Management of **root rots in field peas & lentils** with **planting date, seed treatment,** and **crop rotation**

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John Rickertsen - NDSU Hettinger Research Extension Center
Audrey Kalil and staff - NDSU Williston Research Extension Center

Pythium seed decay and damping-off

Causal pathogen: *Pythium* spp.

Conditions that favor infection:

- Soil moisture: high
- Soil temperatures: wide range of soil temperatures, but low to moderate soil temperatures are very high risk

Symptoms: Seed decay and damping-off, resulting in poor stand establishment.

Rhizoctonia seed decay, damping-off, & root rot

Causal pathogen: *Rhizoctonia solani*

Conditions that favor infection:

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

Symptoms:

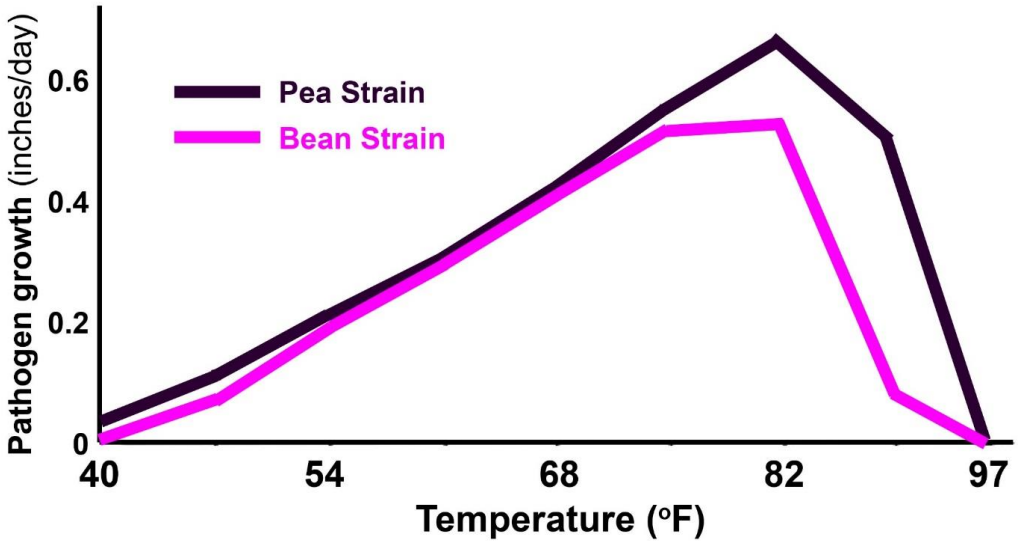
- Poor stand establishment due to seed decay, damping-off
- Root rot: sunken reddish to dark brown lesions

Aphanomyces root rot

Causal pathogen: *Aphanomyces euteiches*

Conditions that favor infection:

- Soil moisture: high
- Soil temperature: high



Pfender and Hagedorn 1982 Phytopathology 72:306-310

Fusarium root rot & Fusarium wilt

Causal pathogens:

- *Fusarium* spp. (root rot), *F. oxsporum* (wilt)

Conditions that favor infection:

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

Improving the management of Fusarium & Aphanomyces root rots in **field peas**

Optimizing planting date, fungicide seed treatment, and crop rotation

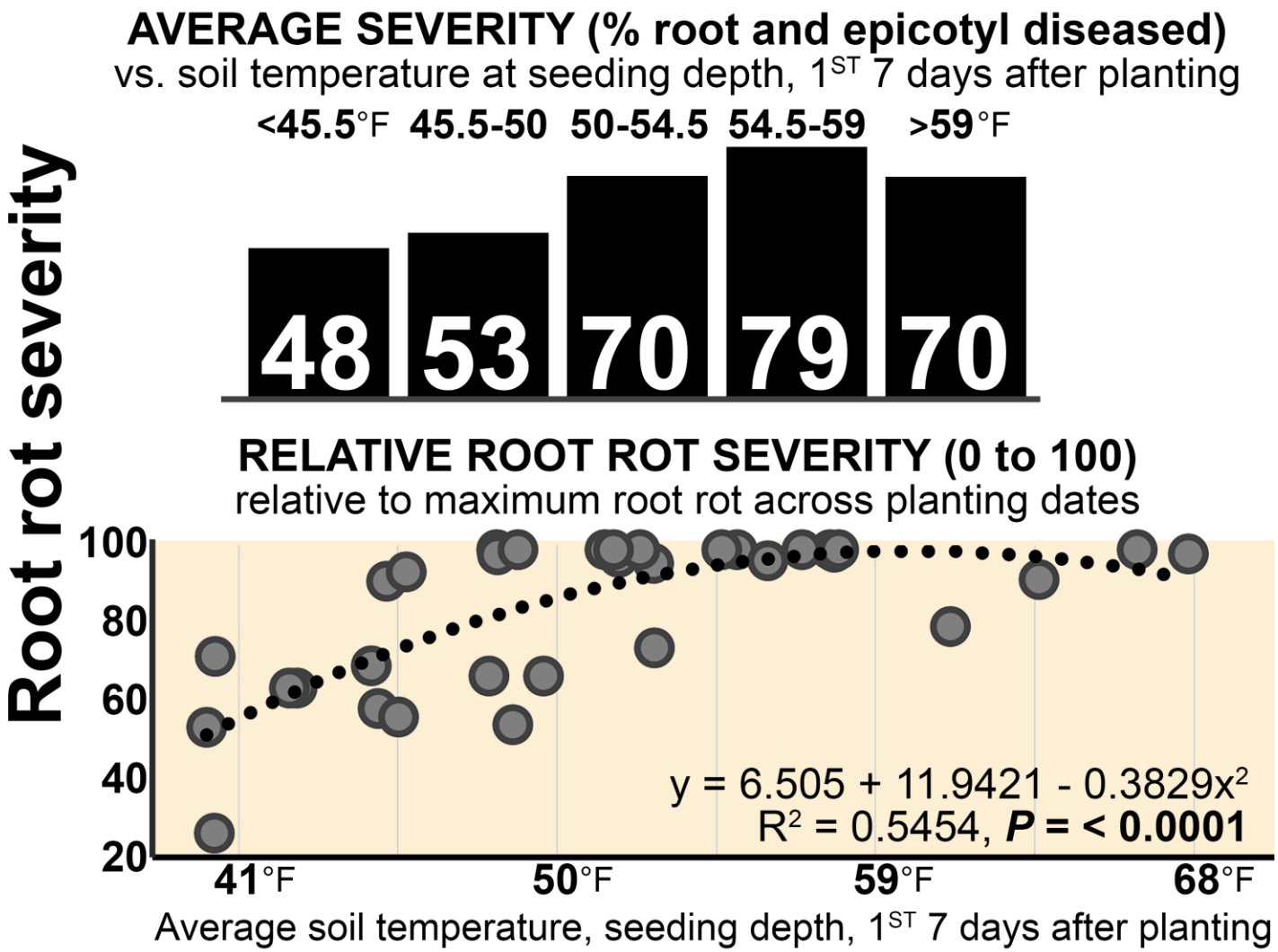
Fusarium and Aphanomyces root rot of field peas

Optimizing planting date:
Fields with elevated **native root rot pressure**

Fields with root rot caused by a long history of field pea and lentil production.
Williams, Mountrail and McLean Counties (2019, 2020); Foster County (2017-2020)

Root rot was minimized when soil temperature was < 50°F
(7 days after planting at 2" seeding depth).

Presented are average results for field peas grown without fungicide seed treatment or with various different seed treatments.



