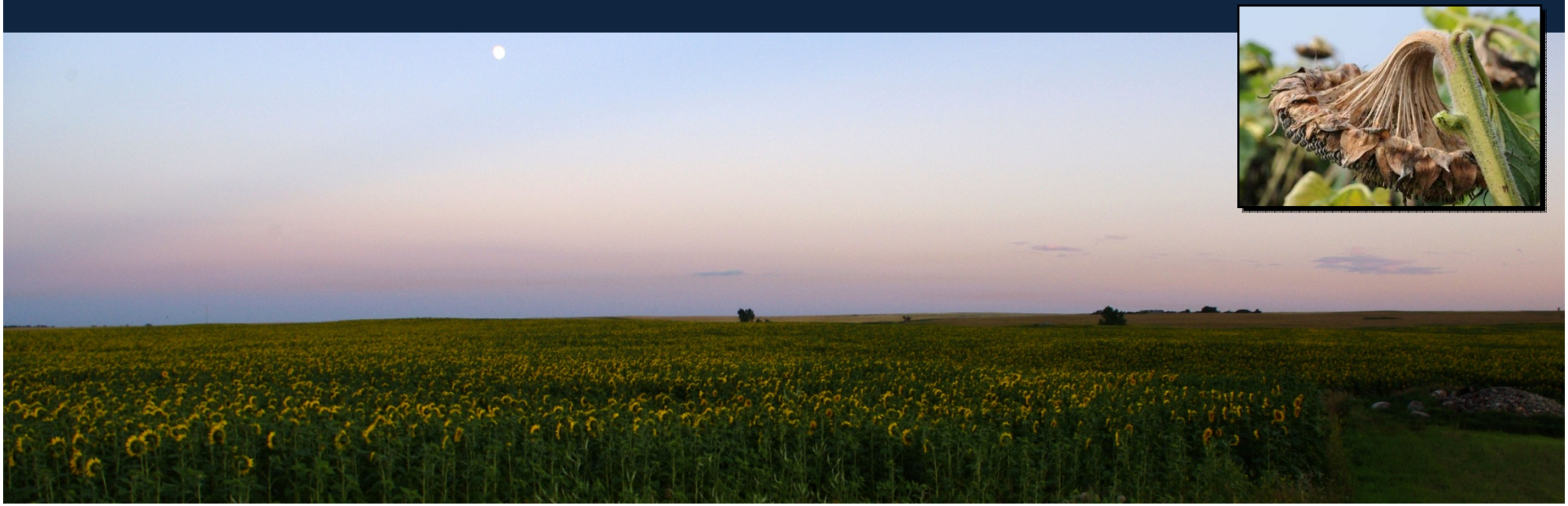
Sclerotinia head rot:
Improving the methods used to screen sunflowers for resistance and prospects for using fungicides for management



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Research Objectives

(1) Facilitate the development of commercial sunflower hybrids with reduced susceptibility to Sclerotinia head rot

- Multi-location testing: supports the development of commercial hybrids with improved resistance to head rot

Blaine Schatz

Sam Markell

Research Objectives

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

- Screening nurseries have not always produced replicable results

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

- Several fungicides are effective against Sclerotinia diseases on other crops.
- Achieving satisfactory fungicide coverage is a challenge for Sclerotinia head rot of sunflower.

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METHODS – Evaluation of hybrids for head rot resistance

PLOTS: Hybrids planted in one-row plots

Row length: Carrington, 29 feet; Langdon, 26 feet; Oakes, 17 feet.

DESIGN: Completely randomized block with 4 or 6 replicates

Multilocation nurseries: 4 replicates Large screening nursery, Carrington: 6 replicates

INOCULATION: approx. 15,000 ascospores of *Sclerotinia sclerotiorum* applied twice at flowering (R5.2 to R5.8)

MISTING: Microsprinklers utilized to facilitate disease

METHODS – Evaluation of hybrids for head rot resistance

LARGE SCREENING NURSERY: Carrington, ND

28 hybrids + 3 standard checks; 6 replicates

MULTI-LOCATION SCREENING NURSERIES:

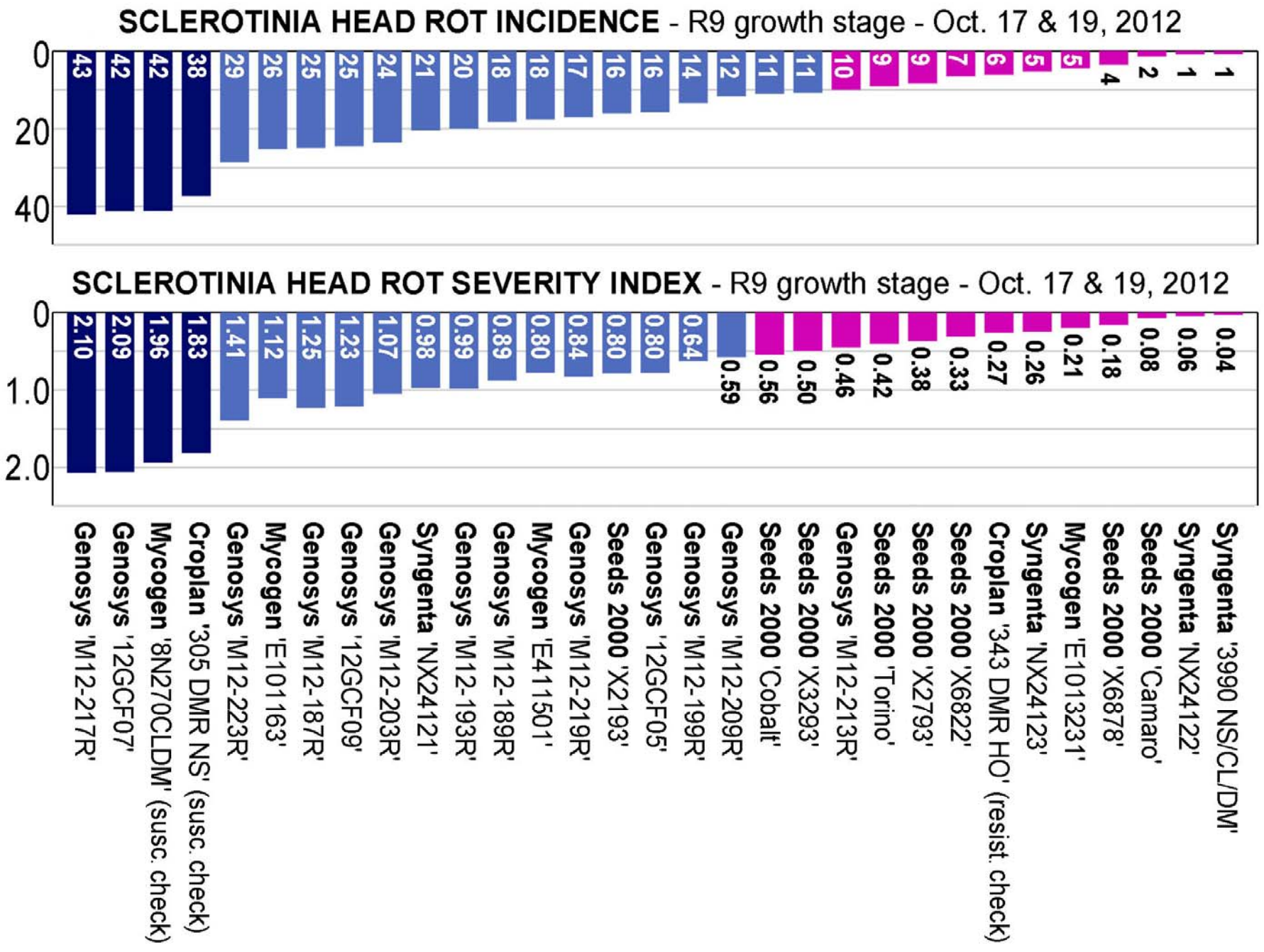
Carrington, Langdon, and Oakes, ND

22 hybrids + 3 standard checks; 4 replicates per site

SELECTION NURSERY: Carrington, ND

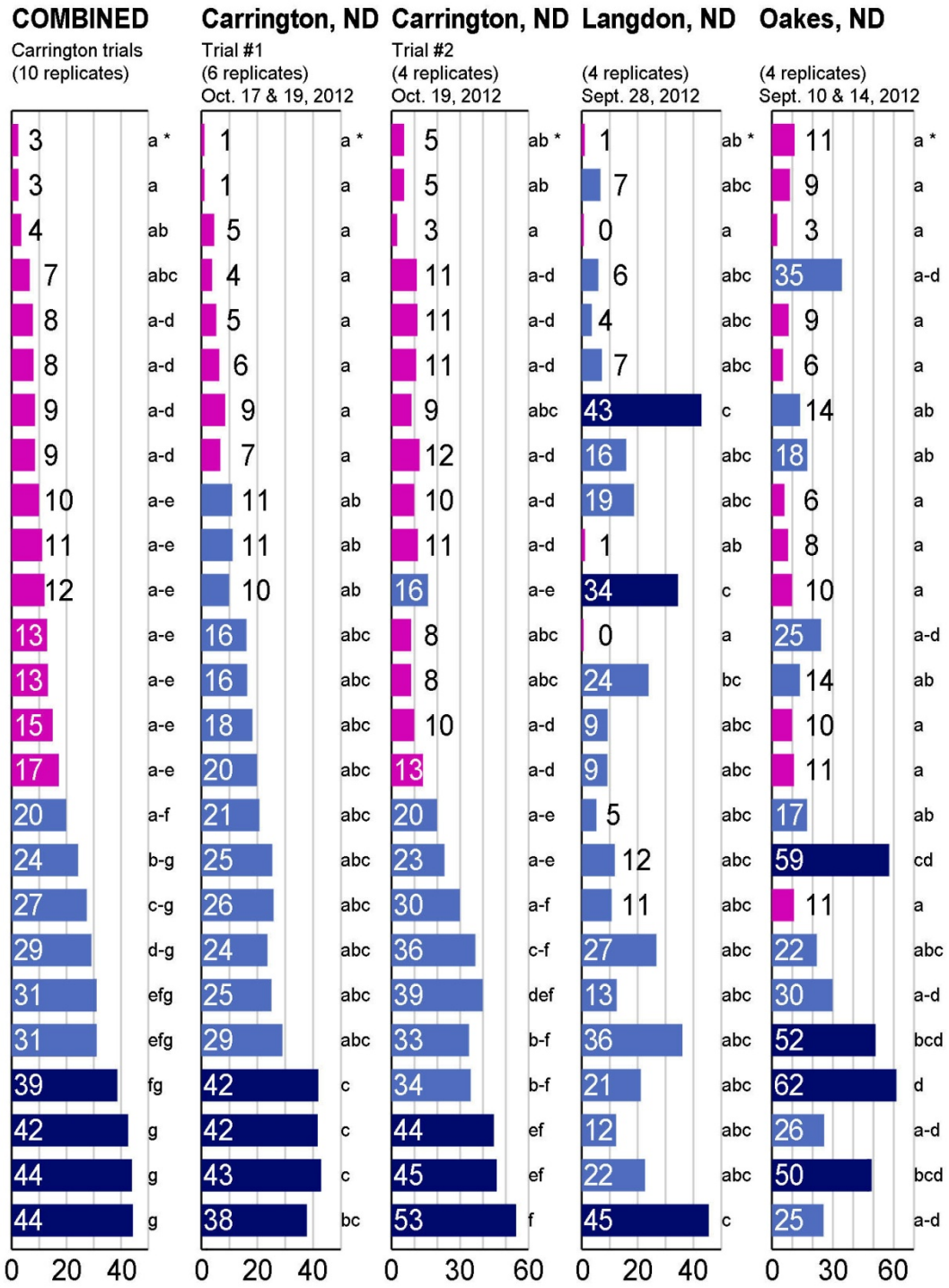
3 hybrids + 3 standard checks; 4 replicates

