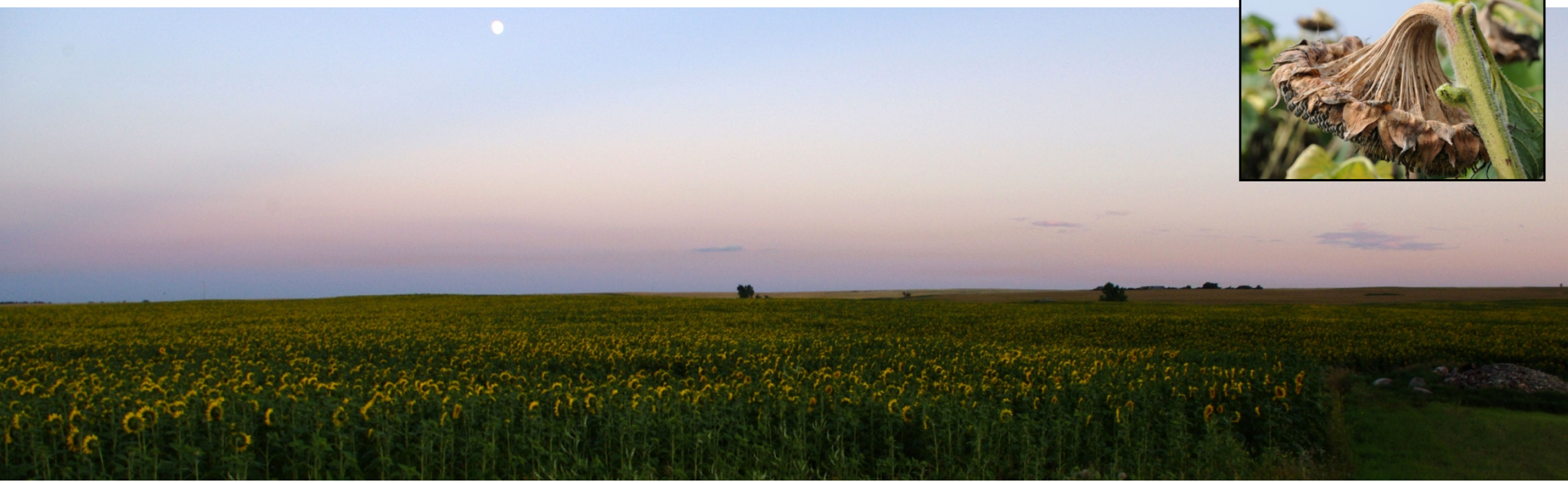
Challenges managing Sclerotinia head rot of sunflowers with partially resistant hybrids and with fungicides



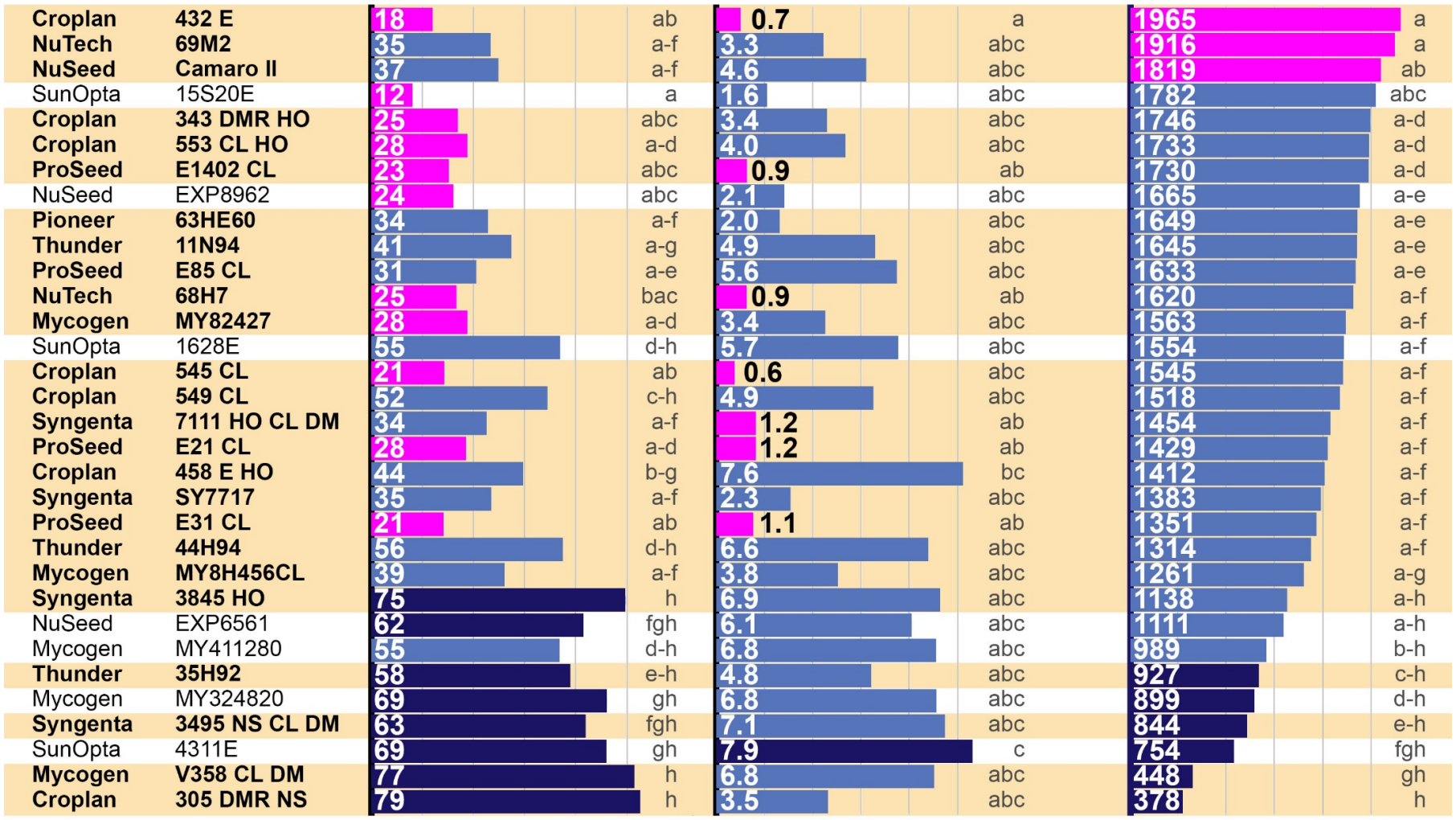
Michael Wunsch, Jesse Hafner, Billy Kraft, Suanne Kallis, Michael Schaefer and Thomas Miorini
NDSU Carrington Research Extension Center

Leonard Besemann, Kelly Cooper, Heidi Eslinger, and Seth Nelson
NDSU Robert Titus Research Farm, Oakes

Scott Halley, Amanda Arens and Pravin Gautam
NDSU Langdon Research Extension Center

Susceptibility of oilseed hybrids to Sclerotinia head rot

Carrington, ND (2015)



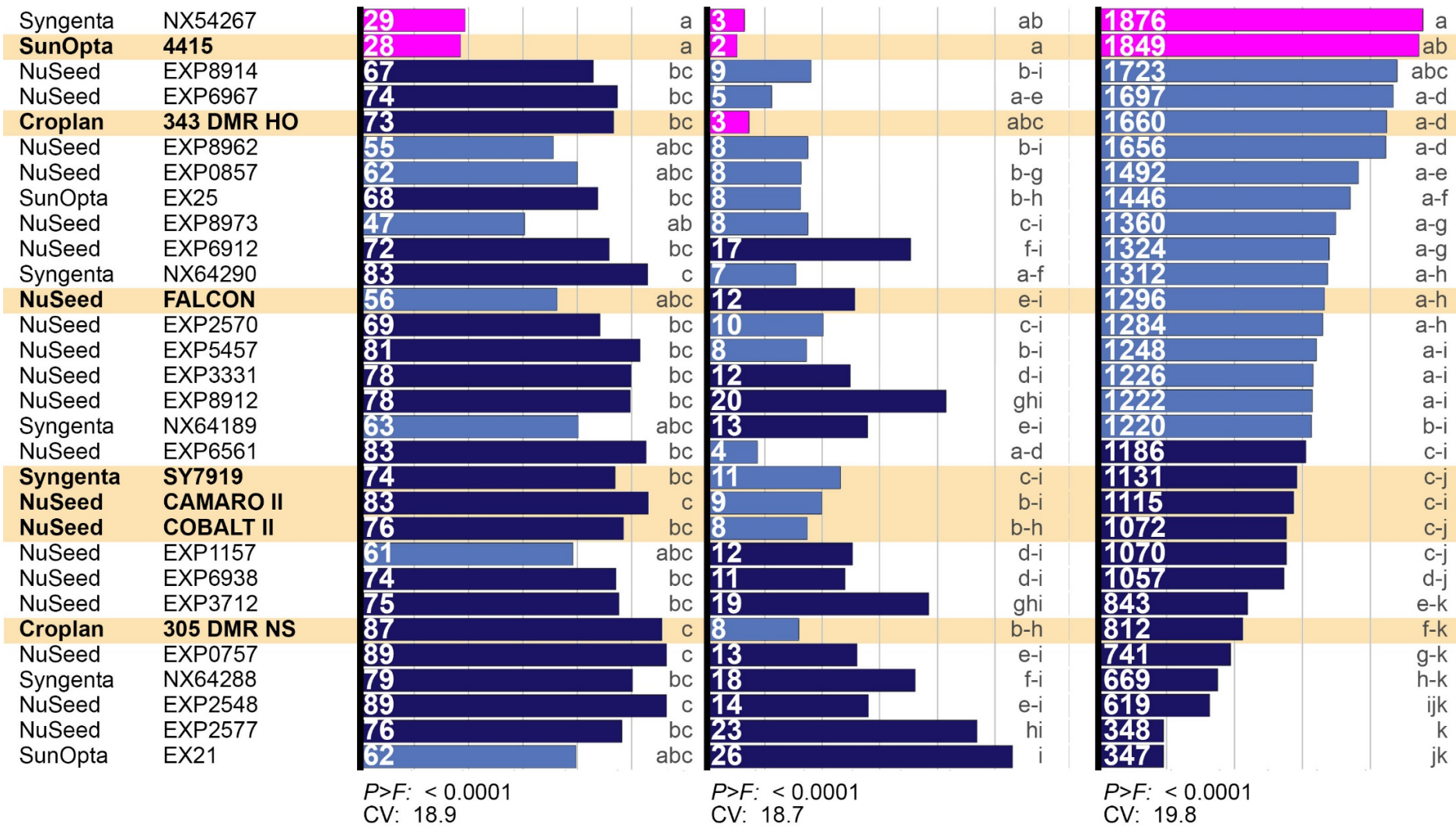
		Sclerotinia Head Rot (% incidence)		Sclerotia in Grain (% by weight)		Yield (pounds/acre)	
Croplan	**432 E**	18	ab	0.7	a	1965	a
NuTech	**69M2**	35	a-f	3.3	abc	1916	a
NuSeed	**Camaro II**	37	a-f	4.6	abc	1819	ab
SunOpta	15S20E	12	a	1.6	abc	1782	abc
Croplan	**343 DMR HO**	25	abc	3.4	abc	1746	a-d
Croplan	**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)

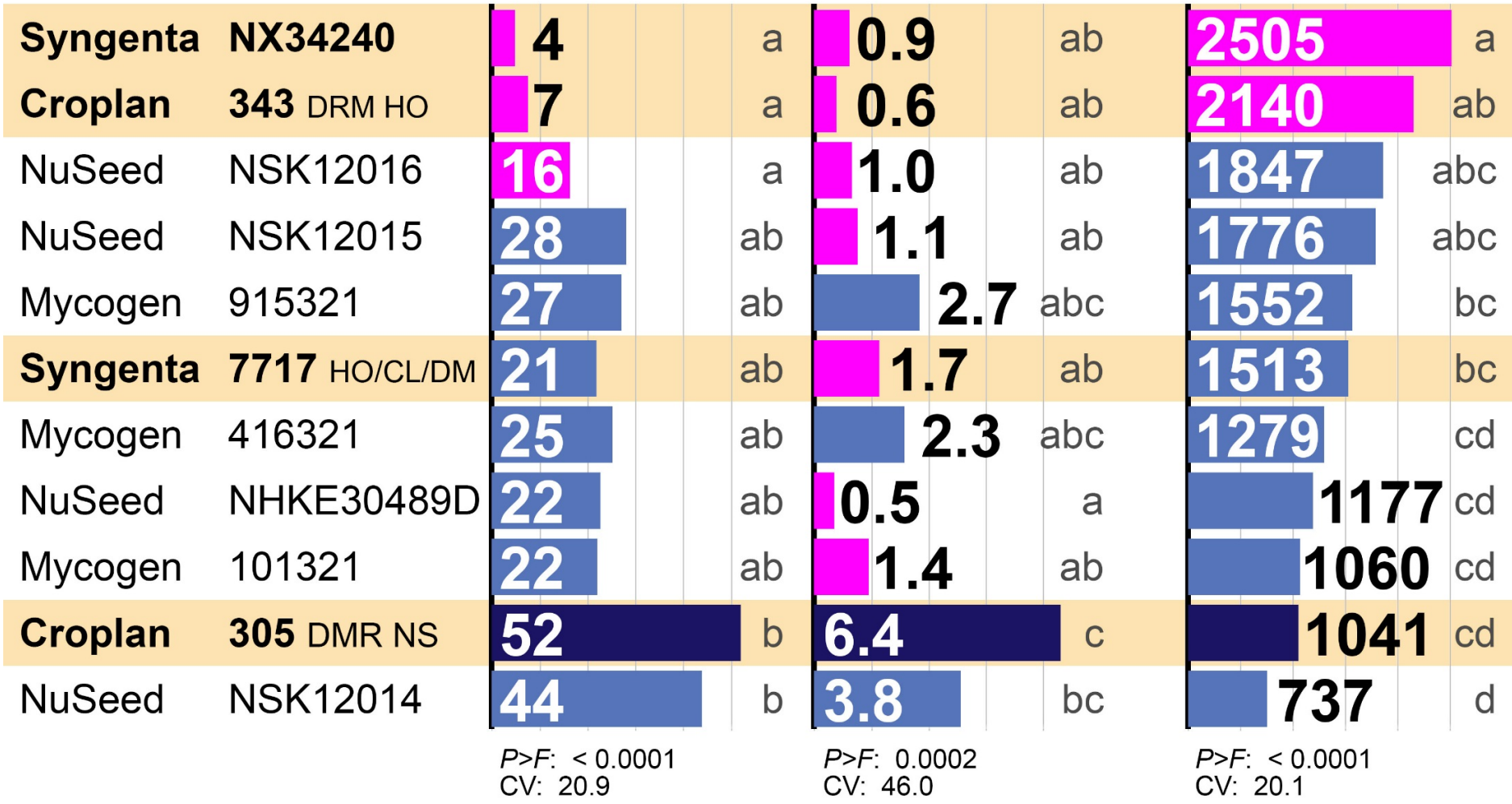


Yellow background = commercial hybrid

White background = experimental hybrid

Susceptibility of oilseed hybrids to Sclerotinia head rot

Carrington, ND (2014)



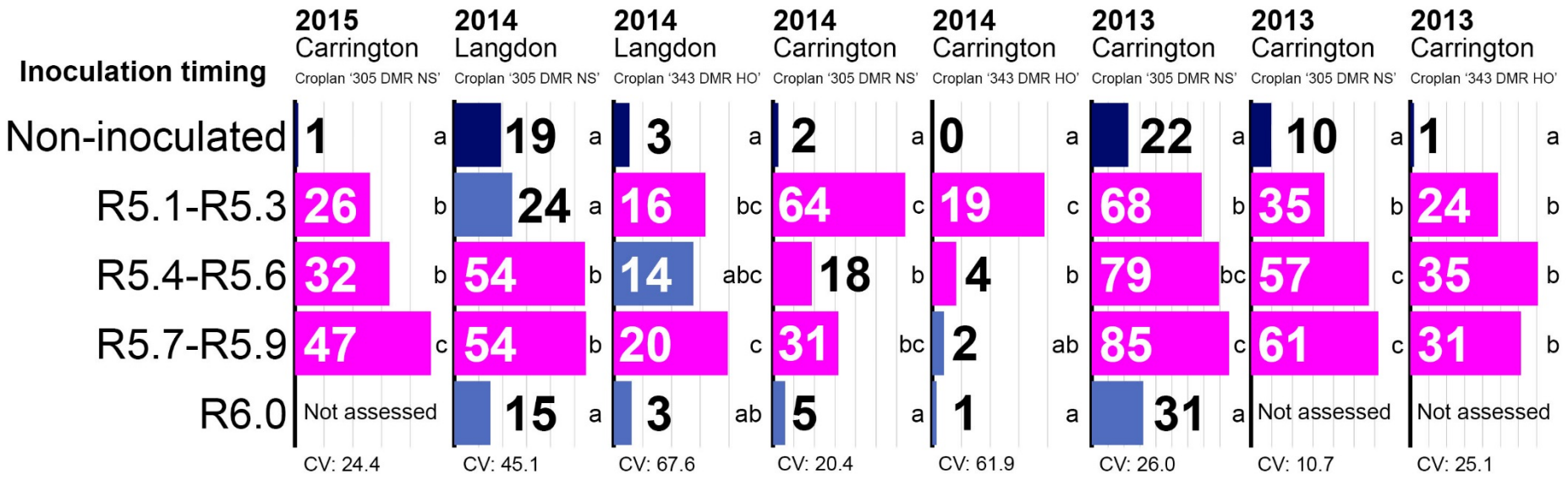
Yellow background = commercial hybrid

White background = experimental hybrid

Susceptibility to Sclerotinia head rot

relative to sunflower growth stage

Oilseed sunflowers:

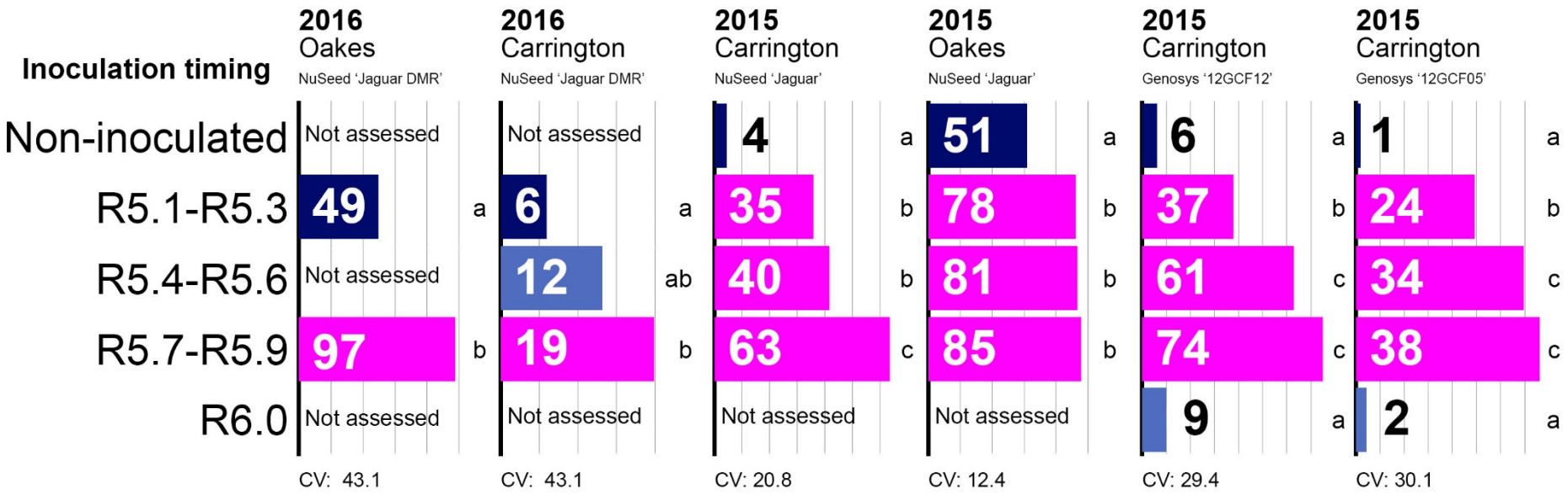


- In six of eight trials, susceptibility increased as bloom progressed
- In two trials, susceptibility was highest in the first third of bloom
- Susceptibility dropped sharply at the R6 growth stage

Susceptibility to Sclerotinia head rot

relative to sunflower growth stage

Confection (non-oil) sunflowers:



- In five of six trials, susceptibility increased as bloom progressed
- In one trial, sunflowers were equally susceptible throughout bloom
- Susceptibility dropped sharply at the R6 growth stage

Susceptibility to Sclerotinia head rot

relative to sunflower growth stage

Conclusions from infection timing studies:

Susceptibility to Sclerotinia head rot is conditioned by (1) growth stage and (2) environmental conditions.

- **Susceptibility increases as bloom progresses** unless environmental conditions strongly favor infection at early bloom and become unfavorable at late bloom
- **Susceptibility drops sharply at the end of 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 growth stages

- Reduces bias from differences in susceptibility related to growth stage

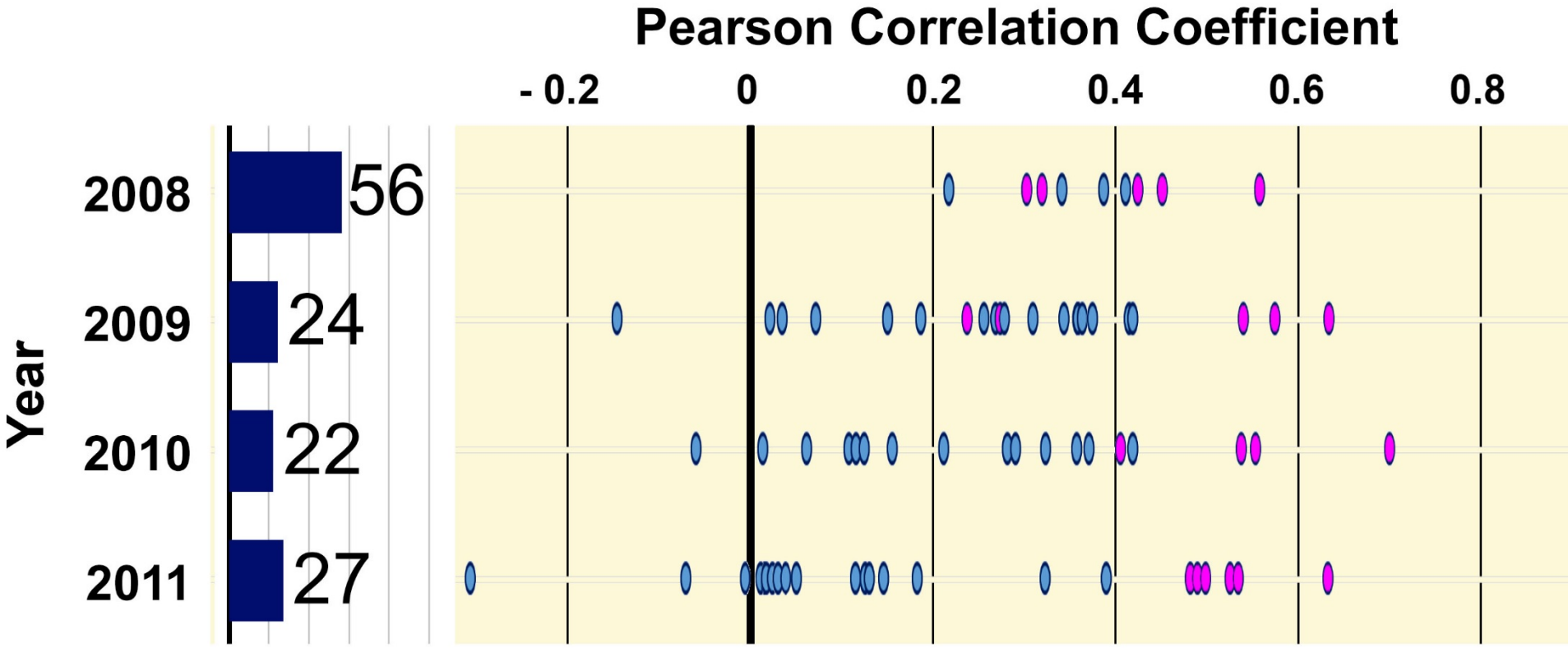
(2) inoculating each head twice (on different dates)

- Reduces bias from differences in susceptibility related to environmental conditions

2008-2011:

Before modified inoculation methods were implemented.

Multi-location nurseries conducted to screen sunflowers for resistance to Sclerotinia head rot produced highly variable results.

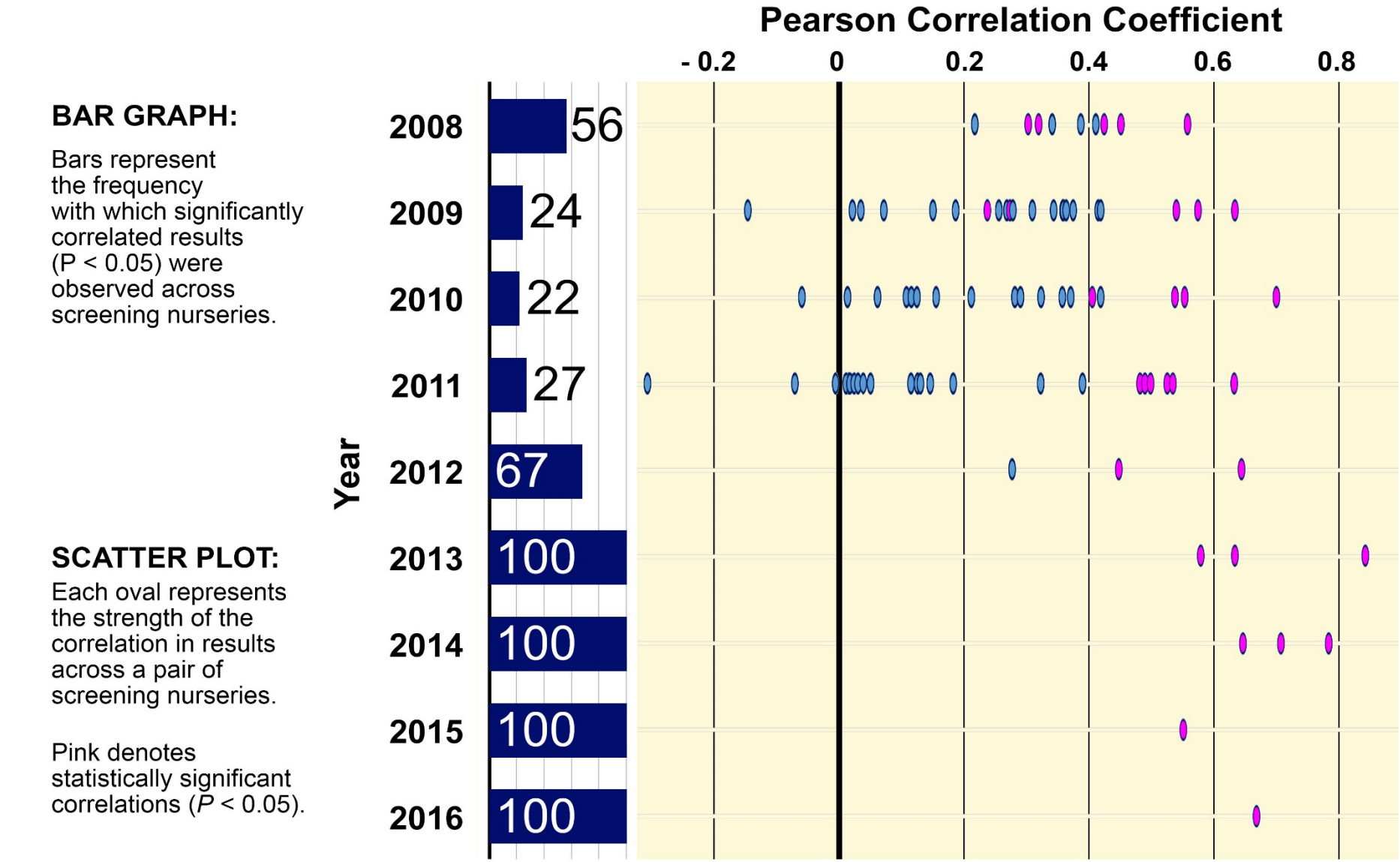


Bars ilustrate the frequency of observing significantly correlated results (*P*<0.05) **across screening nurseries.**

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

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

2012-2016:
The new inoculation procedures produced replicable results.



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 ($P < 0.05$).