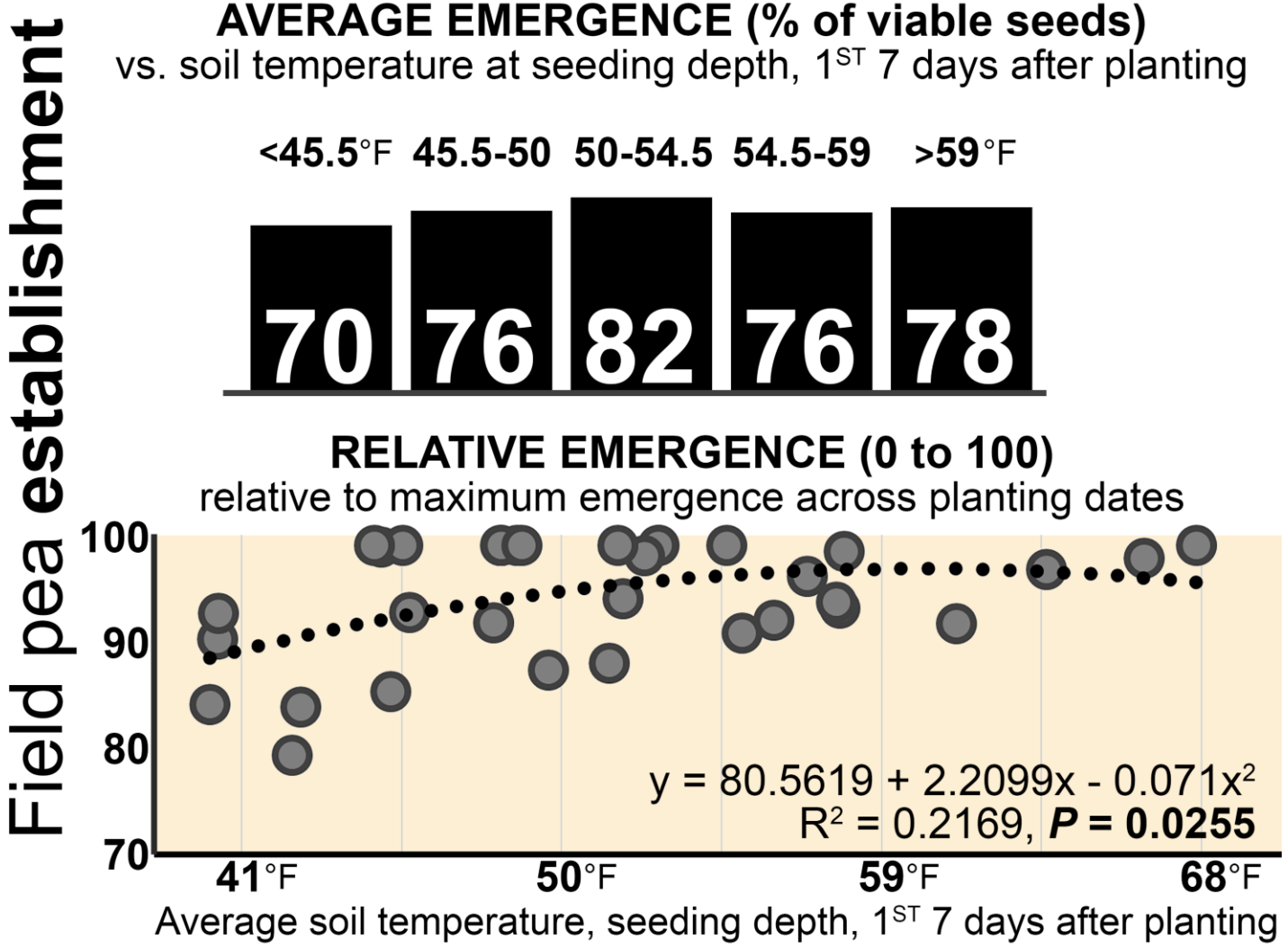
Fusarium and Aphanomyces root rot of field peas

Optimizing planting date:
Fields with elevated **native root rot pressure**

Fields with root rot caused by a long history of field pea and lentil production.
Williams, Mountrail and McLean Counties (2019, 2020); Foster County (2017-2020)

Establishment was problematic when soil temperature was < 45.5°F (7 days after planting at 2" seeding depth).

Presented are average results for field peas grown without fungicide seed treatment or with various different seed treatments.



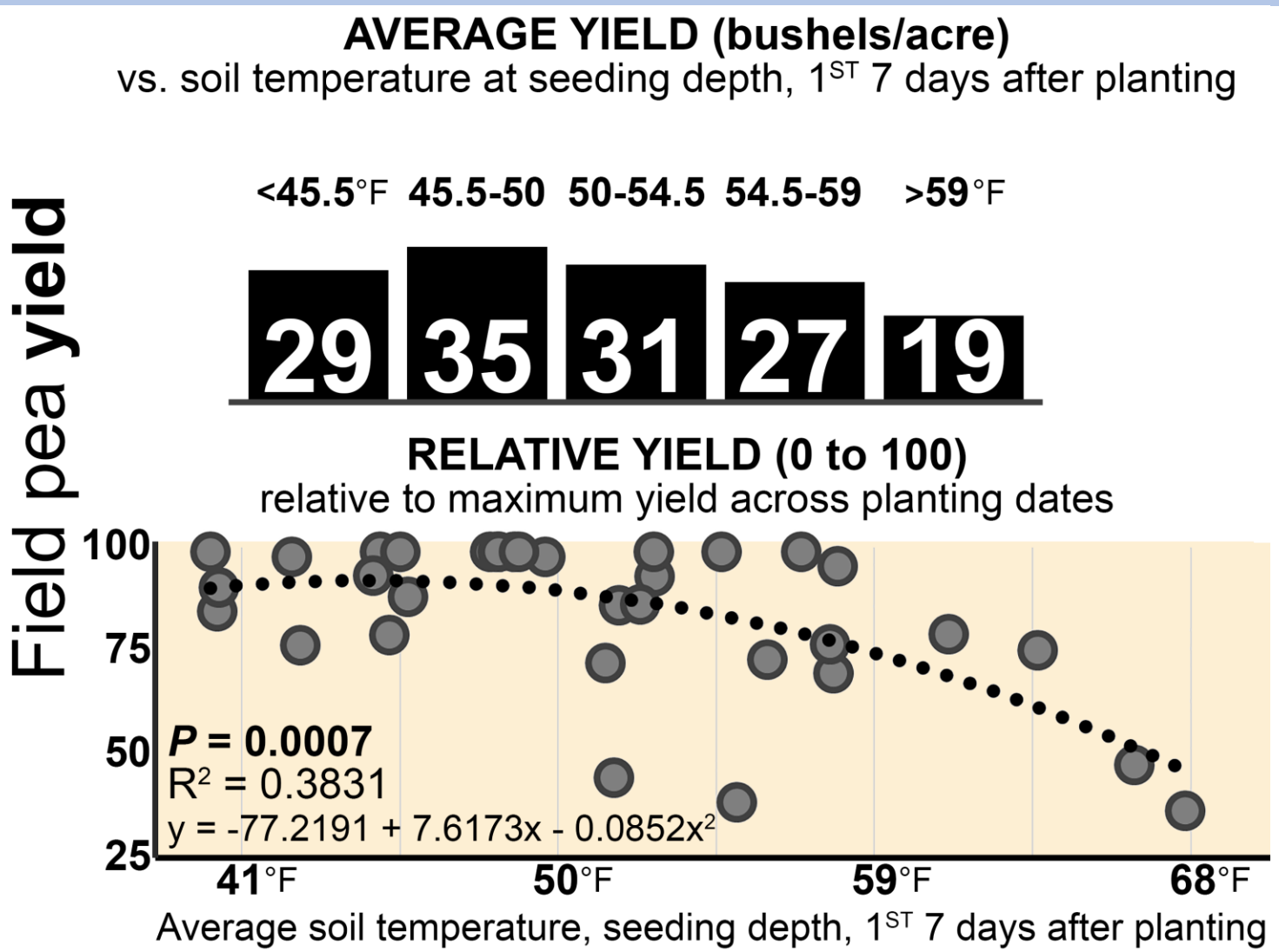
Fusarium and Aphanomyces root rot of field peas

Optimizing planting date:
Fields with elevated **native root rot pressure**

Fields with root rot caused by a long history of field pea and lentil production.
Williams, Mountrail and McLean Counties (2019, 2020); Foster County (2017-2020)

Yield optimized when soil temperature was 45.5-50°F (7 days after planting at 2" seeding depth).

