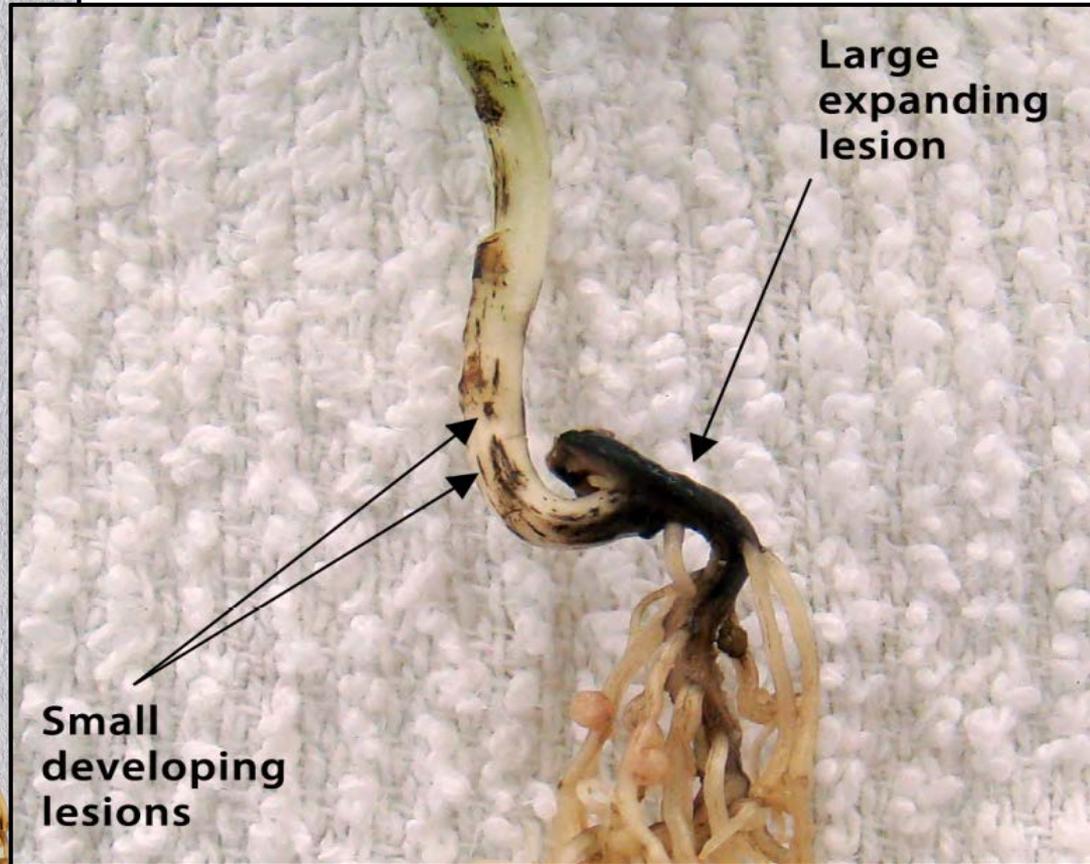


Fusarium root rot



Photos:
Julie Pasche, NDSU (above)
Michael Wunsch, NDSU (left)



Fusarium

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

Causal pathogens:

- *Fusarium* spp. (fungal pathogens)

Conditions that favor infection:

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

Fusarium

Susceptibility:

- Field peas, lentils >> chickpeas
 - Chickpeas are not considered susceptible.
 - Lentils and field peas are highly susceptible.

Fusarium

Impact of soil temperature – field peas

Carrington, ND (2018)

Direct-seeded

	Plant population:	Root rot severity	Wilt symptoms	Yield
Planting date	6-7 nodes plants/ac	early bloom %	late pod-fill %	13.5% moisture bu/ac
1 Early (April 29)	273775 a*	15 a*	1 a*	49 a*
2 Intermediate (May 10)	272831 a	19 a	1 a	45 a
3 Late (May 21)	266369 a	41 b	3 b	39 b
CV:	7.5	21.1	51.0	8.5

Carrington, ND (2018)

Conventional tillage

	Plant population:	Root rot severity	Wilt symptoms	Yield
Planting date	6-8 nodes plants/ac	early bloom %	late pod-fill %	13.5% moisture bu/ac
1 Early (April 29)	272323 b*	20 a*	3 a*‡	42 a*
2 Intermediate (May 10)	332798 a	43 b	4 a	41 a
3 Late (May 21)	330112 a	50 b	7 b	34 b
CV:	10.7	28.3	28.6	8.0

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

‡ To meet model assumptions of normality and/or homoskedasticity, analysis of variance was conducted on data subjected to a systematic natural-log transformation. For ease of interpretation, treatments means are presented for the non-transformed data.