Fungicide efficacy

Endura

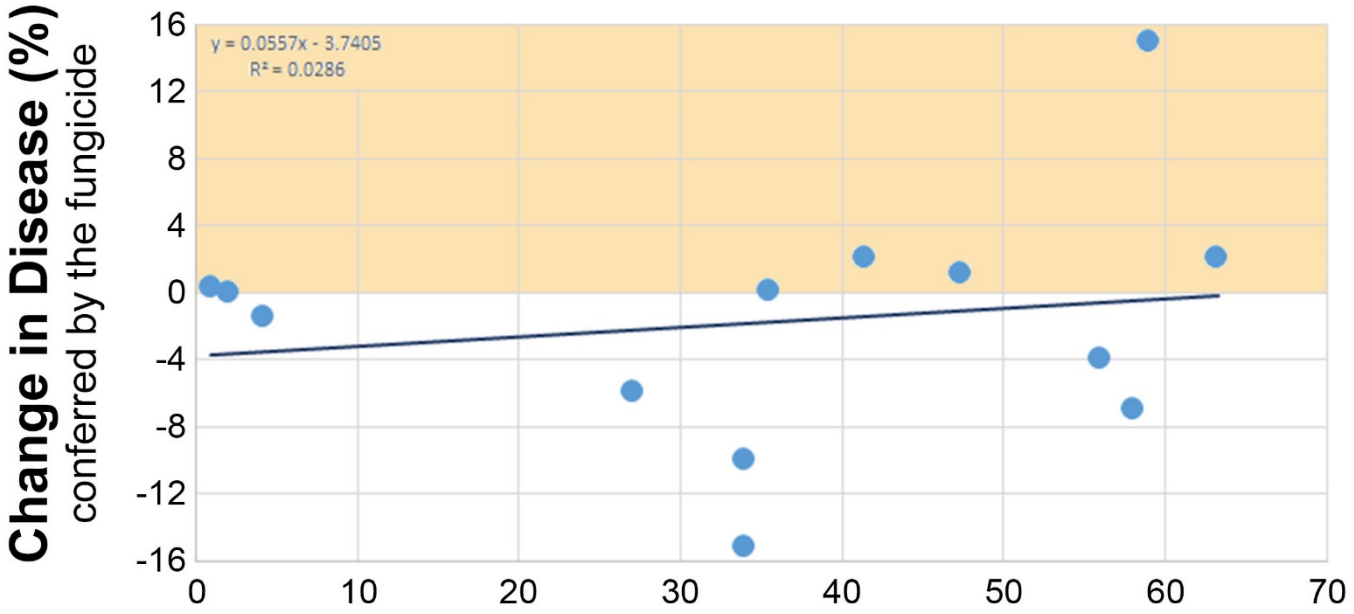
9 oz/ac

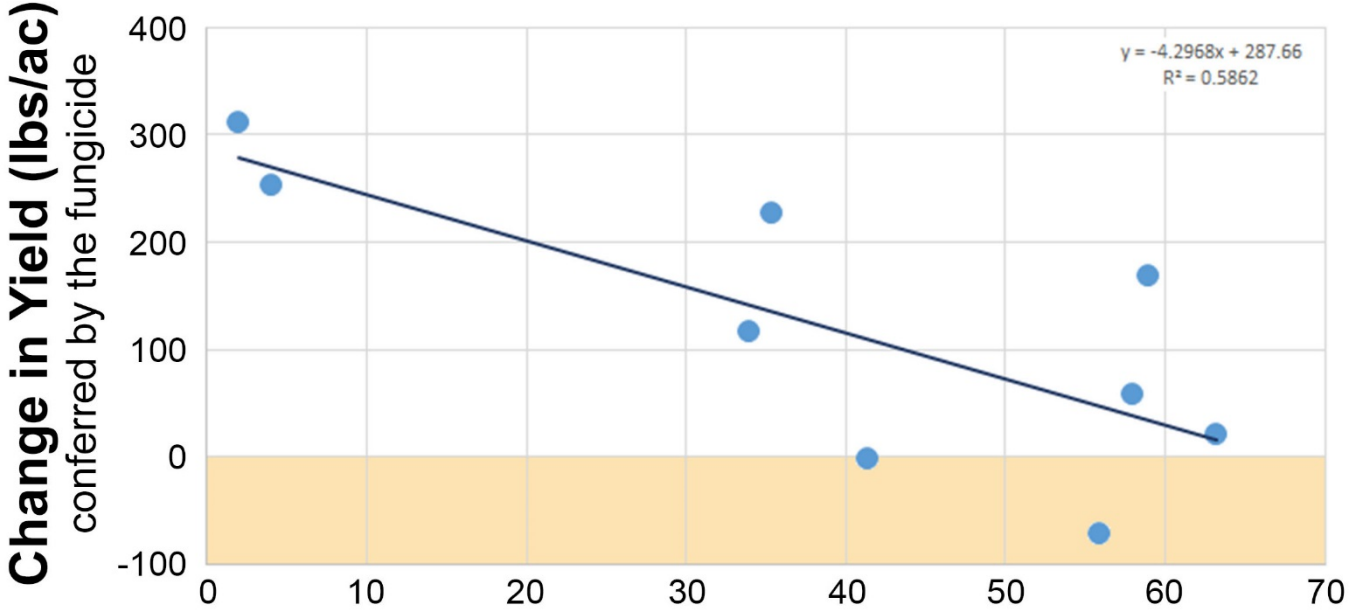
Study locations (years):
Carrington (2012, 2013, 2015)
Oakes (2013)
Langdon (2013)

Spray volume: 10, 15 or 20 gal/ac

Spray nozzles, pressure: flat-fan nozzles, fine to medium droplet size. XR8001, 35 psi; R8002, 30 psi; XR8004, 55 psi; or TT11001, 40 psi

Application method: tractor-mounted boom (11 studies), hand-boom (2 studies)





Sclerotinia head rot disease pressure (%)

Sclerotinia head rot in the non-treated control

Fungicide efficacy

Proline

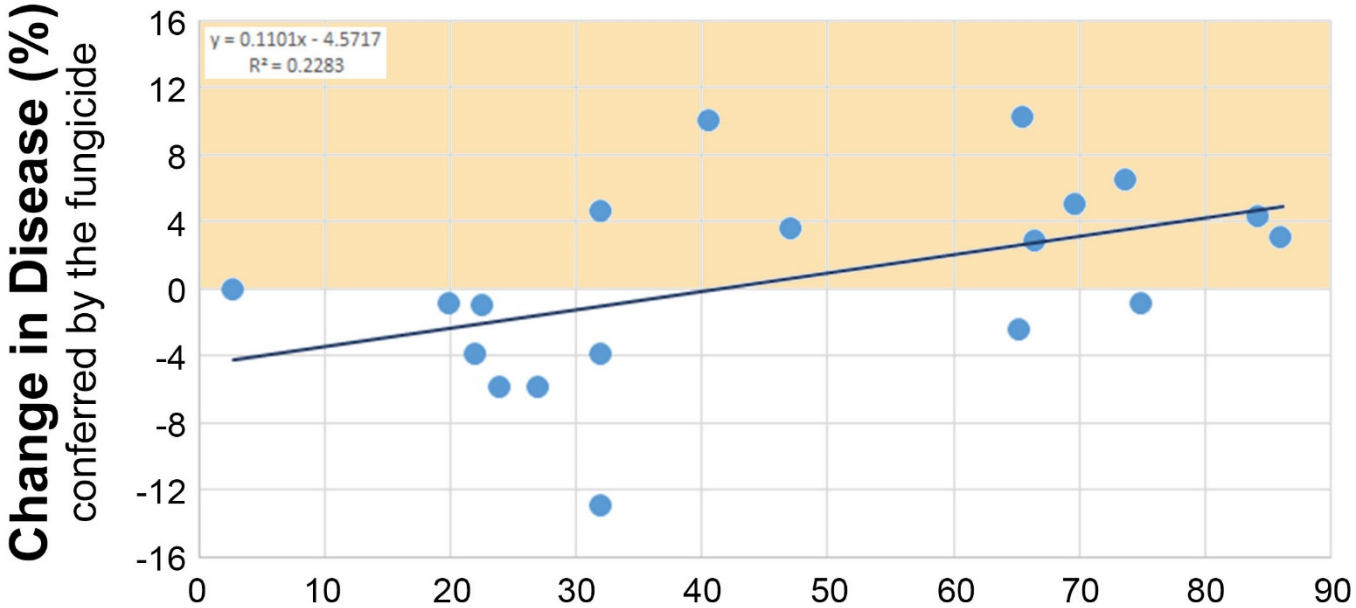
5.7 fl oz/ac

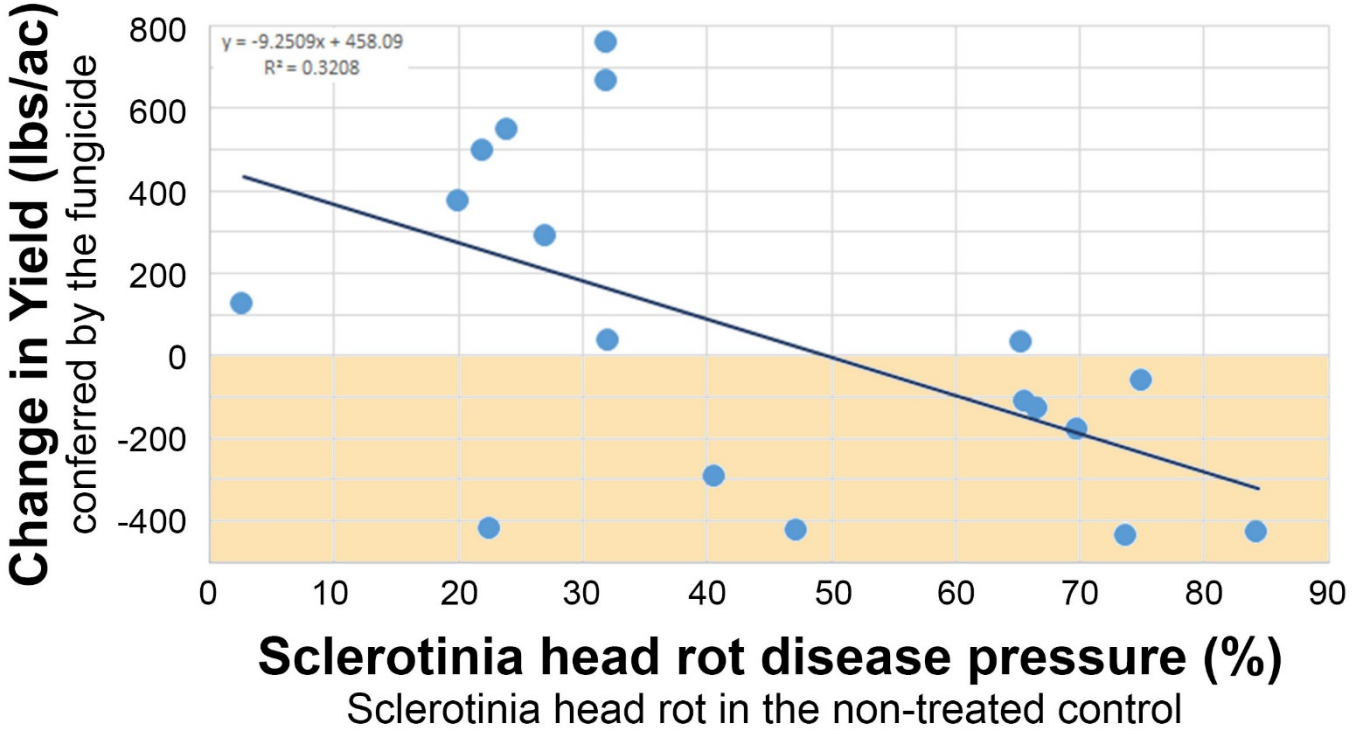
Study locations (years):
Carrington (2017, 2018)
Oakes (2017, 2018)

Spray volume: 15 gal/ac

Spray nozzles, pressure: flat-fan nozzles, very fine to fine droplet size. XR11001, 60 psi or XR11002, 40 psi

Application method: tractor-mounted boom (all studies)





Fungicide efficacy

Endura

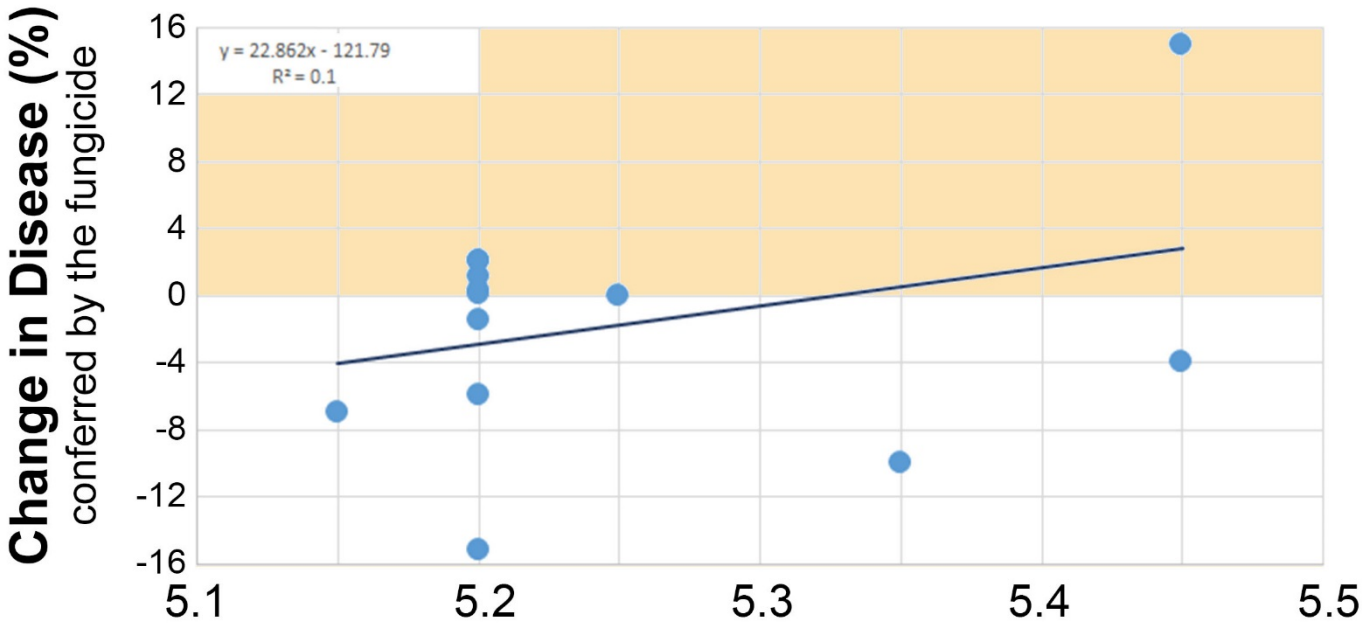
9 oz/ac

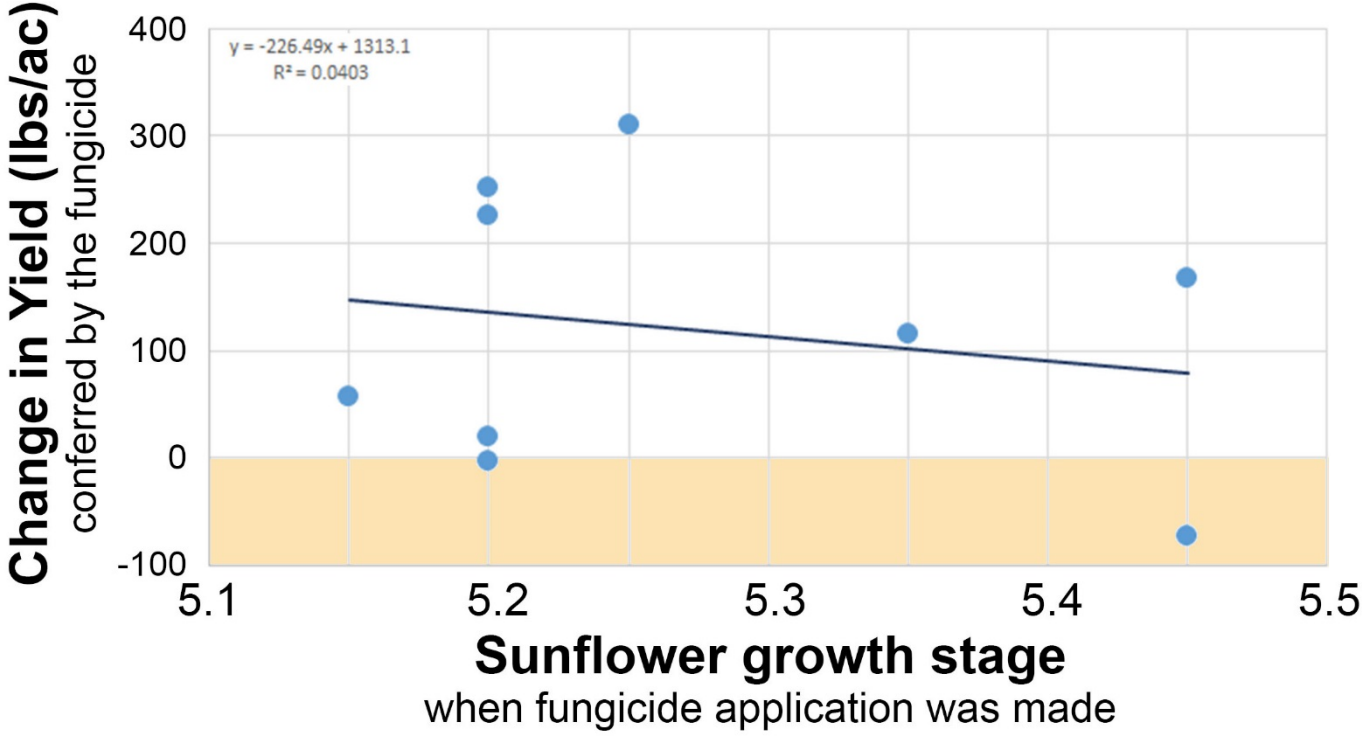
Study locations (years):
Carrington (2012, 2013, 2015)
Oakes (2013)
Langdon (2013)

Spray volume: 10, 15 or 20 gal/ac

Spray nozzles, pressure: flat-fan nozzles, fine to medium droplet size. XR8001, 35 psi; R8002, 30 psi; XR8004, 55 psi; or TT11001, 40 psi

Application method: tractor-mounted boom (11 studies), hand-boom (2 studies)





Fungicide efficacy

Proline

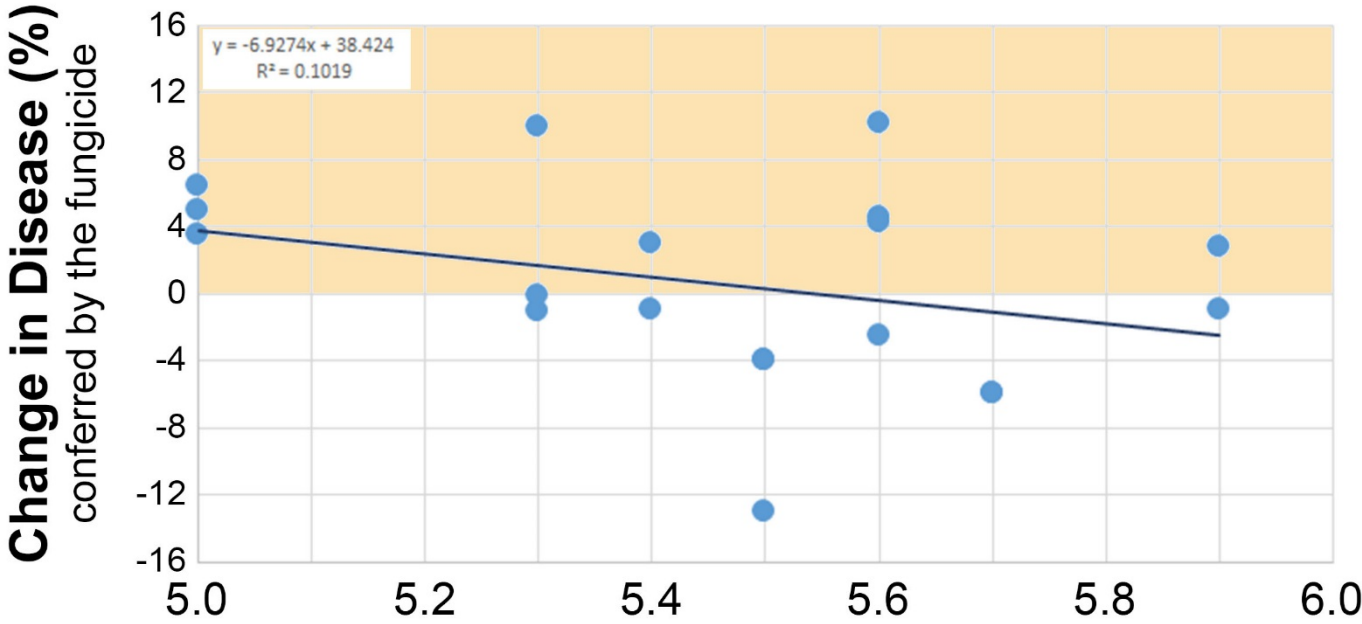
5.7 fl oz/ac

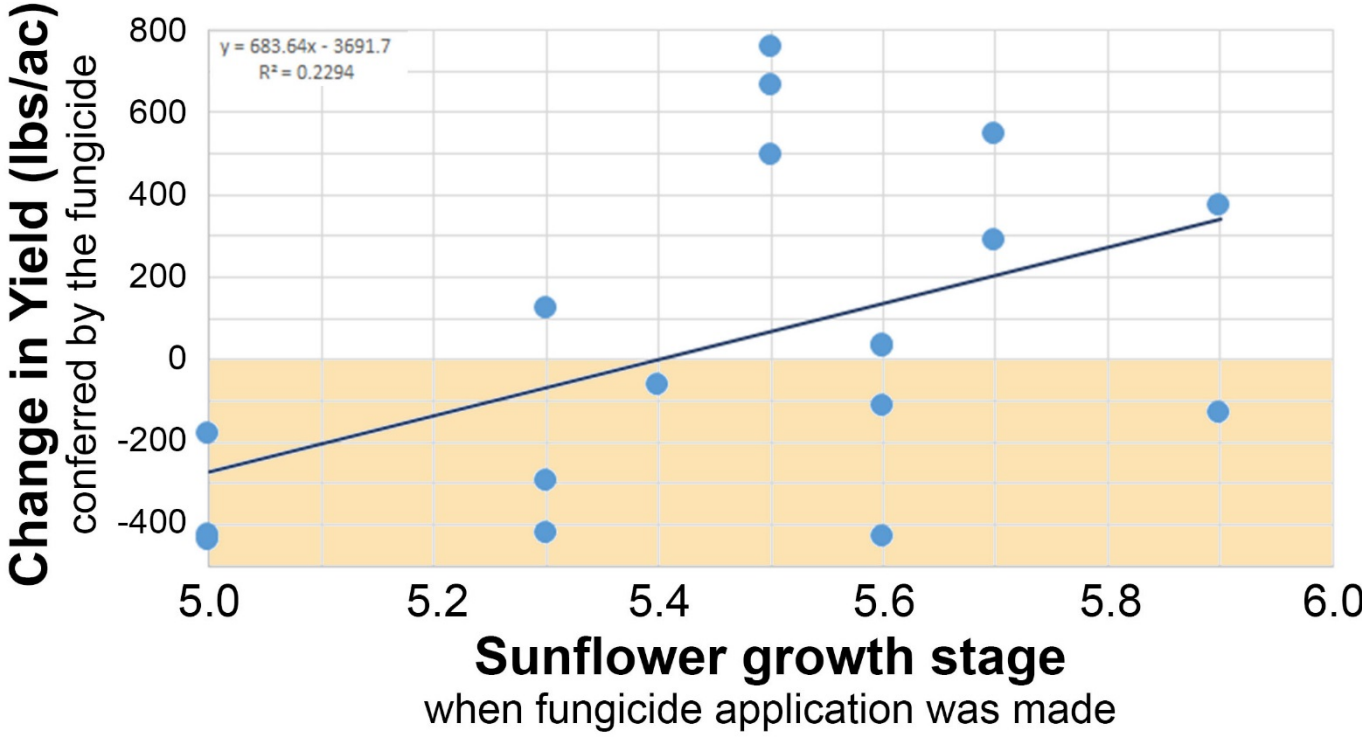
Study locations (years):
Carrington (2017, 2018)
Oakes (2017, 2018)

Spray volume: 15 gal/ac

Spray nozzles, pressure: flat-fan nozzles, very fine to fine droplet size. XR11001, 60 psi or XR11002, 40 psi

Application method: tractor-mounted boom (all studies)





Applying fungicides with drop nozzles

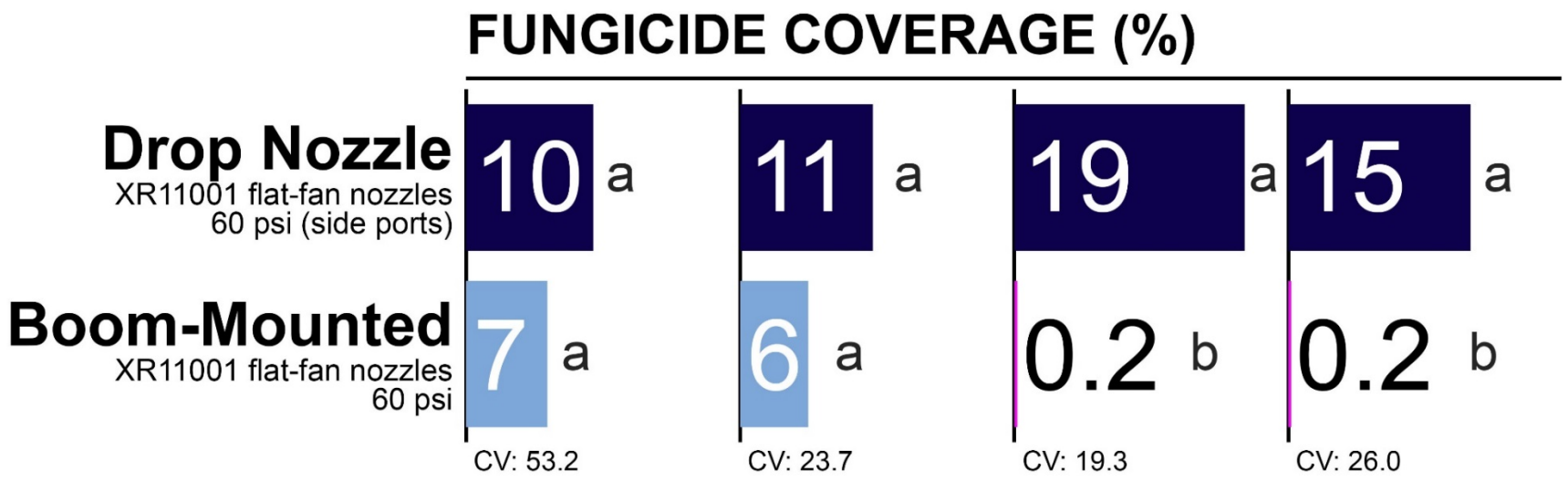
Managing Sclerotinia head rot with fungicides

Fungicide application timing

Field trials conducted in 2018

Fungicide coverage relative to fungicide application method and sunflower growth stage

	Carrington 2018	Carrington 2018	Oakes 2018	Carrington 2018
Plants with open disk flowers:	**43%**	**79%**	**95%**	**100%**
Average growth stage:	**R5.0**	**R5.3**	**R5.6**	**R5.9**
Range of growth stages:	R4-R5.4	R4-R5.8	R4-R5.9	R5.1-R6.0



Fungicide efficacy – drop nozzles

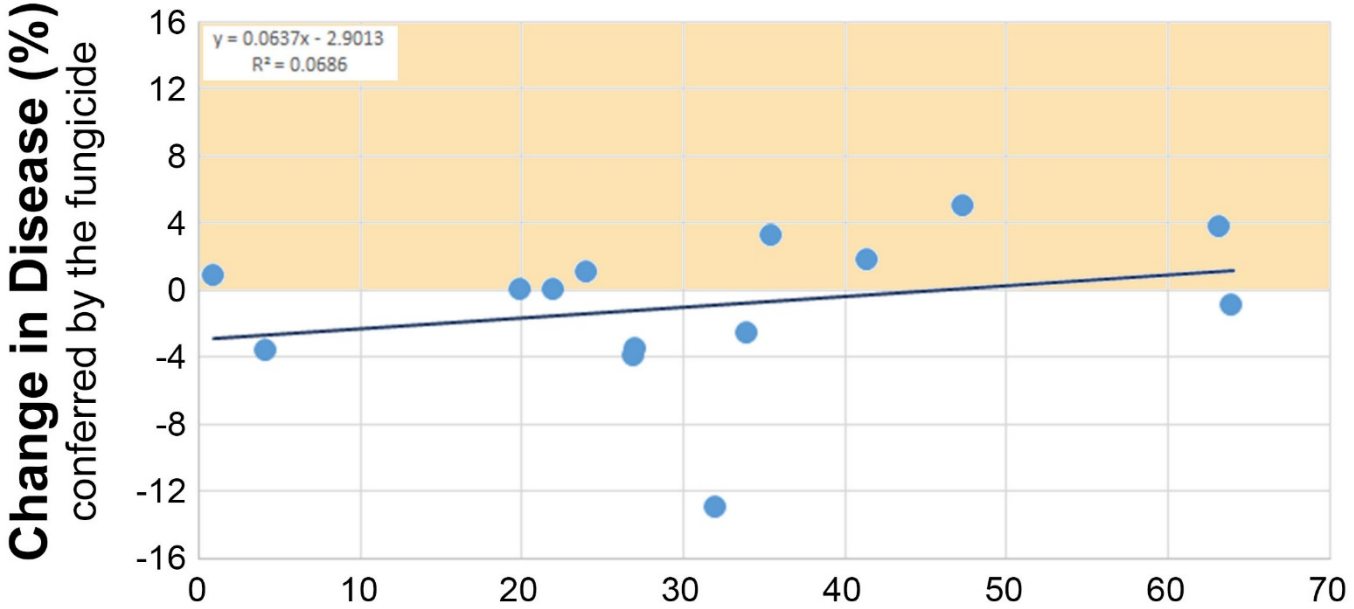
Endura
9 oz/ac

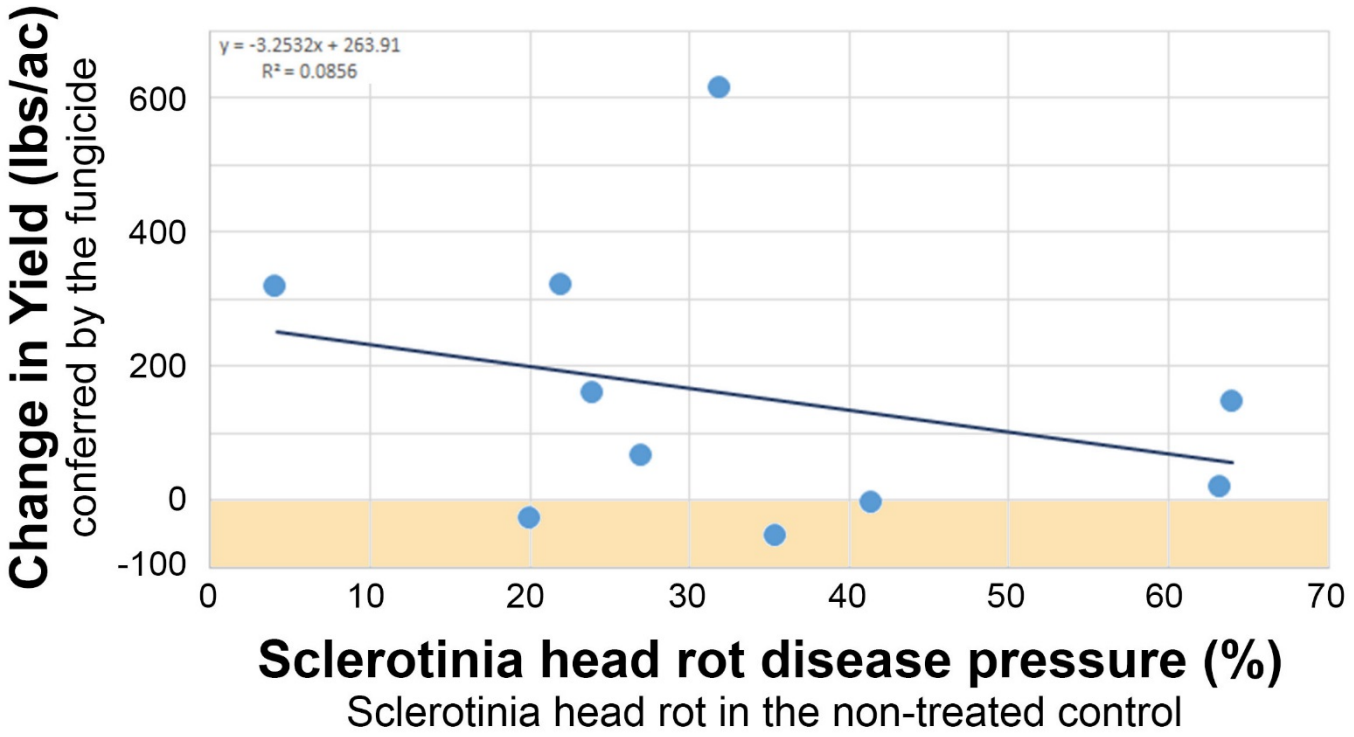
Study locations (years):
Carrington (2015, 2017)
Oakes (2017)