LARGE SCREENING NURSERY - Carrington



MULTI-LOCATION NURSERIES

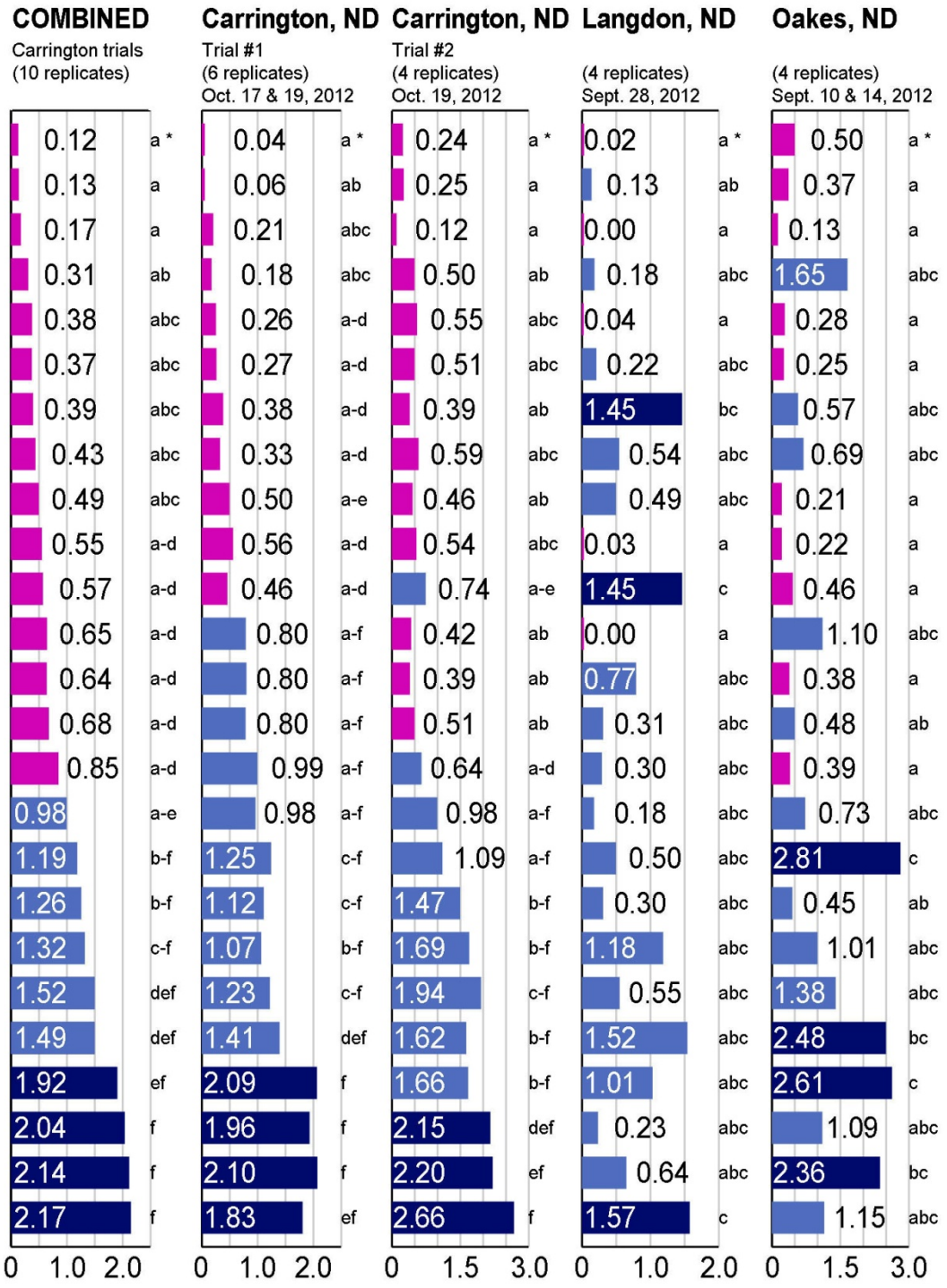
Disease Incidence



Within-column means followed by different letters are significantly different ($P < 0.05$; Tukey multiple comparison procedure).

MULTI-LOCATION NURSERIES

Disease Severity Index



Within-column means followed by different letters are significantly different (*P* < 0.05; Tukey multiple comparison procedure).

REPEATABILITY OF RESULTS

Correlation of results across trials: **Sclerotinia head rot incidence**

	Carrington - trial 1	Carrington - trial 2	Oakes	Langdon
Carrington - trial 1		*<0.0001*	*0.0003*	*0.0514*
Carrington - trial 2	**0.8939**		*0.0023*	*0.0140*
Oakes	**0.6629**	**0.5811**		*0.1826*
Langdon	**0.3940**	**0.4849**	**0.2755**	

Correlation of results across trials: **Sclerotinia head rot severity index**

	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**	

KEY:

$P > 0.05$
$0.01 < P \leq 0.05$
$P \leq 0.01$

Below the axis: Pearson correlation coefficient

Above the axis: *P*-level associated with correlation

METHODS - Susceptibility to head rot after flowering

LOCATIONS: Carrington, Langdon, and Oakes, ND

DESIGN: Completely randomized split-split-plot, 4 or 6 replications

MAIN FACTOR: **bagged vs. unbagged** heads (Carrington and Langdon only)

SUB-FACTOR: **susceptible vs. partially resistant** hybrid

SUB-SUB-FACTOR: **inoculation timing** (R5, R6, R7, R8, non-inoculated)

INOCULATION: ascospores of *Sclerotinia sclerotiorum* applied twice at appropriate growth stage

51,000 spores to the front of head + 15,000 spores to the back of head in each inoculation

MISTING: At each growth stage, overhead irrigation was applied for 4 days after the first inoculation.

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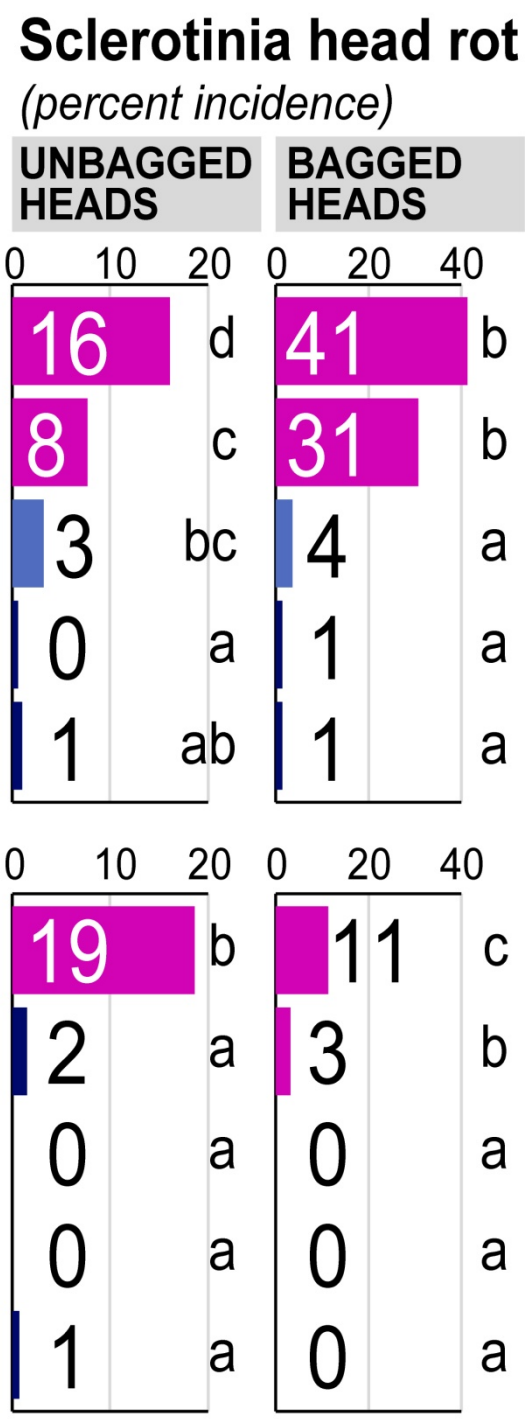
CARRINGTON - Susceptibility to head rot after flowering (2012)

Within-column means followed by different letters are significantly different
(*P* < 0.05; Fisher's protected least significant difference).



