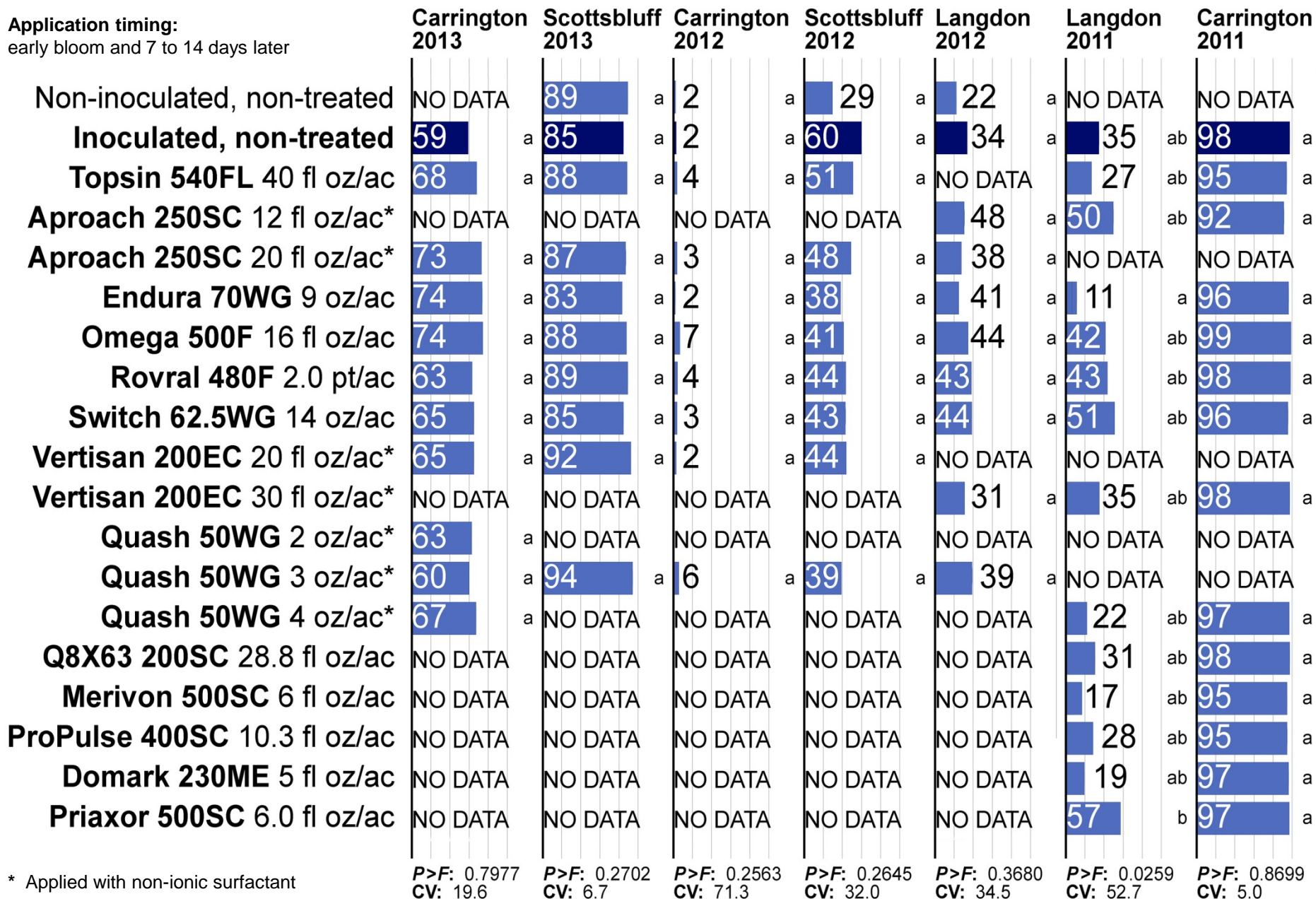


Results – Fungicide efficacy

SCLEROTINIA HEAD ROT INCIDENCE (%)