Spray volume: 15 gal/ac

Spray nozzles, pressure: flat-fan nozzles on side ports, fine droplet size.
XR11001, 40 psi
XR11002, 40 psi

Application method: tractor-mounted boom equipped with '360 Undercover' drop nozzles





Fungicide efficacy – drop nozzles

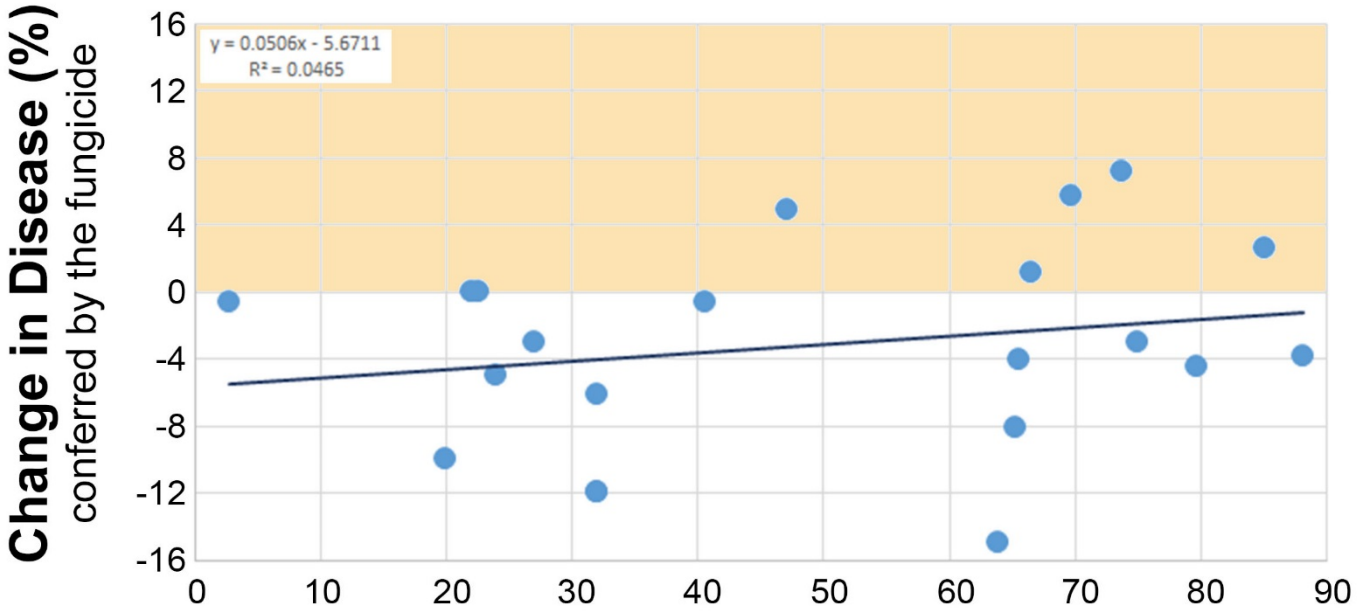
Proline
5.7 fl oz/ac

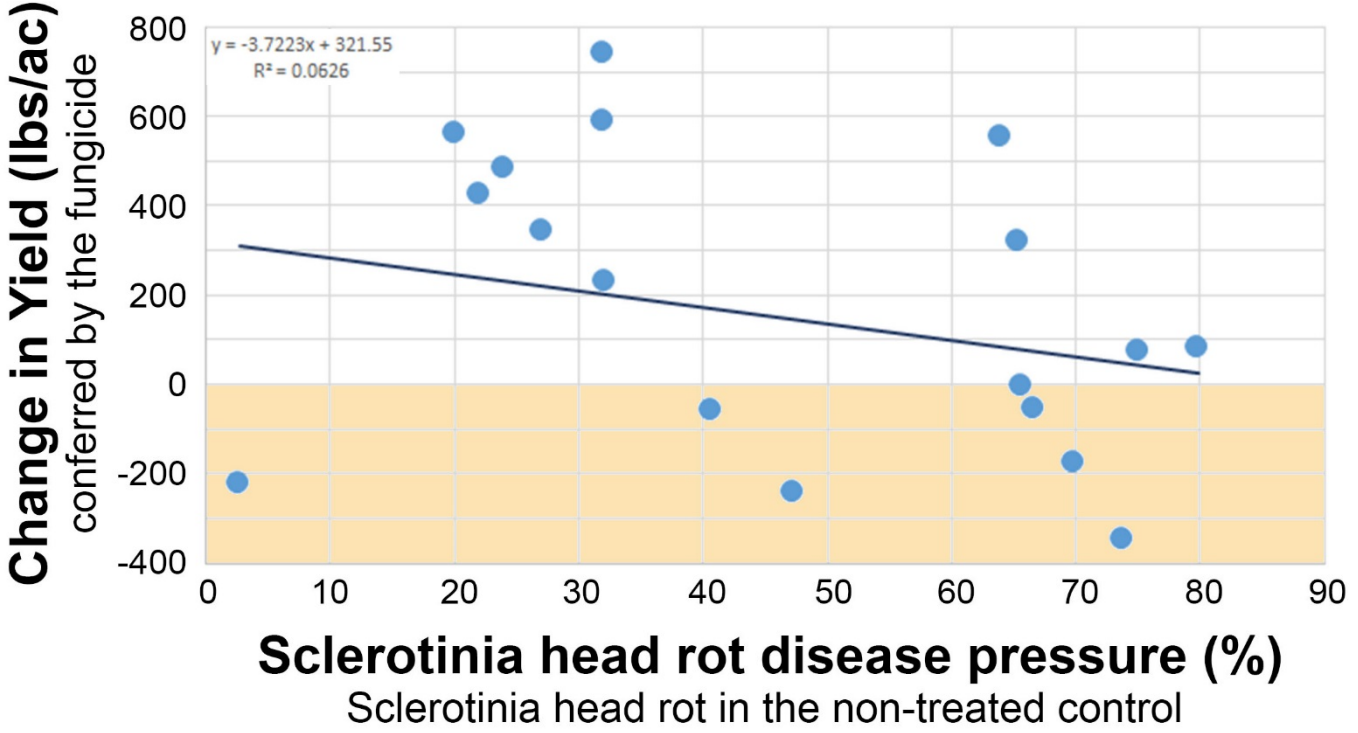
Study locations (years):
Carrington (2017, 2018)
Oakes (2017, 2018)

Spray volume: 15 gal/ac

Spray nozzles, pressure: flat-fan nozzles on side ports, fine or very fine droplet size.
XR11001, 60 psi or XR11002, 40 psi

Application method: tractor-mounted boom equipped with '360 Undercover' drop nozzles





Improving disease management in chickpeas and field peas

Ascochyta blight – chickpeas, field peas
Fusarium, Aphanomyces root rots – field peas

Collaborative research:

John Rickertsen, NDSU Hettinger Research Extension Center
Audrey Kalil, NDSU Williston Research Extension Center
Tyler Tjelde, NDSU Williston Research Extension Center
Julie Pasche, NDSU Department of Plant Pathology
Michael Wunsch, NDSU Carrington Research Extension Center

Michael Wunsch, plant pathologist **NDSU Carrington Research Extension Center**

Managing QoI-resistant Ascochyta blight in chickpeas

Pathogen: *Ascochyta rabiei*

TIMELINE:

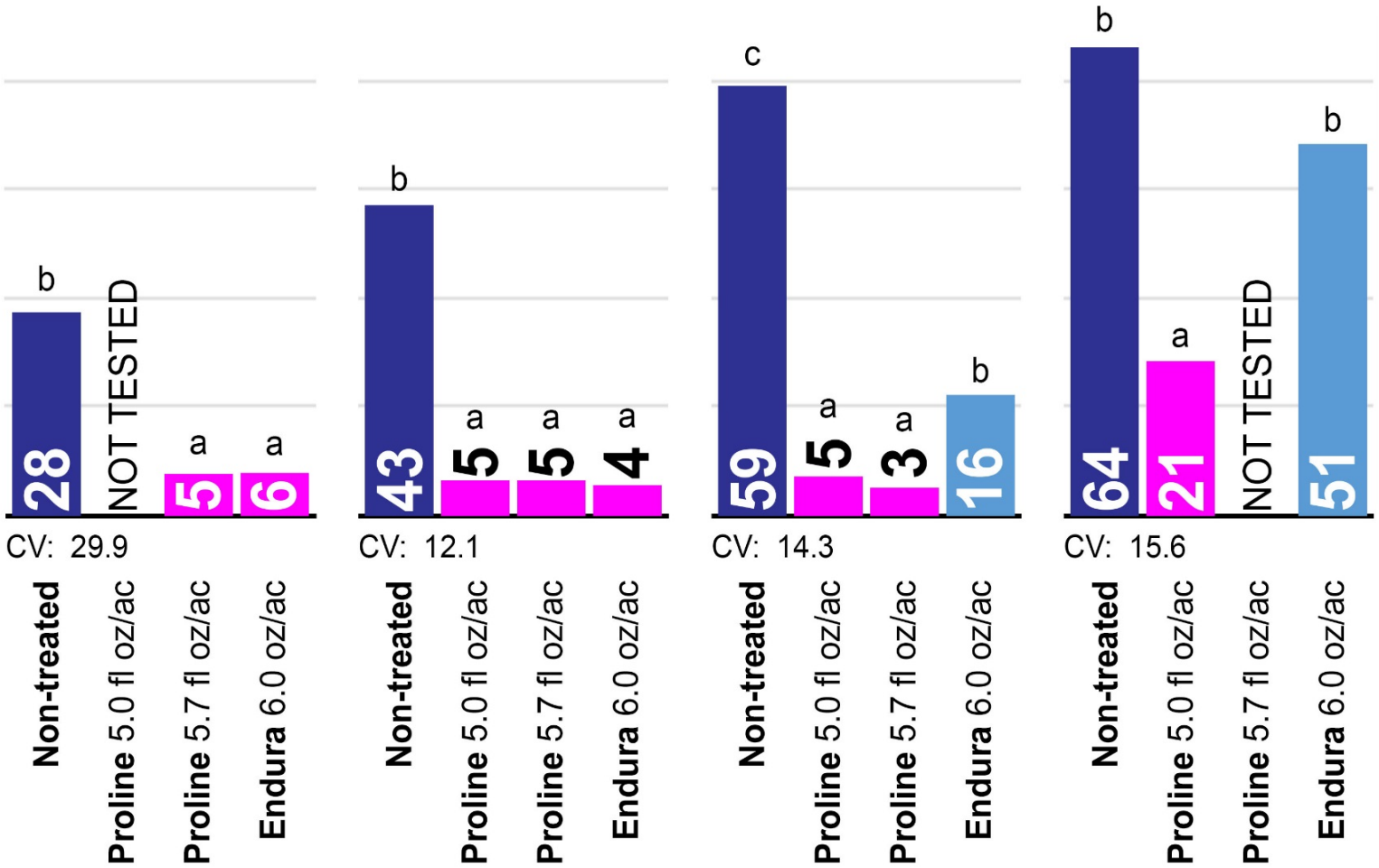
2007: laboratory confirmation of QoI resistance

2008: loss of efficacy in Carrington field trials

Ascochyta management in chickpeas:
Proline (FRAC 3) vs. Endura (FRAC 7)

Hofflund (**2013**) CDC **'Frontier'**	Carrington (**2010**) **'Sierra'**	Carrington (**2009**) **'Sierra'**	Minot (**2011**) CDC **'Xena'**
Three fungicide applications	Four fungicide applications	Three fungicide applications	Four fungicide applications
Spray droplet size: **fine**	Spray droplet size: **very fine**	Spray droplet size: **fine**	Spray droplet size: **fine**

Ascochyta severity (0-100; bloom through maturity)



Spray volume:

2013 Hofflund:
20 gal/ac

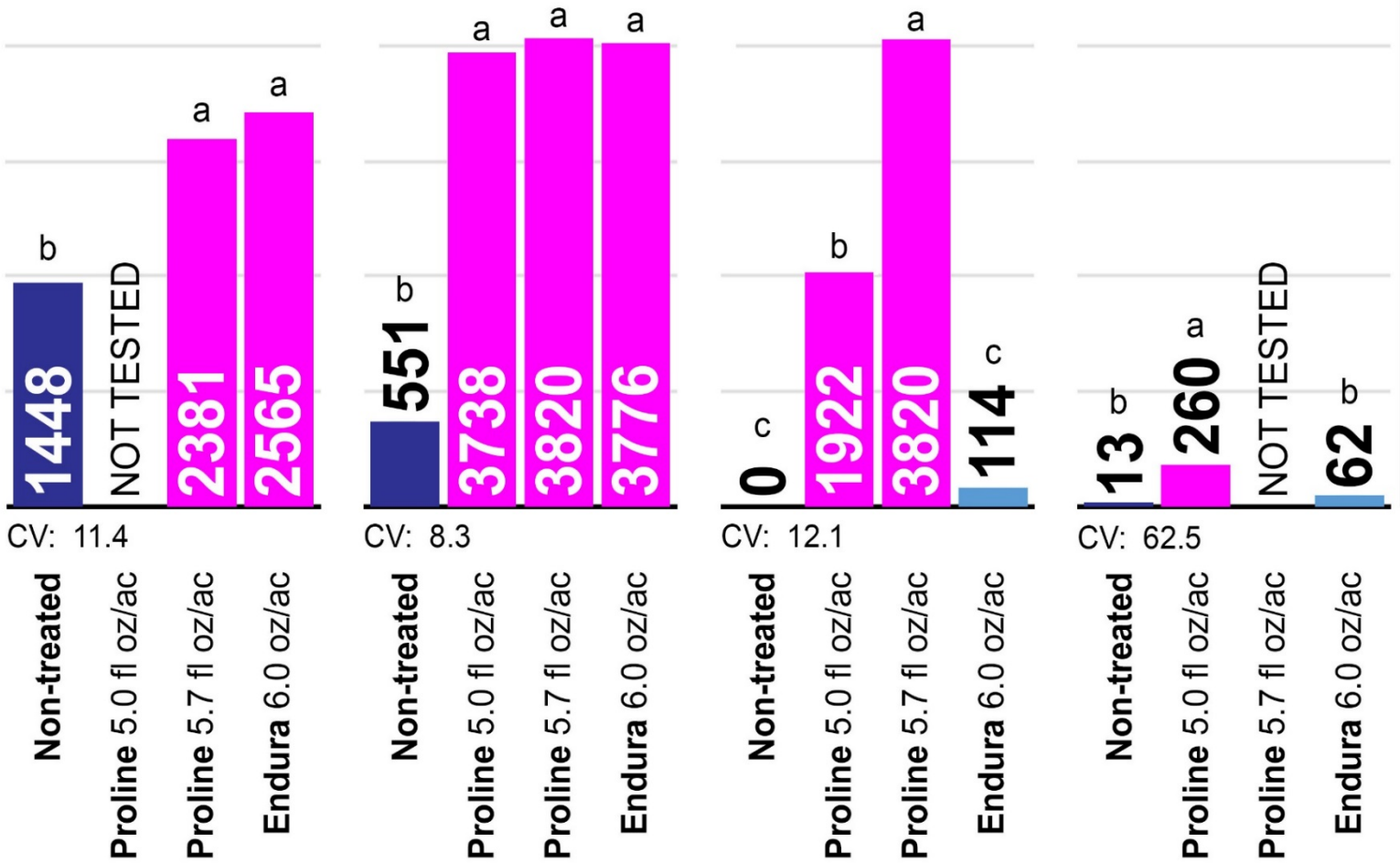
2011 Minot:
17.5 gal/ac

2009, 2010:
17 gal/ac

Ascochyta management in chickpeas:
Proline (FRAC 3) vs. Endura (FRAC 7)

Hofflund (**2013**) CDC **'Frontier'**	Carrington (**2010**) **'Sierra'**	Carrington (**2009**) **'Sierra'**	Minot (**2011**) CDC **'Xena'**
Three fungicide applications Spray droplet size: **fine**	Four fungicide applications Spray droplet size: **very fine**	Three fungicide applications Spray droplet size: **fine**	Four fungicide applications Spray droplet size: **fine**

Chickpea yield (pounds/acre; 13.5% moisture)



Spray volume:

2013
Hofflund:
20 gal/ac

2011
Minot:
17.5 gal/ac

2009, 2010:
17 gal/ac

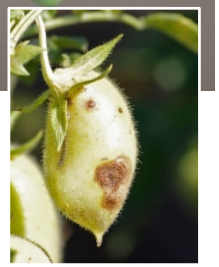
Ascochyta management in chickpeas:
Proline (FRAC 3) vs. Delaro (FRAC 3,11)

Delaro should be applied with supplemental Proline

5.0 fl oz/ac Proline =
71 g/ac prothioconazole

5.7 fl oz/ac Proline =
81 g/ac prothioconazole

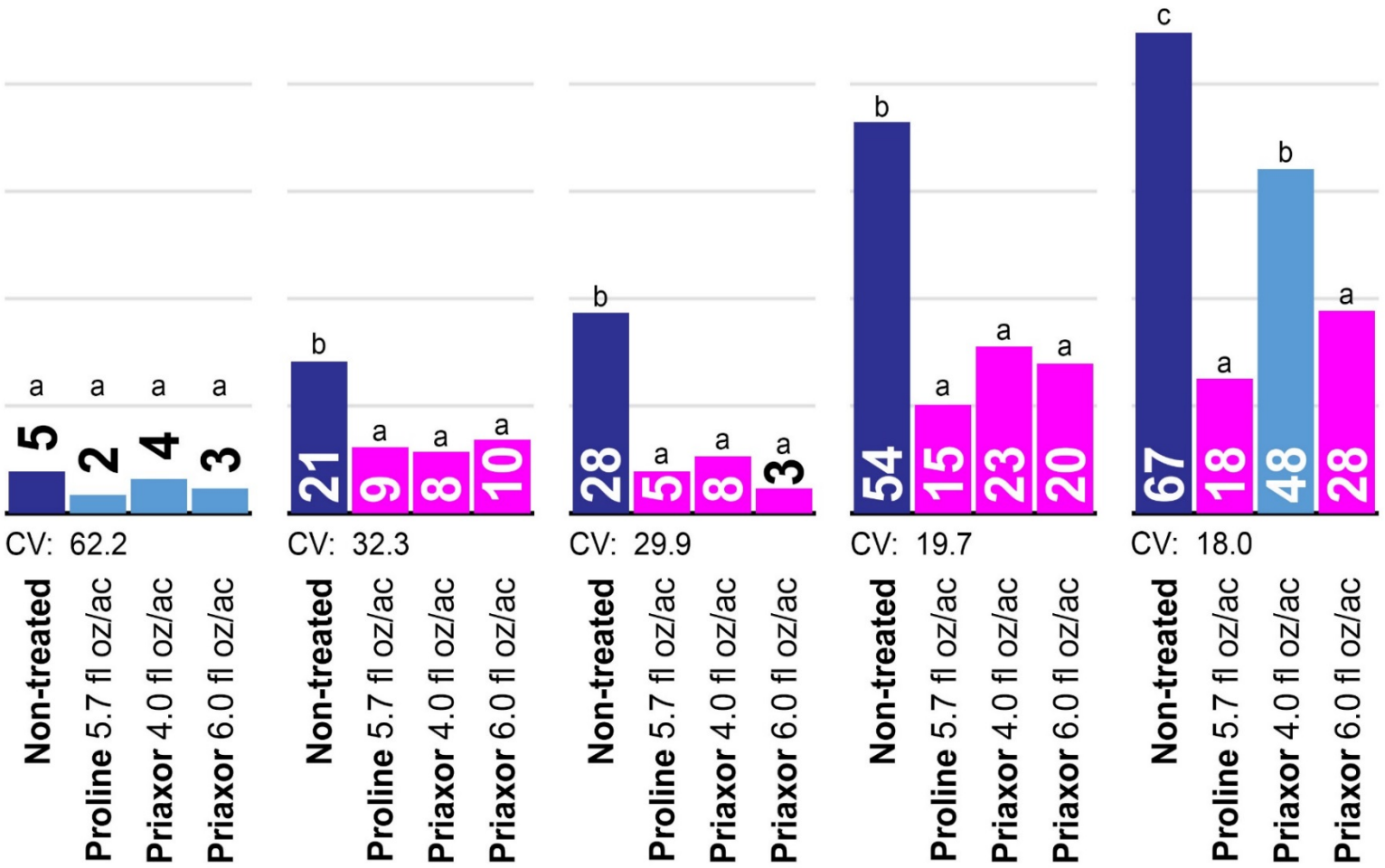
12 fl oz/ac Delaro =
63 g/ac prothioconazole



Ascochyta management in chickpeas:
Proline (FRAC 3) vs. Priaxor (FRAC 7,11)

Carrington (**2012**) CDC **'Frontier'**	Hofflund (**2012**) CDC **'Frontier'**	Hofflund (**2013**) CDC **'Frontier'**	Carrington (**2018**) CDC **'Frontier'**	Carrington (**2015**) CDC **'Alma'**
Three fung. applications Spray droplet size: **fine**	Four fung. applications Spray droplet size: **fine**	Three fung. applications Spray droplet size: **fine**	Four fung. applications Spray droplets: **medium**	Four fung. applications Spray droplet size: **fine**

Ascochyta severity (0-100; bloom through maturity)



Spray volume:

2012, 2013 Hofflund:
20 gal/ac

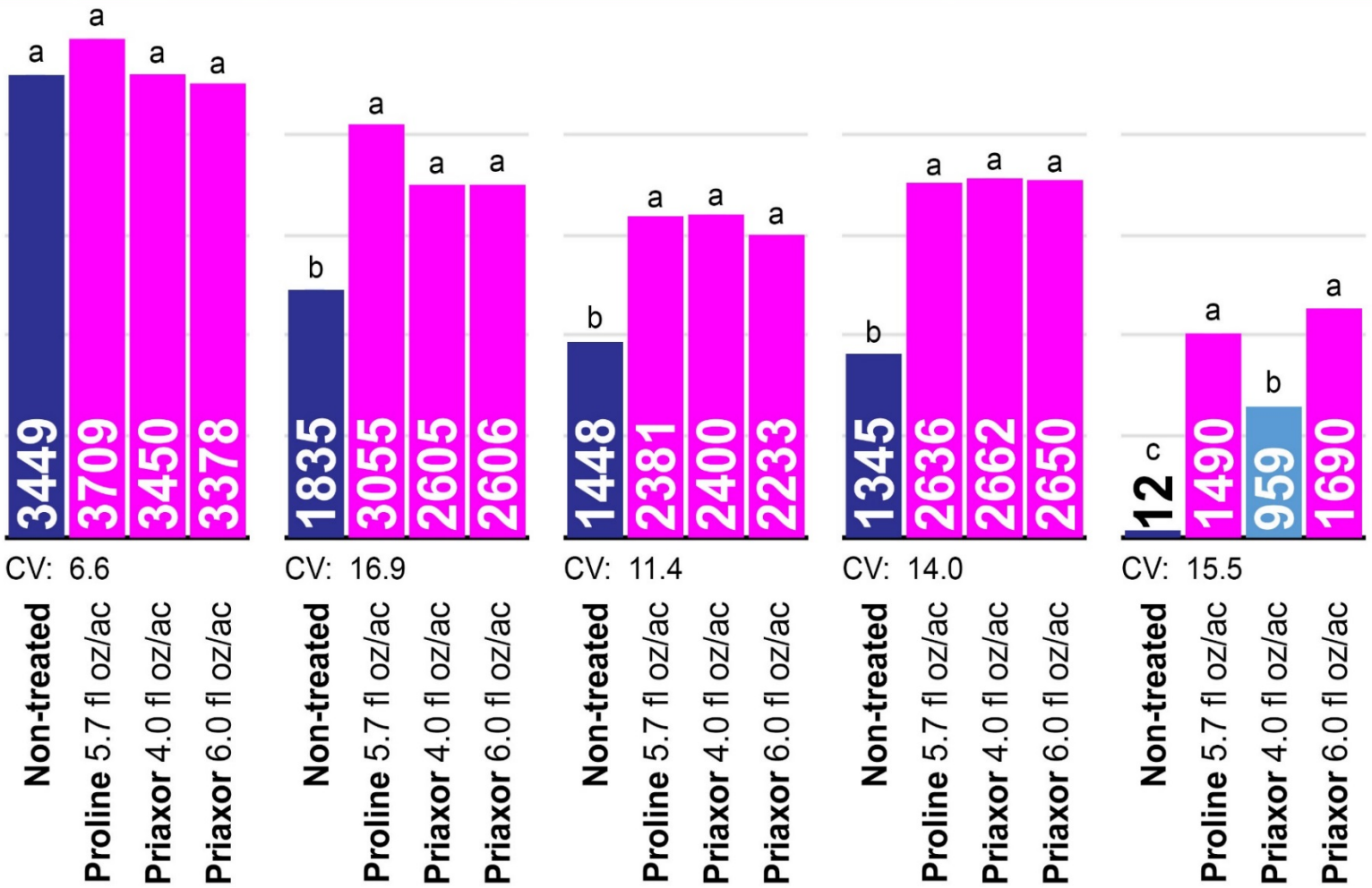
2012 Carrington:
17.5 gal/ac

2015, 2018:
15 gal/ac

Ascochyta management in chickpeas:
Proline (FRAC 3) vs. Priaxor (FRAC 7,11)

Carrington (**2012**) CDC **'Frontier'**	Hofflund (**2012**) CDC **'Frontier'**	Hofflund (**2013**) CDC **'Frontier'**	Carrington (**2018**) CDC **'Frontier'**	Carrington (**2015**) CDC **'Alma'**
Three fung. applications Spray droplet size: **fine**	Four fung. applications Spray droplet size: **fine**	Three fung. applications Spray droplet size: **fine**	Four fung. applications Spray droplets: **medium**	Four fung. applications Spray droplet size: **fine**

Chickpea yield (**pounds/acre**; 13.5% moisture)



Spray volume:

2012, 2013 Hofflund:
20 gal/ac

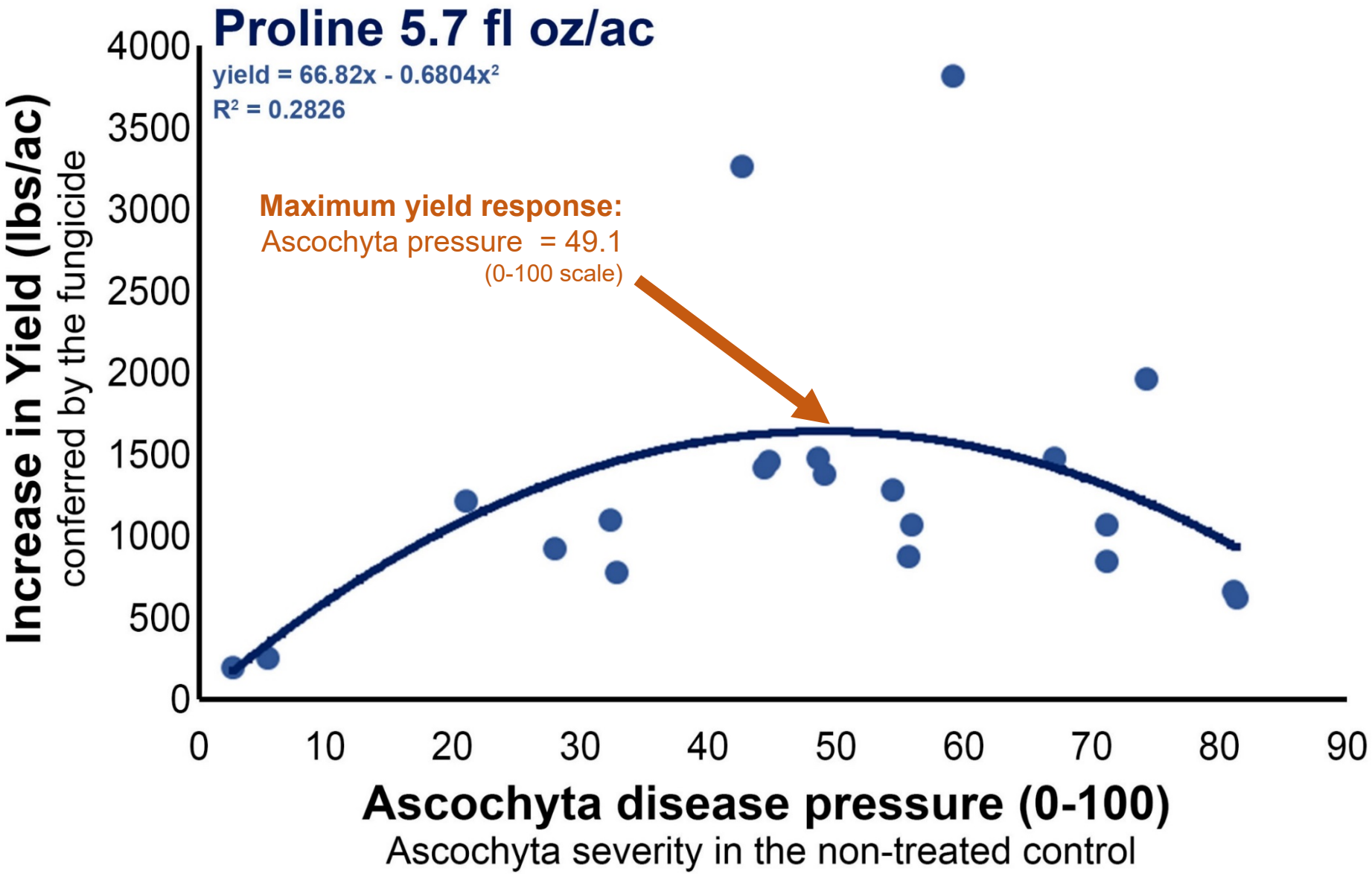
2012 Carrington:
17.5 gal/ac

2015, 2018:
15 gal/ac

Performance of Proline relative to Ascochyta pressure in chickpeas

'CDC Frontier', 'CDC Alma', 'CDC Orion' and 'Sierra' kabuli chickpeas

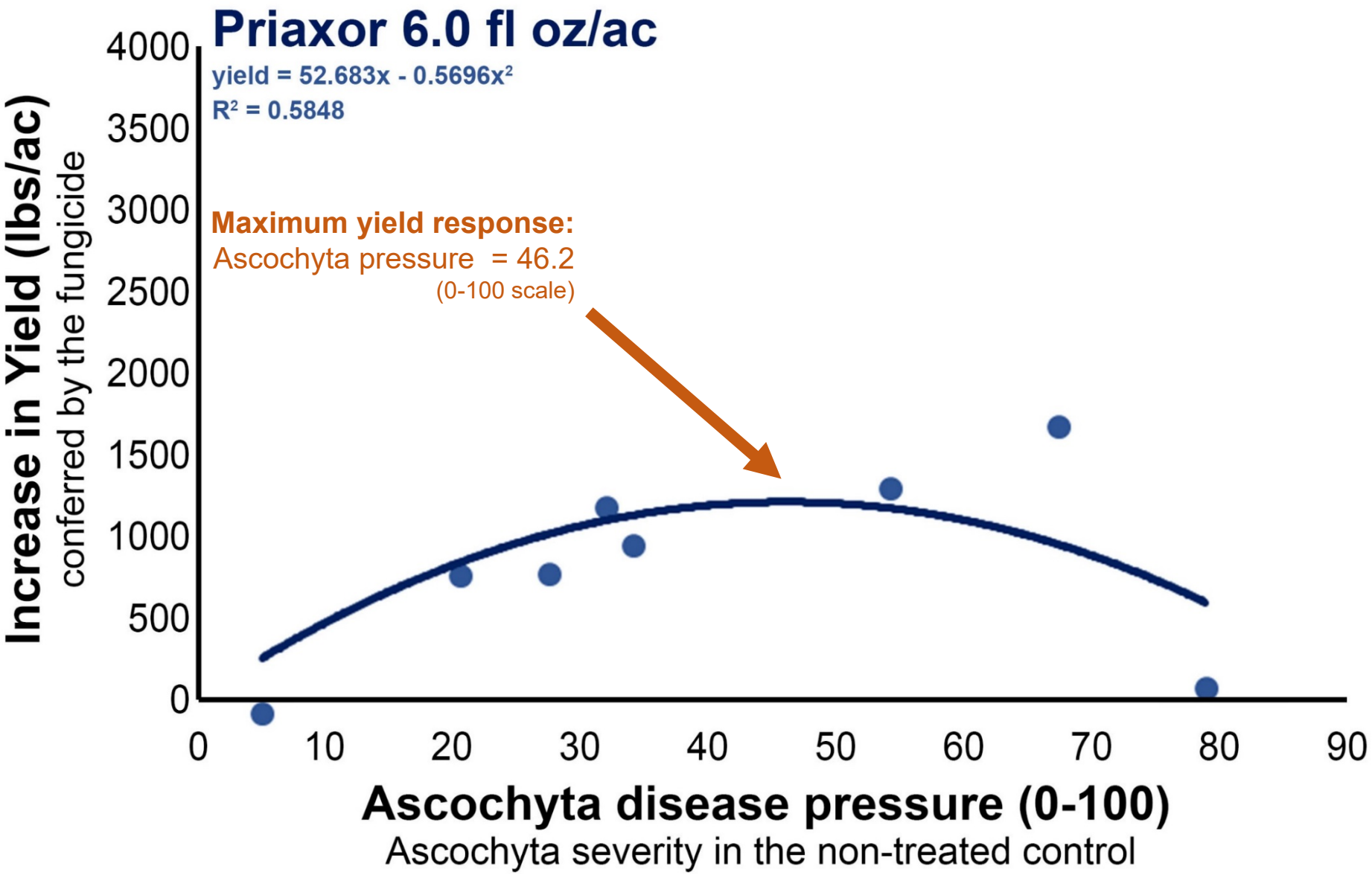
Carrington and Hofflund, ND (2008-2018)



Performance of Priaxor relative to Ascochyta pressure in chickpeas

'CDC Frontier', 'CDC Alma', and 'CDC Xena' kabuli chickpeas

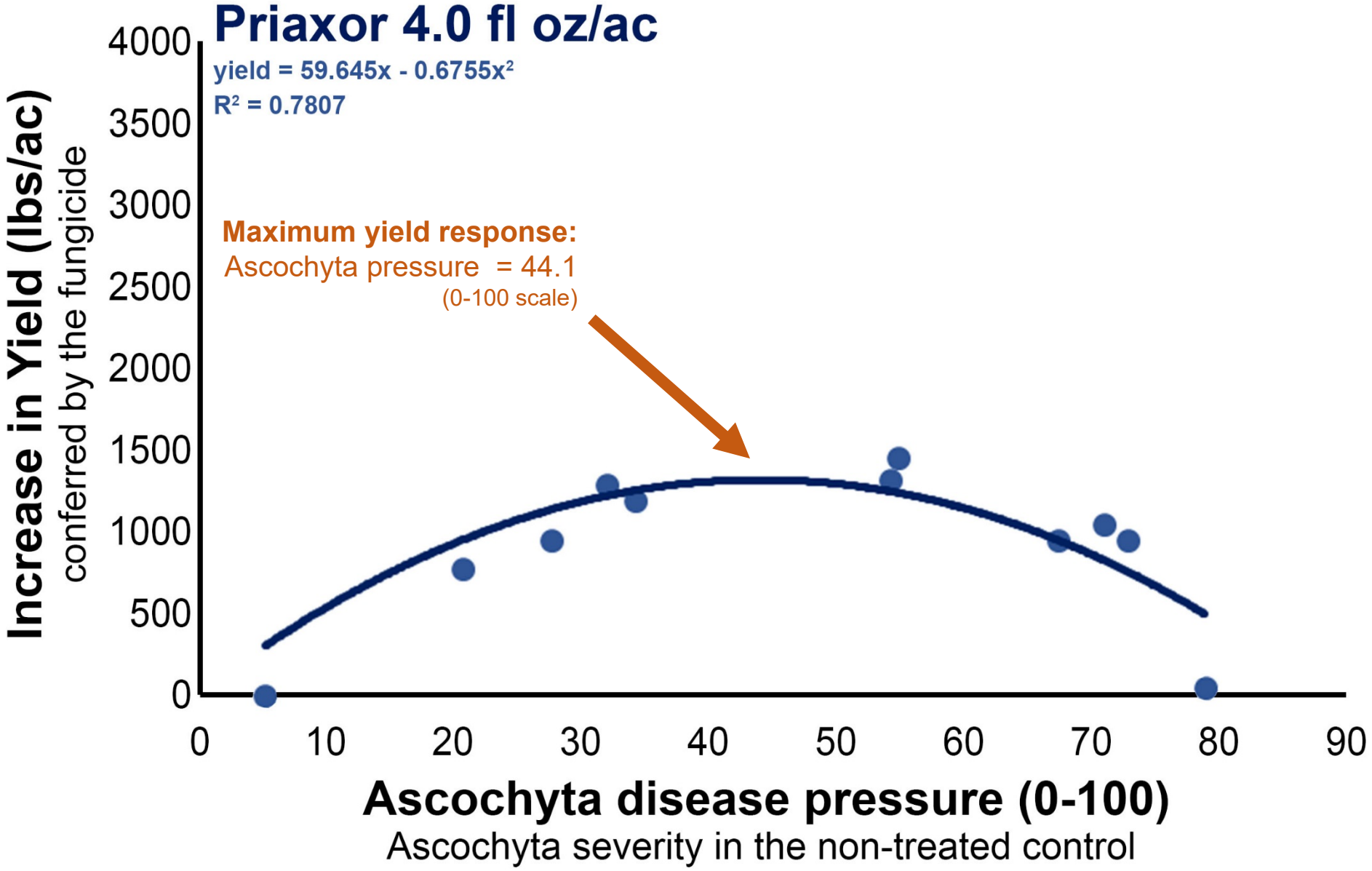
Carrington and Hofflund, ND (2011-2018)



Performance of Priaxor relative to Ascochyta pressure in chickpeas

'CDC Frontier', 'CDC Alma', 'CDC Orion' and 'CDC Xena' kabuli chickpeas

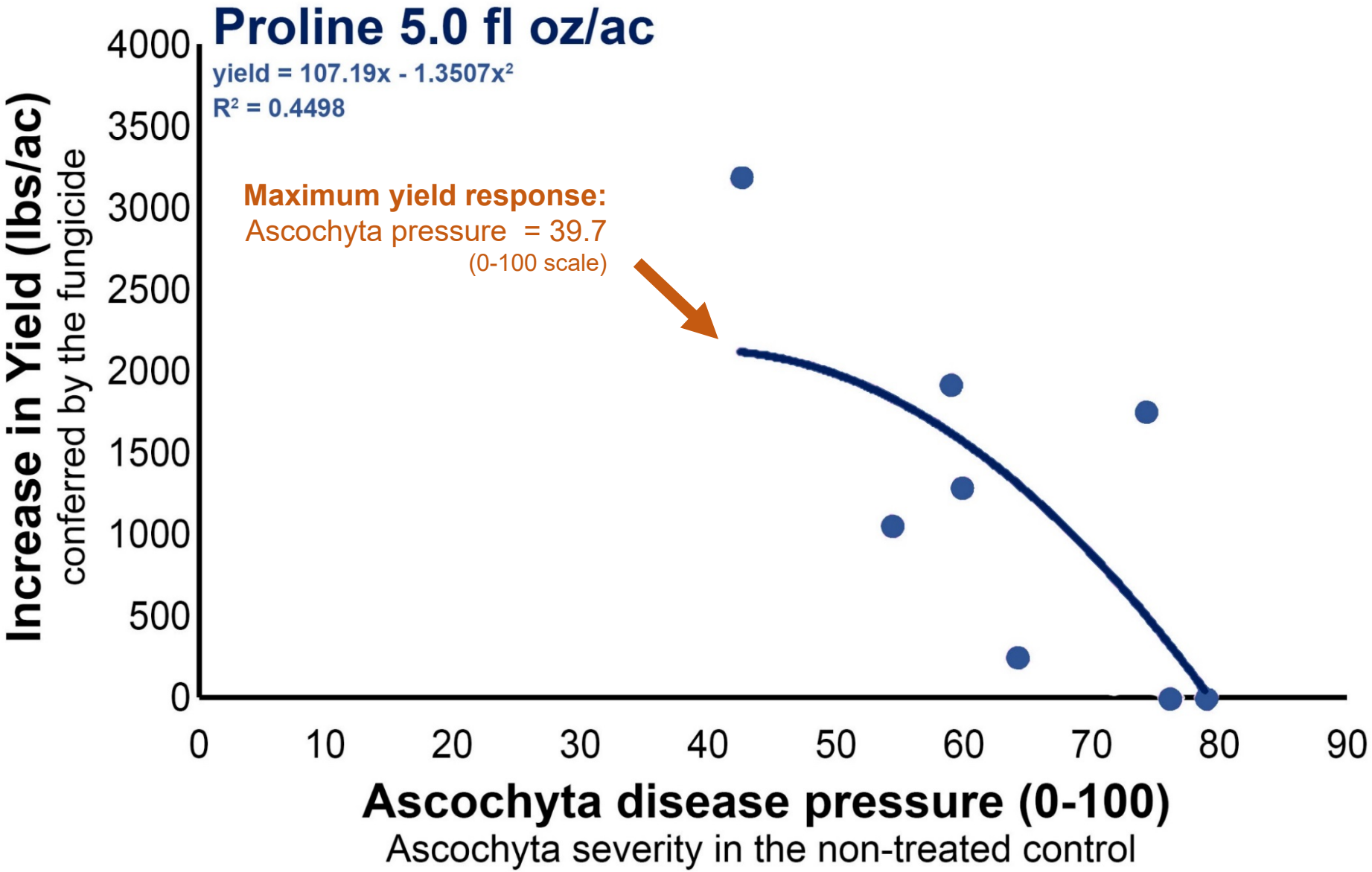
Carrington and Hofflund, ND (2011-2018)



Performance of Proline relative to Ascochyta pressure in chickpeas

'CDC Frontier', 'CDC Alma', 'CDC Orion' and 'Sierra' kabuli chickpeas

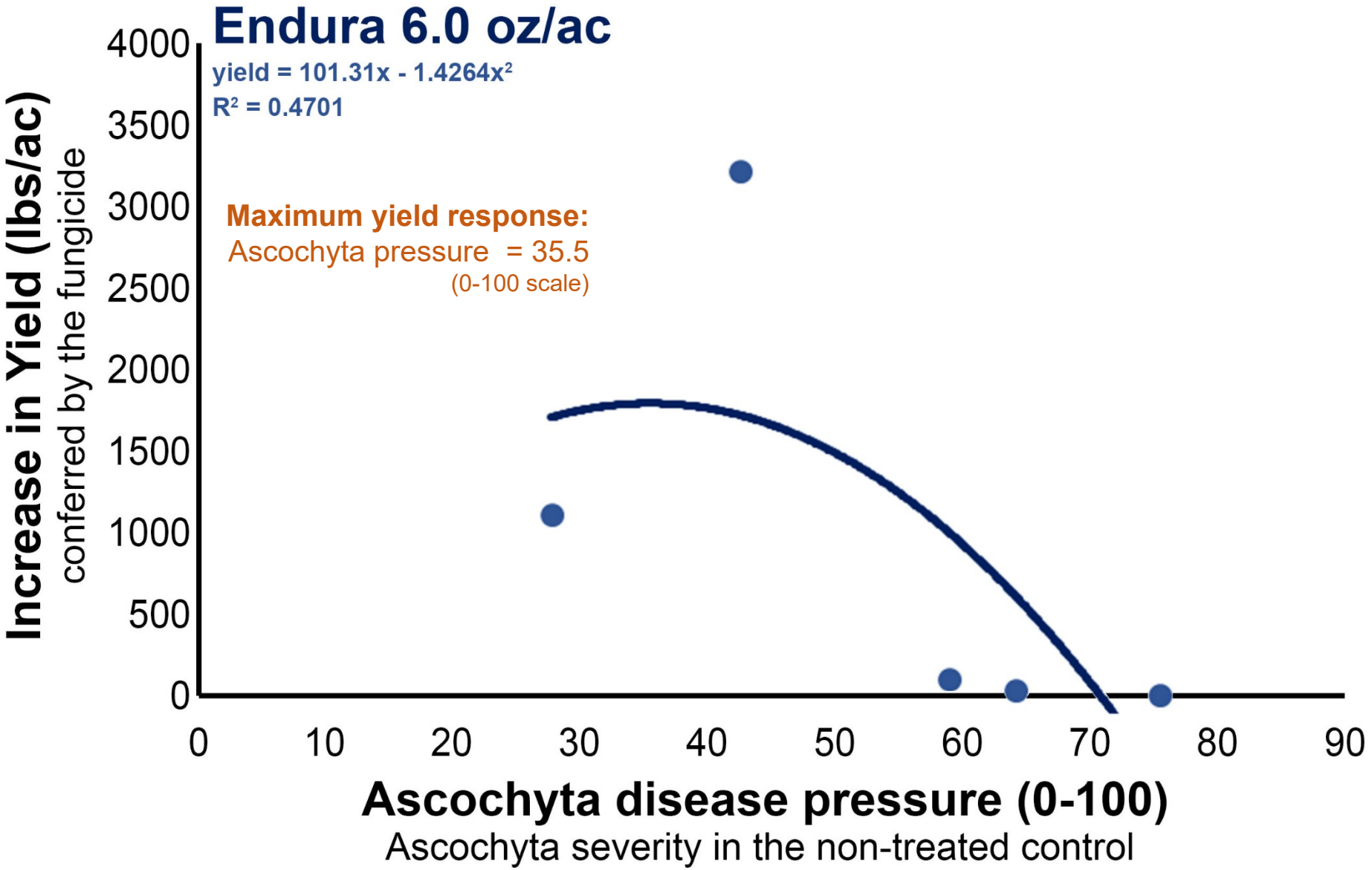
Carrington and Minot, ND (2007-2018)



Performance of Endura relative to Ascochyta pressure in chickpeas

'CDC Frontier', 'CDC Xena', and 'Sierra' kabuli chickpeas

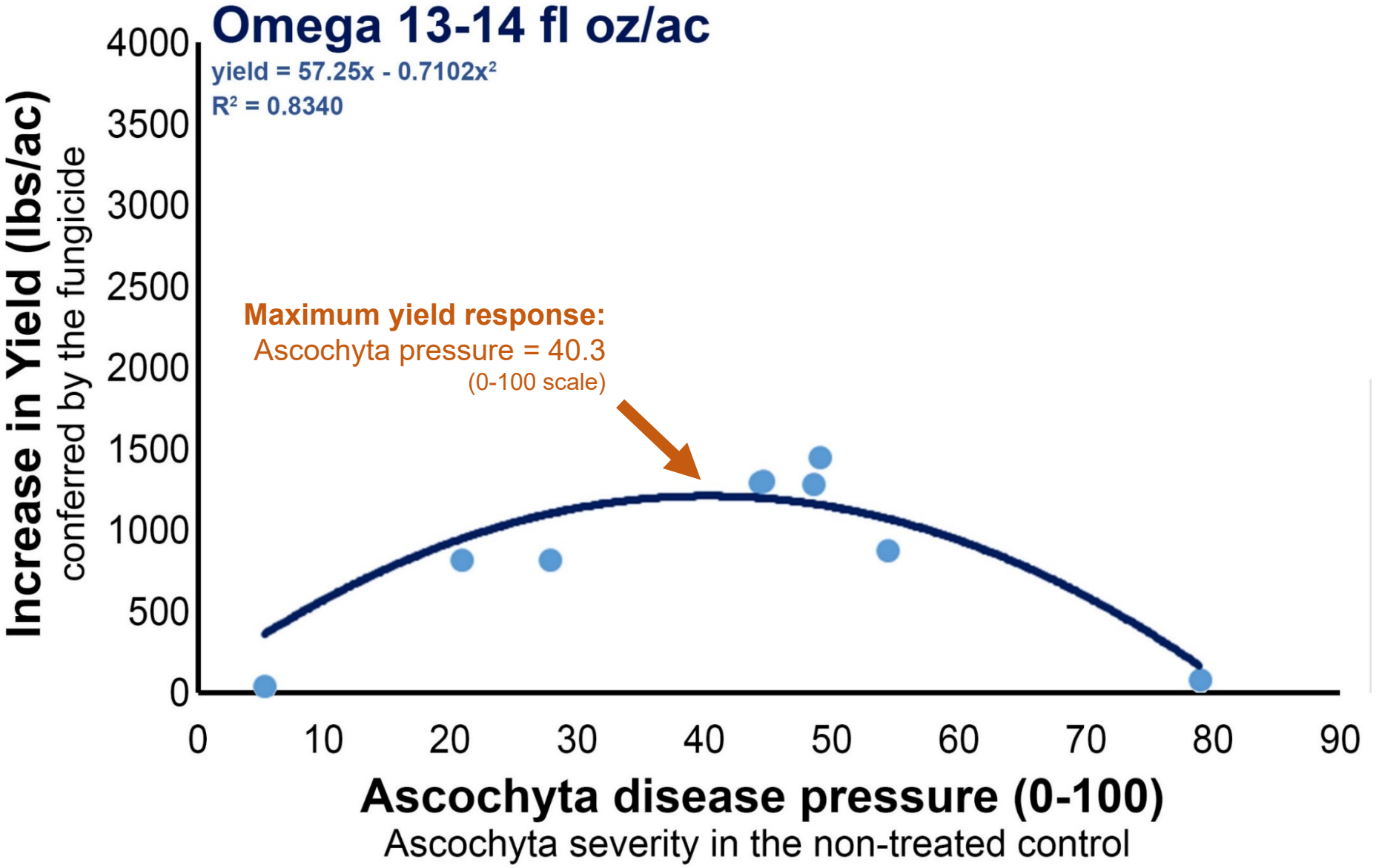
Carrington, Minot and Hofflund, ND (2009-2013)



Performance of Omega relative to Ascochyta pressure in chickpeas

'CDC Frontier', 'CDC Alma', 'CDC Xena' and 'Sierra' kabuli chickpeas

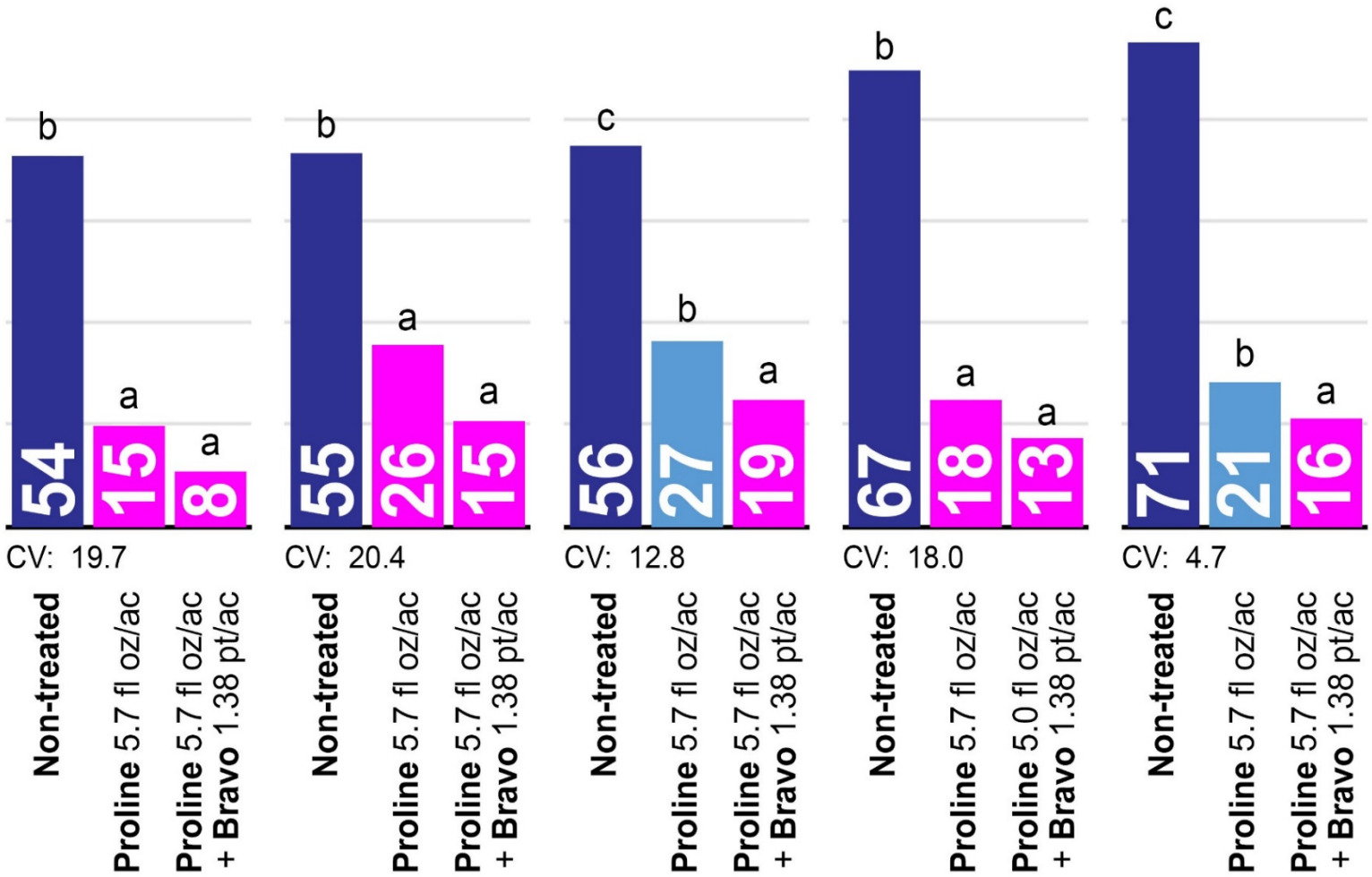
Carrington and Hofflund, ND (2011-2018)



Ascochyta management in chickpeas:
Proline (FRAC 3) vs. Proline + Bravo WS (FRAC 3, M)

Carrington (**2018**) CDC **'Frontier'**	Carrington (**2018**) CDC **'Frontier'**	Carrington (**2018**) CDC **'Frontier'**	Carrington (**2015**) CDC **'Alma'**	Carrington (**2016**) CDC **'Orion'**
Four fung. applications Spray droplets: **medium**	Four fung. applications Spray droplets: **medium**	Five fung. applications Spray droplets: **fine**	Five fung. applications Spray droplets: **fine**	Six fung. applications Spray droplets: **fine**

Ascochyta severity (0-100; bloom through maturity)