CARRINGTON - Susceptibility to head rot after flowering (2012)

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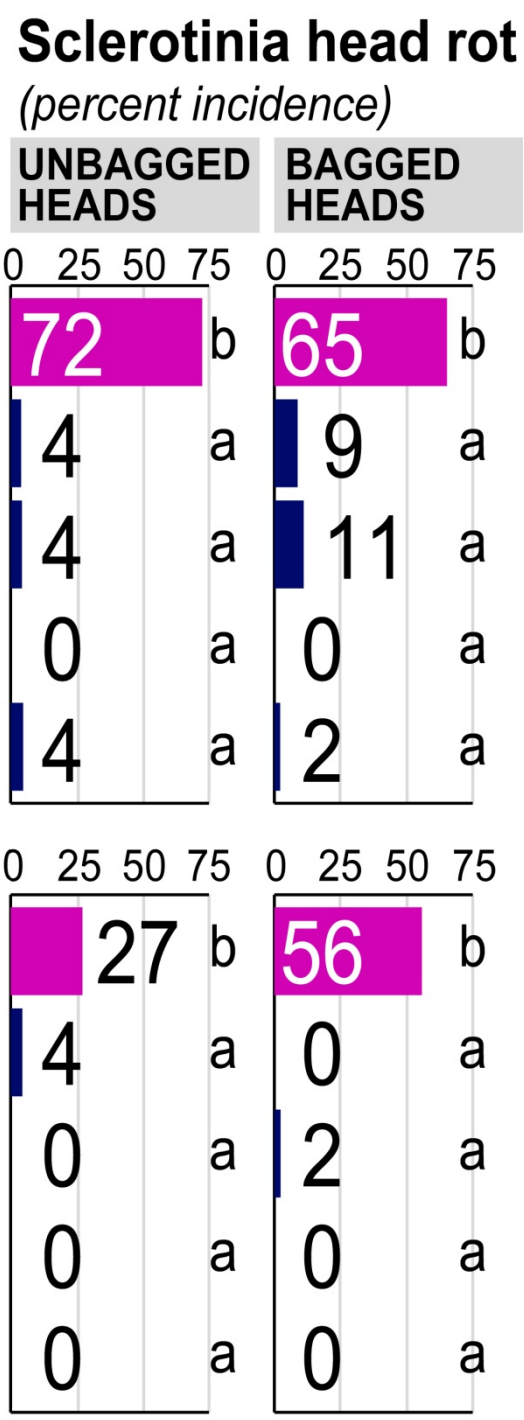
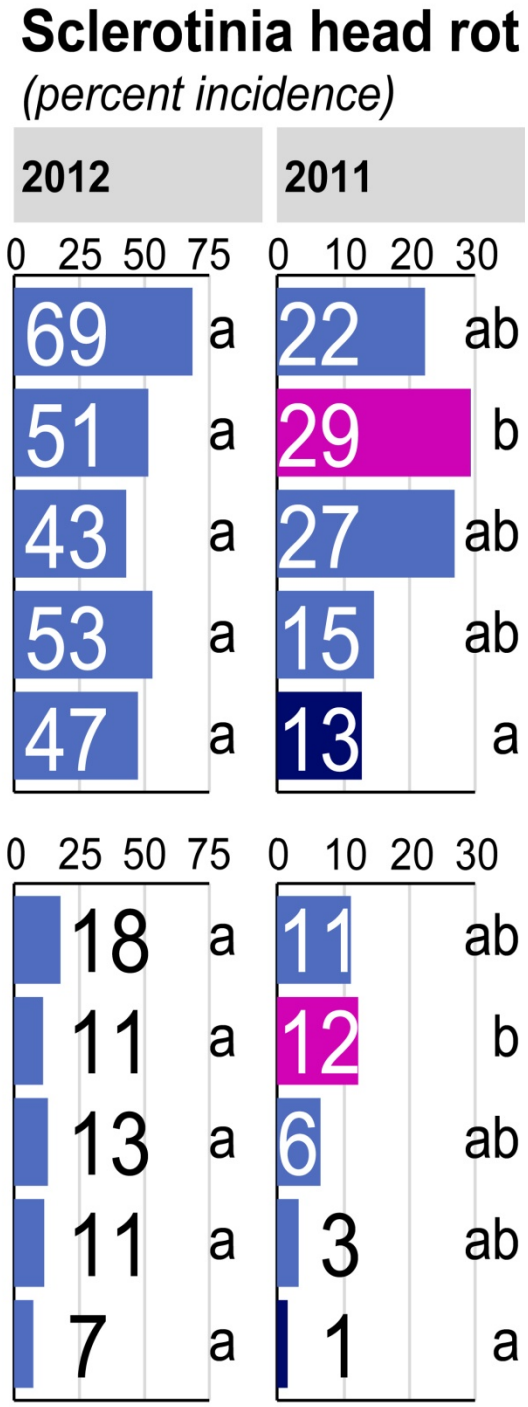


LANGDON - Susceptibility to head rot after flowering (2011 and 2012)

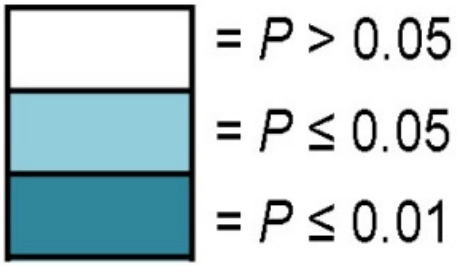
Within-column means followed by different letters are significantly different
(*P* < 0.05; Fisher's protected least significant difference).



REPEATABILITY OF RESULTS FROM SCREENING NURSERIES

2011: Repeatable results were obtained when inoculations were conducted over multiple days such that each head was inoculated twice at the same growth stage.

	Morden	Sidney	Carrington	Crookston	Oakes	Langdon
Morden		0.6604	0.9951	0.0214	0.6818	0.088
Sidney	-0.08		0.0363	0.3822	0.8688	0.1129
Carrington	0	0.51		0.7352	0.9807	0.0367
Crookston	0.47	0.18	0.09		0.0064	0.0007
Oakes	0.08	0.03	0	0.53		0.0119
Langdon	0.37	0.32	0.50	0.63	0.49	