Presented are average results for field peas grown without fungicide seed treatment or with various different seed treatments.



Fusarium and Aphanomyces root rot of field peas

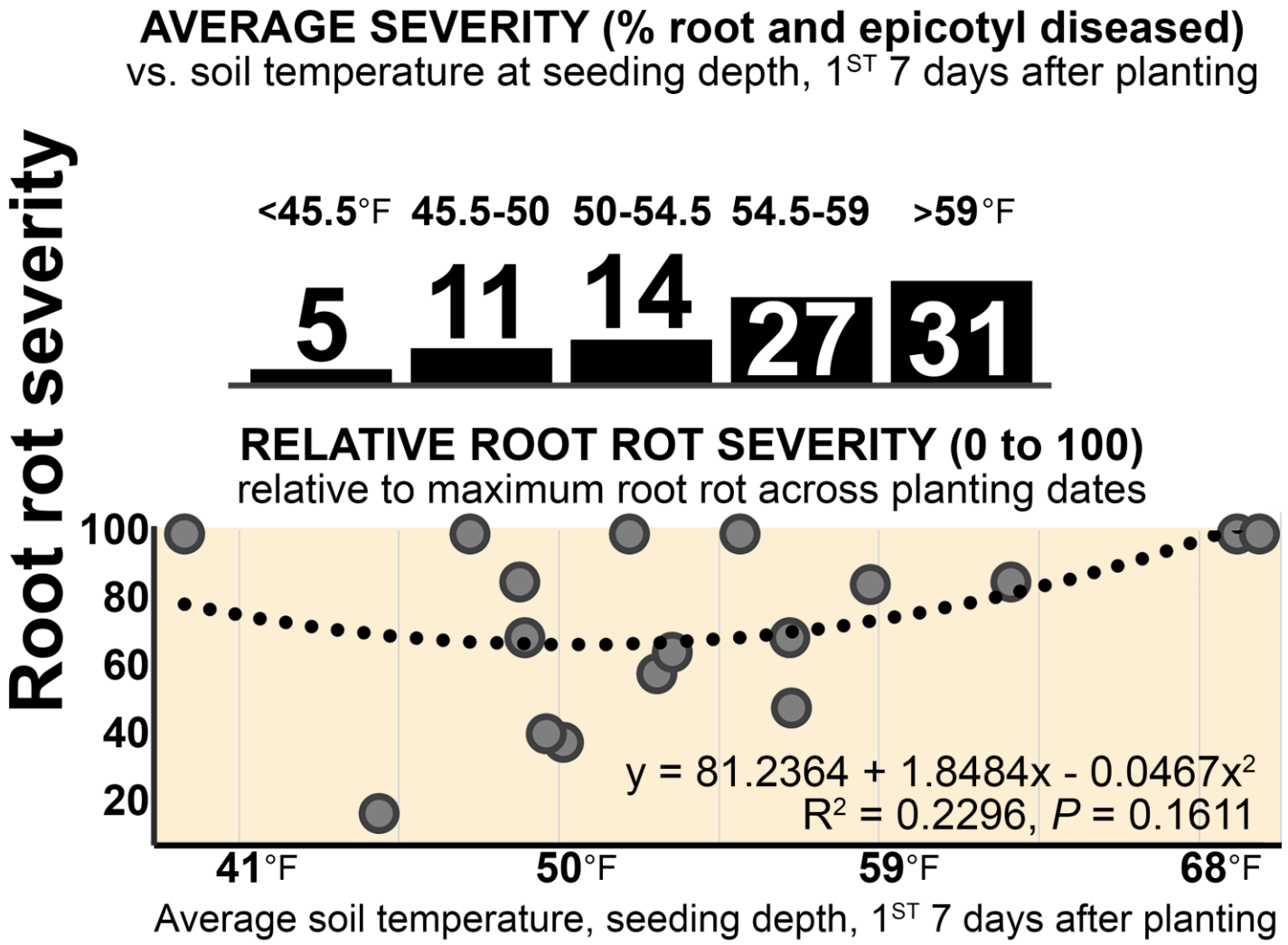
Optimizing planting date:

Studies inoculated with the Fusarium root rot pathogen

Fields without a long history of field pea & lentil production and without native root rot pressure.
Williams and Foster County (2017-2019)

Root rot was minimized when soil temperature was < 54.5°F (7 days after planting at 2" seeding depth).

Presented are average results for field peas grown without fungicide seed treatment or with various different seed treatments.



Fusarium and Aphanomyces root rot of field peas

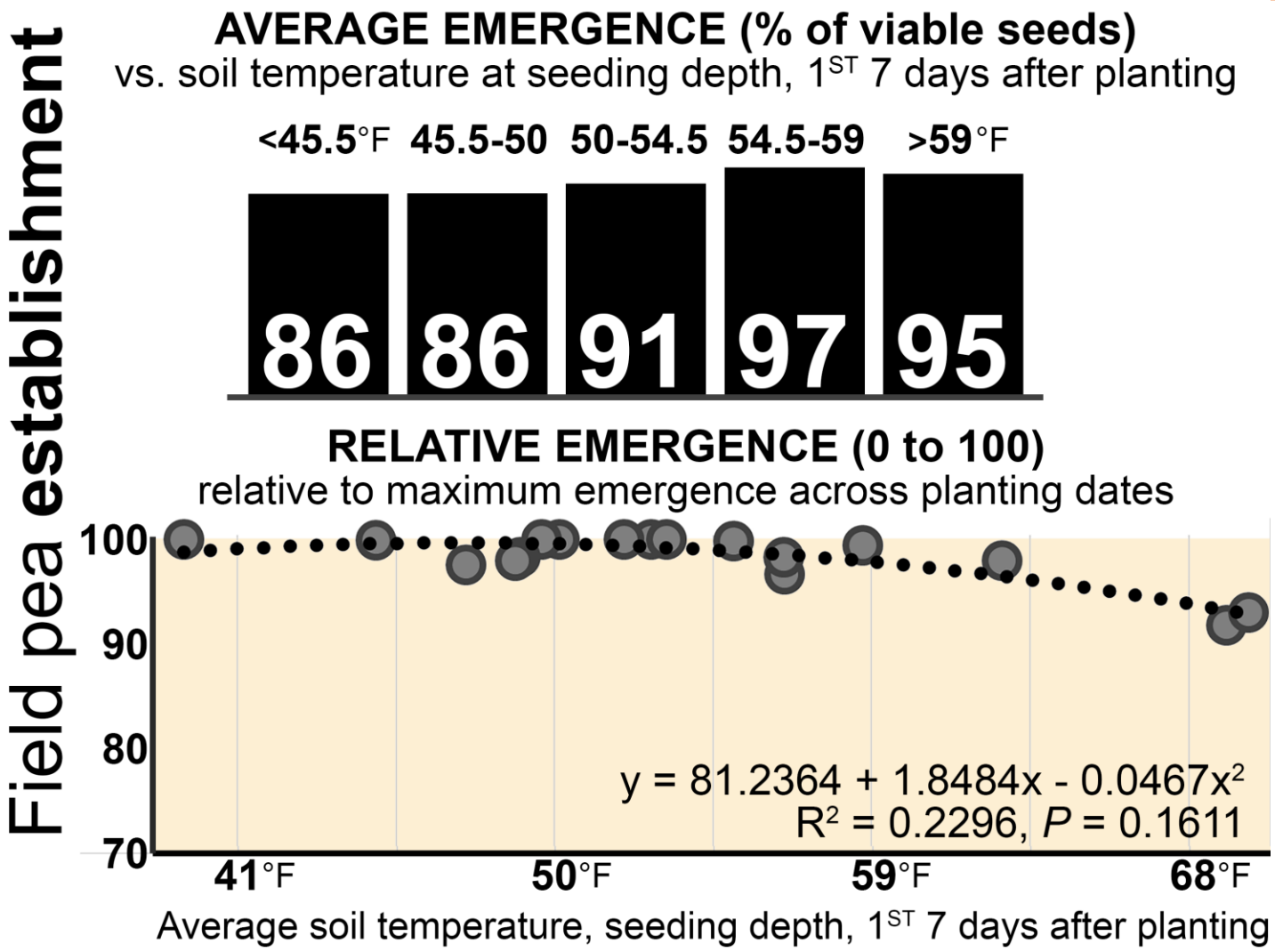
Optimizing planting date:

Studies inoculated with the Fusarium root rot pathogen

Fields without a long history of field pea & lentil production and without native root rot pressure.
Williams and Foster County (2017-2019)

Establishment was only slightly reduced in cold soils
(7 days after planting at 2" seeding depth).

Presented are average results for field peas grown without fungicide seed treatment or with various different seed treatments.



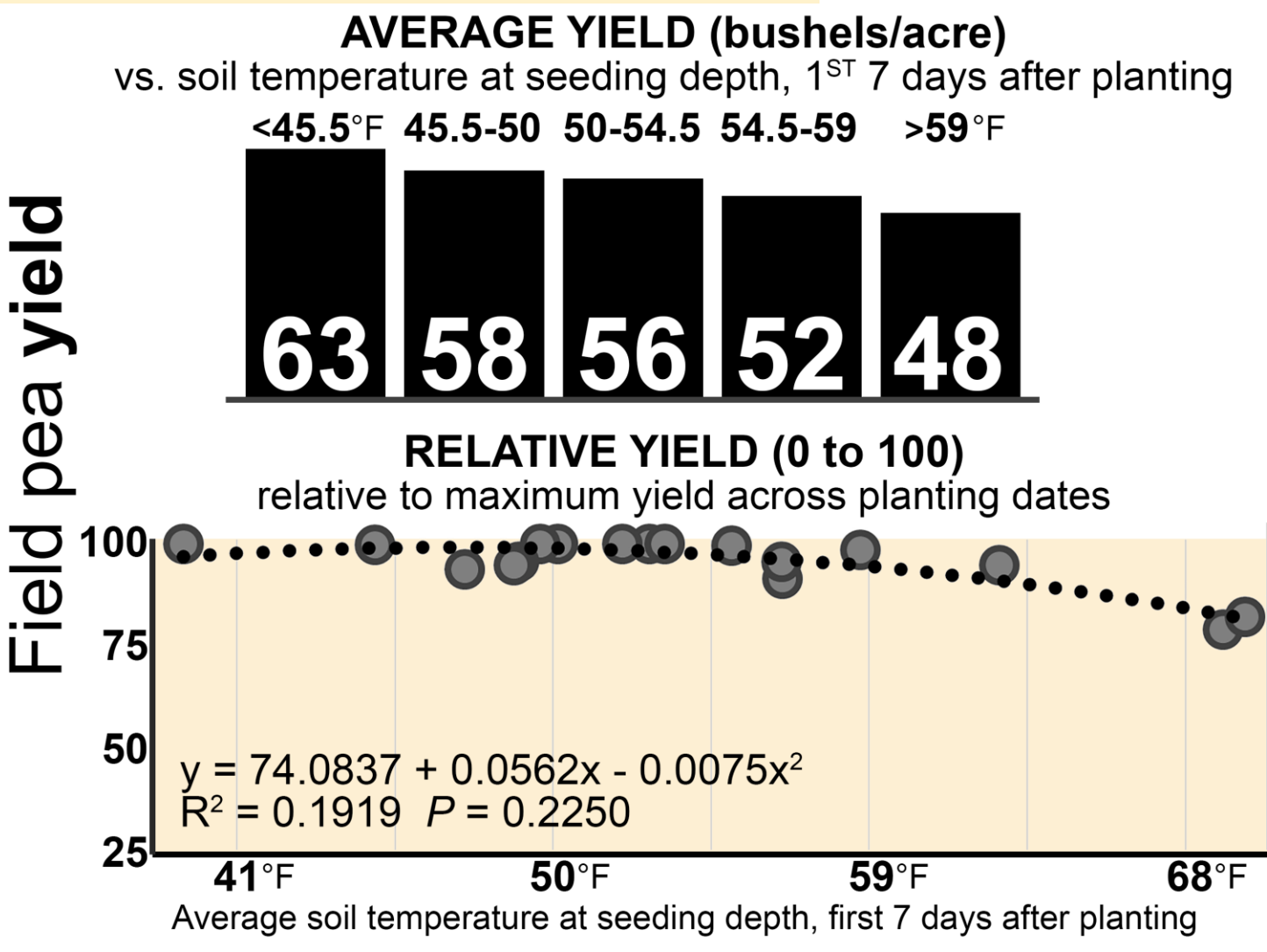
Fusarium and Aphanomyces root rot of field peas

Optimizing planting date:
Studies inoculated with the Fusarium root rot pathogen

Fields without a long history of field pea & lentil production and without native root rot pressure.
Williams and Foster County (2017-2019)

Yield optimized when soil temperature was <45.5°F (7 days after planting at 2" seeding depth).

Presented are average results for field peas grown without fungicide seed treatment or with various different seed treatments.