Fusarium

Impact of soil temperature – field peas

Carrington, ND (2017)

Direct-seeded

Planting date	Plant population:	Root rot severity	Wilt symptoms	Yield
	4-6 nodes plants/ac	early bloom %	late pod-fill %	13.5% moisture bu/ac
1 Early (April 17)	285608 b*	7 a*	1 a*	51 a*
2 Intermediate (May 2)	320456 ab	24 b	2 a	51 a
3 Late (May 15)	334686 a	42 c	1 a	51 a
	CV: 6.8	13.9	45.8	6.7

Williston, ND (2018)

No-till production

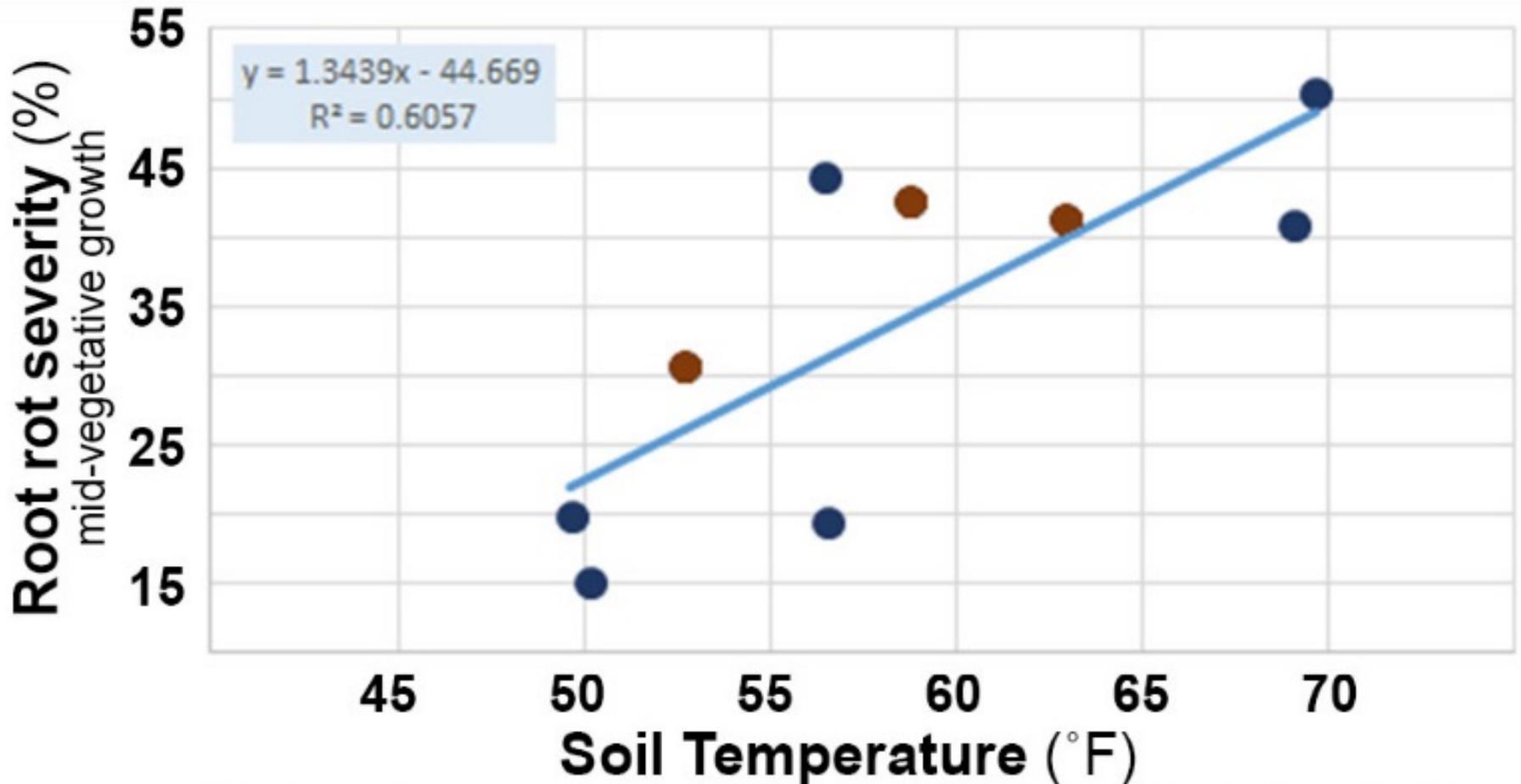
Planting date	Plant population:	Root rot severity	Wilt symptoms	Yield
	plants/ac	%	late pod-fill %	13.5% moisture bu/ac
1 Early (April 27)	211605 a*	31 a*	3 a*	28 a*
2 Intermediate (May 7)	192051 a	44 b	4 a	26 a
3 Late (May 16)	210250 a	41 b	2 a	23 b
	CV: 9.7	14.1	40.9	8.0