Application timing:

early bloom and 7 to 14 days later



* Applied with non-ionic surfactant

P>F: 0.7977
CV: 19.6

P>F: 0.2702
CV: 6.7

P>F: 0.2563
CV: 71.3

P>F: 0.2645
CV: 32.0

P>F: 0.3680
CV: 34.5

P>F: 0.0259
CV: 52.7

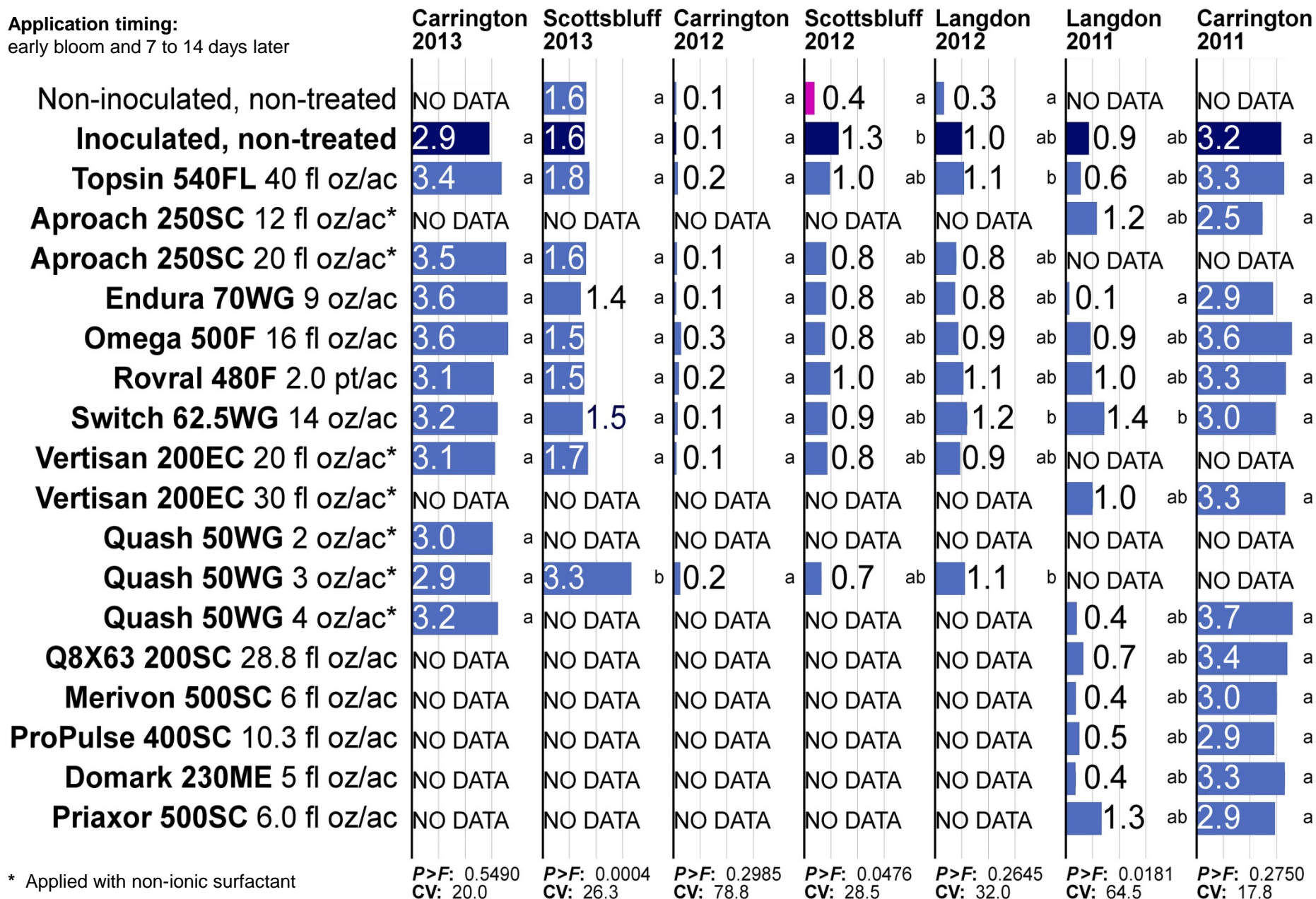
P>F: 0.8699
CV: 5.0

Results – Fungicide efficacy

SCLEROTINIA HEAD ROT SEVERITY INDEX (0-5)