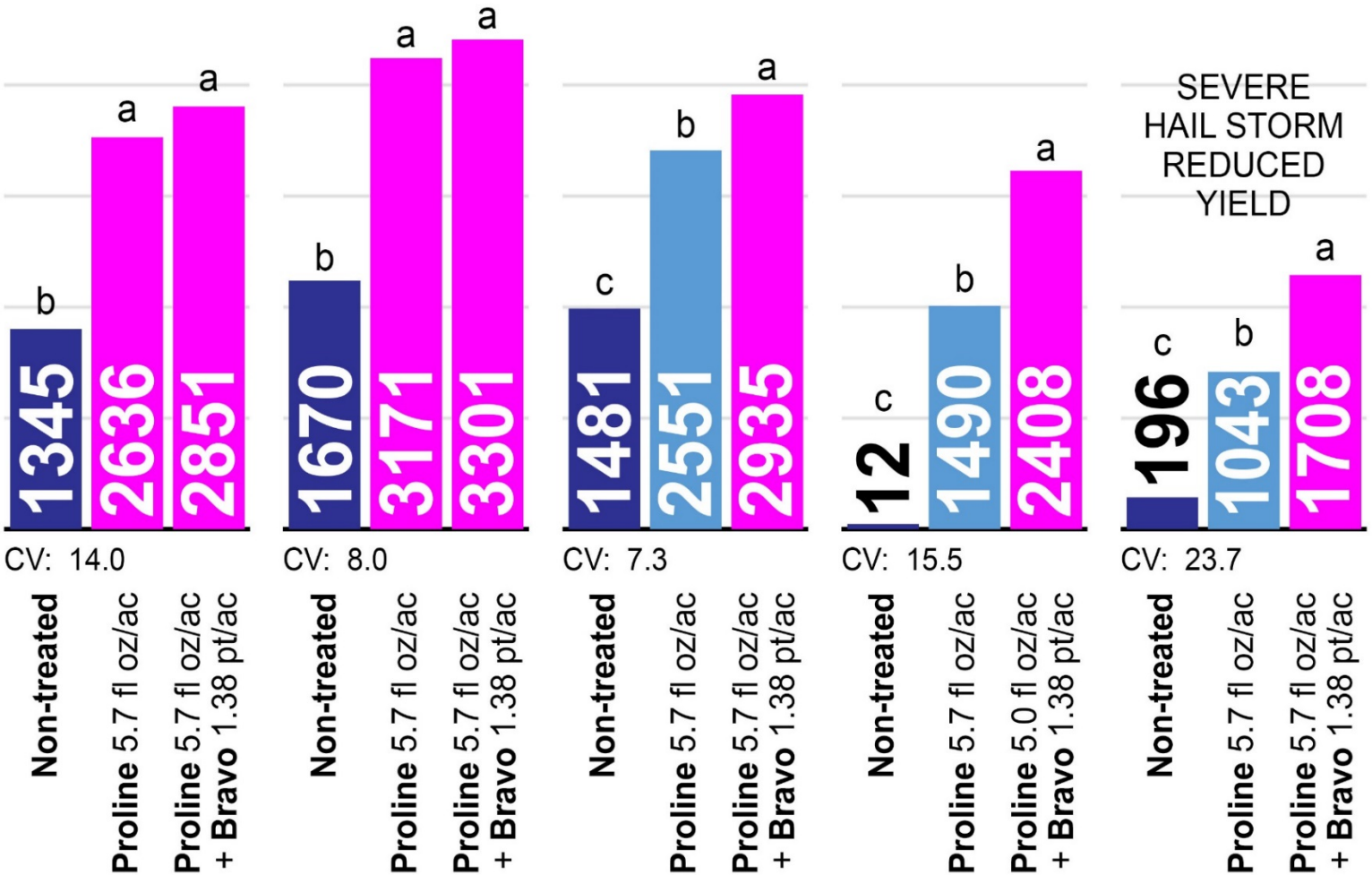
Spray volume

All studies:
15 gal/ac

Ascochyta management in chickpeas:
Proline (FRAC 3) vs. Proline + Bravo WS (FRAC 3, M)

Carrington (**2018**) CDC **'Frontier'**	Carrington (**2018**) CDC **'Frontier'**	Carrington (**2018**) CDC **'Frontier'**	Carrington (**2015**) CDC **'Alma'**	Carrington (**2016**) CDC **'Orion'**
Four fung. applications Spray droplets: **medium**	Four fung. applications Spray droplets: **medium**	Five fung. applications Spray droplets: **fine**	Five fung. applications Spray droplets: **fine**	Six fung. applications Spray droplets: **fine**

Chickpea yield (pounds/acre; 13.5% moisture)



Spray volume

All studies:
15 gal/ac

Ascochyta management in chickpeas:
Proline (FRAC 3) vs. Proline + Bravo WS (FRAC 3, M)

	Ascochyta bloom to late pod-fill 0-100		Yield 13.5% moisture pounds/acre	
Proline 5.7 fl oz/ac + NIS (Preference) 0.125% v/v				
Non-treated control	56	b	1509	b
Droplet size: **Fine** TT110015, 60 psi	27	a	2551	a
Droplet size: **Medium** TT11003, 50 psi	22	a	2570	a
Droplet size: **Very Coarse** TT11003, 40 psi	22	a	2570	a
	CV: 15.8		CV: 11.4	
Proline 5.7 fl oz/ac + **Bravo WS** 1.38 pt/ac + NIS (Preference) 0.125% v/v				
Non-treated control	56	b	1453	b
Droplet size: **Fine** TT110015, 60 psi	19	a	2935	a
Droplet size: **Medium** TT11003, 50 psi	21	a	2864	a
Droplet size: **Very Coarse** TT11003, 40 psi	23	a	2782	a
	CV: 10.4		CV: 8.6	

Driving speed: 3.6 mph **Spray volume:** 15 gal/ac
Calibrated pulse widths: TT110015 = 100%; TT11003 = 42%; TT11006 = 24%

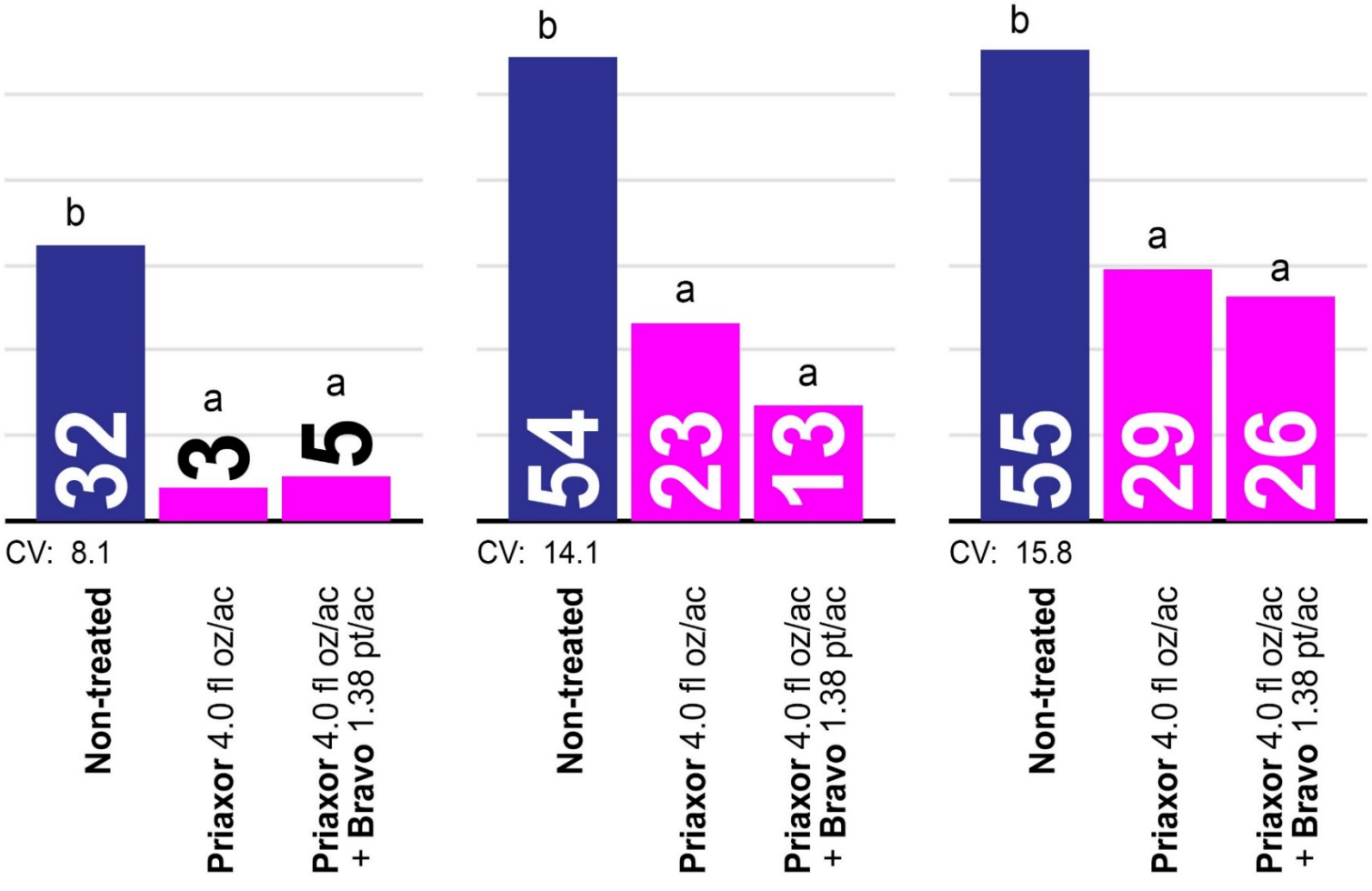
Ascochyta management in chickpeas:
Priaxor (FRAC 7,11) vs. Priaxor + Bravo WS (FRAC 7, 11, M)

Carrington (**2017**)
CDC **'Frontier'**
Five fung. applications
Spray droplet size: **medium**

Carrington (**2018**)
CDC **'Frontier'**
Four fung. applications
Spray droplet size: **medium**

Carrington (**2018**)
CDC **'Frontier'**
Four fung. applications
Spray droplet size: **medium**

Ascochyta severity (0-100; bloom through maturity)



Spray volume

All studies:
15 gal/ac

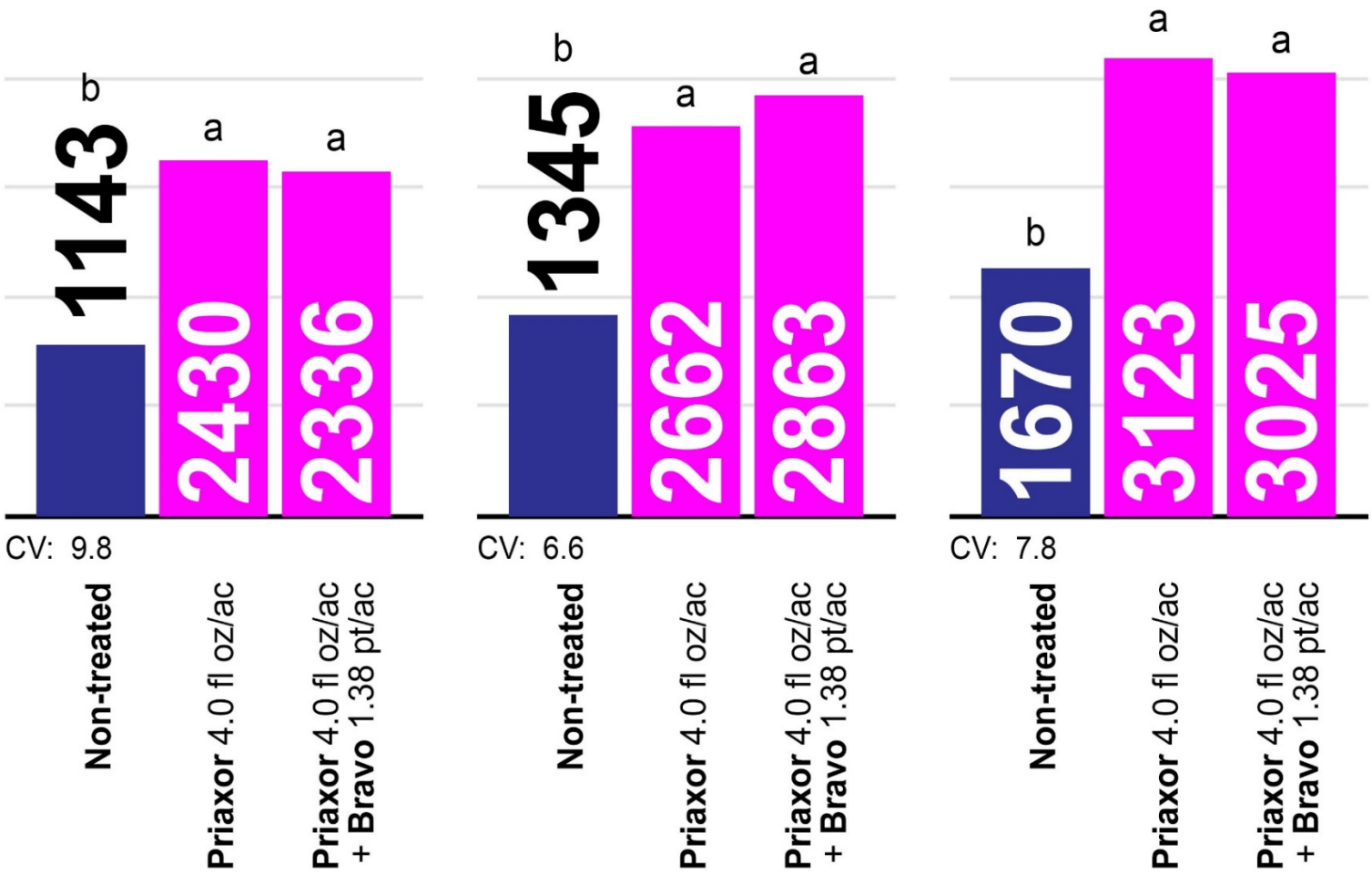
Ascochyta management in chickpeas:
Priaxor (FRAC 7,11) vs. Priaxor + Bravo WS (FRAC 7, 11, M)

Carrington (**2017**)
CDC **'Frontier'**
Five fung. applications
Spray droplet size: **medium**

Carrington (**2018**)
CDC **'Frontier'**
Four fung. applications
Spray droplet size: **medium**

Carrington (**2018**)
CDC **'Frontier'**
Four fung. applications
Spray droplet size: **medium**

Chickpea yield (**pounds/acre;** 13.5% moisture)



Spray volume

All studies:
15 gal/ac

Managing QoI-resistant Ascochyta in field peas

Pathogen: *Ascochyta pinodes*

TIMELINE:

2010:	laboratory confirmation of QoI resistance - Canada
2016:	loss of efficacy in Carrington field trials
2017:	first report of a loss of efficacy, commercial production – North Dakota
2018:	laboratory confirmation of QoI resistance – North Dakota

Ascochyta blight of field peas: QoI resistance

FUNGICIDE EFFICACY, 2010-2018:

Headline
(FRAC 11)

6.0 fl oz/ac

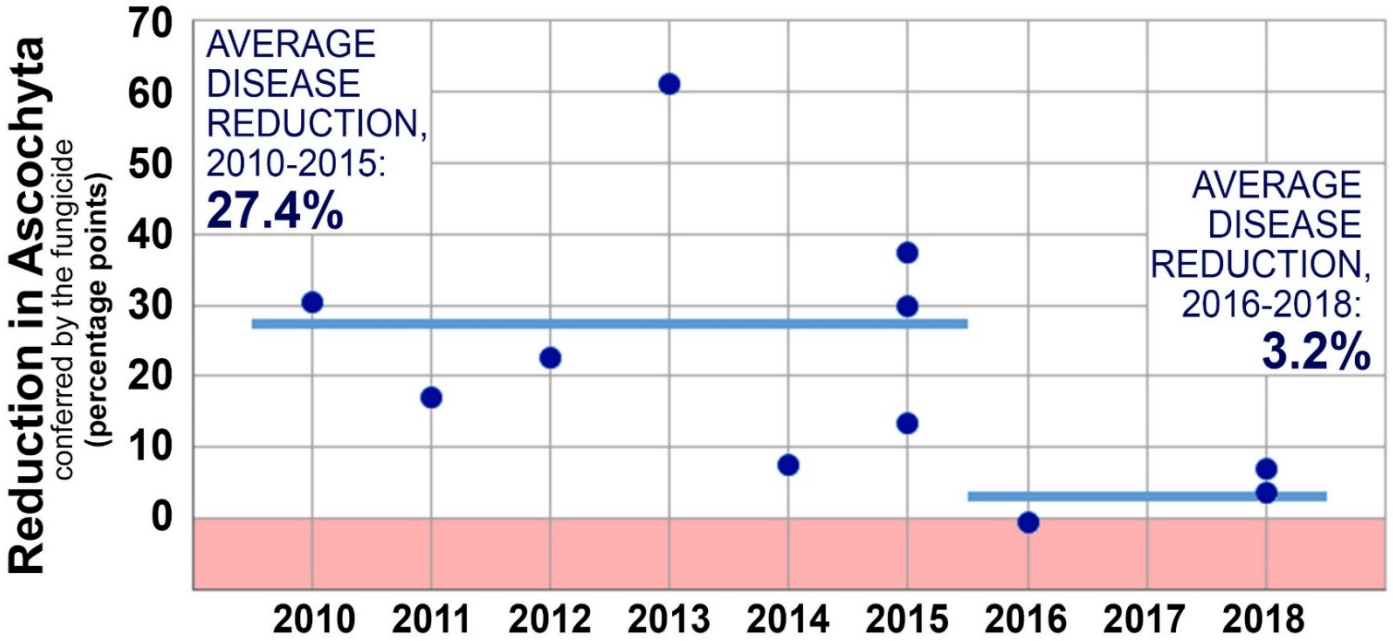
Spray volume

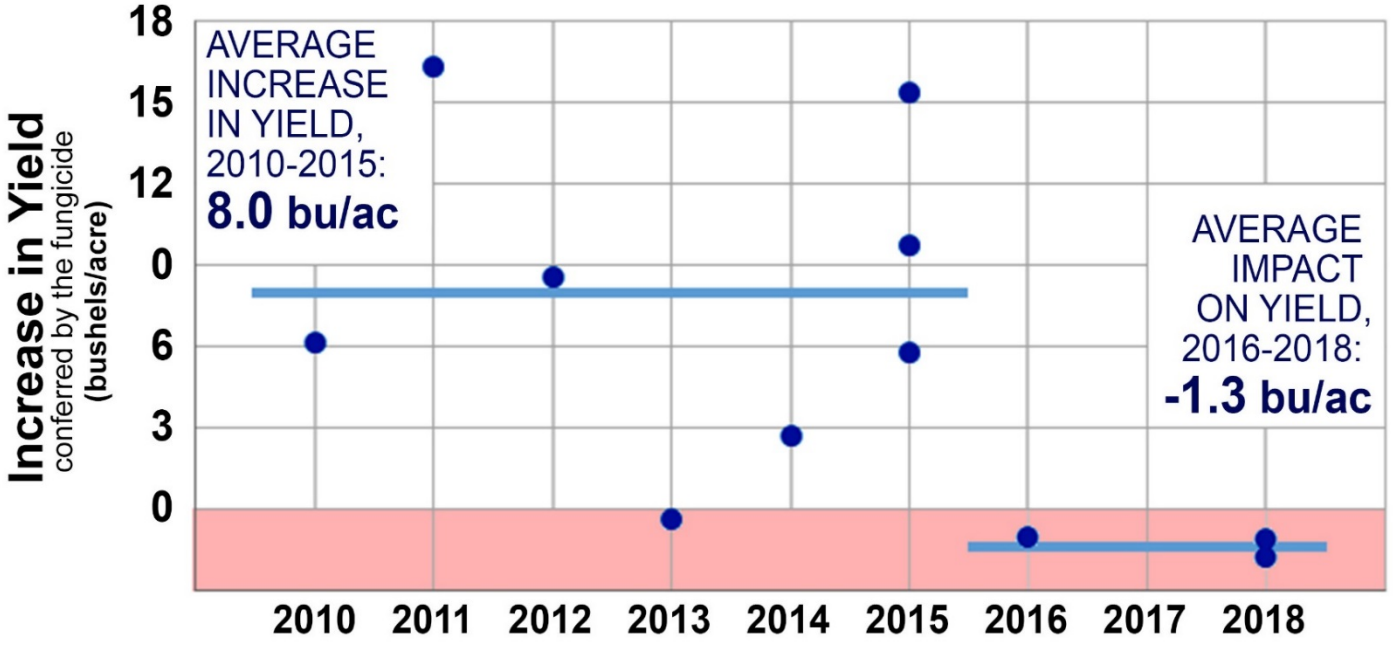
2010:
17 gal/ac

2011-2013:
17.5 gal/ac

2014-2018:
15 gal/ac

Study locations:
2011-2018:
Carrington, ND
2010:
Newburg, ND





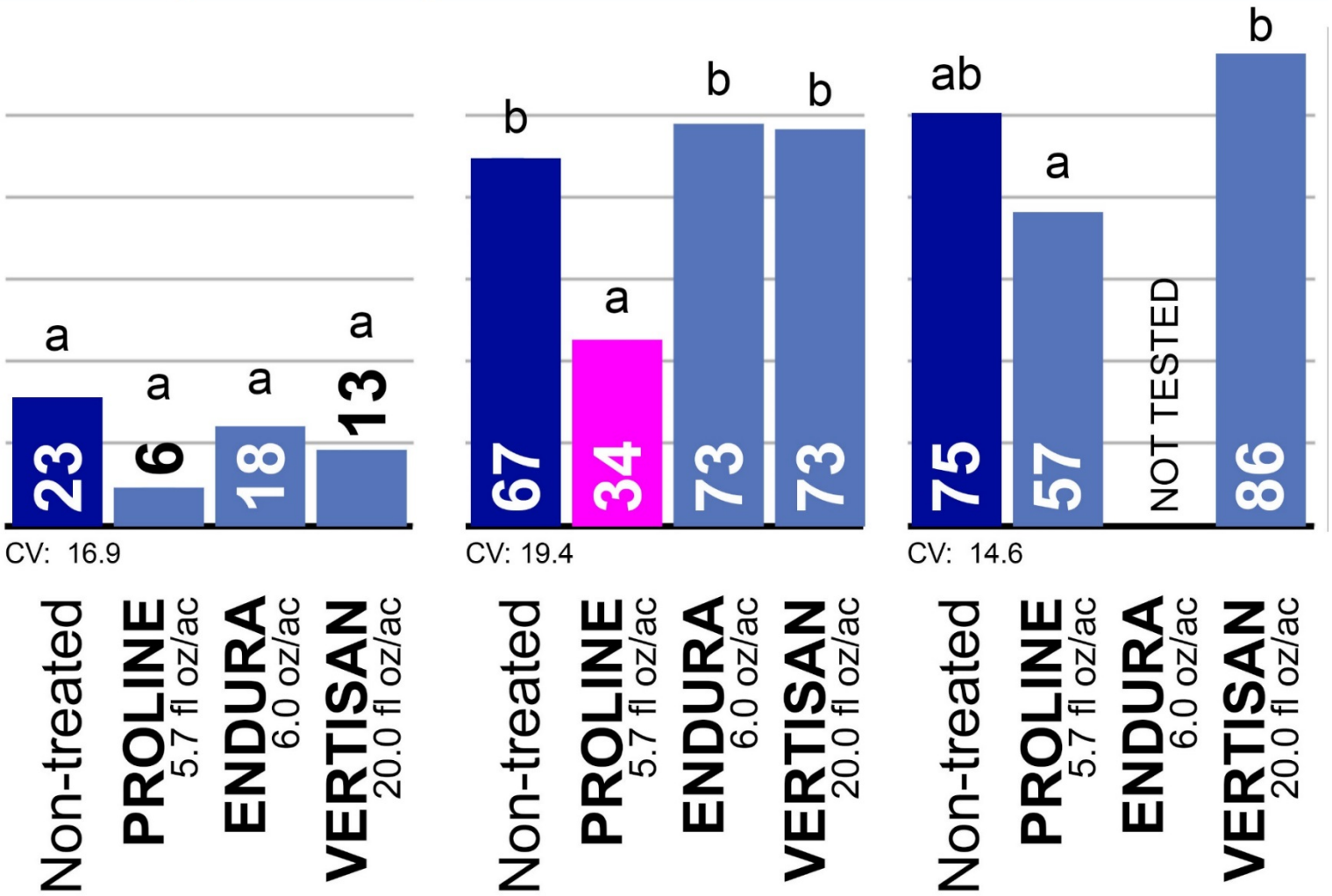
Ascochyta management in field peas:
Proline (FRAC 3) vs. Endura, Vertisan (FRAC 7)

Carrington **(2011)**
'DS Admiral'

Carrington **(2012)**
'DS Admiral'

Carrington **(2018)**
'DS Admiral'

Ascochyta severity (**percent;** late pod-fill)



Spray volume

2011-2012:
17.5 gal/ac

2018:
15 gal/ac

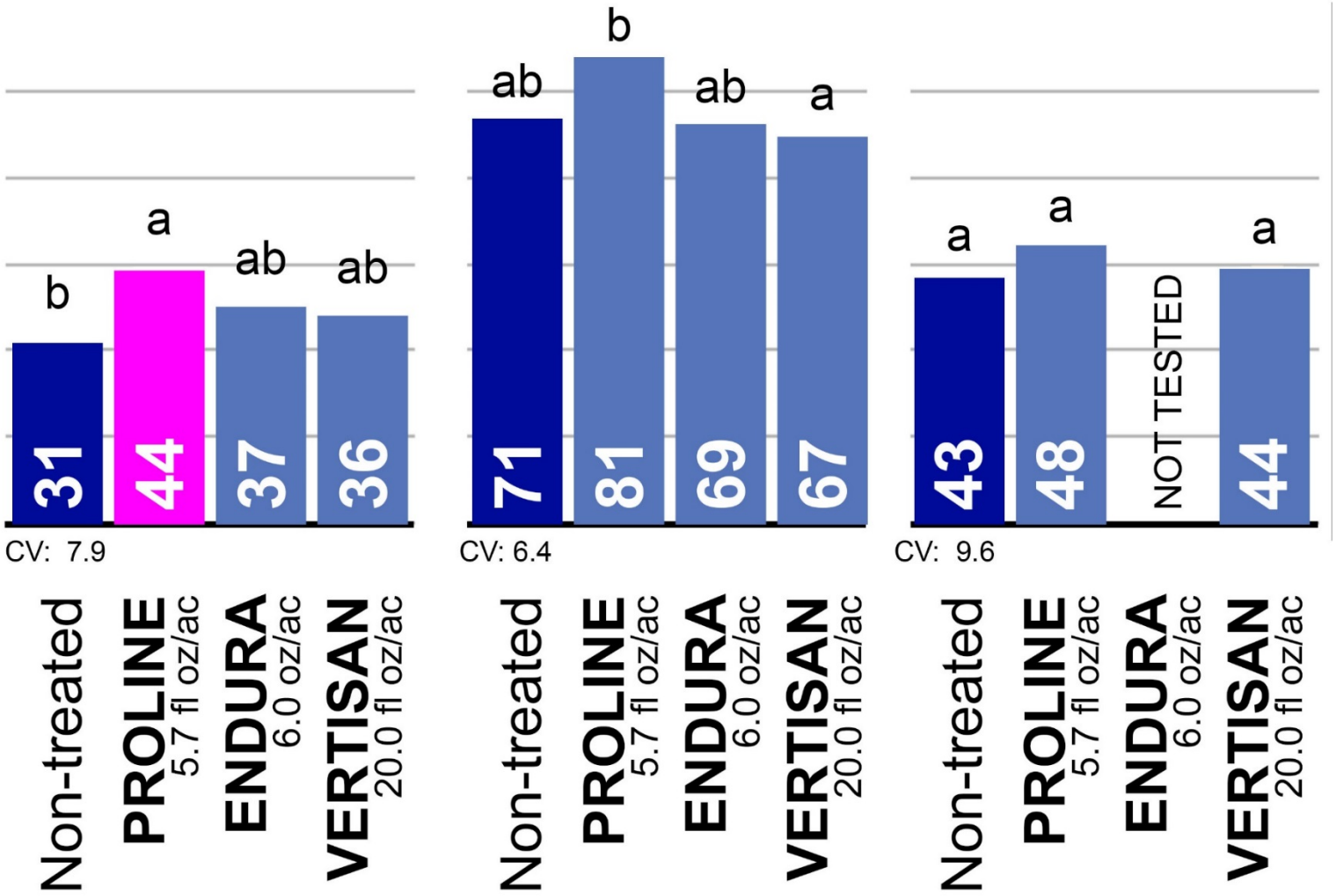
Ascochyta management in field peas:
Proline (FRAC 3) vs. Endura, Vertisan (FRAC 7)

Carrington **(2011)**
'DS Admiral'

Carrington **(2012)**
'DS Admiral'

Carrington **(2018)**
'DS Admiral'

Field pea yield (**bushels/acre;** 13.5% moisture)



