

# Susceptibility to Sclerotinia head rot

## relative to sunflower growth stage

### Conclusions from inoculation timing studies:

#### (1) Susceptibility to head rot increases as bloom progresses

- Sunflowers are more susceptible to head rot at late bloom (R5.7-R5.9) than mid-bloom (R5.4-R5.6)
- Sunflowers are more susceptible to head rot at mid-bloom (R5.4-R5.6) than early bloom (R5.1-R5.3)
- Exceptions may occur when cool, wet weather occurs when sunflowers are predominantly at R5.1-R5.3 and hot dry weather occurs later in bloom

#### (2) Susceptibility to head rot drops sharply at R6

- Risk of head rot infection at R6 is low unless weather is extremely favorable for head rot (very cool and wet).

#### (3) Sunflowers do not appear to be susceptible to head rot at R7

- Water that pools on backs of cupped heads facilitates head rot development from disease initiated during bloom

# Susceptibility to *Sclerotinia* head rot relative to sunflower growth stage

## Implications for identifying partially resistant hybrids:

Obtaining unbiased, replicable results from screening nurseries is likely to be facilitated by

### (1) Inoculating every sunflower head at the same stage of bloom

- Inoculations must be conducted **over multiple dates** such that all heads across all entries are inoculated at the same growth stage
- Reduces bias from differences in susceptibility related to growth stage

### (2) Inoculating each head twice (on different dates)

- Reduces bias from differences in susceptibility related to environmental conditions (hot & dry vs. cool & wet weather)

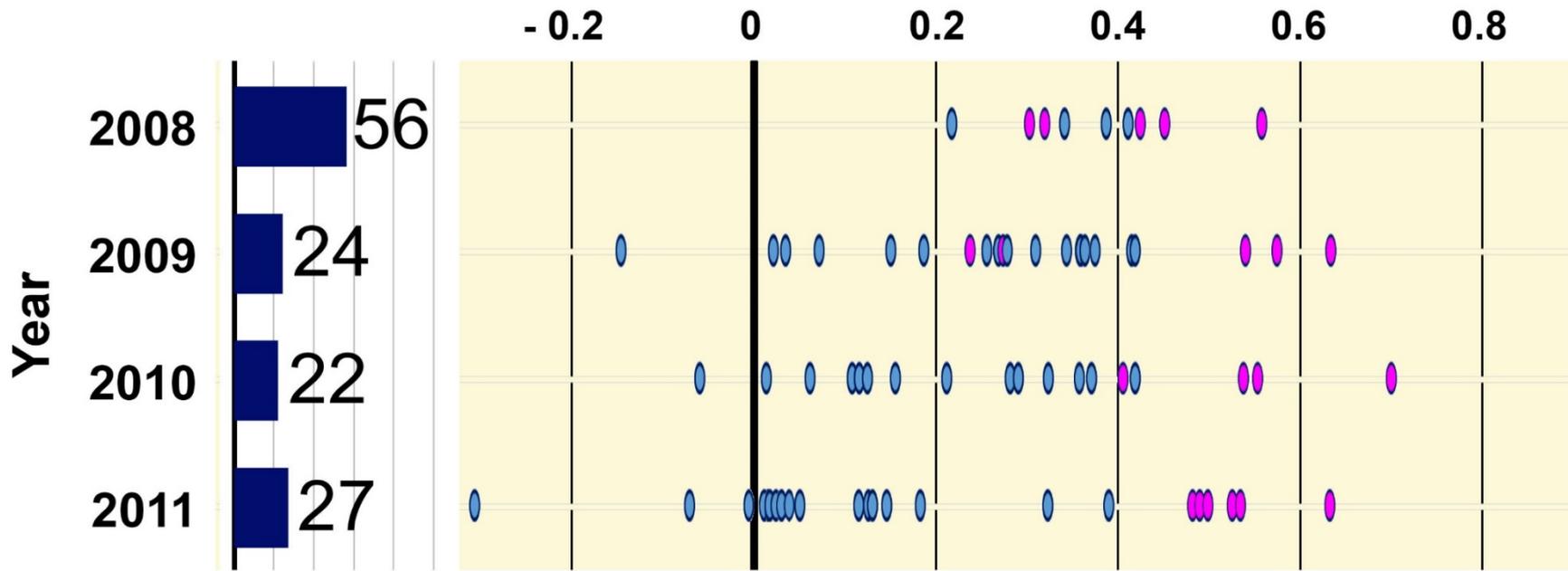


# Sclerotinia head rot screening nurseries conducted in North Dakota, Manitoba and Minnesota in 2008-2011:

In studies conducted in 2008-2011, sunflowers were inoculated on two dates (with inoculations conducted across all hybrids irrespective of growth stage) or every 2 to 3 days throughout bloom (with inoculations conducted to every sunflower in bloom irrespective of how many times it was previously inoculated).