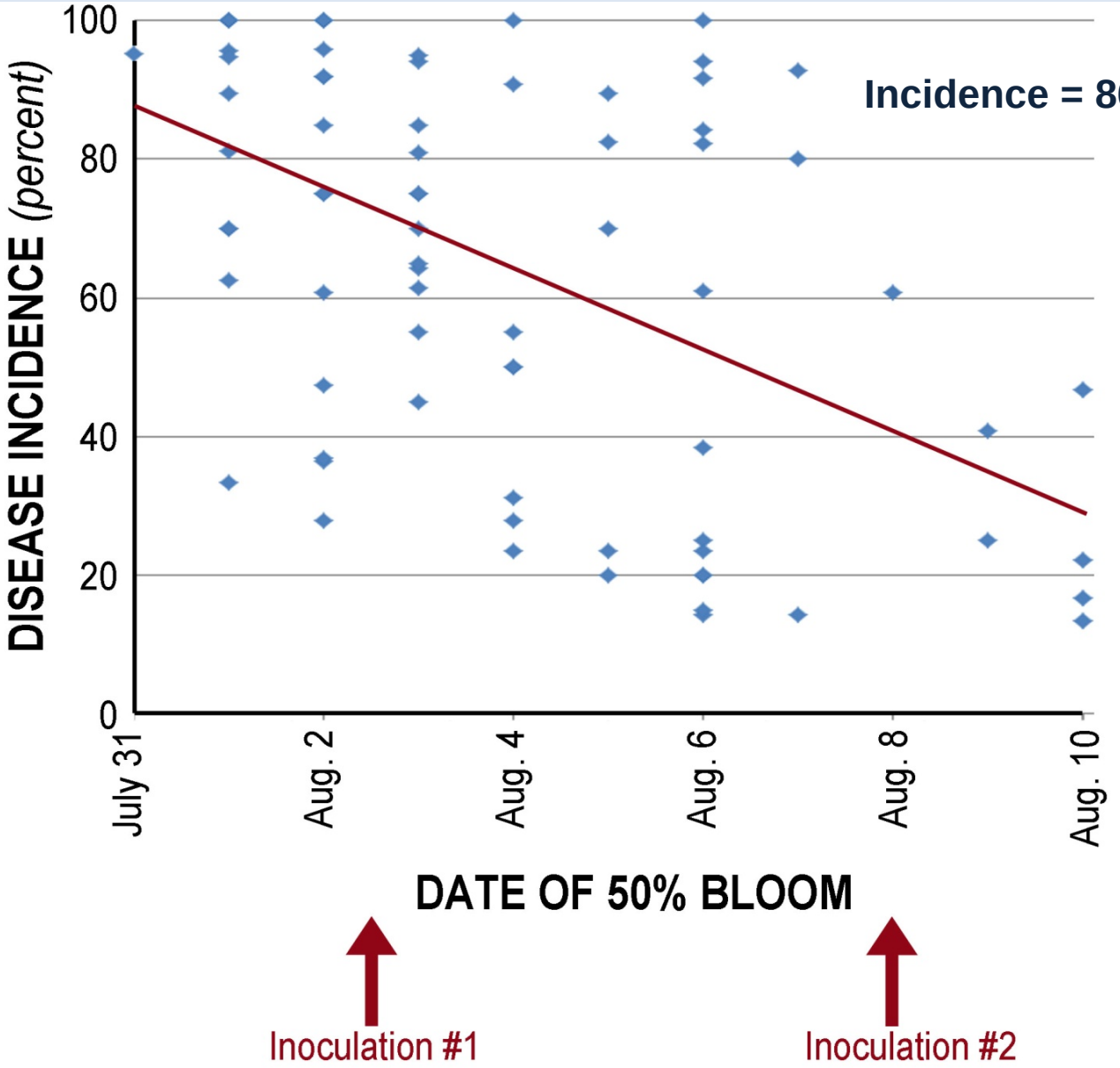


CORRELATION, **DISEASE INCIDENCE**

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

Sidney, MT (2011):

- All plants inoculated on Aug 2-3 and Aug. 8, irrespective of growth stage.
- Disease incidence correlated with flowering date.



Incidence = 86.7 – 5.8*(flowering date)

$R^2 = 0.2550$

$P < 0.0001$

REPEATABILITY OF RESULTS FROM SCREENING NURSERIES

2012: Results from Langdon were poorly correlated with results from other trials.

	Carrington - trial 1	**Carrington** - trial 2	**Oakes**	**Langdon**
Carrington - trial 1		*<0.0001*	*0.0003*	*0.0514*
Carrington - trial 2	**0.8939**		*0.0023*	*0.0140*
Oakes	**0.6629**	**0.5811**		*0.1826*
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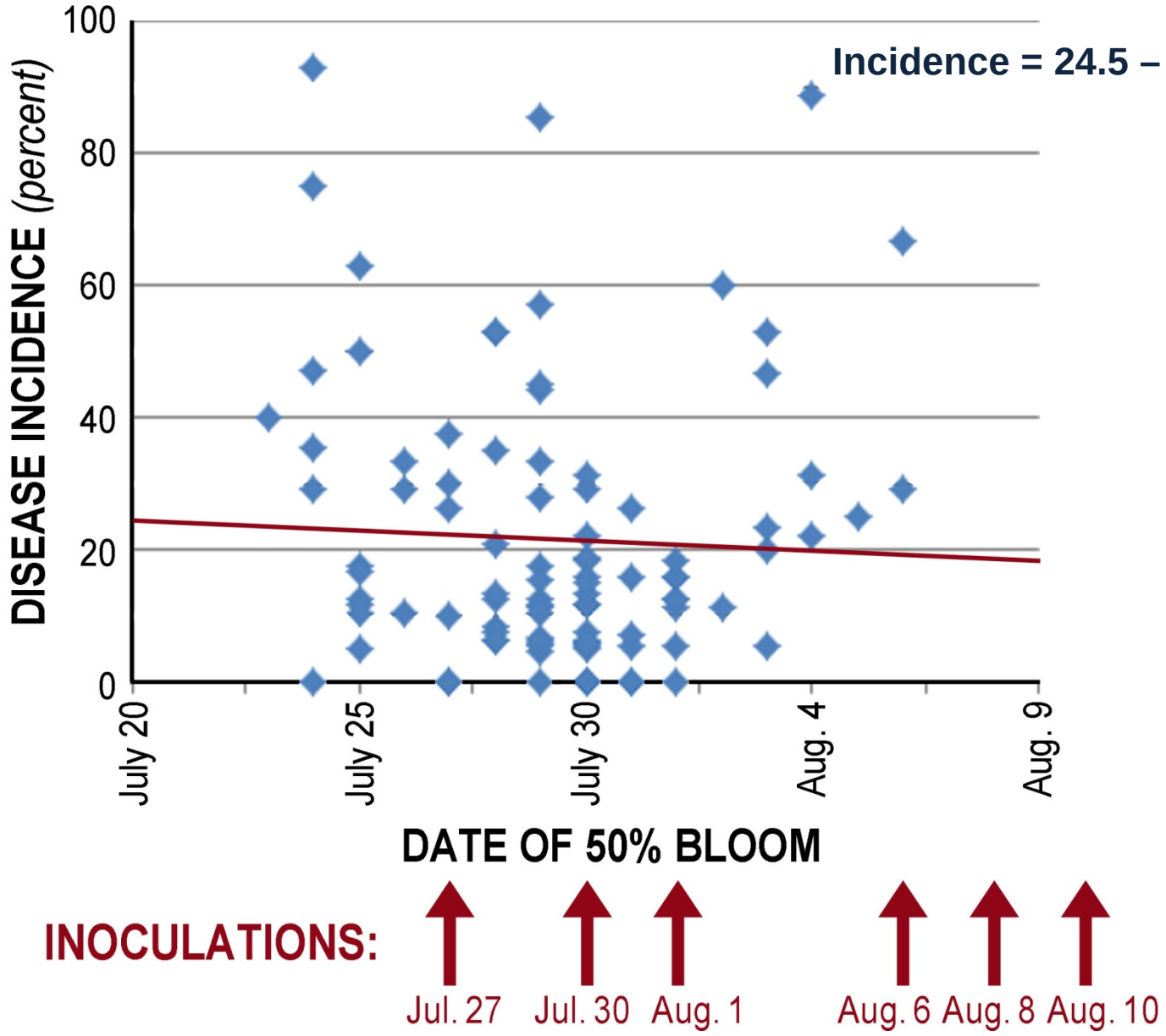
CORRELATION, **DISEASE INCIDENCE**

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

Oakes, ND (2012):

- Inoculations were conducted on 6 dates over a 14-day period.
- Disease incidence did not correlate with flowering date.



REPEATABILITY OF RESULTS FROM SCREENING NURSERIES

2012:

Carrington, trial 1**:**

- Inoculations conducted on 8 dates over a 24-day period.

Carrington, trial 2**:**

- Inoculations conducted on 8 dates over a 23-day period.

Oakes:

- Inoculations conducted on 6 dates over a 14-day period.