Spray volume

2011-2012:
17.5 gal/ac

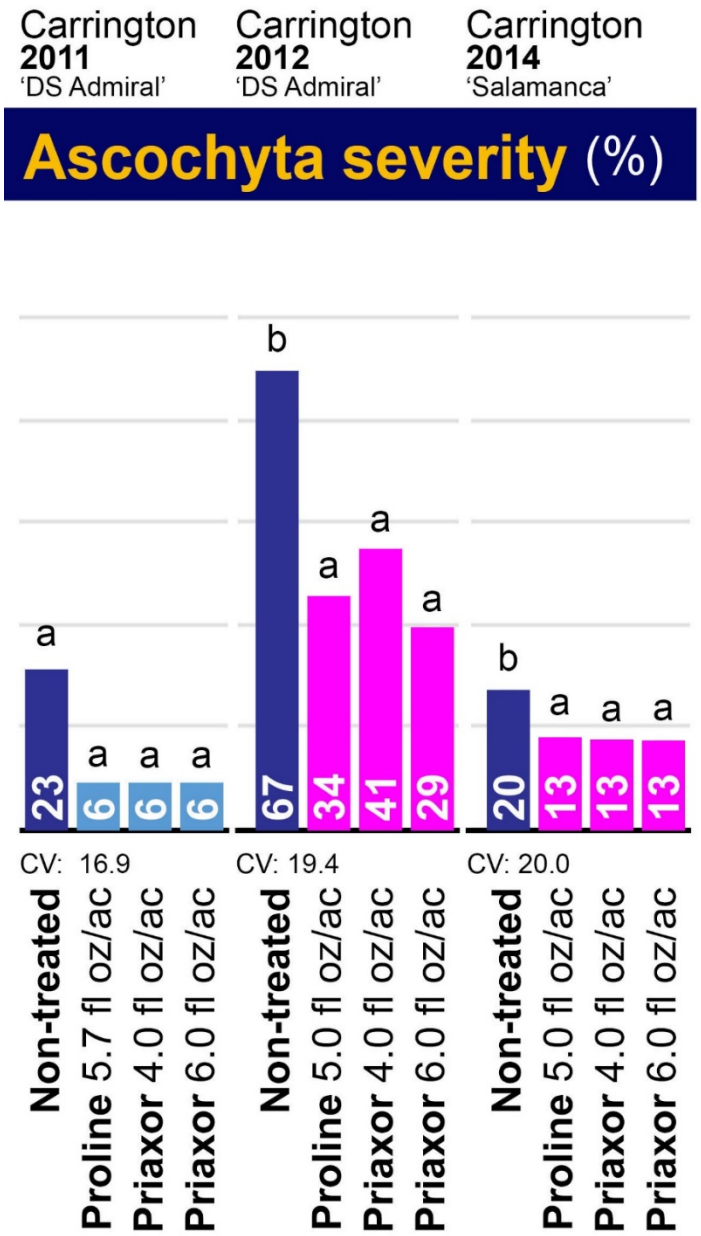
2018:
15 gal/ac

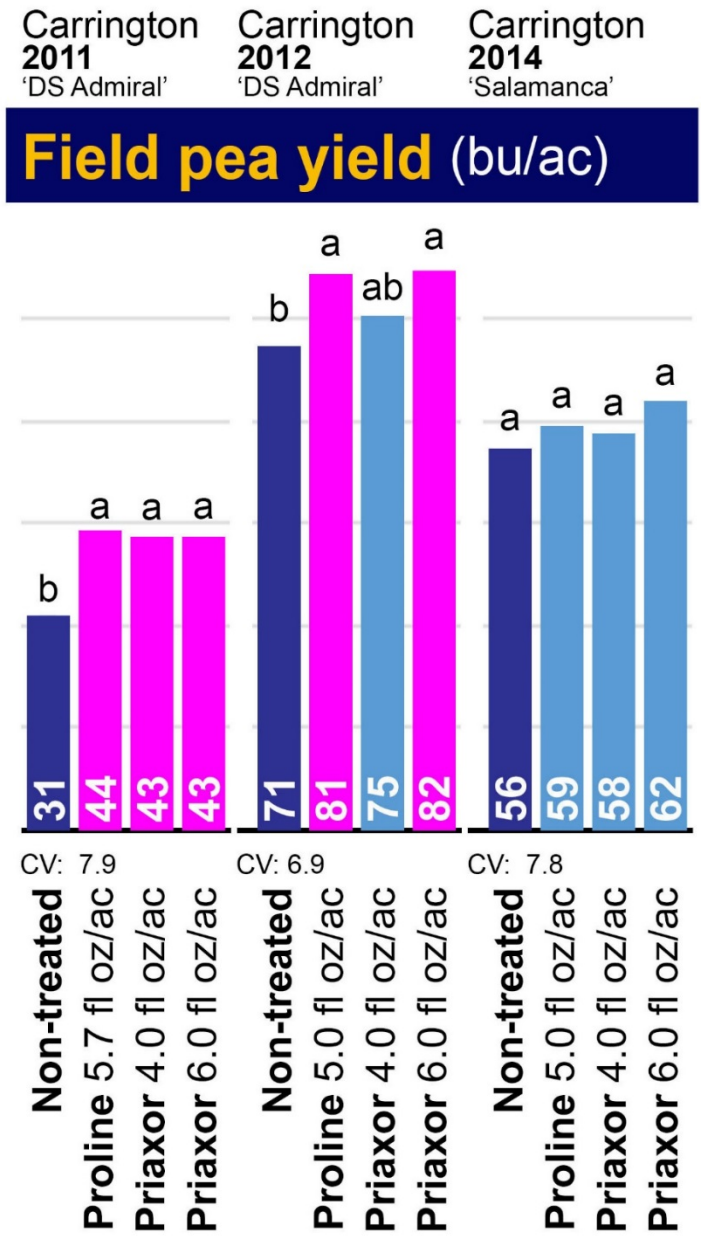
Ascochyta management in field peas:
Proline (FRAC 3) vs. Priaxor (FRAC 7,11) - **prior to QoI resistance**

Spray volume

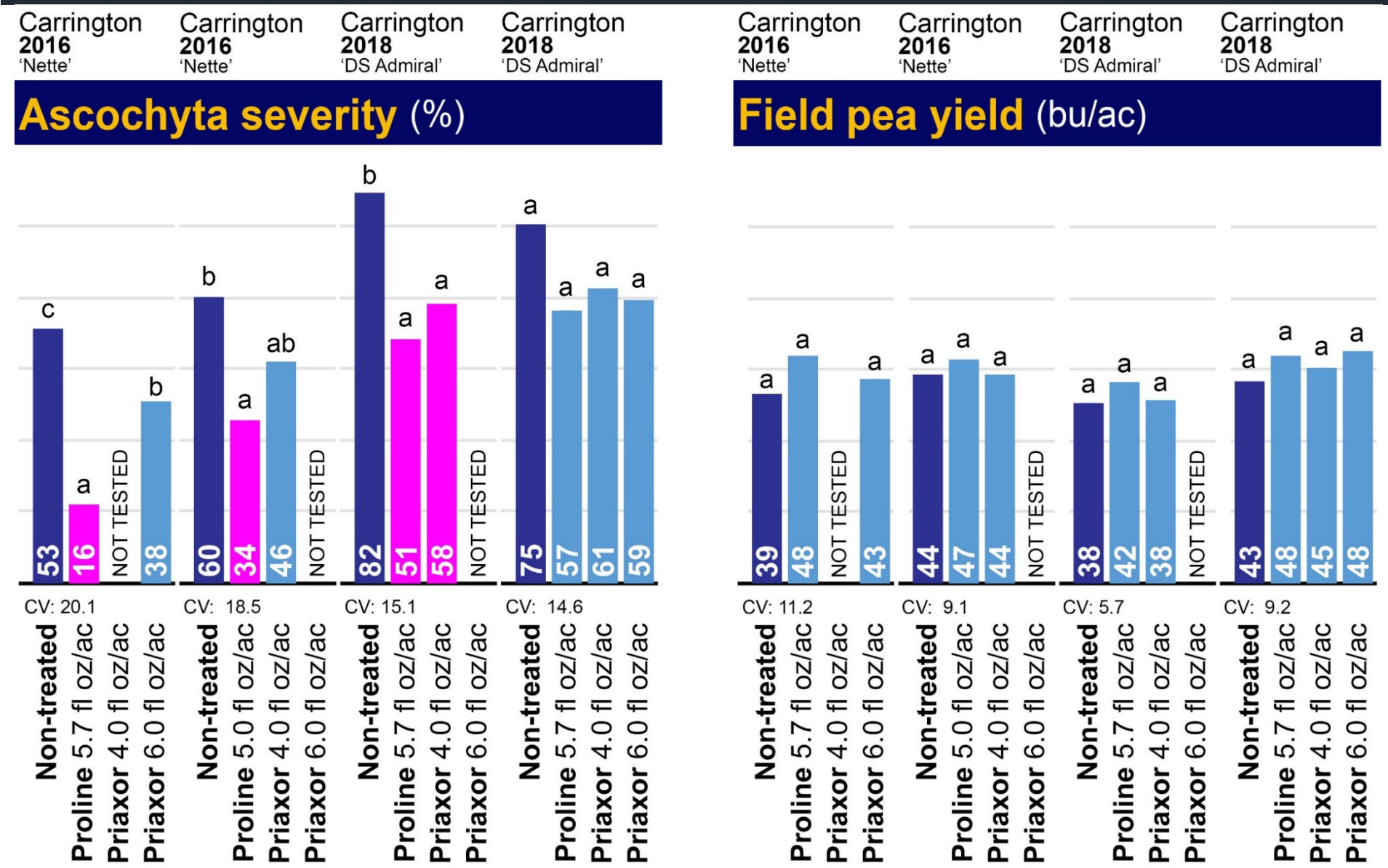
2011-2012:
17.5 gal/ac

2014:
15 gal/ac





Ascochyta management in field peas:
Proline (FRAC 3) vs. Priaxor (FRAC 7,11) – after QoI resistance



Spray volume - All studies: 15 gal/ac

Ascochyta management in field peas:
Proline (FRAC 3) vs. Miravis TOP (FRAC 7, 3)

	Carrington **(2015)** 'Viper'		Carrington **(2018)** 'DS Admiral'	
Ascochyta (% of canopy)				
Non-treated control	68	a	75	a
Proline 5.7 fl oz/ac	Not tested		57	a
Miravis TOP 13.7 fl oz/ac	47	a	48	a
	CV: 21.1		CV: 14.6	
Yield (bushels/acre)				
Non-treated control	54	b	43	a
Proline 5.7 fl oz/ac	Not tested		48	a
Miravis TOP 13.7 fl oz/ac	63	a	46	a
	CV: 4.3		CV: 9.2	

Spray volume

Both studies:
15 gal/ac

Improving the management of Fusarium and Aphanomyces root rots in field peas

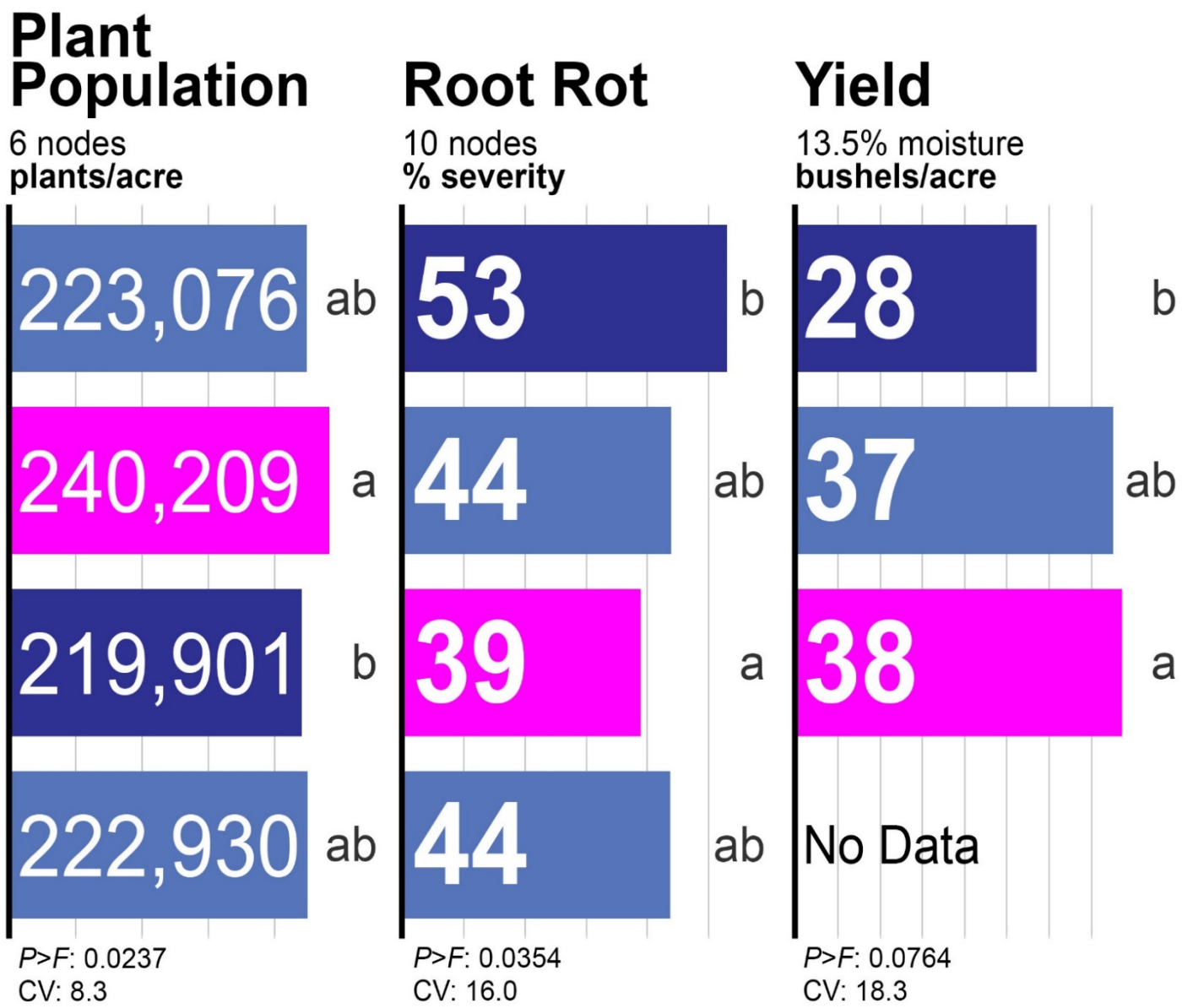
Collaborative research:

John Rickertsen, NDSU Hettinger Research Extension Center
Audrey Kalil, NDSU Williston Research Extension Center
Julie Pasche, NDSU Department of Plant Pathology
Michael Wunsch, NDSU Carrington Research Extension Center

Fusarium & Aphanomyces root rots of field peas: Impact of crop rotation

Carrington, ND
2018

Field with a history of severe field pea root rot



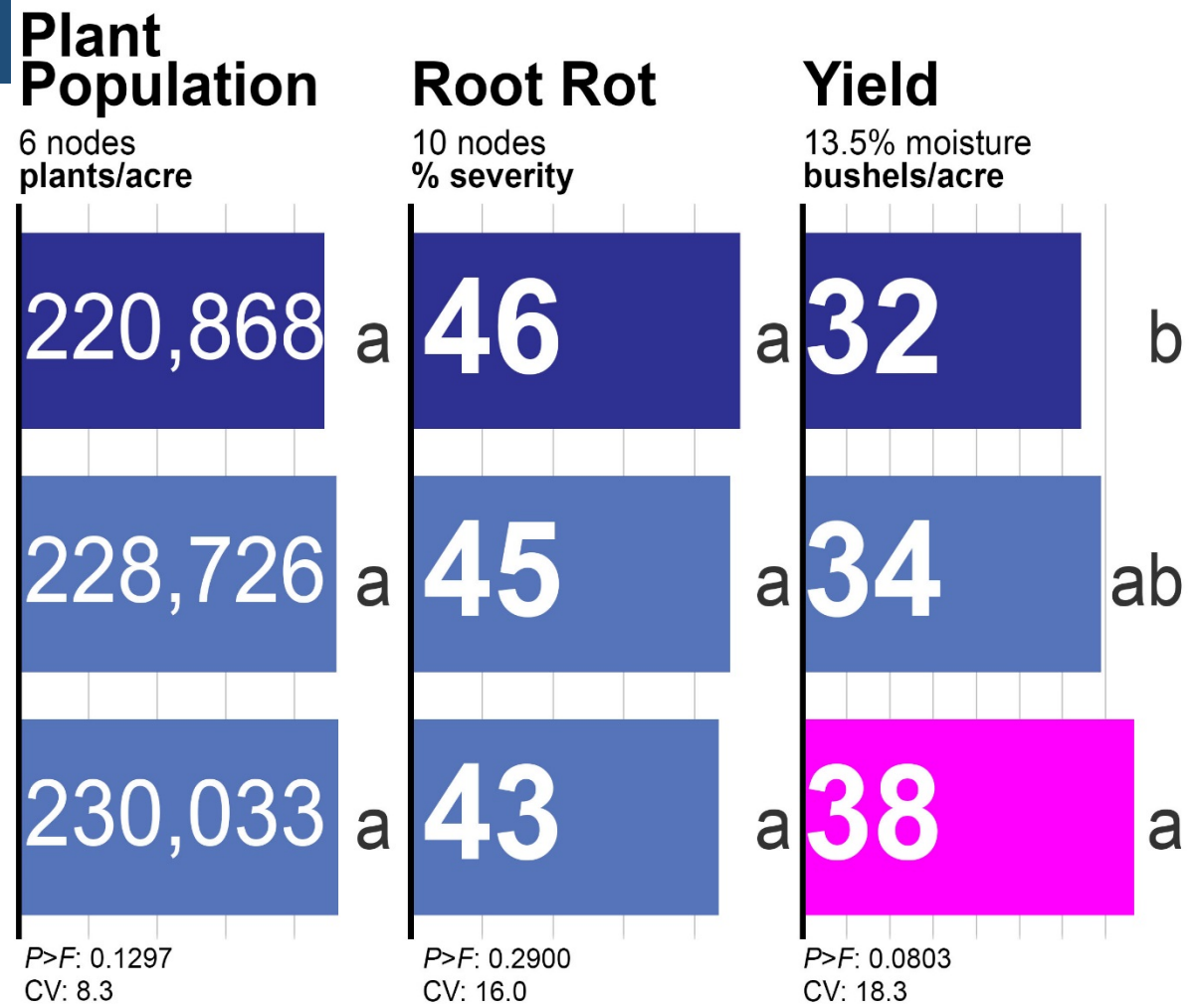
Variety: 'Salamanca' (yellow-cotyledon type) **Seeding rate:** 300,000 pure live seeds/acre

Within-column means followed by different letters are significantly different: $P < 0.05$ (plant population, root rot), $P < 0.10$ (yield), Tukey multiple comparison procedure.

Fusarium & Aphanomyces root rots of field peas:
Impact of fungicide seed treatment across crop rotation treatments

Carrington, ND
2018

Field with a history of severe field pea root rot



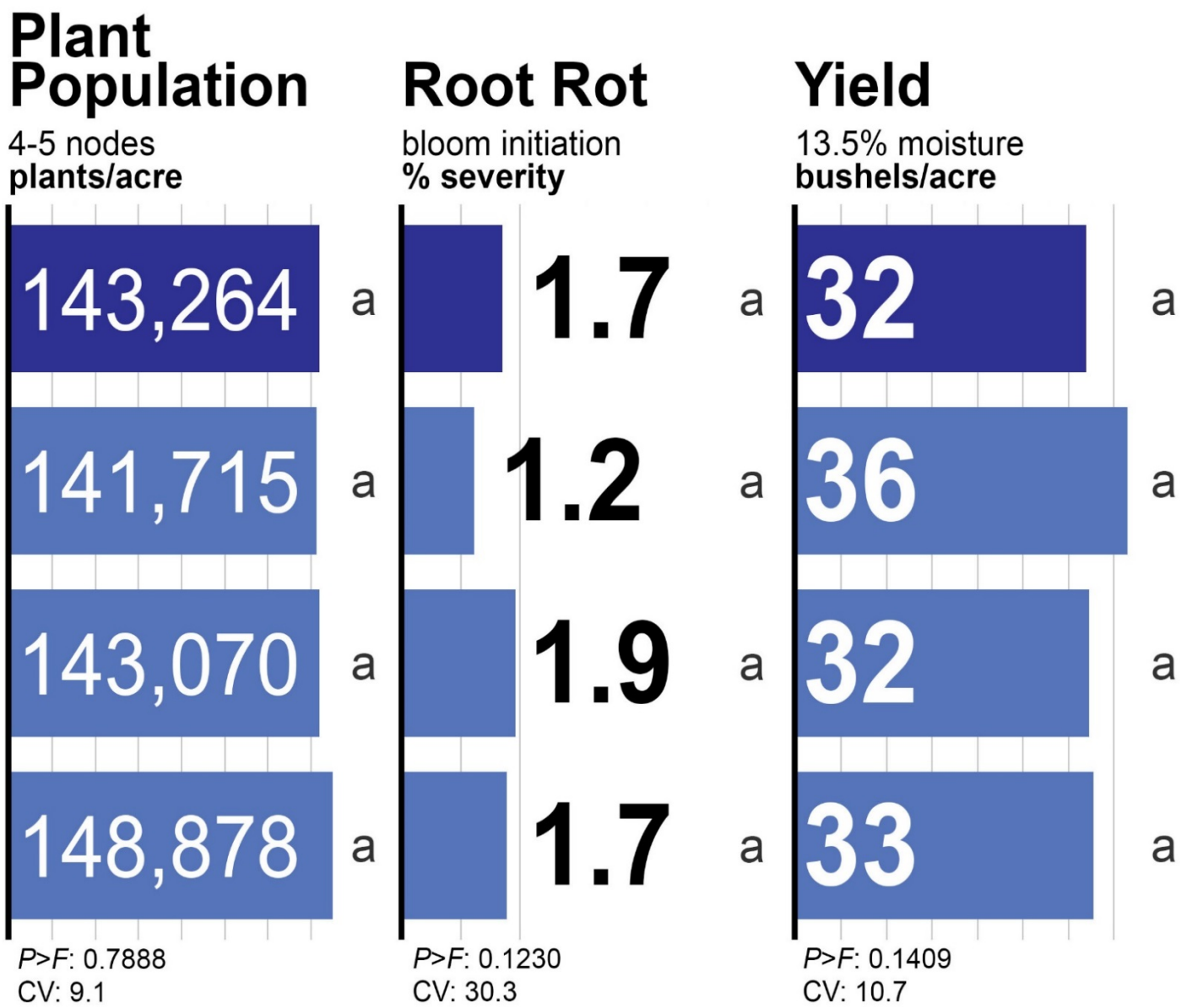
Variety: 'DS Admiral' (yellow-cotyledon type) **Seeding rate:** 300,000 pure live seeds/acre

Within-column means followed by different letters are significantly different ($P < 0.10$; Tukey multiple comparison procedure)

Fusarium & Aphanomyces root rots of field peas: Impact of crop rotation

Hettinger, ND
2018

Field with no previous field pea production



Variety: 'Bridger' (yellow-cotyledon type) **Seeding rate:** 300,000 pure live seeds/acre

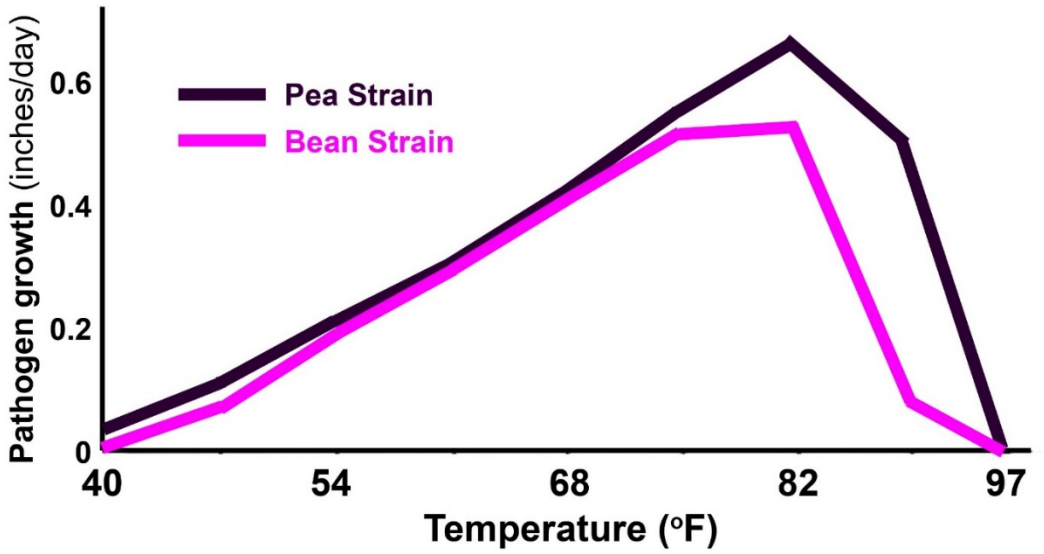
Within-column means followed by different letters are significantly different: $P < 0.05$, Tukey multiple comparison procedure.

Aphanomyces root rot of field peas:
Biology

Causal pathogen: *Aphanomyces euteiches*
(an oomycete; "water mold")

Conditions that favor infection:

- Soil moisture: high
- Soil temperature: high

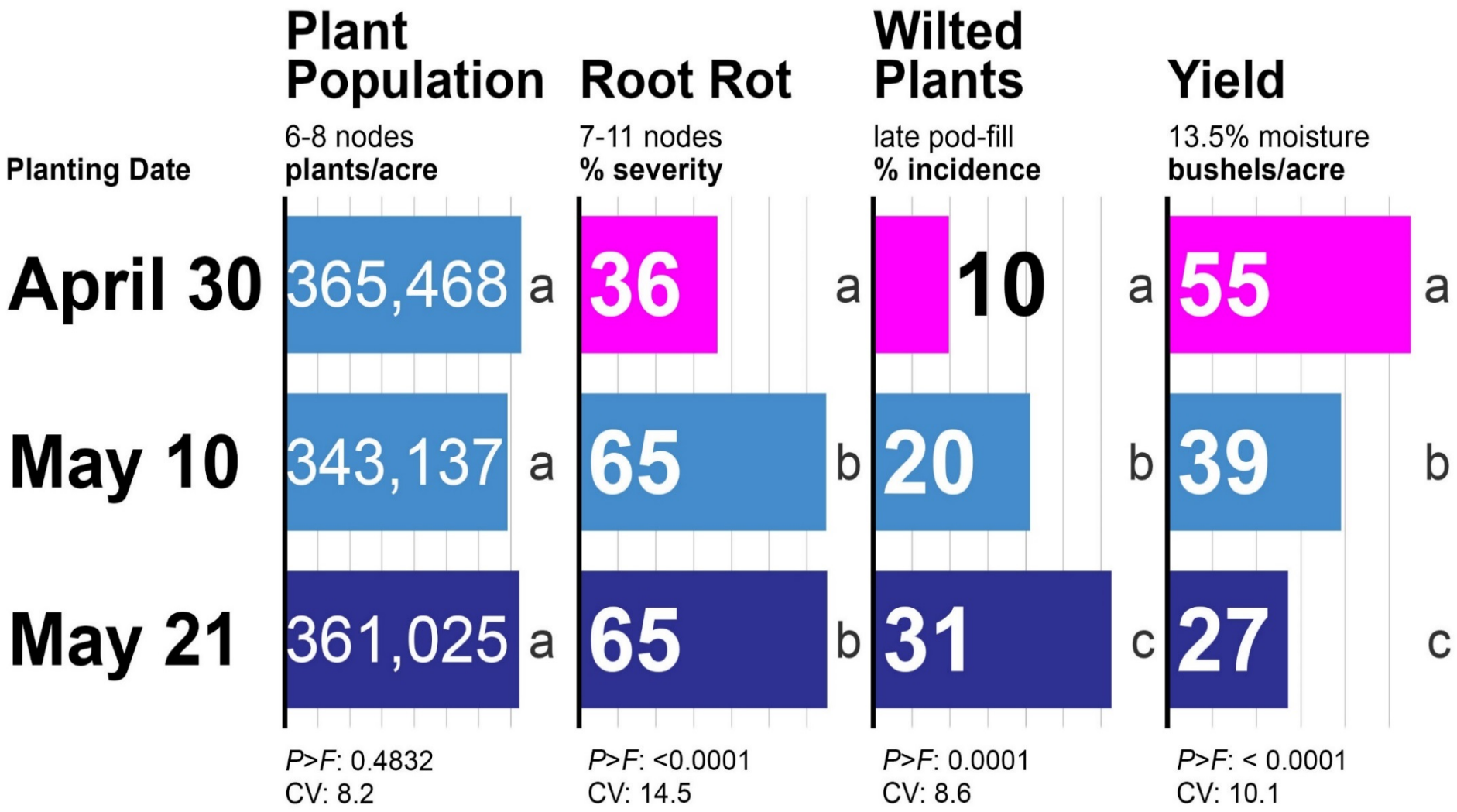


Pfender and Hagedorn 1982
Phytopathology 72:306-310

Aphanomyces root rot of field peas: Impact of planting date

No-till production – Carrington, ND

2018 Field with history of severe field pea root rot (Aphanomyces & Fusarium, Aphanomyces predominant)

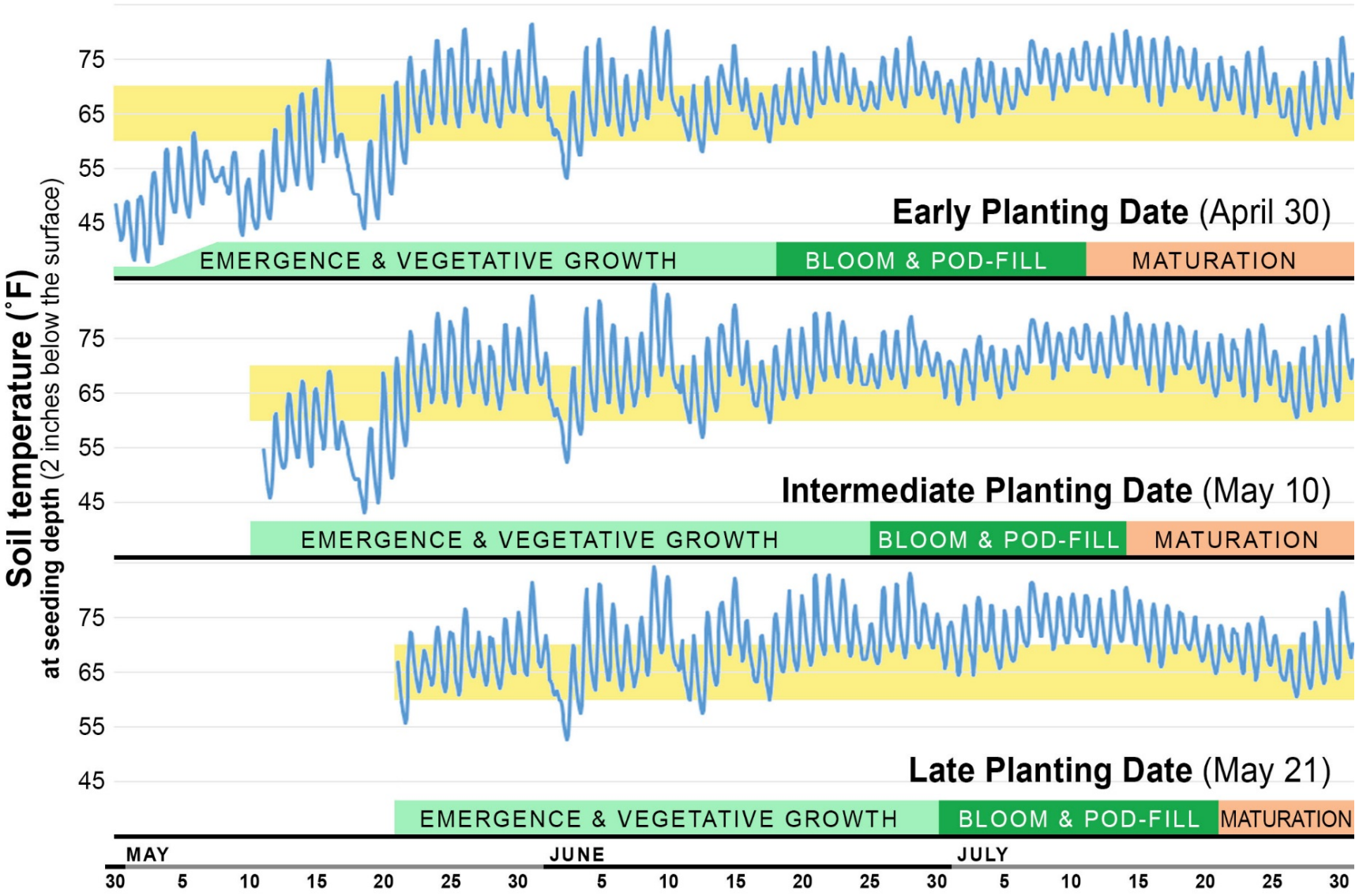


Variety: 'DS Admiral' (yellow-cotyledon type) **Seeding rate:** 385,000 pure live seeds/acre