Application timing:

early bloom and 7 to 14 days later



* Applied with non-ionic surfactant

P>F: 0.5490
CV: 20.0

P>F: 0.0004
CV: 26.3

P>F: 0.2985
CV: 78.8

P>F: 0.0476
CV: 28.5

P>F: 0.2645
CV: 32.0

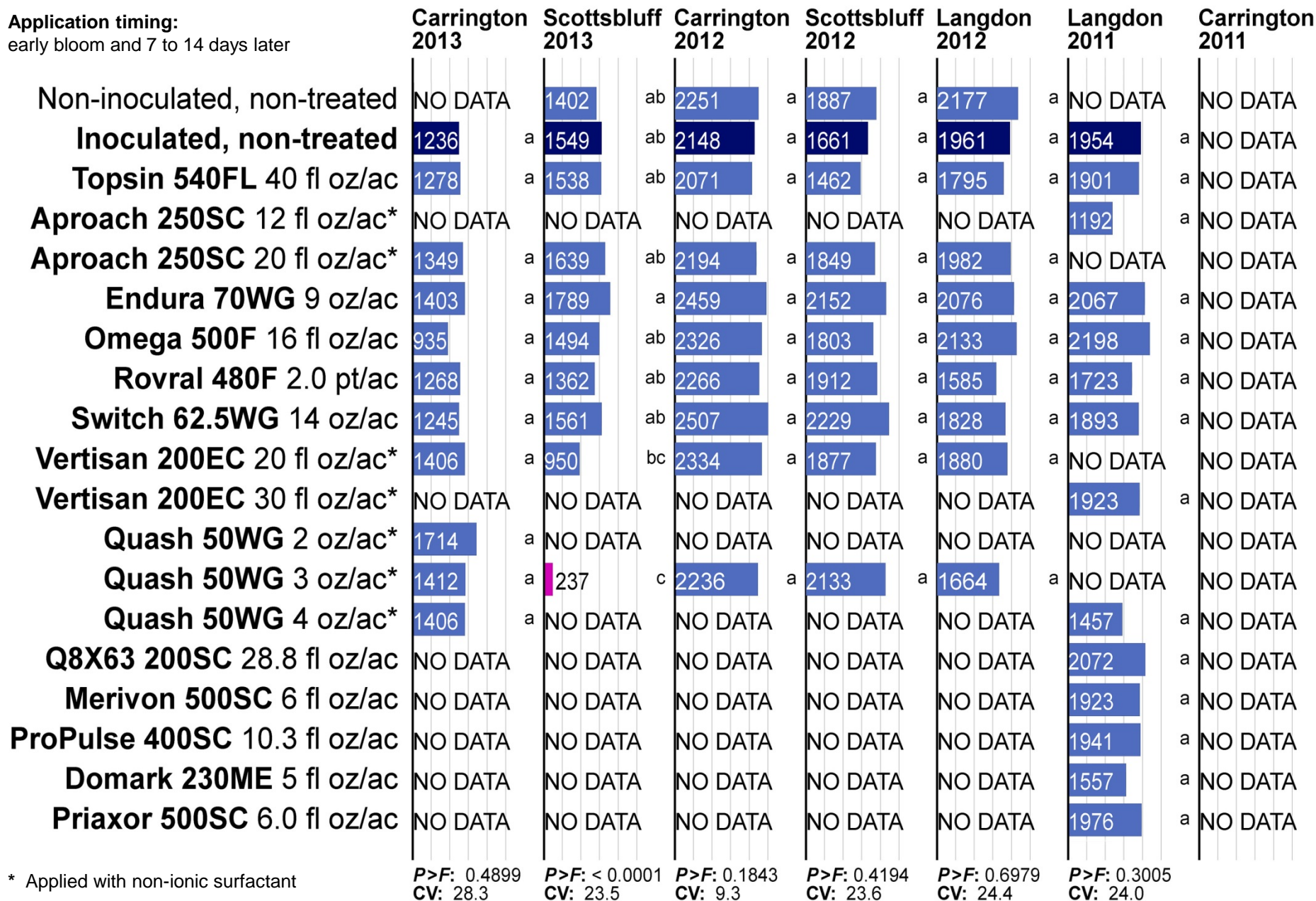
P>F: 0.0181
CV: 64.5

P>F: 0.2750
CV: 17.8

Results – Fungicide efficacy

YIELD (pounds/acre)

Application timing:
early bloom and 7 to 14 days later



* Applied with non-ionic surfactant

P>F: 0.4899
CV: 28.3

P>F: < 0.0001
CV: 23.5

P>F: 0.1843
CV: 9.3

P>F: 0.4194
CV: 23.6

P>F: 0.6979
CV: 24.4

P>F: 0.3005
CV: 24.0

Results – Fungicide efficacy

ONE vs. TWO vs. THREE APPLICATIONS

Application timing:

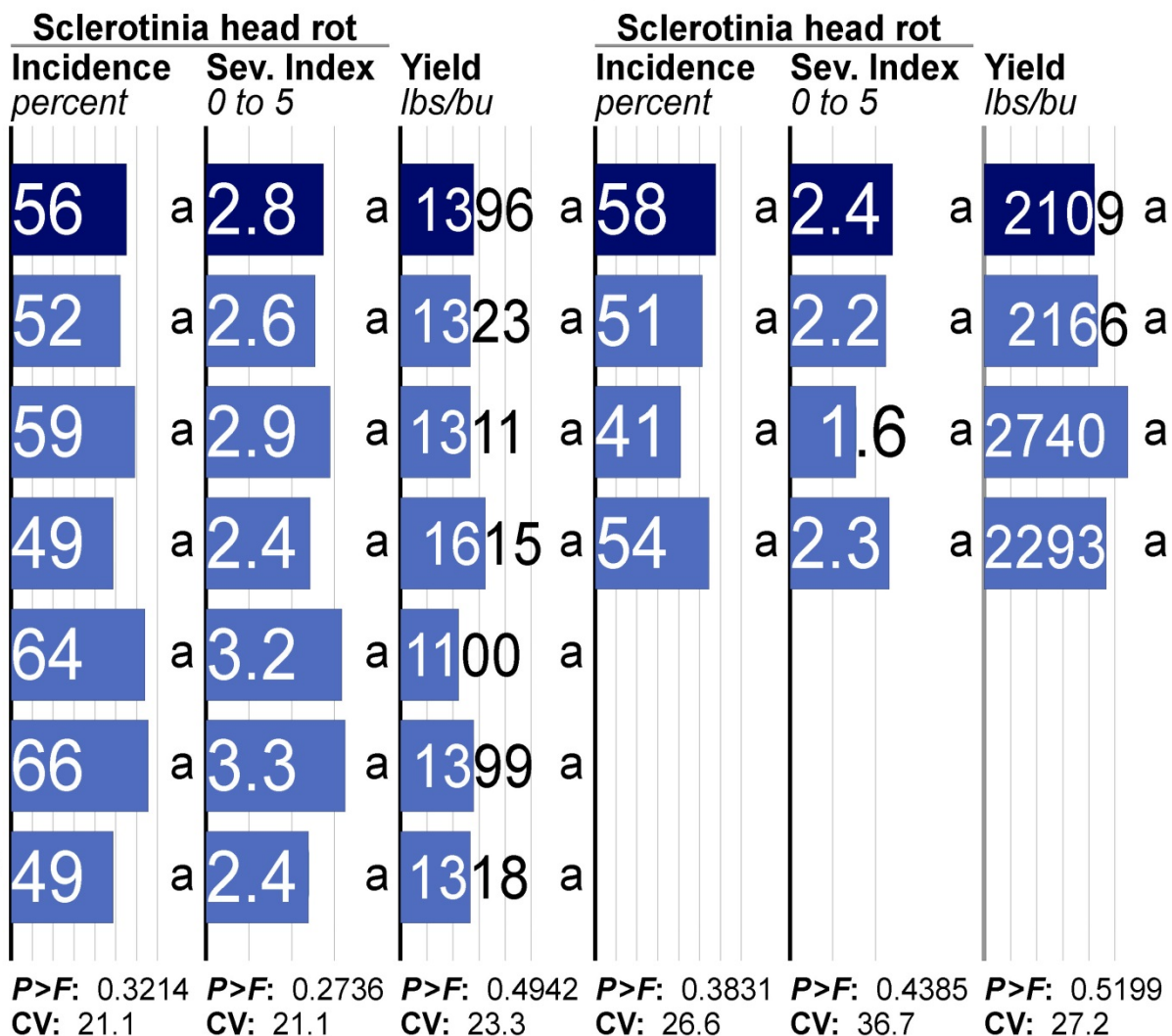
(A): early bloom

(B): 10-12 days after application A

(C): 8-10 days after application B

Carrington, ND (2013)

Oakes, ND (2013)



Conclusions –

Fungicide efficacy for control of Sclerotinia head rot of sunflowers

WHEN APPLIED ACROSS THE TOP OF THE CANOPY, FOLIAR FUNGICIDES EXHIBIT LITTLE OR NO EFFICACY AGAINST SCLEROTINIA HEAD ROT

The poor efficacy is likely due to the difficulty of achieving satisfactory fungicide coverage.



Thank you!



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the **USDA National Sclerotinia Initiative**,
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and the **National Sunflower Association**