Langdon:

- Inoculations conducted on 3 dates over a 5-day period.

METHODS – FUNGICIDE EVALUATIONS

PLOTS: Harvested plot size = 2 rows, each 26 to 30 ft long

- Carrington: 29 x 5 ft
- Langdon: 26 x 5 ft
- Scottsbluff: 30 x 5 ft

DESIGN: Randomized complete block with 4 replications

FUNGICIDE APPLICATIONS:

Carrington – 20 gallons water/ac, 35 psi

Langdon – 15 gallons water/ac, 35 psi

Scottsbluff – 35 gallons water/ac, 20 psi

INOCULATION:

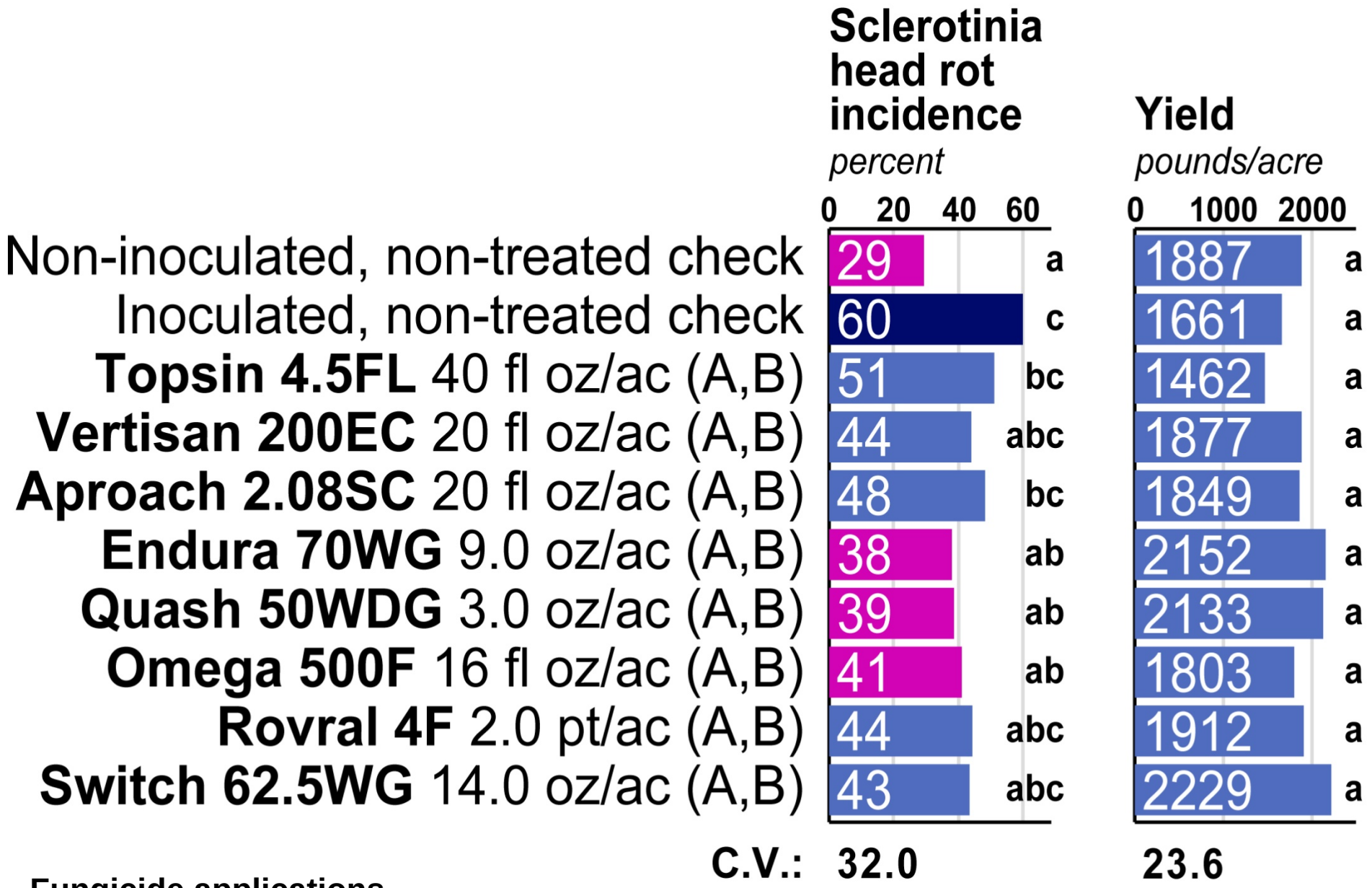
30,000 ascospores of *S. sclerotiorum* were applied per head at early to mid flowering

Carrington, Langdon: 10,000 ascospores/head on each of three different dates

Scottsbluff: 15,000 ascospores/head on each of two different dates

MISTING: Microsprinklers utilized to facilitate disease.

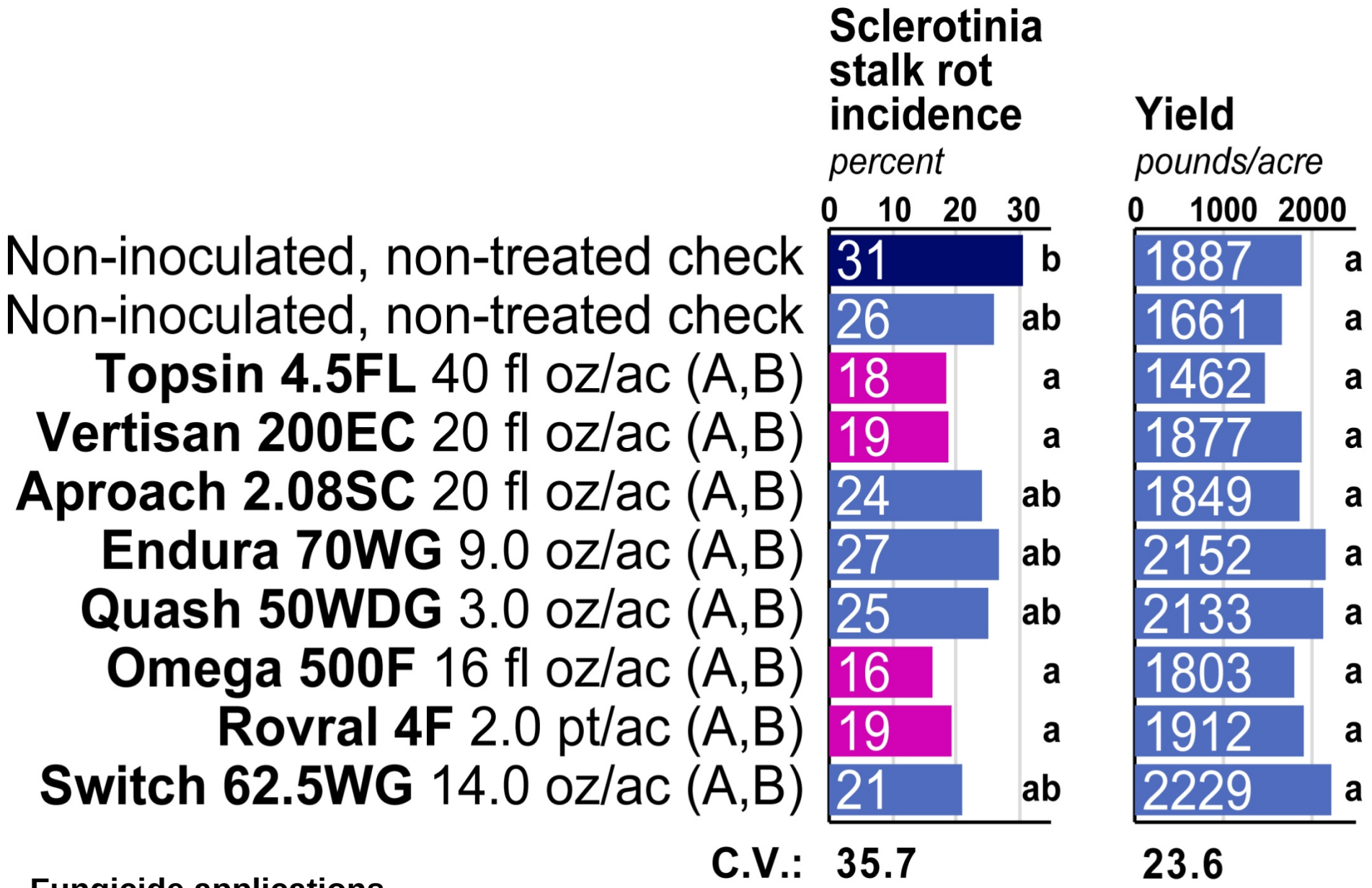
FUNGICIDE EFFICACY TESTING – Scottsbluff, NE