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Fusarium

Impact of soil temperature – **field peas**



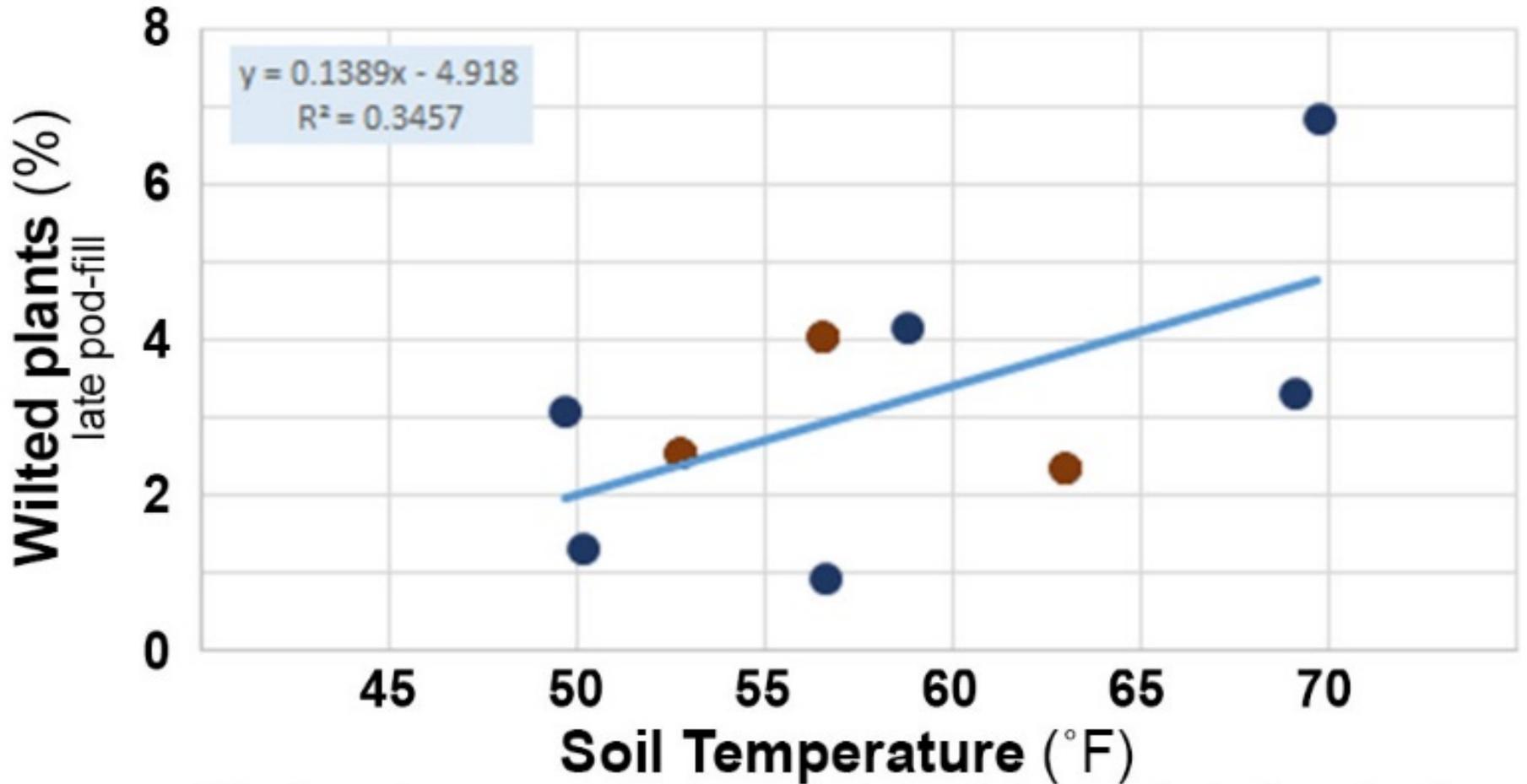
2 inches deep; average temperature, 7-day period after planting