Fusarium and Aphanomyces root rot of field peas

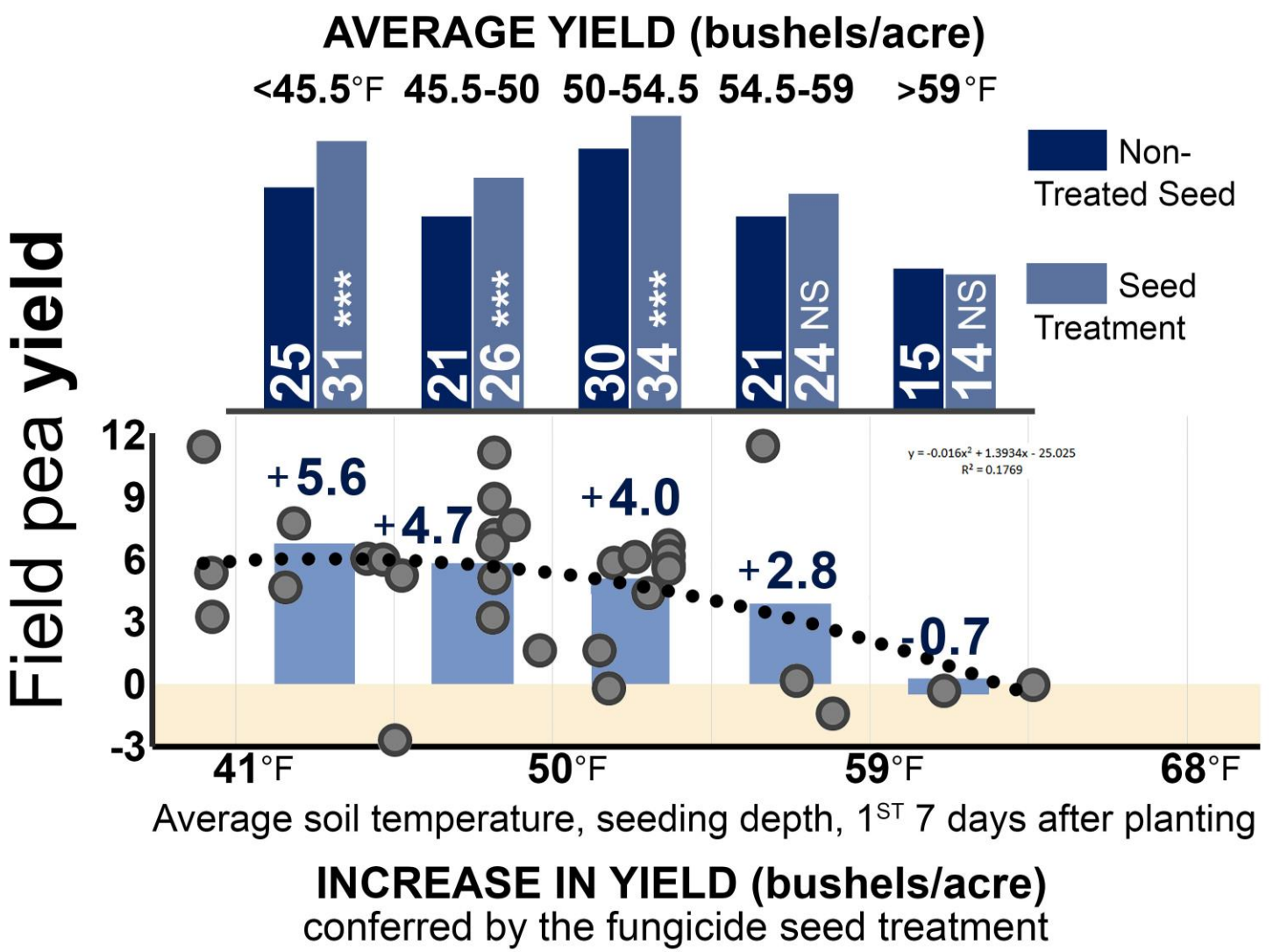
Efficacy of fungicide seed treatments:
Fields with elevated **native root rot pressure**

Fields with root rot caused by a long history of field pea and lentil production.
Williams, Mountrail and McLean Counties (2019, 2020); Foster County (2017-2022)

IMPACT OF SEED TREATMENT ON YIELD

Seed treatment with **Obvius (4.6 fl oz/cwt)** conferred average yield gains of **4.0 to 5.6 bu/ac** when soil temp. was <54.5°F in the first 7 days after planting

(soil temperature at 2-inch seeding depth)



Fusarium and Aphanomyces root rot of field peas

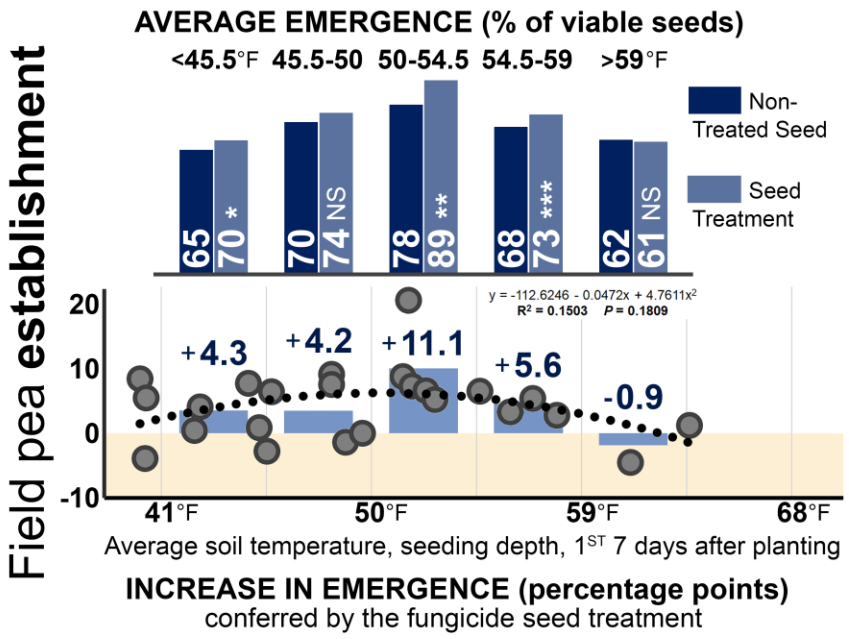
Efficacy of fungicide seed treatments:
Fields with elevated **native root rot pressure**

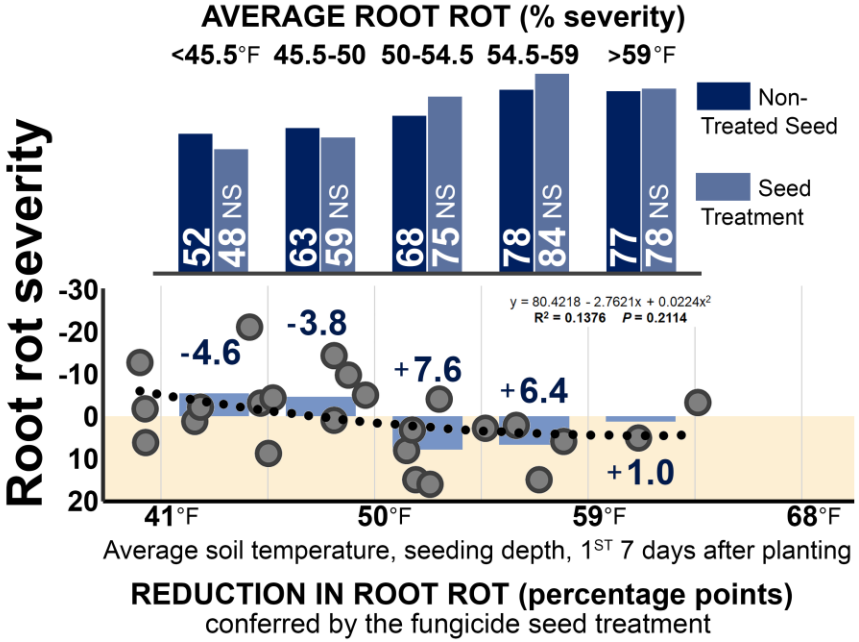
Fields with root rot caused by a long history of field pea and lentil production.
Williams, Mountrail and McLean Counties (2019, 2020); Foster County (2017-2020)

SEED TREATMENT WITH OBVIUS (4.6 FL OZ/CWT):

Yield gains from the seed treatment were conferred primarily by improvements in field pea establishment, not reductions in root rot.