Fungicide applications

A: Aug. 22 at early bloom; **B:** Sept. 1 at late bloom to flowering complete

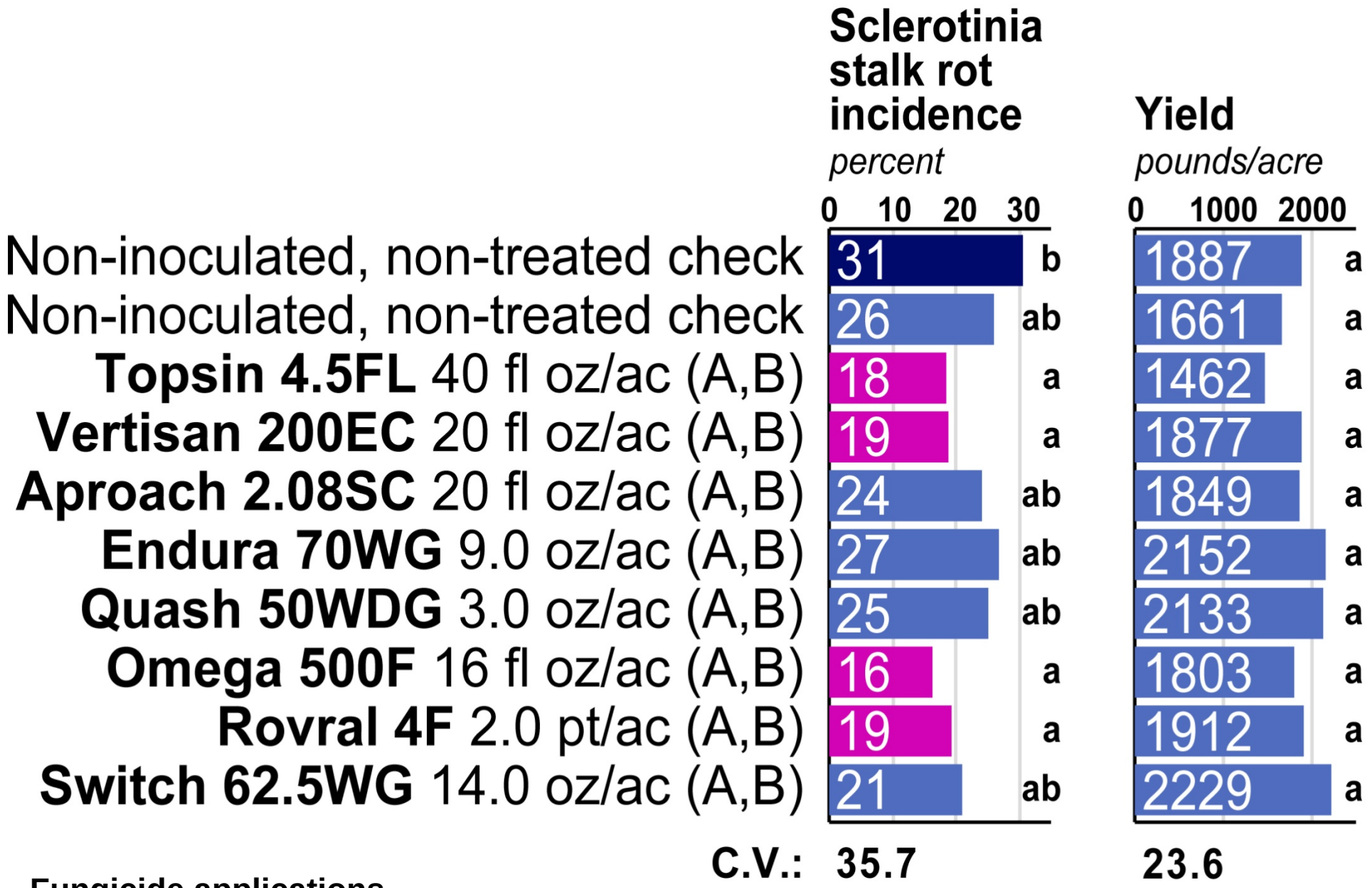
FUNGICIDE EFFICACY TESTING – Scottsbluff, NE