Williston:
BROWN DATA POINTS

Carrington:
BLUE DATA POINTS

Fusarium

Impact of soil temperature – **field peas**



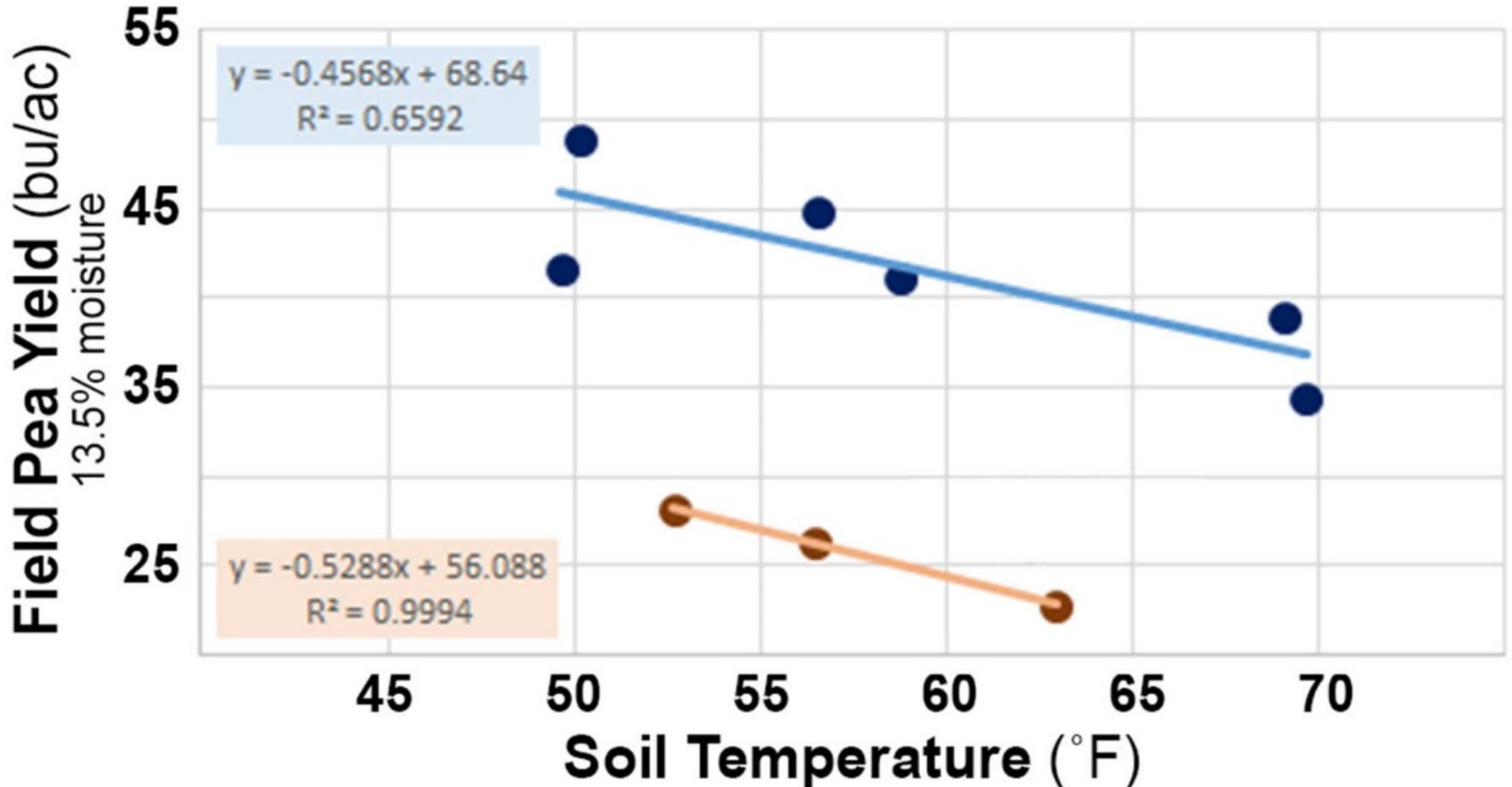
2 inches deep; average temperature, 7-day period after planting

Williston:
BROWN DATA POINTS

Carrington:
BLUE DATA POINTS

Fusarium

Impact of soil temperature – **field peas**



2 inches deep; average temperature, 7-day period after planting

Williston:
BROWN DATA POINTS

Carrington:
BLUE DATA POINTS

Fusarium

Seed treatments:

- Most seed treatments are effective against seed decay and damping off, not root rot.

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

Fusarium

Effectiveness of fungicide seed treatments

Carrington, ND (2016)

			Plant population	Root rot	Yield
			5-6 nodes	6-10 nodes	13.5% moisture
			plants/ac	% severity	bu/ac
1	Allegiance FL 0.75 fl oz/cwt	Non-inoculated	241447 a*	1 a*	52 a*
2	Allegiance FL 0.75 fl oz/cwt	Inoculated	211577 a	12 b	50 a
3	Evergol Energy 176.6FS 1.0 fl oz/cwt	Inoculated	222778 a	9 b	50 a
4	Obvius 4.6 fl oz/cwt	Inoculated	252026 a	10 b	53 a
5	Vibrance Maxx RFC 1.54 fl oz/ac	Inoculated	203487 a	8 b	52 a
		CV:	16.3	38.5	11.2

Carrington, ND (2017)