- Due to growth stage-dependent differences in susceptibility, both of these strategies are likely to produce biased results.
- Results from different nurseries were poorly correlated. The hybrids that developed the least disease differed across screening nurseries.

## Pearson Correlation Coefficient



Bars illustrate the frequency of observing significantly correlated results ( $P < 0.05$ ) across screening nurseries.

Each oval illustrates the strength of the correlation between trials in which the same hybrids were evaluated.

Pink denotes a statistically significant correlation ( $P < 0.05$ ).

# Sclerotinia head rot screening nurseries conducted in North Dakota in 2012-2016:

## The new inoculation procedures produced replicable results.

In all studies conducted in 2012-2016, inoculations were conducted on multiple dates such that all sunflower heads were inoculated twice, once at mid-bloom and once at late bloom: First inoculation at R5.4-R5.6; second inoculation at R5.6-R5.9

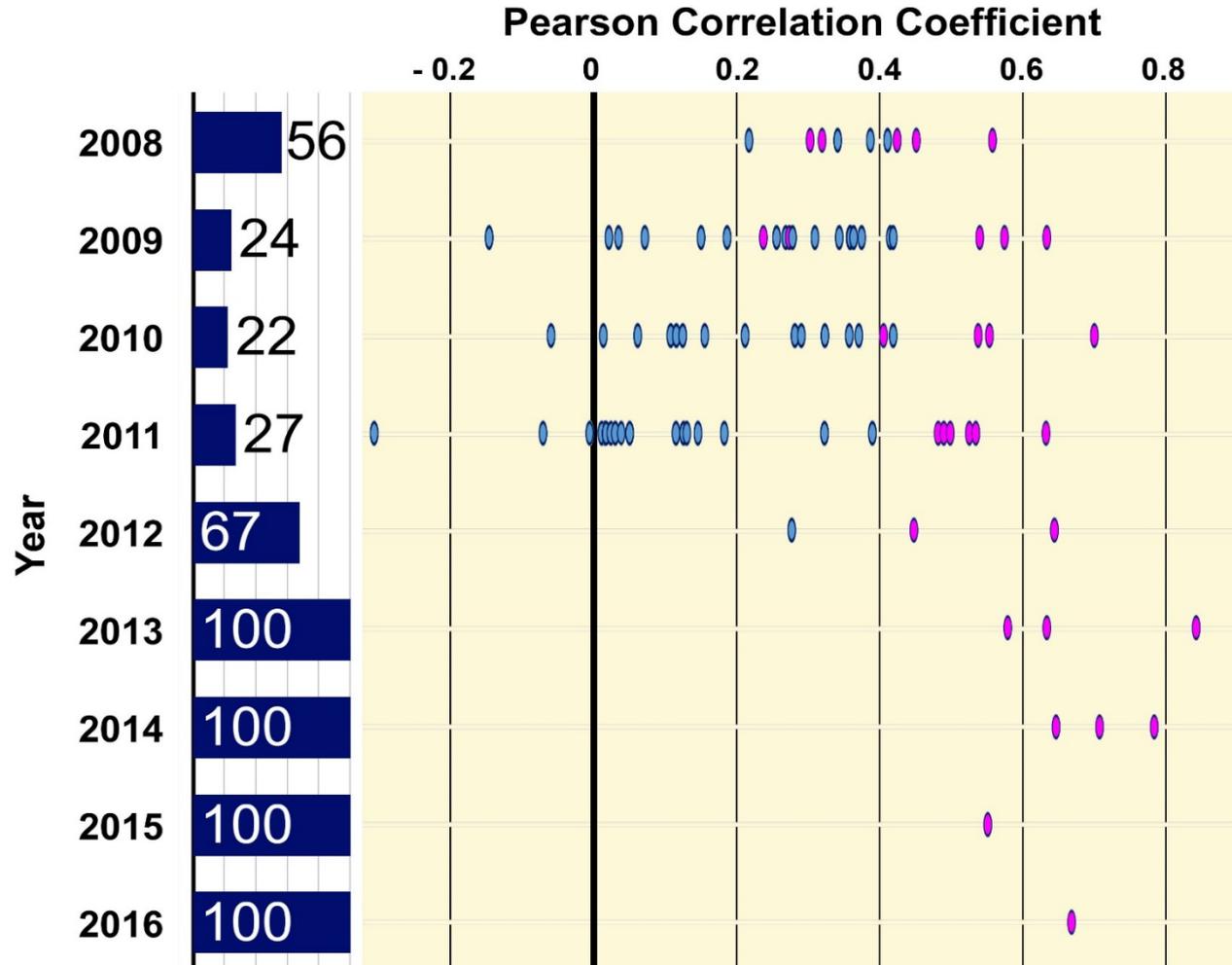
### BAR GRAPH:

Bars represent the frequency with which significantly correlated results ( $P < 0.05$ ) were observed across screening nurseries.

### SCATTER PLOT:

Each oval represents the strength of the correlation in results across a pair of screening nurseries.

Pink denotes statistically significant correlations ( $P < 0.05$ ).



## Conclusions –

### Screening commercial sunflower hybrids and breeding lines for resistance

#### TO PRODUCE REPLICABLE, UNBIASED RESULTS:

Conditions favorable for head rot must be maintained throughout the bloom period across all hybrids – including early and late-maturity hybrids.

When sunflowers are inoculated with the causal pathogen, inoculations must be **conducted over multiple dates** such that all heads across all entries are inoculated at the same stage of bloom.

#### **Susceptibility data generated in agronomic yield nurseries in which Sclerotinia head rot developed naturally will often be biased:**

- Hybrids that were primarily in mid- to late bloom (R5.4-R5.9) when conditions favored head rot will develop the most disease.
- Hybrids that were primarily at the end of bloom (R6) or the first third of bloom (R5.1-R5.3) when conditions favored head rot will escape the disease and likely be erroneously identified as less susceptible.

# Can partially resistant hybrids be utilized to manage Sclerotinia head rot?

## METHODS:

- Randomized complete block with four replicates
- Plots 5 ft (2 rows) wide x 25 to 60 feet long (depending on study)
- Inoculations conducted over multiple dates such that all sunflower heads were inoculated twice, once at mid-bloom and once at late bloom: First inoculation at R5.4-R5.6; second inoculation at R5.6-R5.9
  - In each inoculation, approx. 15,000 spores were delivered to the front of sunflower heads (each head received total 30,000 spores)
  - Spores were delivered with a hand-held spray bottle calibrated to deliver 5,000 spores per squirt.

# Susceptibility of oilseed hybrids to Sclerotinia head rot

Carrington, ND (2015)

## Sclerotinia Head Rot

R9 growth stage  
% incidence

## Sclerotia in Grain

uncleaned grain  
% by weight

## Yield

10% moisture  
pounds/acre

Croplan 432 E	18	ab	0.7	a	1965	a
NuTech 69M2	35	a-f	3.3	abc	1916	a
NuSeed Camaro II	37	a-f	4.6	abc	1819	ab
SunOpta 15S20E	12	a	1.6	abc	1782	abc
Croplan 343 DMR HO	25	abc	3.4	abc	1746	a-d
Croplan 553 CL HO	28	a-d	4.0	abc	1733	a-d
ProSeed E1402 CL	23	abc	0.9	ab	1730	a-d
NuSeed EXP8962	24	abc	2.1	abc	1665	a-e
Pioneer 63HE60	34	a-f	2.0	abc	1649	a-e
Thunder 11N94	41	a-g	4.9	abc	1645	a-e
ProSeed E85 CL	31	a-e	5.6	abc	1633	a-e
NuTech 68H7	25	bac	0.9	ab	1620	a-f
Mycogen MY82427	28	a-d	3.4	abc	1563	a-f
SunOpta 1628E	55	d-h	5.7	abc	1554	a-f
Croplan 545 CL	21	ab	0.6	abc	1545	a-f
Croplan 549 CL	52	c-h	4.9	abc	1518	a-f
Syngenta 7111 HO CL DM	34	a-f	1.2	ab	1454	a-f
ProSeed E21 CL	28	a-d	1.2	ab	1429	a-f
Croplan 458 E HO	44	b-g	7.6	bc	1412	a-f
Syngenta SY7717	35	a-f	2.3	abc	1383	a-f
ProSeed E31 CL	21	ab	1.1	ab	1351	a-f
Thunder 44H94	56	d-h	6.6	abc	1314	a-f
Mycogen MY8H456CL	39	a-f	3.8	abc	1261	a-g
Syngenta 3845 HO	75	h	6.9	abc	1138	a-h
NuSeed EXP6561	62	fgh	6.1	abc	1111	a-h
Mycogen MY411280	55	d-h	6.8	abc	989	b-h
Thunder 35H92	58	e-h	4.8	abc	927	c-h
Mycogen MY324820	69	gh	6.8	abc	899	d-h
Syngenta 3495 NS CL DM	63	fgh	7.1	abc	844	e-h
SunOpta 4311E	69	gh	7.9	c	754	fgh
Mycogen V358 CL DM	77	h	6.8	abc	448	gh
Croplan 305 DMR NS	79	h	3.5	abc	378	h