Impact of seed treatment with Obvius (4.6 fl oz/cwt) on **emergence** and **root rot severity**:





Fusarium and Aphanomyces root rot of field peas

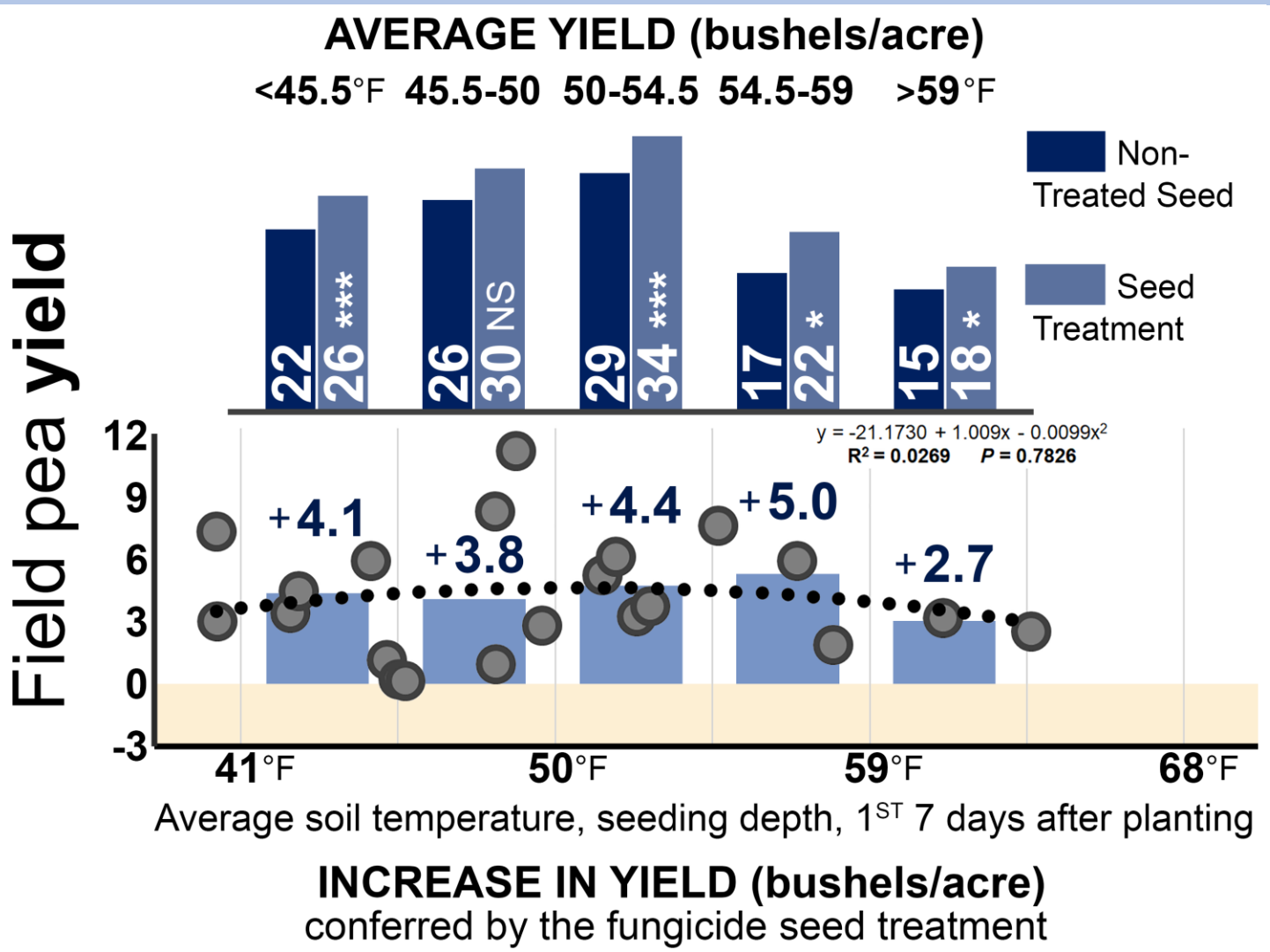
Efficacy of fungicide seed treatments:
Fields with elevated **native root rot pressure**

Fields with root rot caused by a long history of field pea and lentil production.
Williams, Mountrail and McLean Counties (2019, 2020); Foster County (2017-2020)

IMPACT OF SEED TREATMENT ON YIELD

Seed treatment with **Xtend C** (0.38 fl oz) + **Proline** (0.26 fl oz) + **Allegiance** (0.25 oz) conferred average yield gains of **3.8 to 4.4 bu/ac** when soil temp. was <54.5°F in the first 7 days after planting

(soil temperature at 2-inch seeding depth)



Fusarium and Aphanomyces root rot of field peas

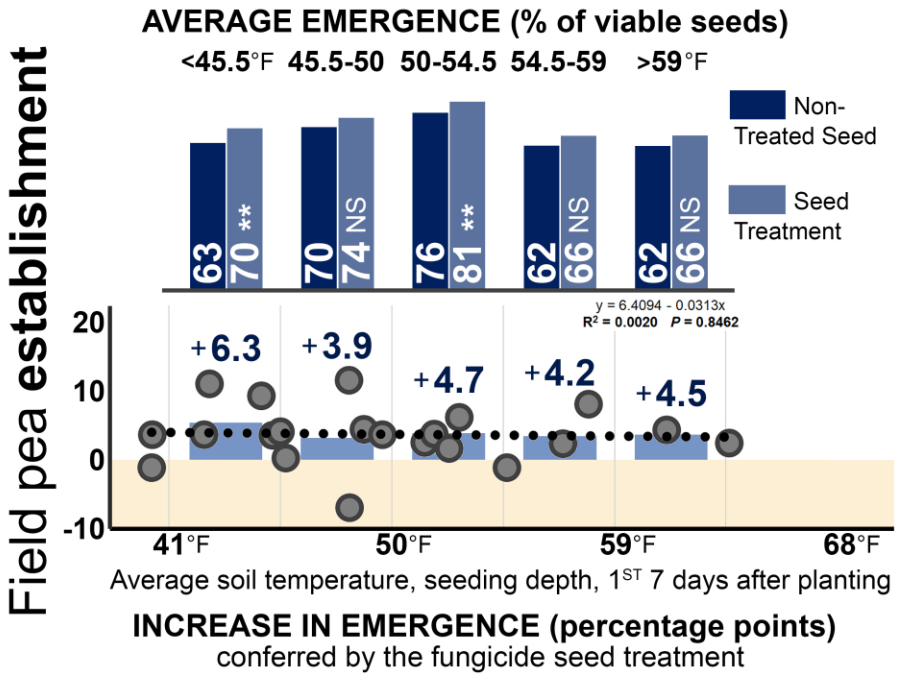
Efficacy of fungicide seed treatments:
Fields with elevated **native root rot pressure**