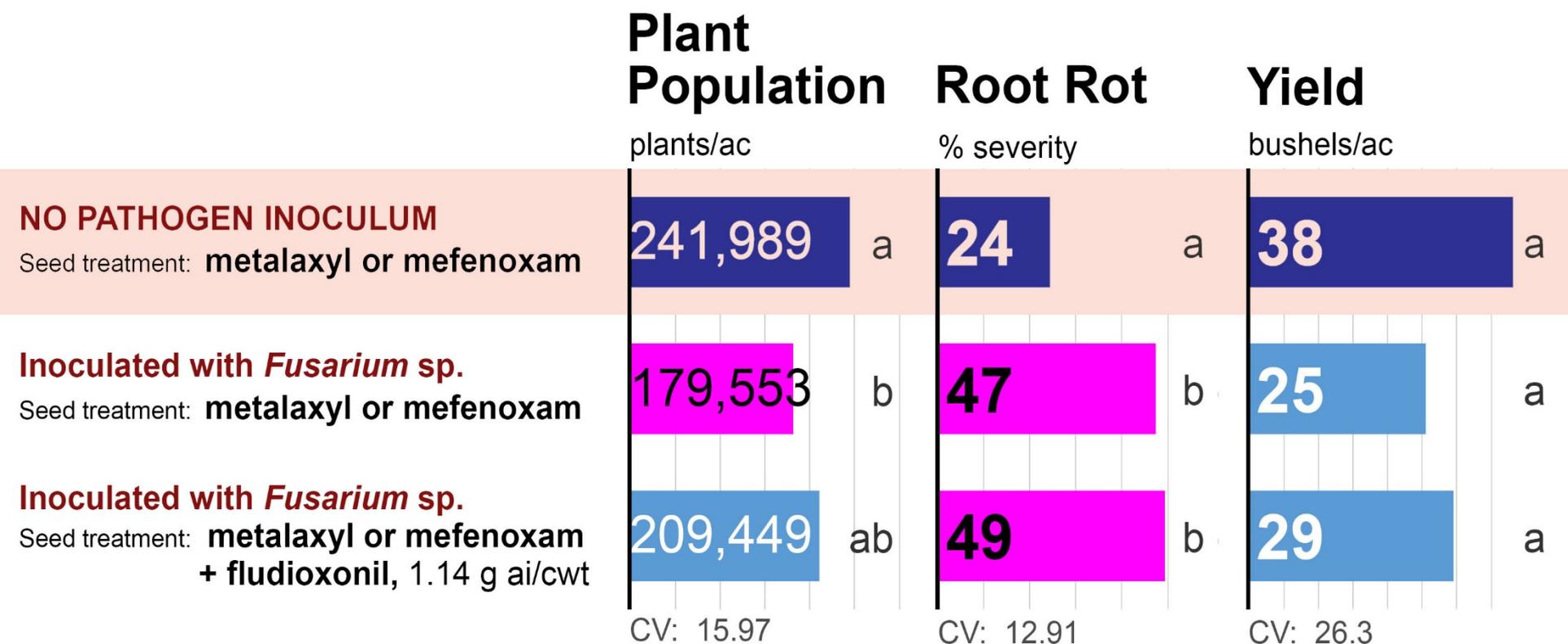
			Plant population	Root rot	Yield
			5 nodes	7-9 nodes	13.5% moisture
			plants/ac	% severity	bu/ac
1	Allegiance FL 0.75 fl oz/cwt	Non-inoculated	259618 a*	7 a*	56 a*
2	Allegiance FL 0.75 fl oz/cwt	Inoculated	151008 b	18 b	53 a
3	Evergol Energy 176.6FS 1.0 fl oz/cwt	Inoculated	282269 a	9 a	55 a
4	Obvius 4.6 fl oz/cwt	Inoculated	287496 a	16 b	57 a
5	Vibrance Maxx RFC 1.54 fl oz/ac	Inoculated	264264 a	15 ab	59 a
		CV:	12.4	27.8	7.7