P>F: < 0.0001  
CV: 25.0

P>F: < 0.0001  
CV: 59.7

P>F: < 0.0001  
CV: 22.9

Yellow background = commercial hybrid

White background = experimental hybrid

# Susceptibility of oilseed hybrids to Sclerotinia head rot

Carrington, ND (2016)

## Sclerotinia Head Rot

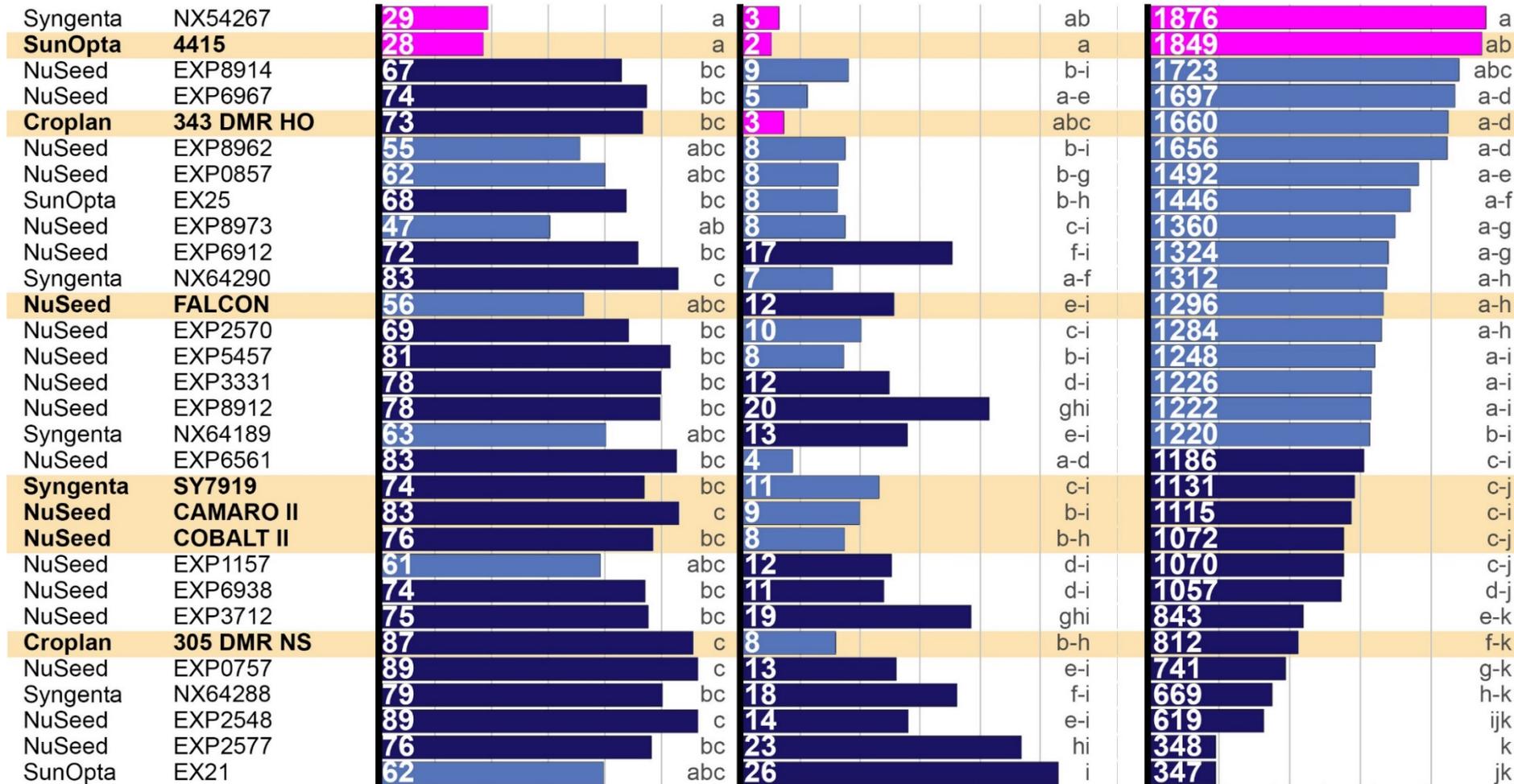
R9 growth stage  
% incidence

## Sclerotia in Grain

uncleaned grain  
% by weight

## Yield

10% moisture  
pounds/acre



P>F: < 0.0001  
CV: 18.9

P>F: < 0.0001  
CV: 18.7

P>F: < 0.0001  
CV: 19.8

Yellow background = commercial hybrid

White background = experimental hybrid

# Susceptibility of oilseed hybrids to Sclerotinia head rot

Carrington, ND (2014)

## Sclerotinia Head Rot

R9 growth stage  
% incidence

## Sclerotia in Grain

uncleaned grain  
% by weight

## Yield

10% moisture  
pounds/acre