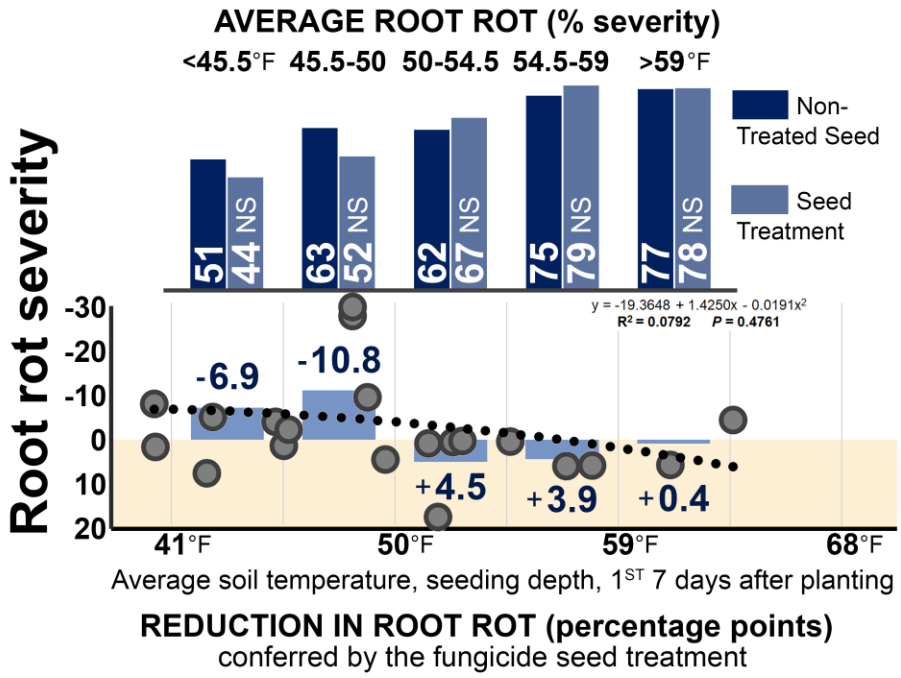
Fields with root rot caused by a long history of field pea and lentil production.
Williams, Mountrail and McLean Counties (2019, 2020); Foster County (2017-2020)

SEED TREATMENT WITH XTEND C (0.38 fl oz/cwt) + PROLINE (0.26 fl oz/cwt) + ALLEGIANCE (0.25 fl oz/cwt):

Yield gains from the seed treatment were conferred primarily by improvements in field pea establishment, not reductions in root rot.

Impact of seed treatment with Xtend C + Proline + Allegiance on **emergence** and **root rot**:



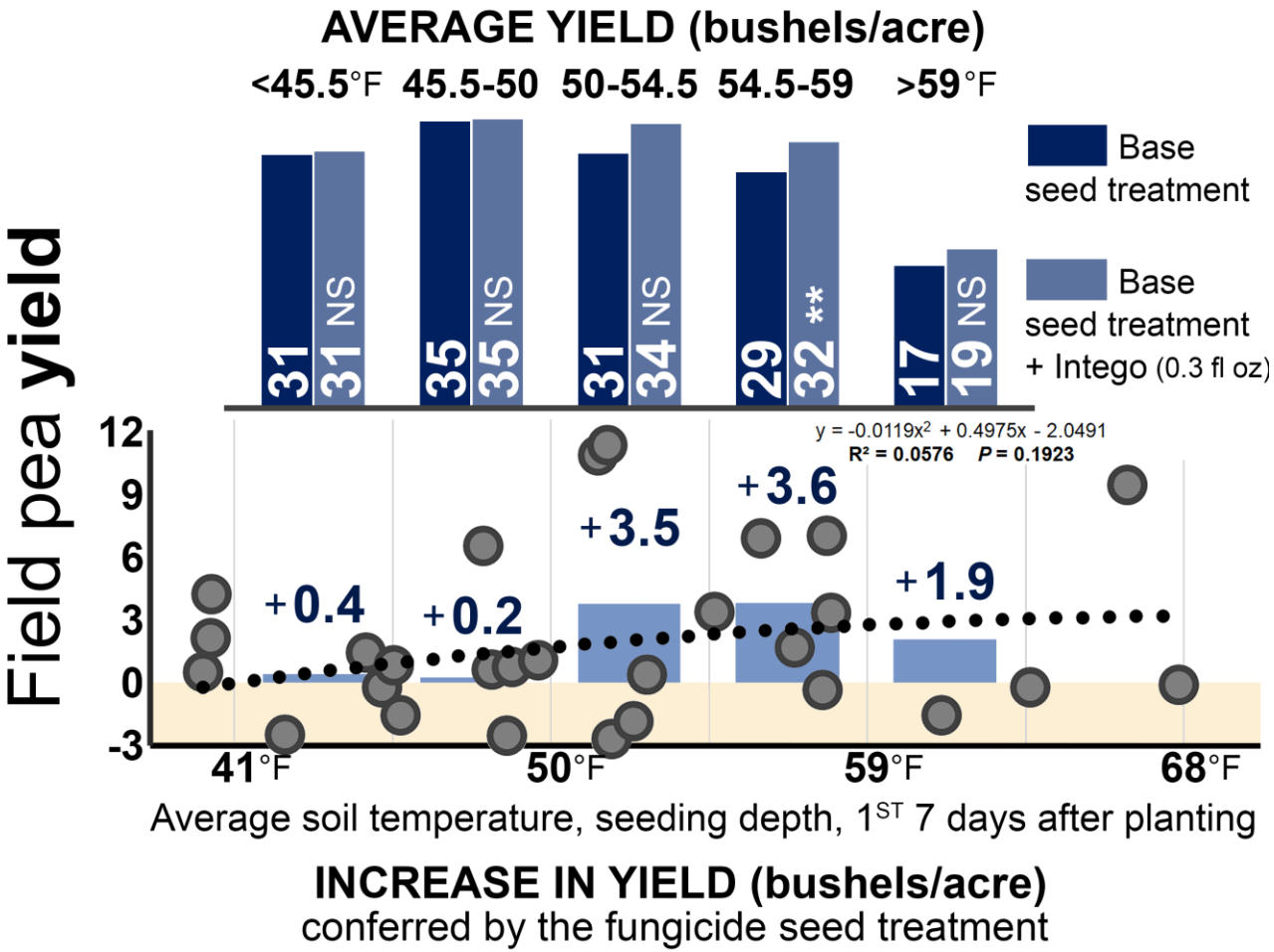


Fusarium and Aphanomyces root rot of field peas

Efficacy of fungicide seed treatments:
Fields with elevated **native root rot pressure**

Seed treatment with **Intego Solo** (0.3 fl oz/cwt) only conferred consistent yield gains when soil temperature was 54.5-59°F in the first 7 days after planting (soil temp. at 2-inch depth).
HIGHER YIELDS WERE ACHIEVED BY PLANTING INTO COOLER SOILS WITHOUT INTEGO.

Intego Solo was tested as an addition to seed treatment packages with efficacy against Pythium, Rhizoctonia, Fusarium and insect pests.



Fusarium and Aphanomyces root rot of field peas

Efficacy of fungicide seed treatments:
Fields with elevated **native root rot pressure**

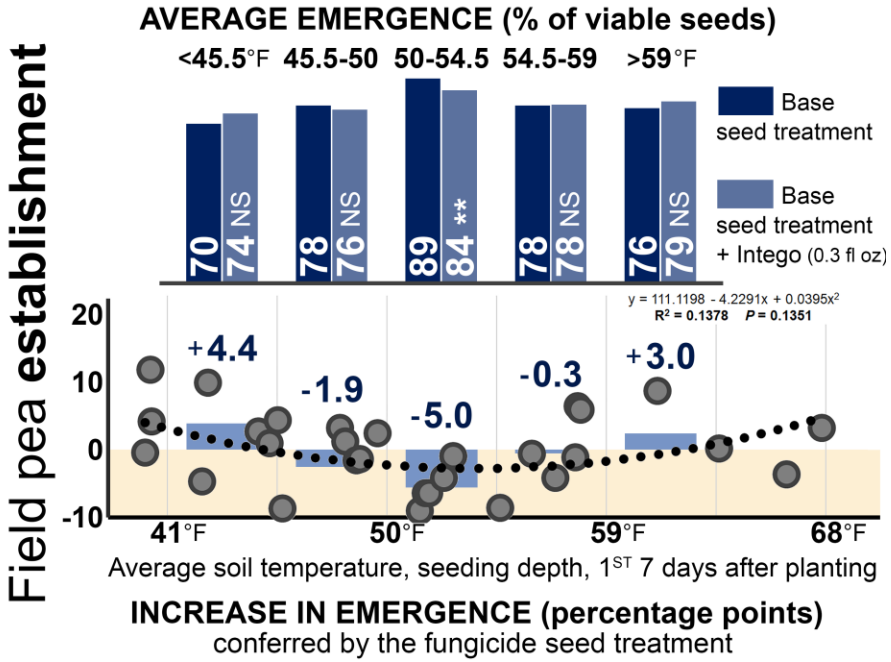
Fields with root rot caused by a long history of field pea and lentil production.
Williams, Mountrail and McLean Counties (2019, 2020); Foster County (2017-2020)