Fusarium

Effectiveness of fungicide seed treatments

Apron Maxx & generics

combined analysis across six field pea studies

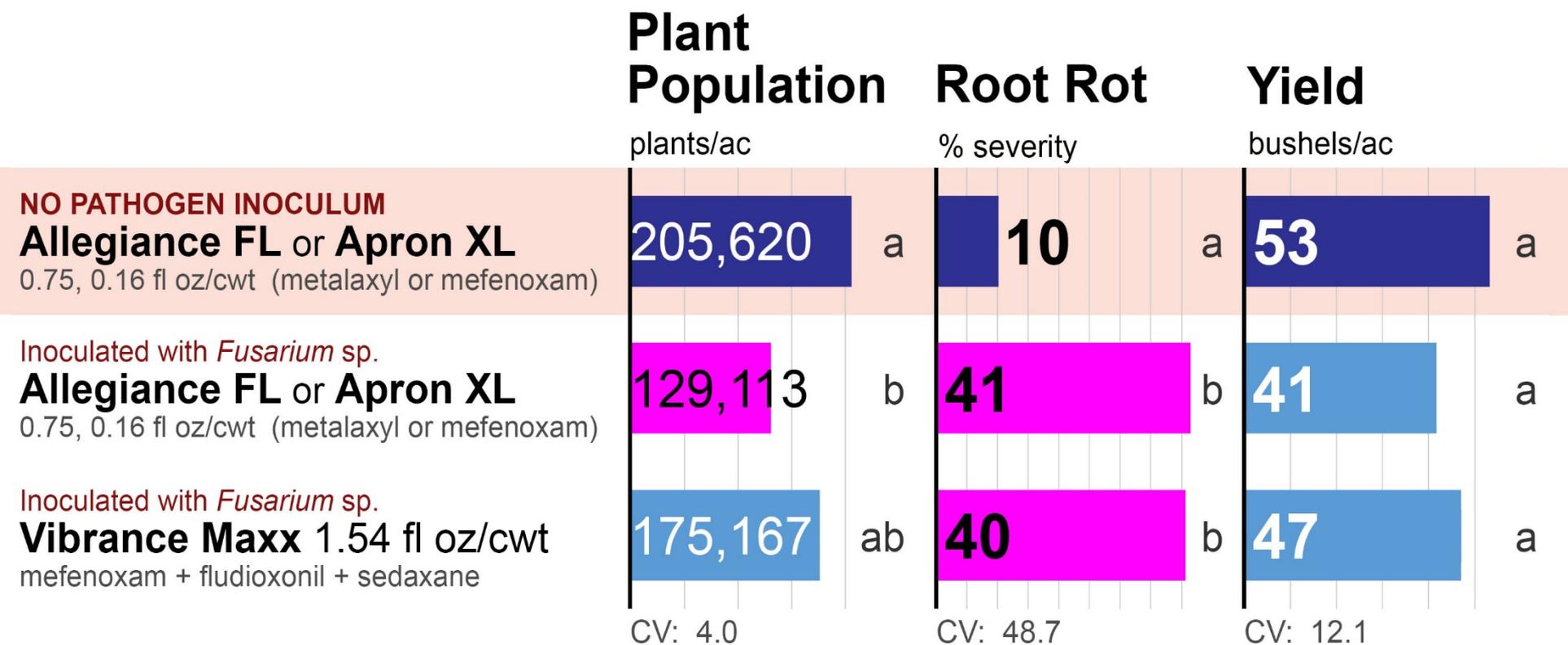


Fusarium

Effectiveness of fungicide seed treatments

Vibrance Maxx

combined analysis across four **field pea** studies

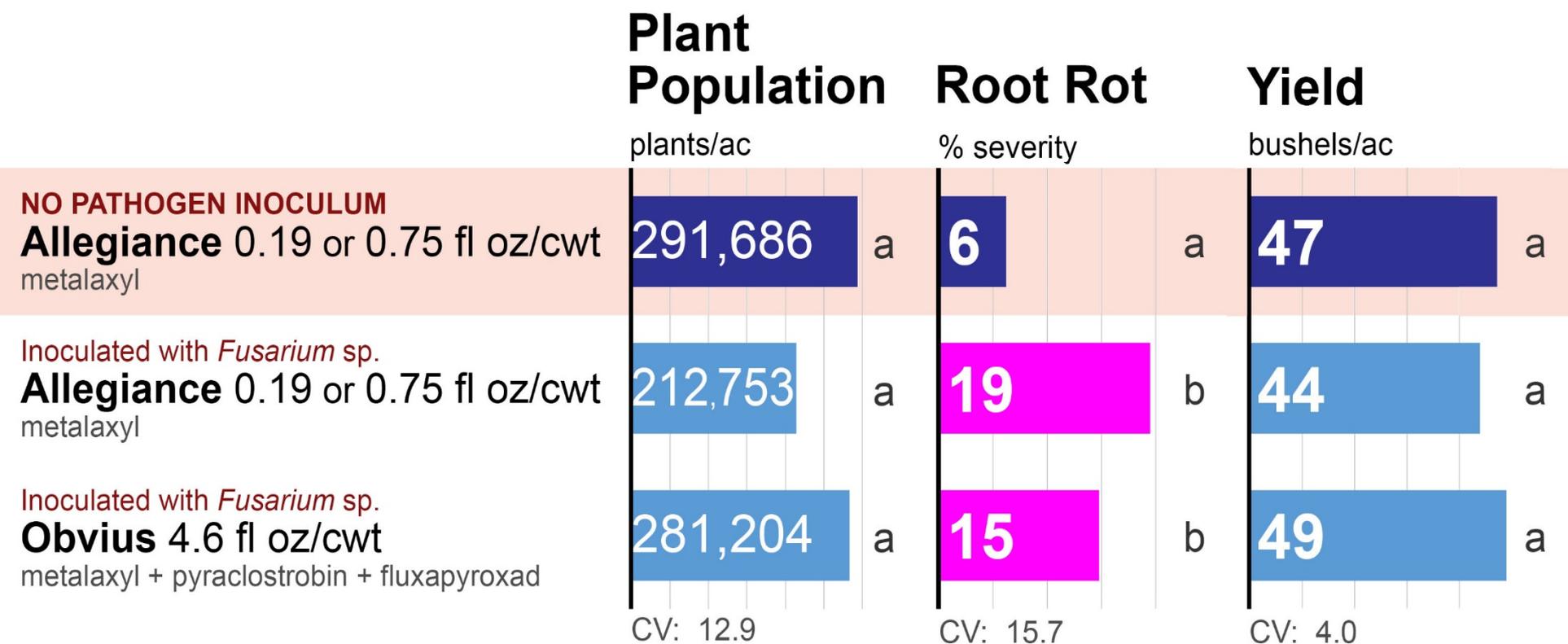


Fusarium

Effectiveness of fungicide seed treatments

Obvius

combined analysis across three **field pea** studies

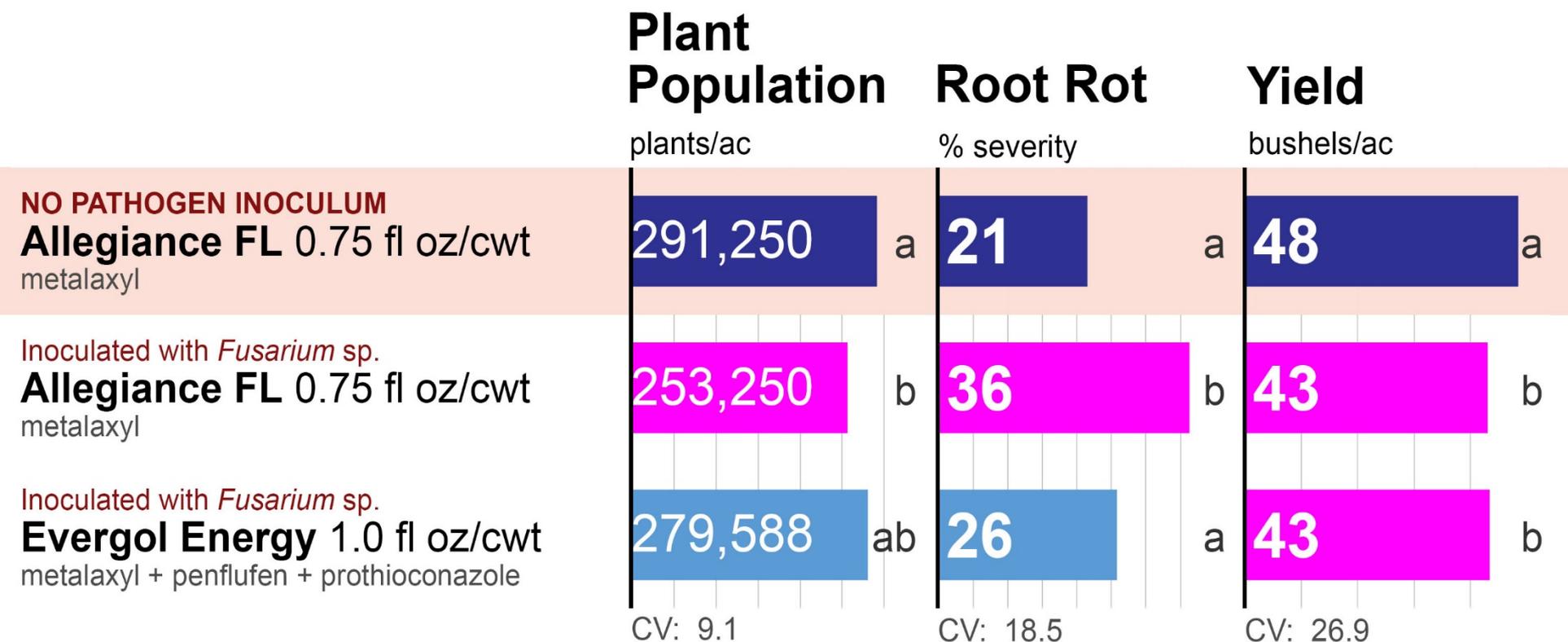


Fusarium

Effectiveness of fungicide seed treatments

EverGol Energy

combined analysis across eight **field pea** studies

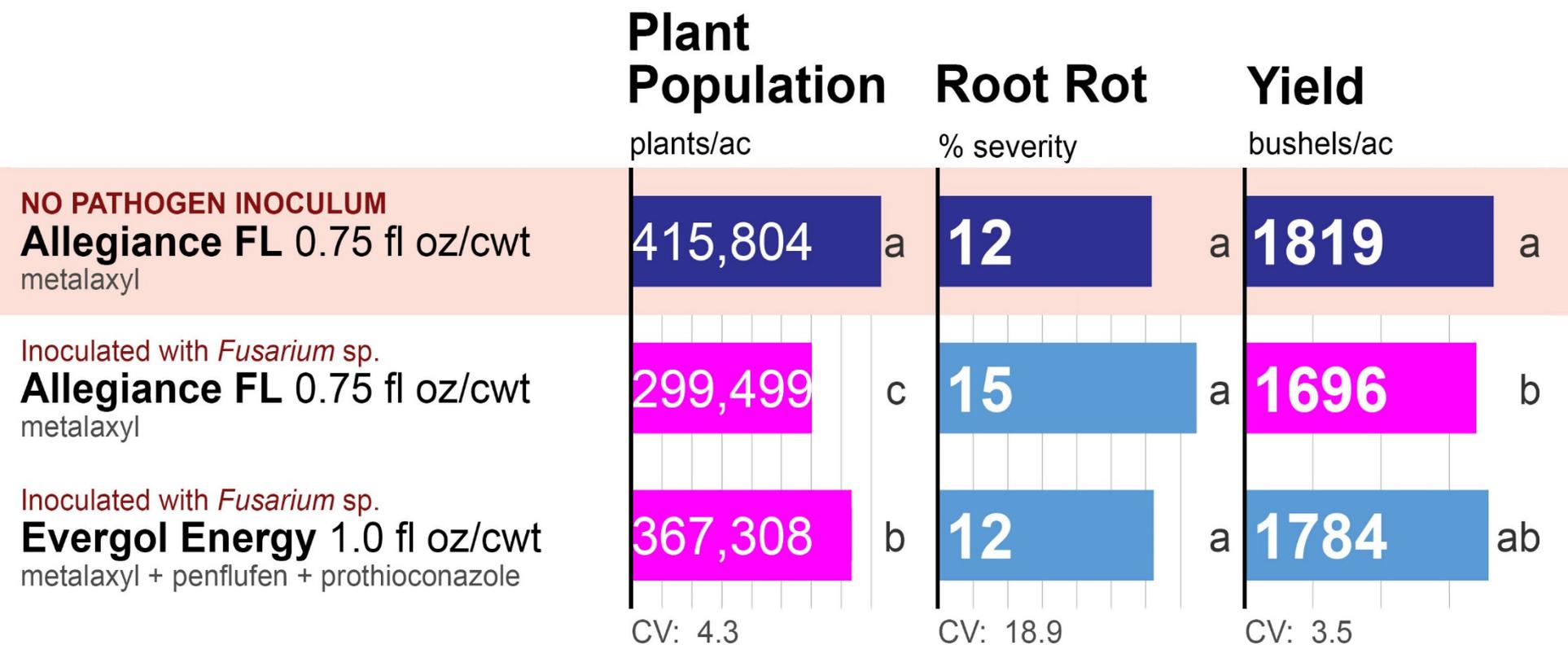


Fusarium

Effectiveness of fungicide seed treatments

EverGol Energy

combined analysis across six **lentil** studies



Fusarium and Aphanomyces root rots

Impact of soil temperature – lentils

Carrington, ND (2018)

Direct-seeded

	Plant population: <i>6-8 nodes</i> plants/ac	Root rot severity <i>early bloom</i> %	Wilt symptoms <i>late bloom</i> %	Yield 13.5% moisture bu/ac
Planting date				
1 Early (April 29)	400825 a*	5 a*	0 a*‡	2270 a*
2 Intermediate (May 10)	366049 a	8 b	0 a	2120 a