Hybrid	Sclerotinia Head Rot (% incidence)	Sclerotia in Grain (% by weight)	Yield (pounds/acre)
<b>Syngenta NX34240</b>	<b>4</b> (a)	<b>0.9</b> (ab)	<b>2505</b> (a)
<b>Croplan 343 DRM HO</b>	<b>7</b> (a)	<b>0.6</b> (ab)	<b>2140</b> (ab)
NuSeed NSK12016	<b>16</b> (a)	<b>1.0</b> (ab)	<b>1847</b> (abc)
NuSeed NSK12015	<b>28</b> (ab)	<b>1.1</b> (ab)	<b>1776</b> (abc)
Mycogen 915321	<b>27</b> (ab)	<b>2.7</b> (abc)	<b>1552</b> (bc)
<b>Syngenta 7717 HO/CL/DM</b>	<b>21</b> (ab)	<b>1.7</b> (ab)	<b>1513</b> (bc)
Mycogen 416321	<b>25</b> (ab)	<b>2.3</b> (abc)	<b>1279</b> (cd)
NuSeed NHKE30489D	<b>22</b> (ab)	<b>0.5</b> (a)	<b>1177</b> (cd)
Mycogen 101321	<b>22</b> (ab)	<b>1.4</b> (ab)	<b>1060</b> (cd)
<b>Croplan 305 DMR NS</b>	<b>52</b> (b)	<b>6.4</b> (c)	<b>1041</b> (cd)
NuSeed NSK12014	<b>44</b> (b)	<b>3.8</b> (bc)	<b>737</b> (d)