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

Aphanomyces root rot of field peas: Planting date studies (2018)
Impact of soil temperature on root rot severity

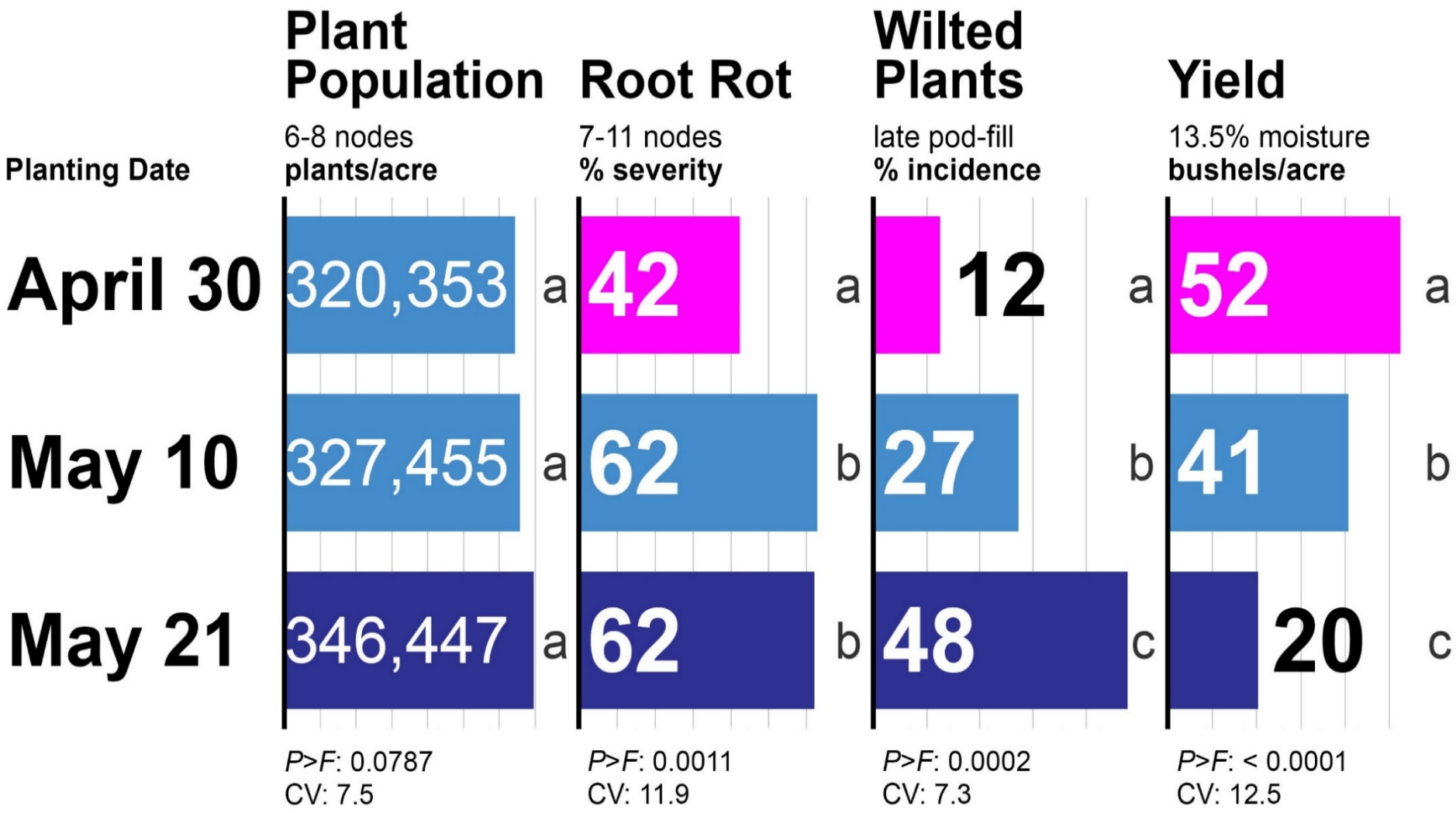
2018 Field with history of severe field pea root rot (Aphanomyces & Fusarium, Aphanomyces predominant) Carrington, ND. Data from study conducted under no-till production.



Aphanomyces root rot of field peas: Impact of planting date

Conventional tillage – Carrington, ND

2018 Field with history of severe field pea root rot (Aphanomyces & Fusarium, Aphanomyces predominant)

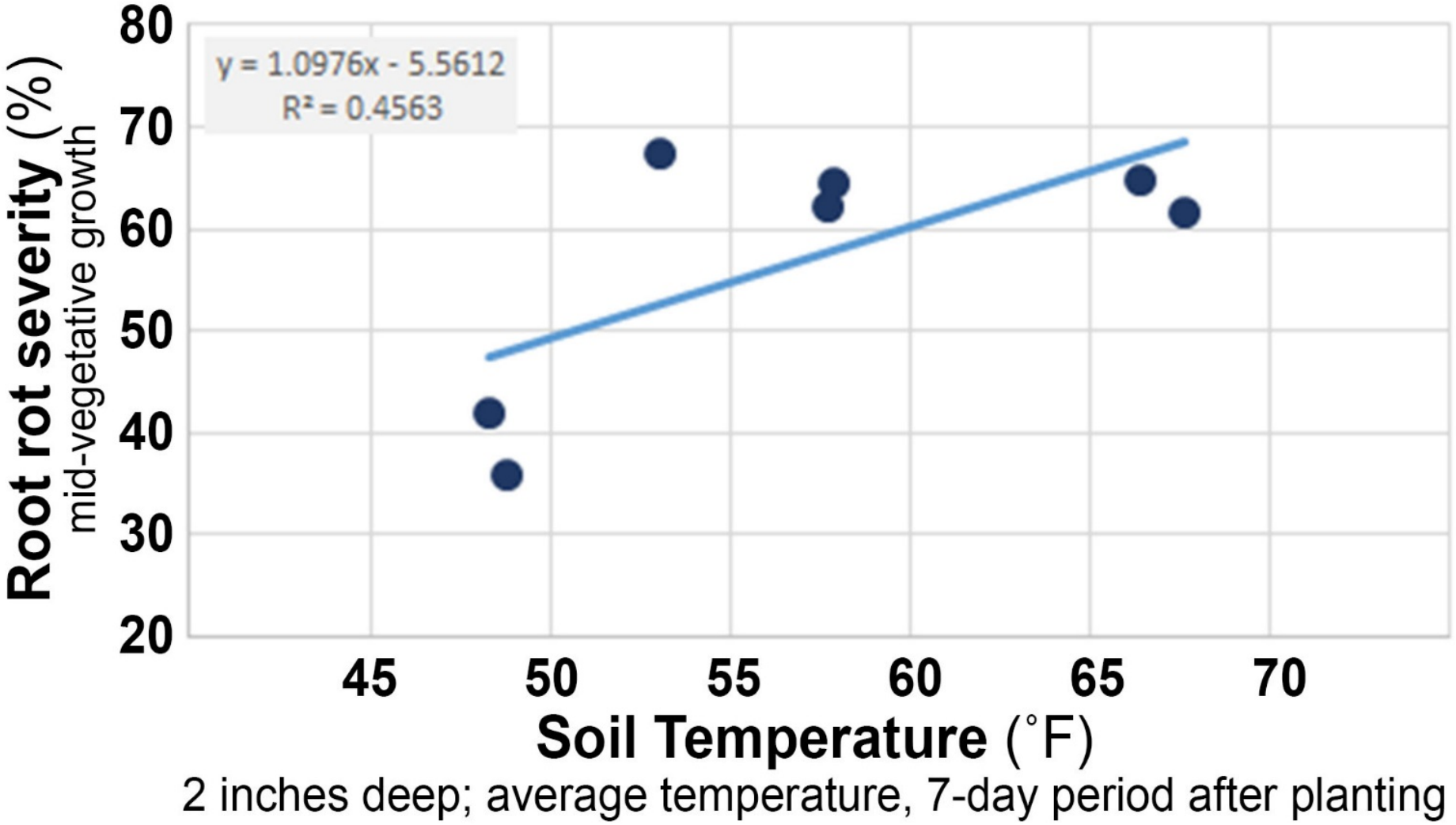


Variety: 'DS Admiral' (yellow-cotyledon type) **Seeding rate:** 385,000 pure live seeds/acre

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

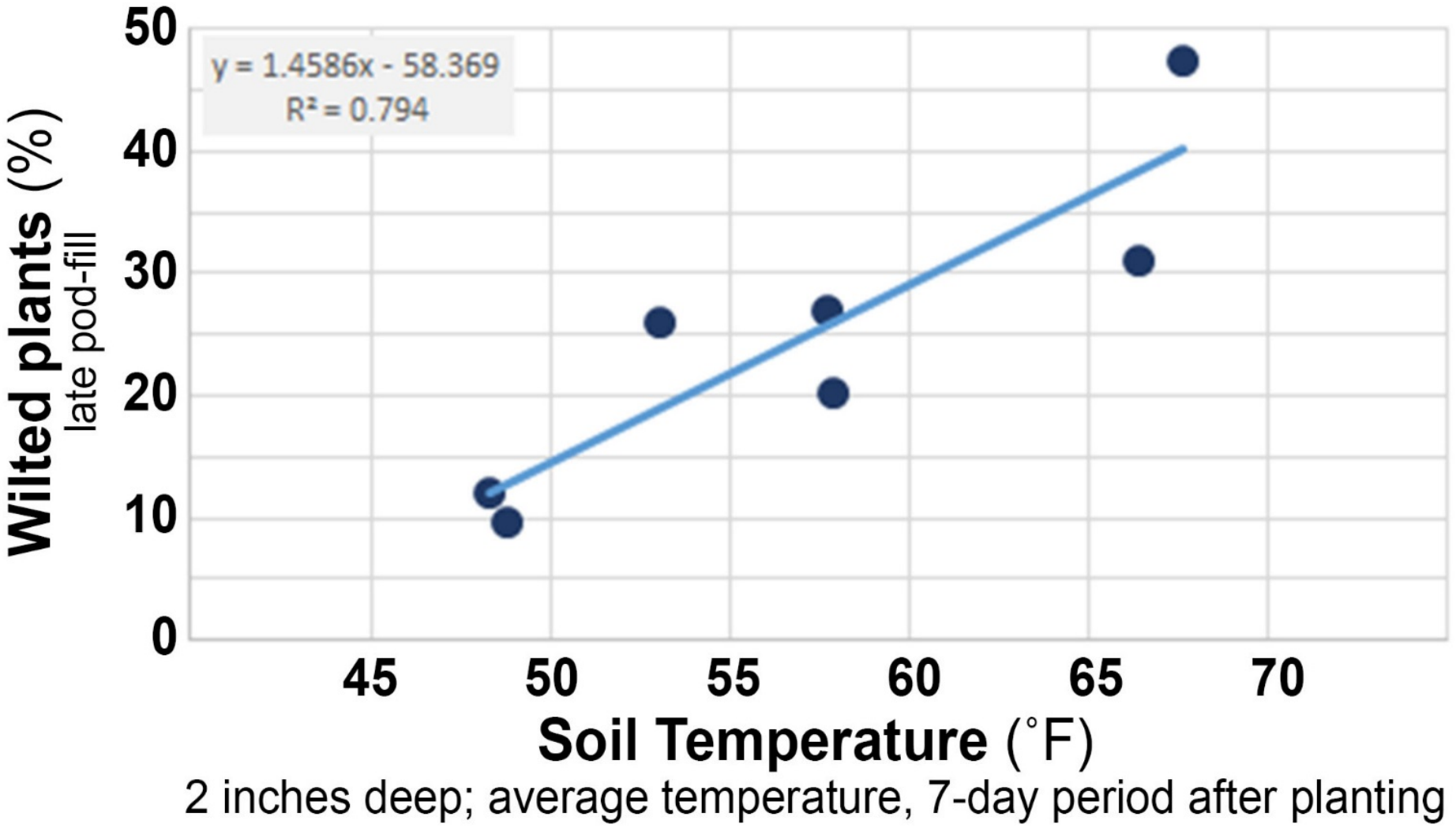
Aphanomyces root rot of field peas: Planting date studies (2018)
Relationship between soil temperature and root rot severity

2018 Field with history of severe field pea root rot (Aphanomyces & Fusarium, Aphanomyces predominant) Carrington, ND. Data from no-till and conventional-till production.



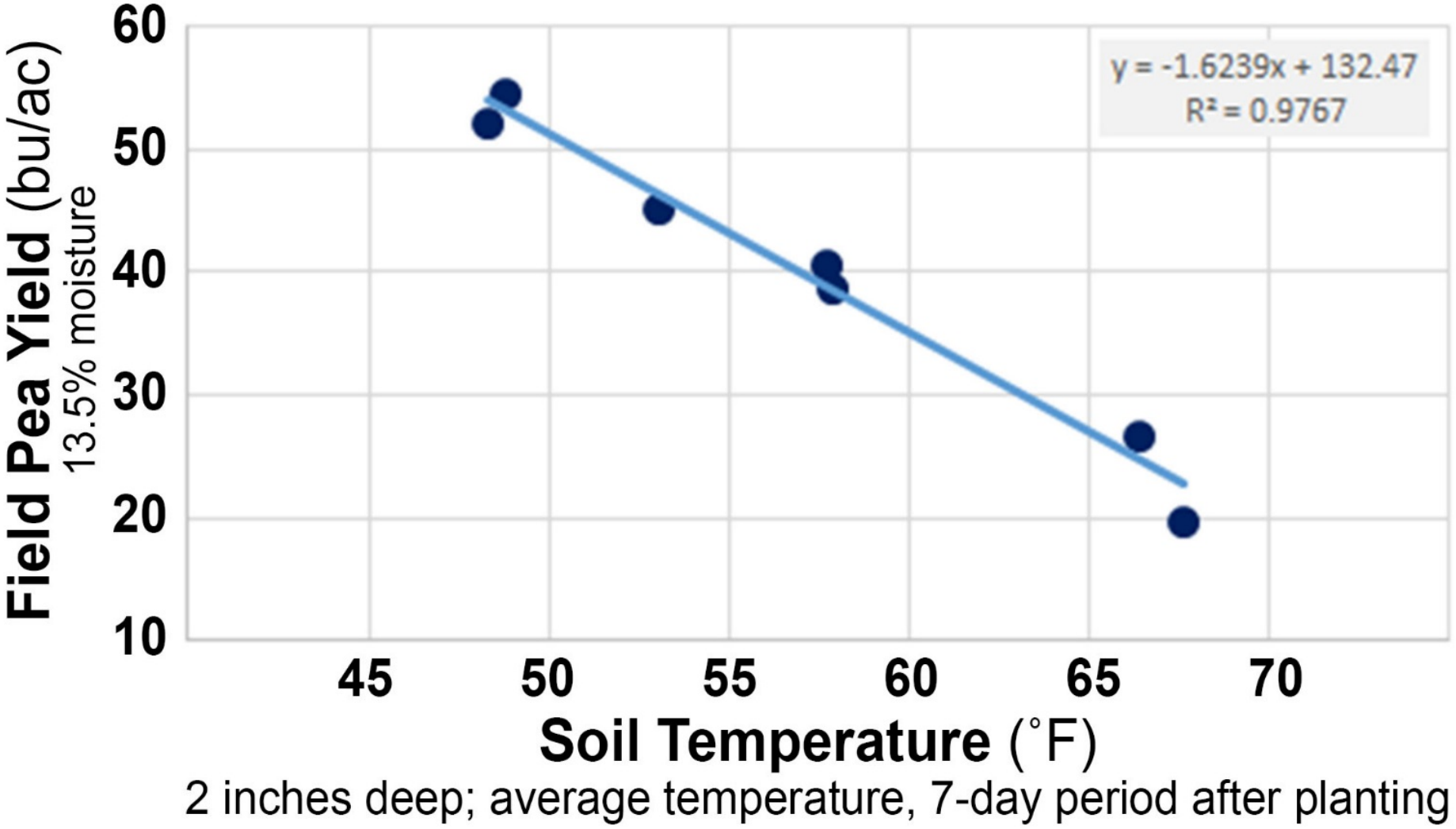
Aphanomyces root rot of field peas: Planting date studies (2018)
Relationship between soil temperature and wilt symptom development

2018 Field with history of severe field pea root rot (Aphanomyces & Fusarium, Aphanomyces predominant) Carrington, ND. Data from no-till and conventional-till production.



Aphanomyces root rot of field peas: Planting date studies (2018)
Relationship between soil temperature and yield

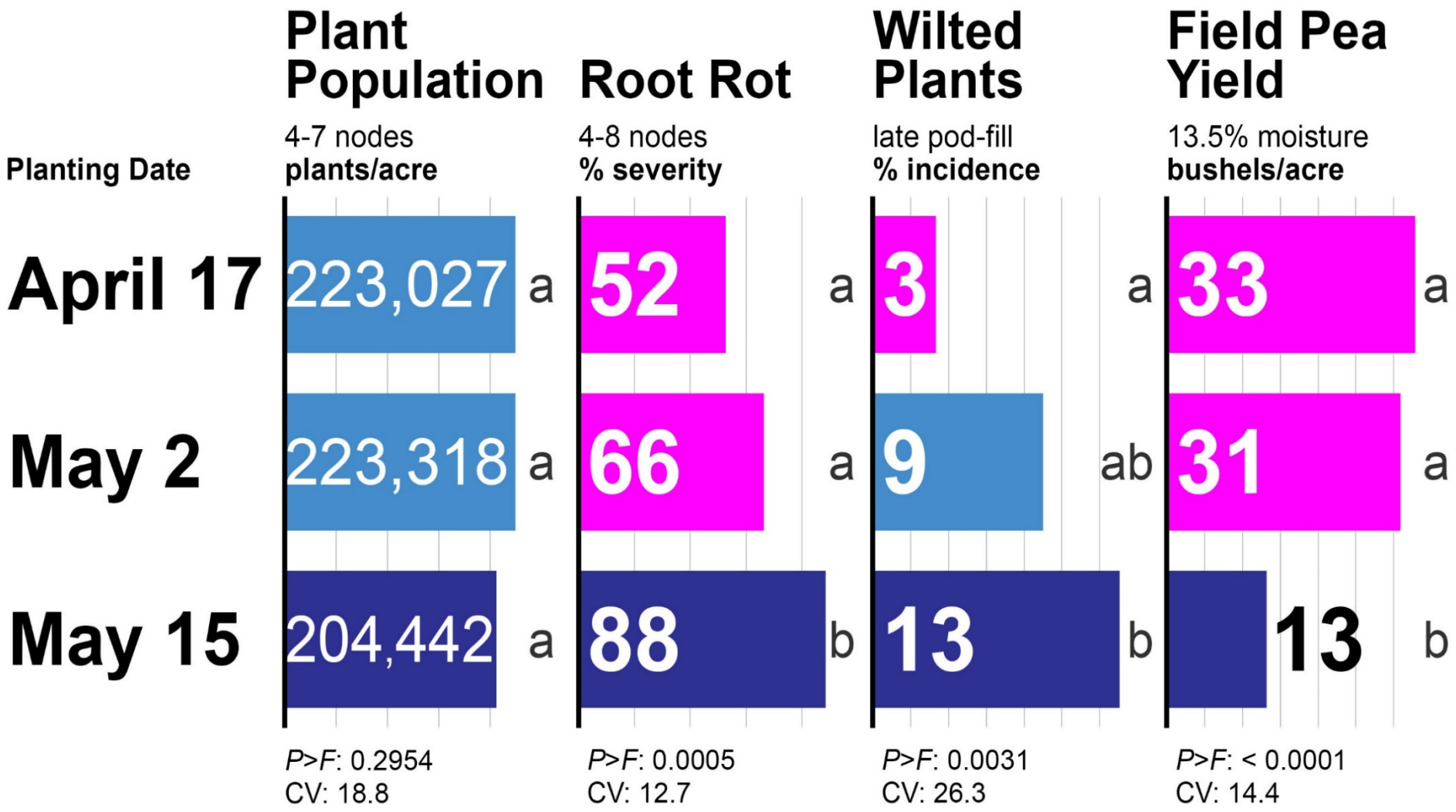
2018 Field with history of severe field pea root rot (Aphanomyces & Fusarium, Aphanomyces predominant) Carrington, ND. Data from no-till and conventional-till production.



Aphanomyces root rot of field peas: Impact of planting date

No-till production – Carrington, ND

2017 Field with history of severe field pea root rot (Aphanomyces & Fusarium, Aphanomyces predominant)



Variety: 'DS Admiral' (yellow-cotyledon type) **Seeding rate:** 300,000 pure live seeds/acre

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

Aphanomyces root rot of field peas:
Efficacy of seed treatments

Seed treatments:

- Metalayxl and mefenoxam: ineffective.
- Ethaboxam (Intego Solo): registered on lentils and chickpeas.

Control of Aphanomyces with seed treatments is difficult:

- Aphanomyces root rot develops during vegetative growth and bloom, when the concentration of fungicide active ingredients in the target tissues (tap root, epicotyl) is low.

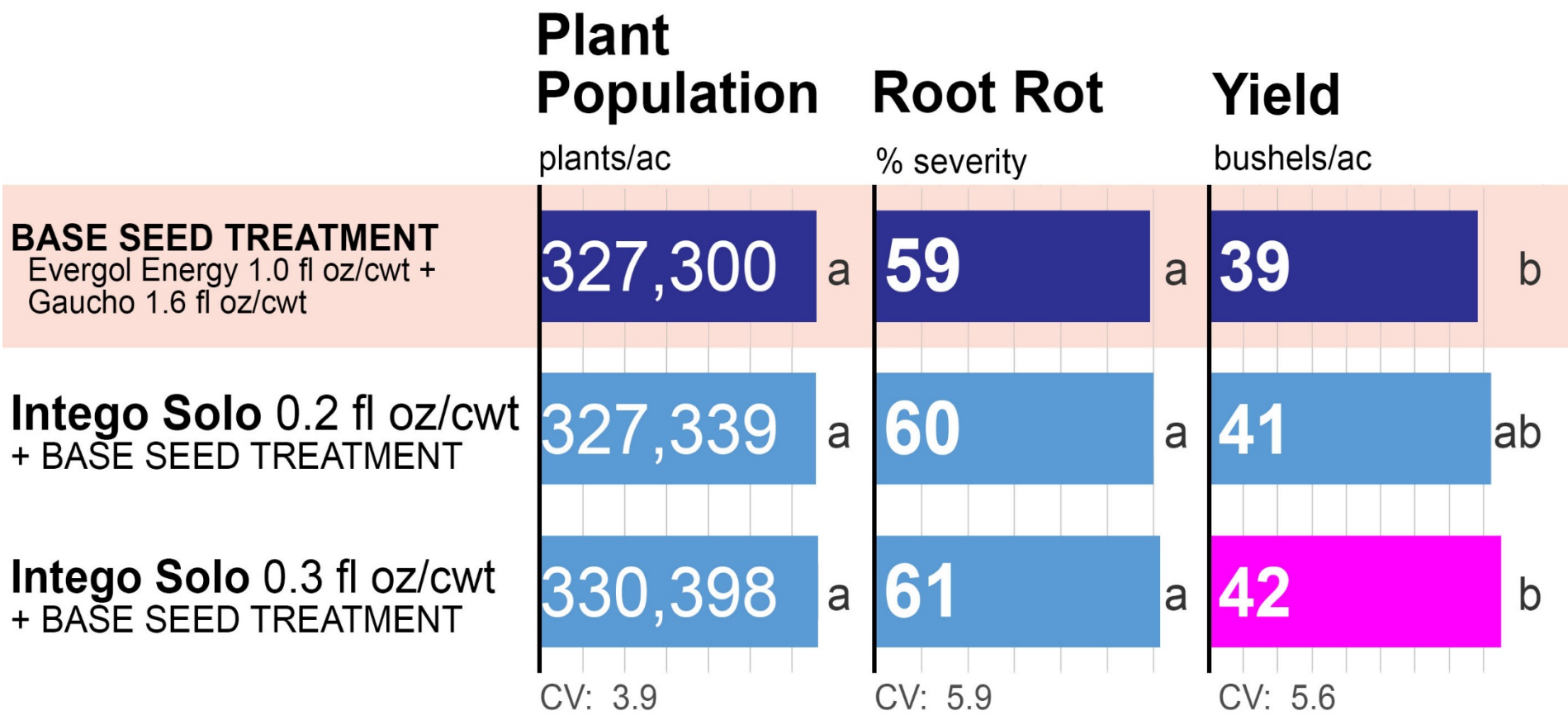
Aphanomyces root rot of field peas:

Efficacy of seed treatments

Intego Solo

combined analysis across nine **field pea** studies

active ingredient: ethaboxam



Fusarium root rot:

Biology

Causal pathogens:

- *Fusarium* spp. (fungal pathogens)

Conditions that favor infection:

- Soil moisture: low to high
- Soil temperatures: high

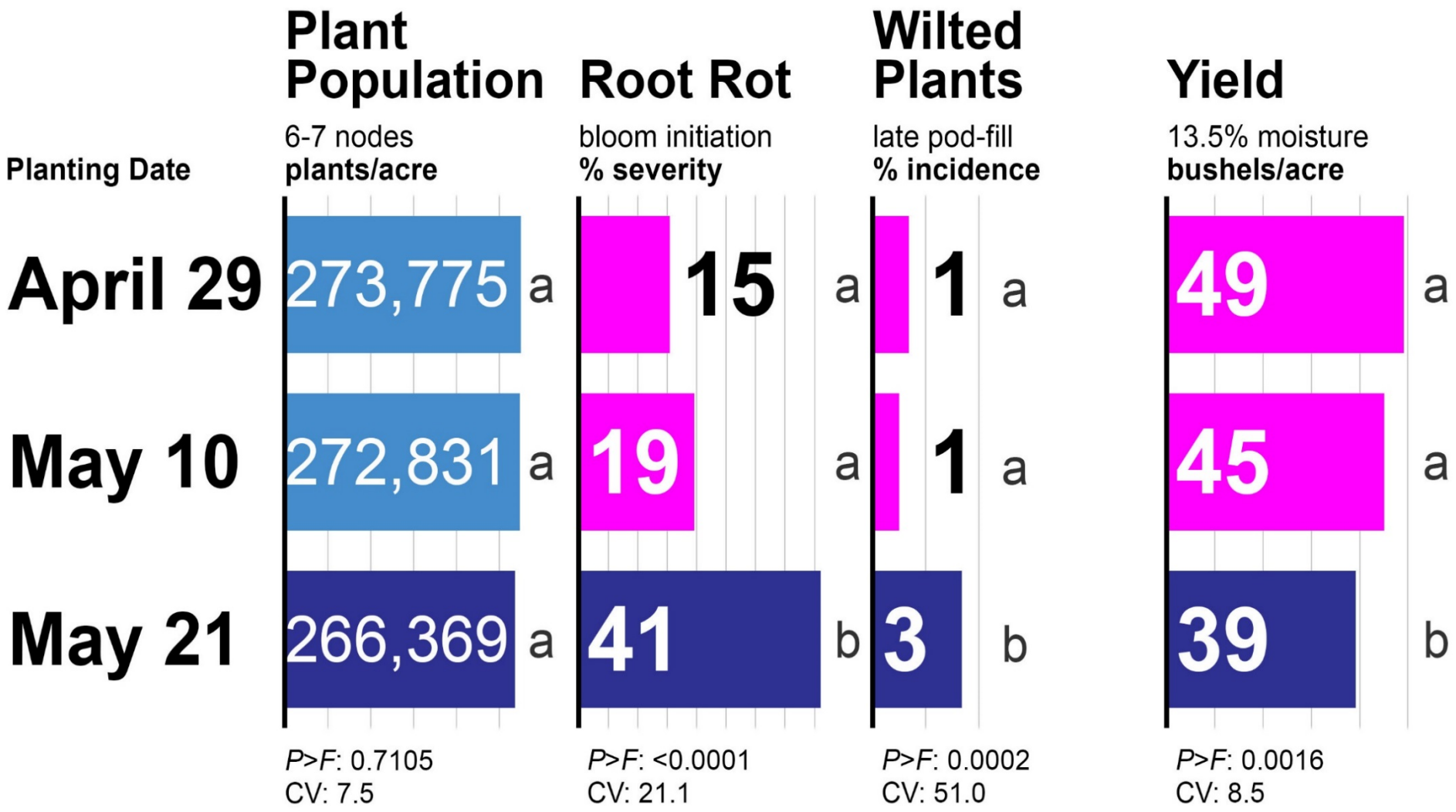
Fusarium root rot:
Biology

Symptoms:

- *When soil temperatures are high prior to emergence:* Poor stand establishment due to seed decay and damping-off
- Root rot: lesions that are initially brick-red to brown and later necrotic
- Wilt: plants yellowing from the bottom up

Fusarium root rot of field peas: Impact of planting date
Direct-seeded – Carrington, ND

2018 Inoculated with *Fusarium solani, F. avenaceum*. Symptoms suggest Aphanomyces pressure was low.

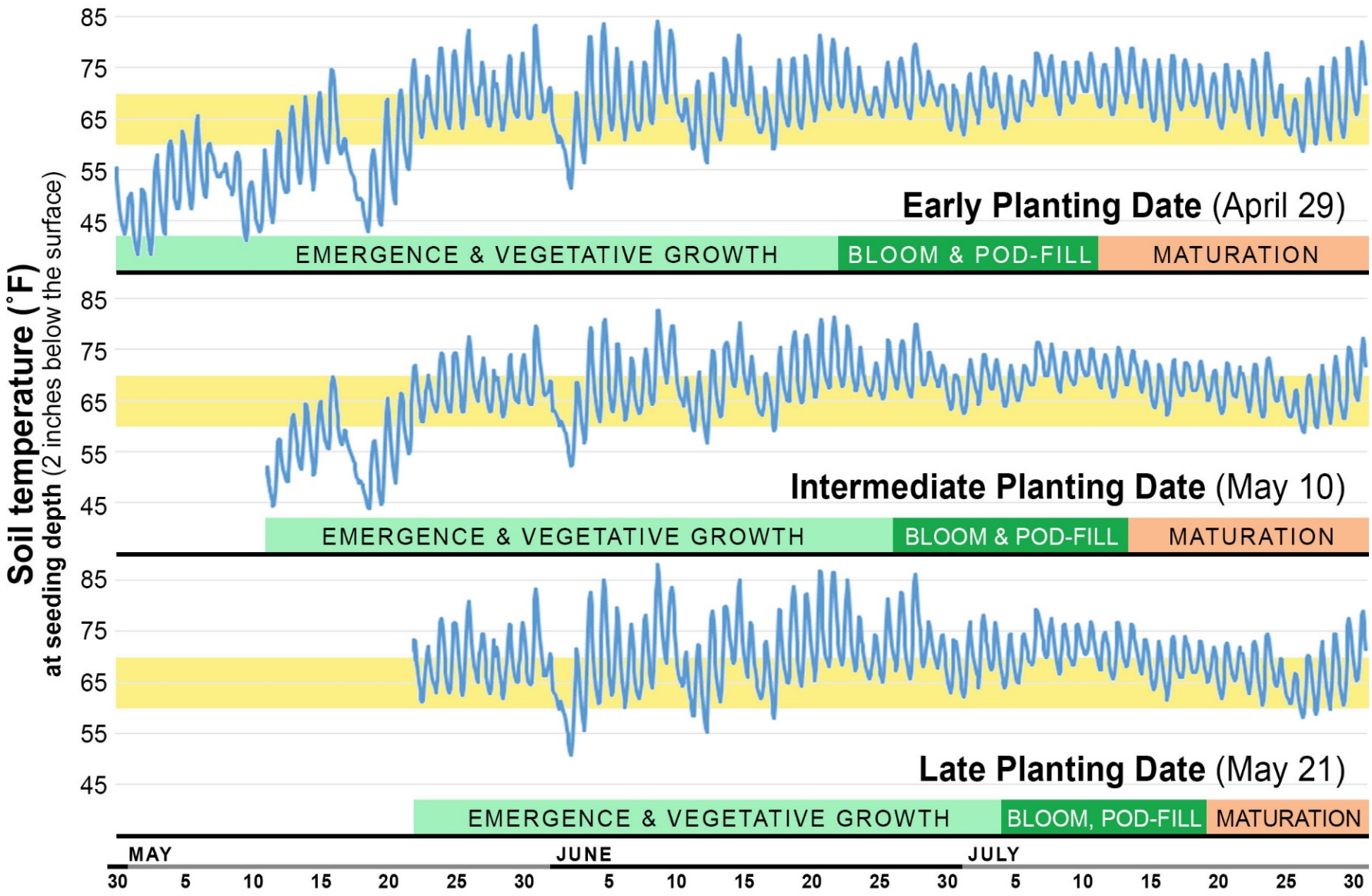


Variety: 'DS Admiral' (yellow-cotyledon type) **Seeding rate:** 308,000 pure live seeds/acre

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

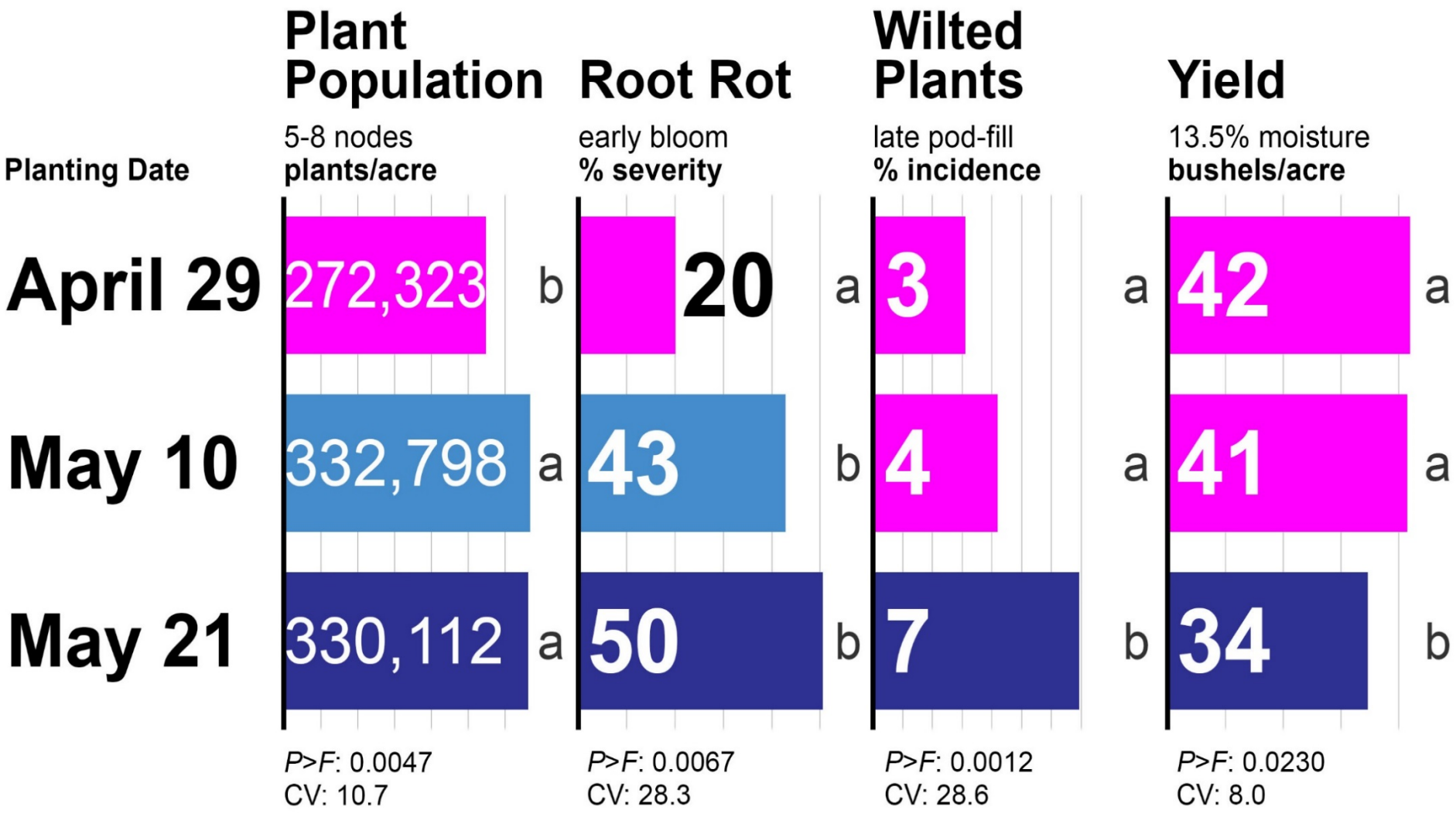
Fusarium root rot of field peas: Impact of planting date
Direct-seeded – Carrington, ND

2018 Inoculated with *Fusarium solani, F. avenaceum*. Symptoms suggest Aphanomyces pressure was low.



Fusarium root rot of field peas: Impact of planting date
Conventional tillage – Carrington, ND

2018 Inoculated with *Fusarium solani, F. avenaceum*. Symptoms: Aphanomyces pressure likely moderate.



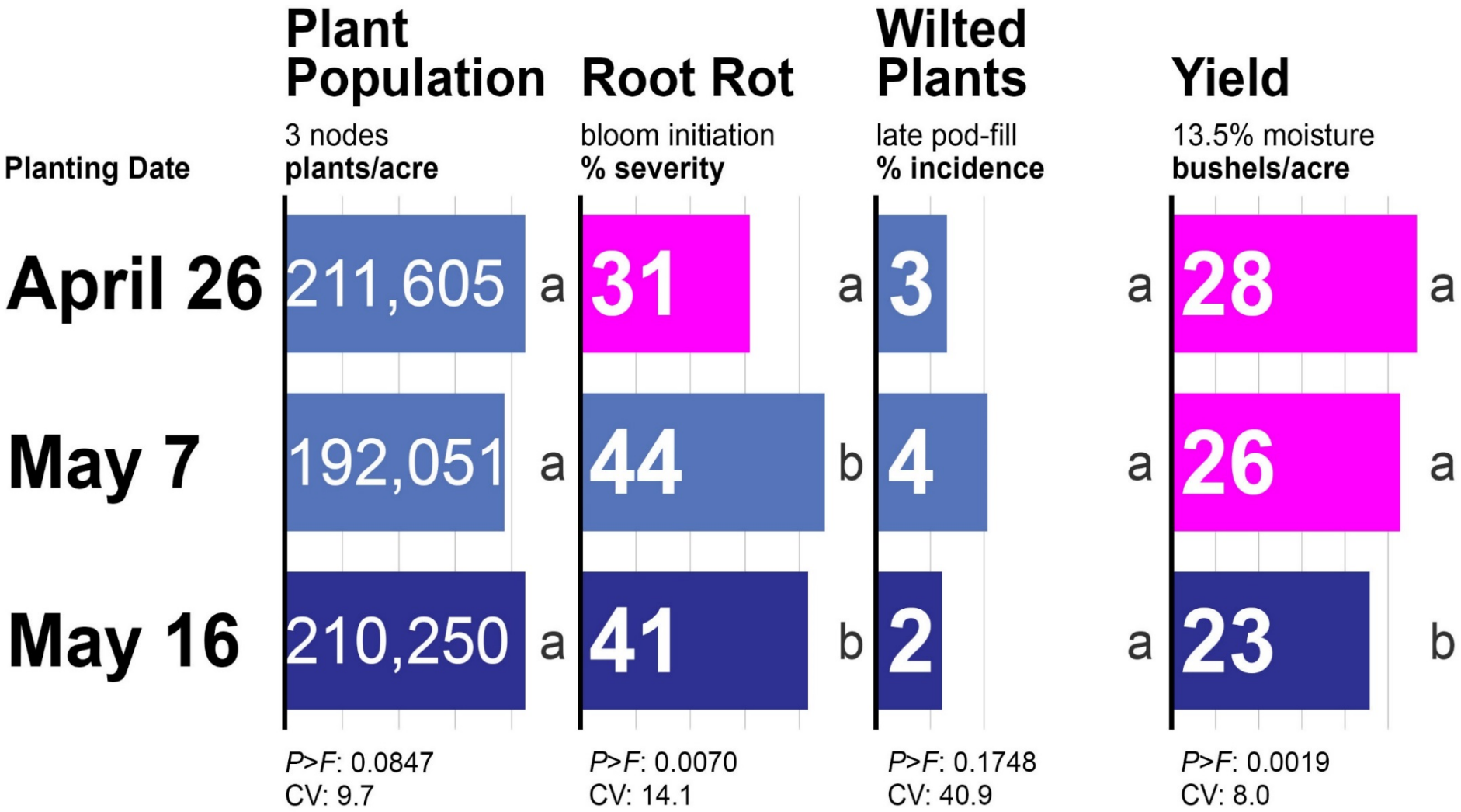
Variety: 'DS Admiral' (yellow-cotyledon type) **Seeding rate:** 308,000 pure live seeds/acre

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

Fusarium root rot of field peas: Impact of planting date

No-till production – Williston, ND

2018 Inoculated with *Fusarium solani, F. avenaceum*. Aphanomyces pressure unknown.

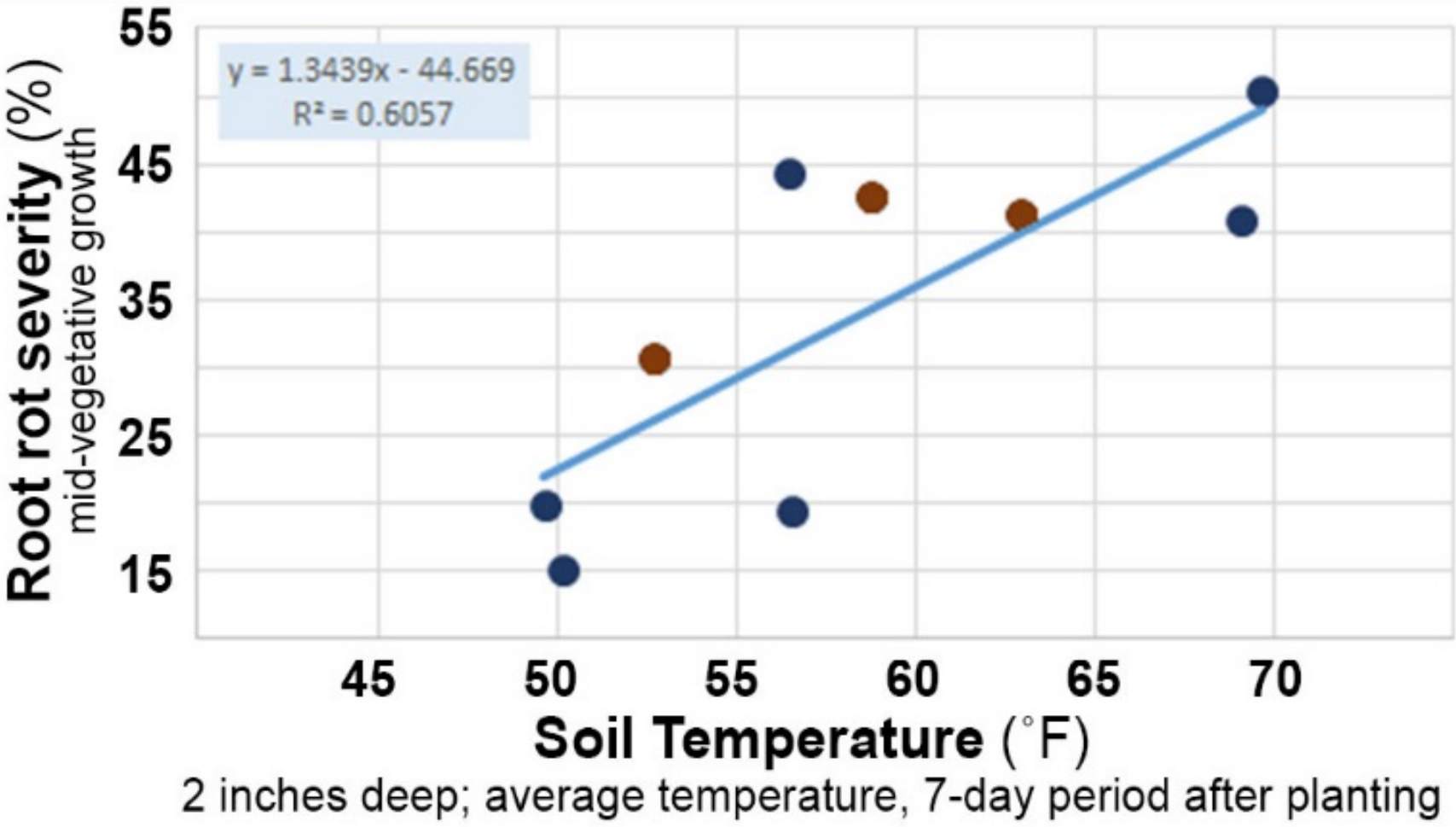


Variety: 'DS Admiral' (yellow-cotyledon type) **Seeding rate:** 330,000 pure live seeds/acre

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

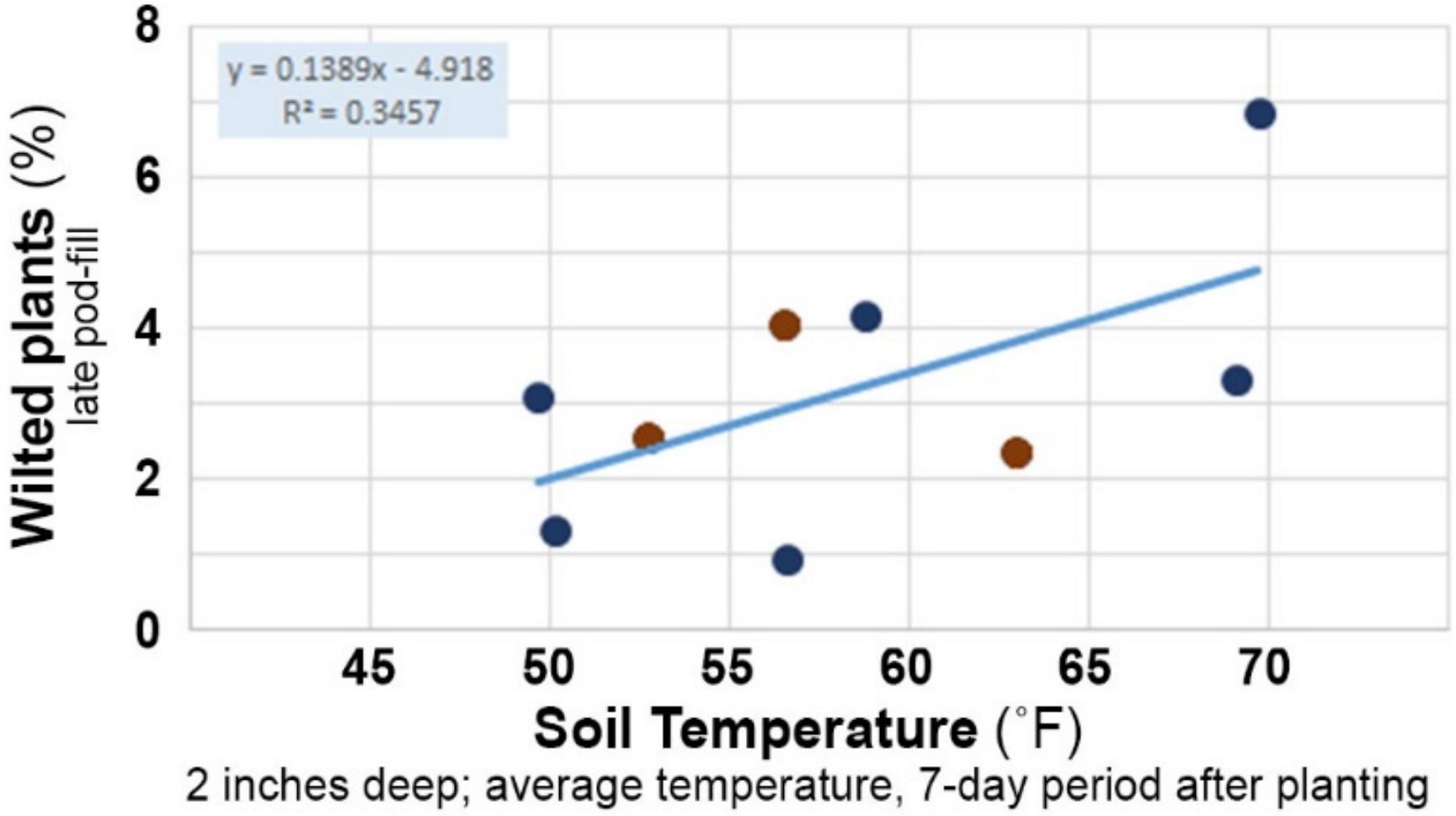
Fusarium root rot of field peas: Planting date studies (2018)
Relationship between soil temperature and root rot severity

2018 Field peas inoculated with *Fusarium solani, F. avenaceum.* Aphanomyces pressure low to moderate. Carrington and Williston, ND. Data from no-till and conventional-till production.



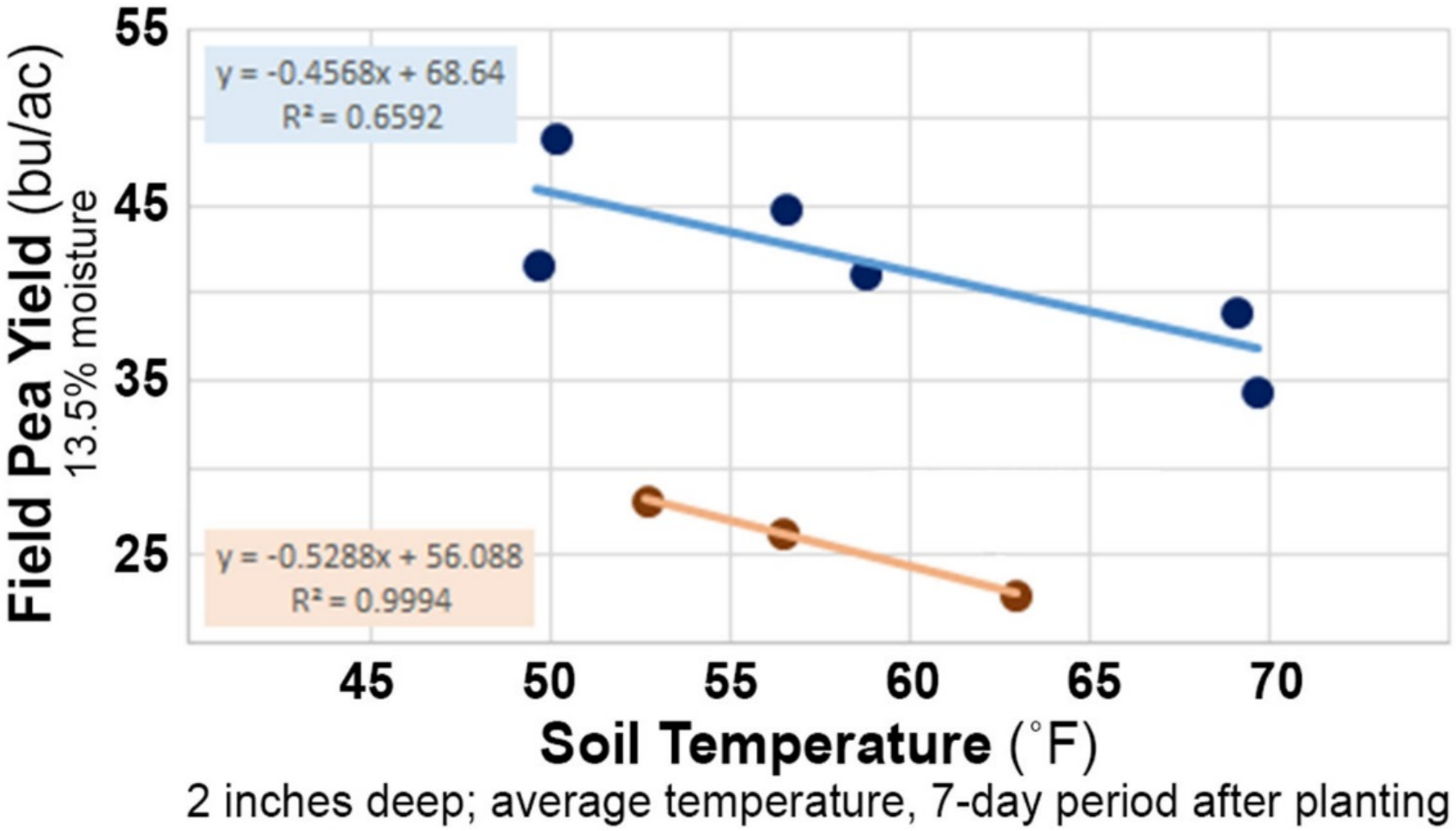
Aphanomyces root rot of field peas: Planting date studies (2018)
Relationship between soil temperature and wilt symptom development

2018 Field peas inoculated with *Fusarium solani, F. avenaceum.* Aphanomyces pressure low to moderate. Carrington and Williston, ND. Data from no-till and conventional-till production.



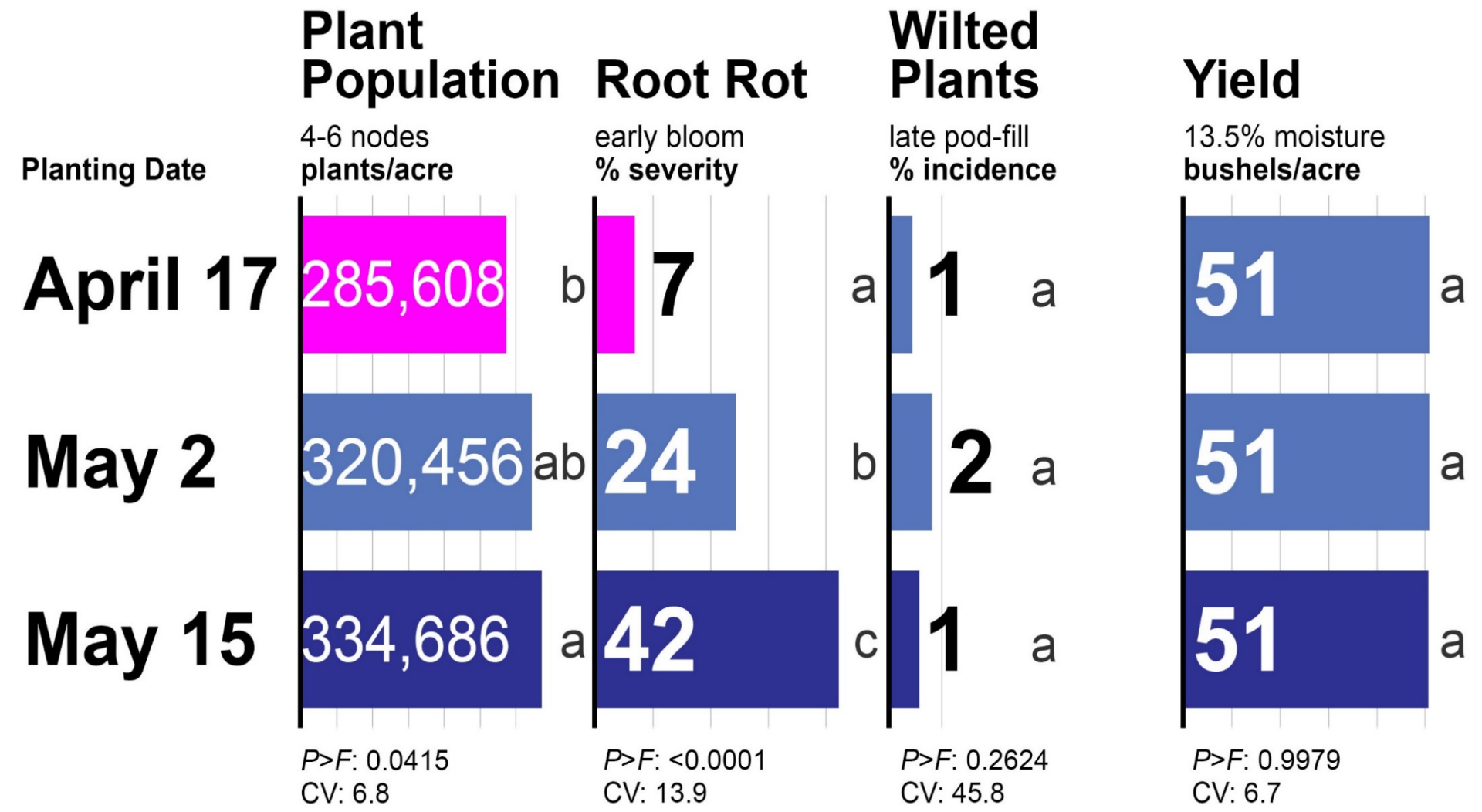
Aphanomyces root rot of field peas: Planting date studies (2018)
Relationship between soil temperature and yield

2018 Field peas inoculated with *Fusarium solani, F. avenaceum.* Aphanomyces pressure low to moderate. Carrington and Williston, ND. Data from no-till and conventional-till production.



Fusarium root rot of field peas: Impact of planting date
Direct-seeded – Carrington, ND

2017 Inoculated with *Fusarium* spp. Symptoms suggest Aphanomyces pressure was low.



Variety: 'Abarth' (yellow-cotyledon type) **Seeding rate:** 330,000 pure live seeds/acre

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

Thank you!

Research funded by:
Northern Pulse Growers Association | USDA Sclerotinia Initiative
North Dakota Crop Protection Product Harmonization Board & Registration Board
North Dakota Department of Agriculture USDA Specialty Crop Block Grant Program