3 Late (May 21)	407867 a	9 b	3 b	1242 b
CV:	11.0	26.2	56.9	11.6

Carrington, ND (2018)

Conventional tillage

	Plant population: <i>6-8 nodes</i> plants/ac	Root rot severity <i>early bloom</i> %	Wilt symptoms <i>late bloom</i> %	Yield 13.5% moisture bu/ac
Planting date				
1 Early (April 28)	334686 a*	20 a*‡	7 a*‡	2370 a*
2 Intermediate (May 10)	335993 a	18 a	13 a	1781 ab
3 Late (May 21)	323433 a	15 a	7 a	788 b
CV:	15.4	16.3	98.9	15.4

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

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Effectiveness of crop rotation

Management of Fusarium and Aphanomyces root rots

Dogma:

- Effectiveness of crop rotation is limited by the pathogen's persistence in the soil and host range

Effectiveness of crop rotation

Management of Fusarium and Aphanomyces root rots

Field peas - Carrington (2018):

FIELD WITH SIGNIFICANT FIELD PEA ROOT ROT PROBLEMS

Peas grown approximately once every 3 years for over 20 years

	Plant population:	Root rot severity	Yield	
	6 nodes	10 nodes	13.5% moisture	
	plants/ac	%	lbs/ac	
1 Wheat / Peas / Wheat / Peas	223076 ab*	53 b*	28 b**	
3 Wheat / Wheat / Wheat / Peas	240209 a	44 ab	37 ab	