$P > F: < 0.0001$   
CV: 20.9

$P > F: 0.0002$   
CV: 46.0

$P > F: < 0.0001$   
CV: 20.1

Yellow background = commercial hybrid

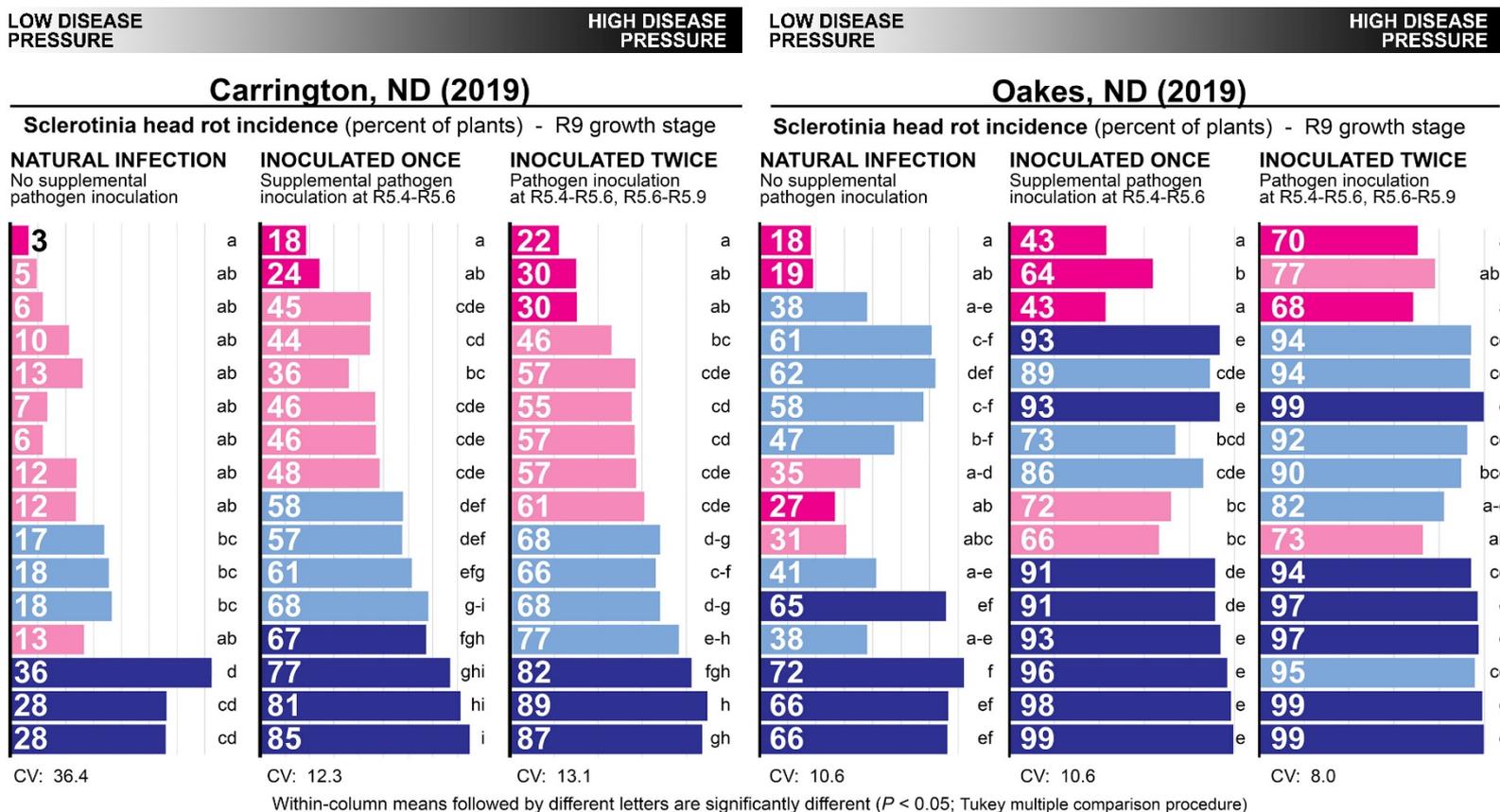
White background = experimental hybrid

# Susceptibility of confection (non-oil) hybrids to Sclerotinia head rot

Carrington and Oakes, ND (2019)

Differences in susceptibility to head rot may also exist among confection hybrids, particularly new hybrids in development

- Most of the hybrids evaluated in this study were advanced experimental hybrids
- Yield data will be forthcoming (grain is currently being cleaned & processed)



# Can partially resistant hybrids be utilized to manage Sclerotinia head rot?

## **CONCLUSIONS:**

### **(1) DIFFERENCES IN SUSCEPTIBILITY**

- Commercial oilseed hybrids differ sharply in susceptibility to head rot.
- Differences in susceptibility to head rot may also exist among confection hybrids, particularly new hybrids in development

### **(2) STRENGTH OF PARTIAL RESISTANCE**

- No hybrids exhibit complete resistance.
- Under high disease pressure, partial resistance can be overwhelmed and result in unacceptable levels of disease.

### **(3) IDENTIFYING PARTIALLY RESISTANT HYBRIDS**

- Susceptibility data generated in variety trials will not be reliable unless conditions favorable for head rot occurred throughout the entire bloom period across all hybrids