Fungicide applications

A: Aug. 22 at early bloom; **B:** Sept. 1 at late bloom to flowering complete

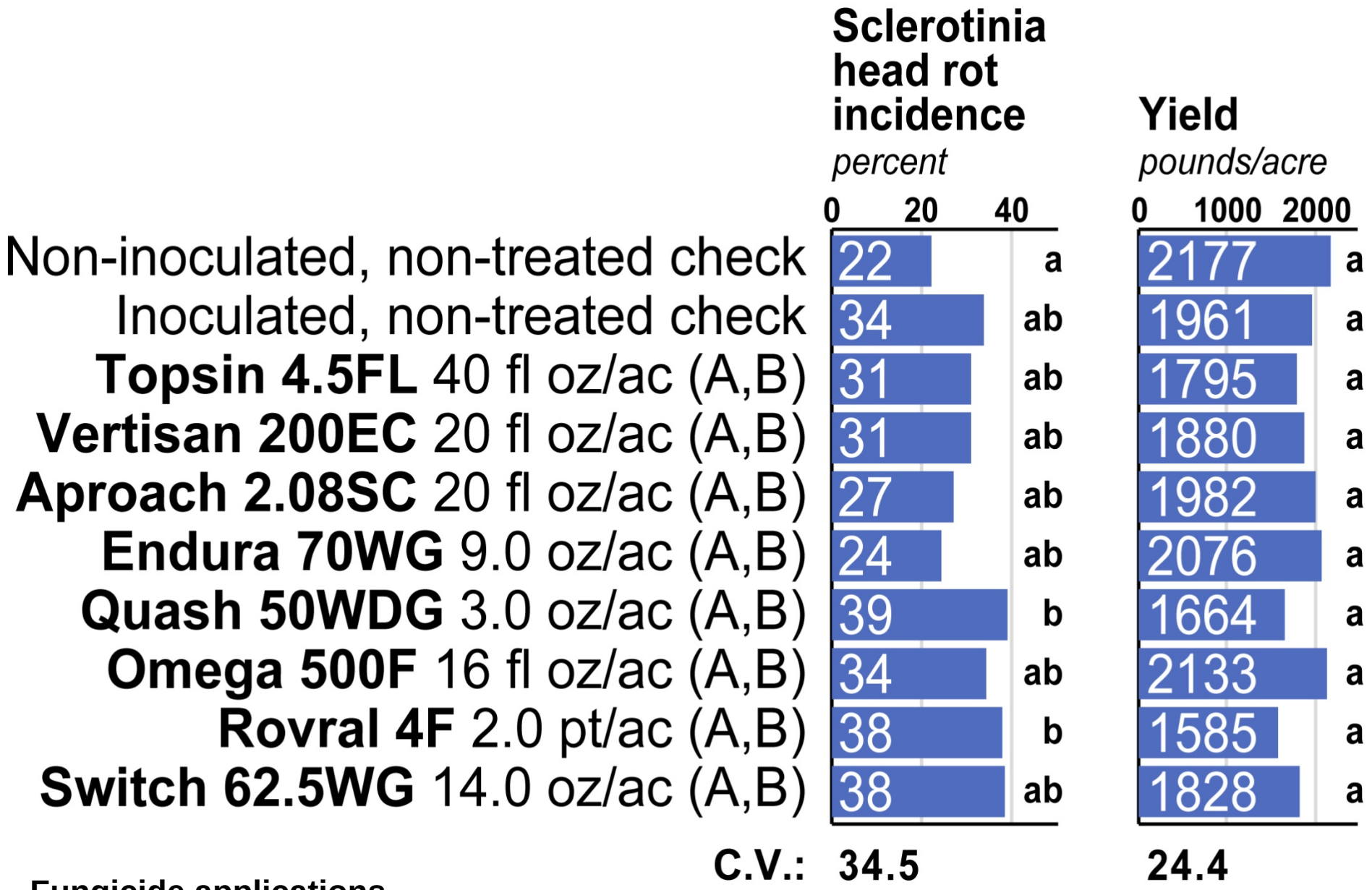
FUNGICIDE EFFICACY TESTING – Scottsbluff, NE



Fungicide applications

A: Aug. 22 at early bloom; **B:** Sept. 1 at late bloom to flowering complete

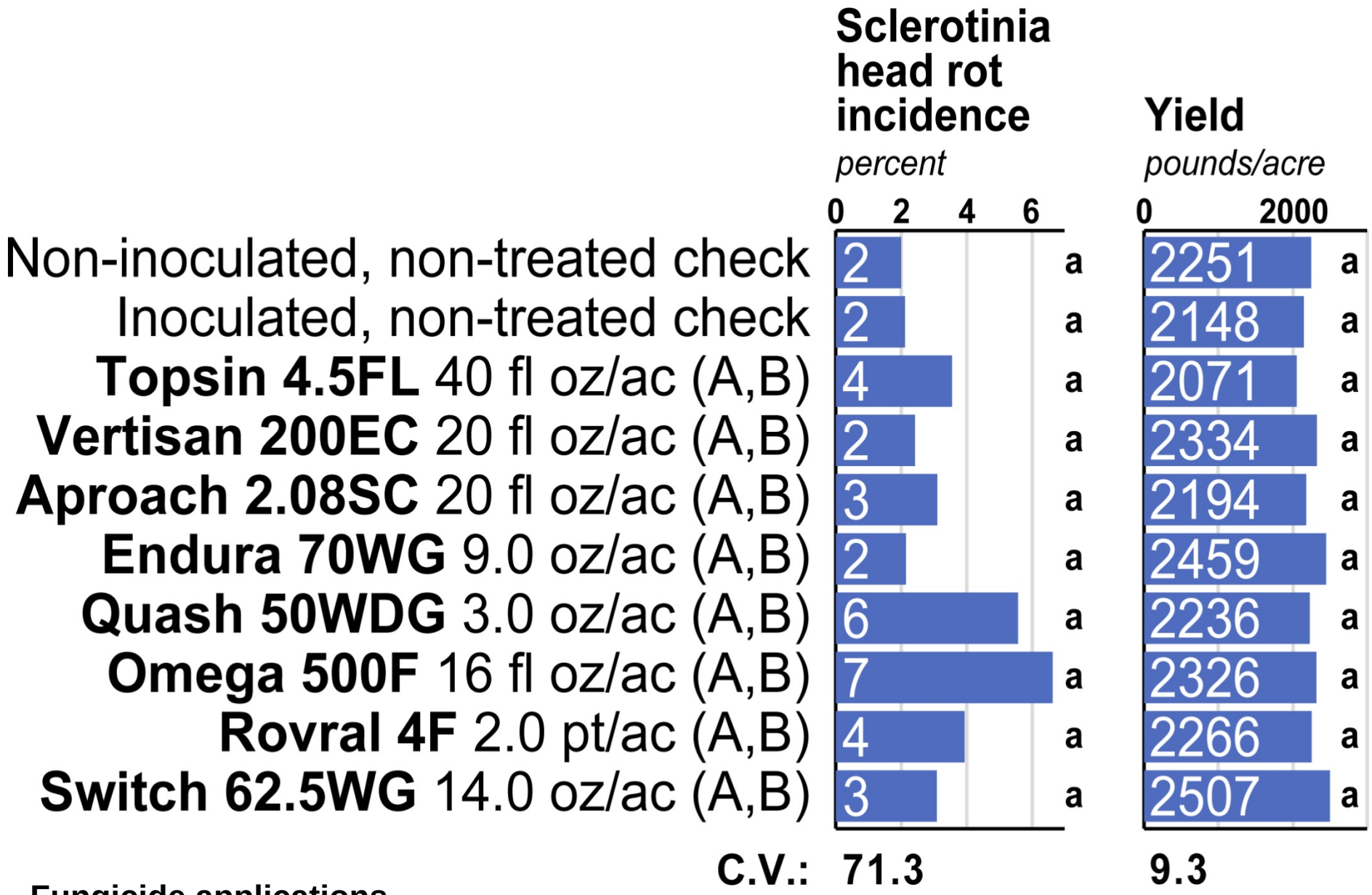
FUNGICIDE EFFICACY TESTING – Langdon, ND



Fungicide applications

A: Aug. 1 at early bloom; **B:** Aug. 11 at late bloom to flowering complete

FUNGICIDE EFFICACY TESTING – Carrington, ND



Fungicide applications

A: Aug. 7 at early bloom; **B:** Aug. 21 at late bloom

Thank you!

Funding:
USDA National Sclerotinia Initiative