4 Wheat / Canola / Wheat / Peas	219901 b	39 a	38 a	
5 Wheat / Flax / Wheat / Peas	222930 ab	44 ab	No Data	
	<i>F</i> :	4.22	3.71	4.07
	<i>P>F</i> :	0.0237	0.0354	0.0764
	<i>CV</i> :	8.3	16.0	18.3

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

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

Effectiveness of crop rotation

Management of Fusarium and Aphanomyces root rots

Field peas - Hettinger (2018):

FIELD WITH NO PRE-EXISTING FIELD PEA ROOT ROT PROBLEM

Peas grown for the first time in 2014.

	Plant population:	Root rot severity	Yield
		bloom initiation	13.5% moisture
	plants/ac	%	bu/ac
1 Peas / wheat / peas / wheat / peas	143264 a*	1.7 a*	32 a*
2 Peas / wheat / wheat / wheat / peas	141715 a	1.2 a	36 a
3 Peas / wheat / canola / wheat / peas	143070 a	1.9 a	32 a
4 Peas / wheat / flax / wheat / peas	148878 a	1.7 a	33 a
	<i>F</i> : 0.35	2.26	2.12
	<i>P>F</i> : 0.7888	0.1230	0.1409
	CV: 9.1	30.3	10.7

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



Thank you!

Funding sources:

**North Dakota Crop Protection Product Harmonization Board & Registration Board
Northern Pulse Growers Association, BASF, Valent USA, Bayer, Syngenta**