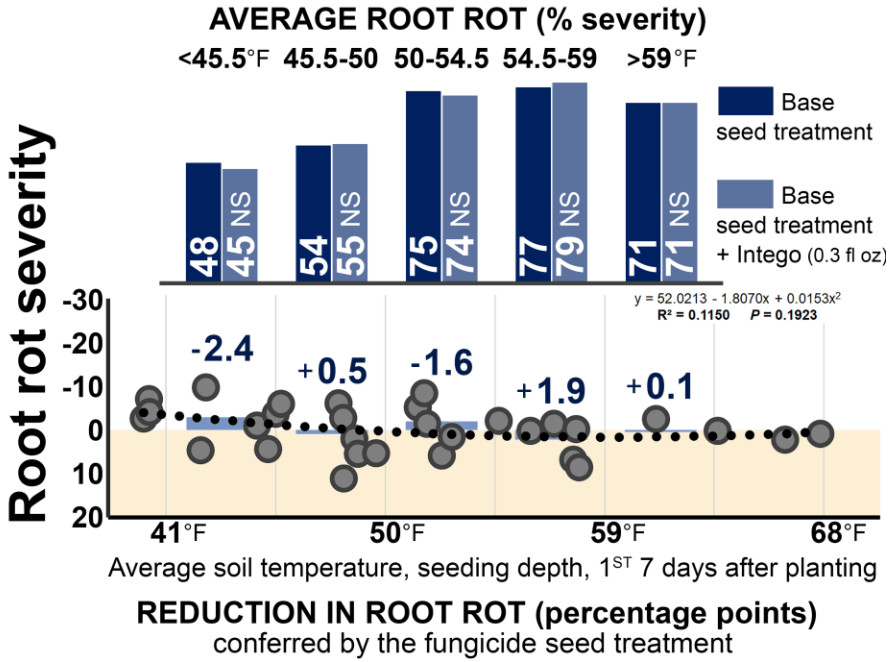
ADDING INTEGO SOLO (0.3 fl oz/cwt) to a base seed treatment with efficacy against Rhizoctonia, Pythium and insect pests:

Intego solo had little or no effect on root rot severity, and increased field pea establishment only under very cool or very warm soils (highly favorable for Pythium or Aphanomyces).

Intego Solo exhibits moderate phytotoxicity to field peas and should not be applied above 0.4 fl oz/cwt. The reduction in field pea emergence observed at 50-54.5°F, soil temperatures not favorable for the pathogens controlled by Intego (Pythium and Aphanomyces), is a reflection of this moderate phytotoxicity

Impact of seed treatment with Intego Solo on **emergence** and **root rot severity**:





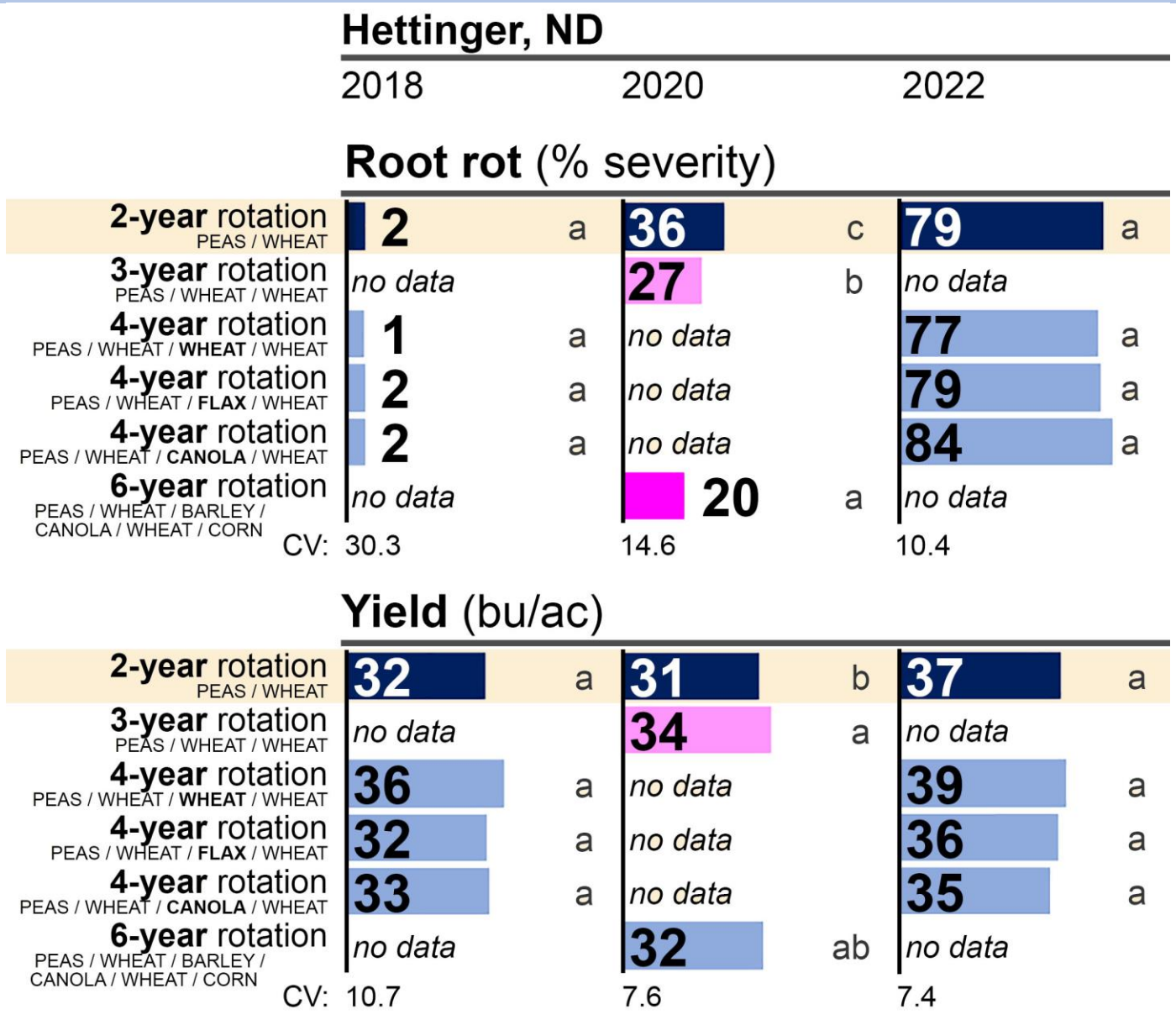
Fusarium and Aphanomyces root rot of field peas

Impact of crop rotation: Hettinger, ND

field with no prior history of field peas & root rot

Root rot elevated by the 4th time peas were grown but impact on yield not yet observed

6-year rotation but not shorter rotations reduced root rot severity



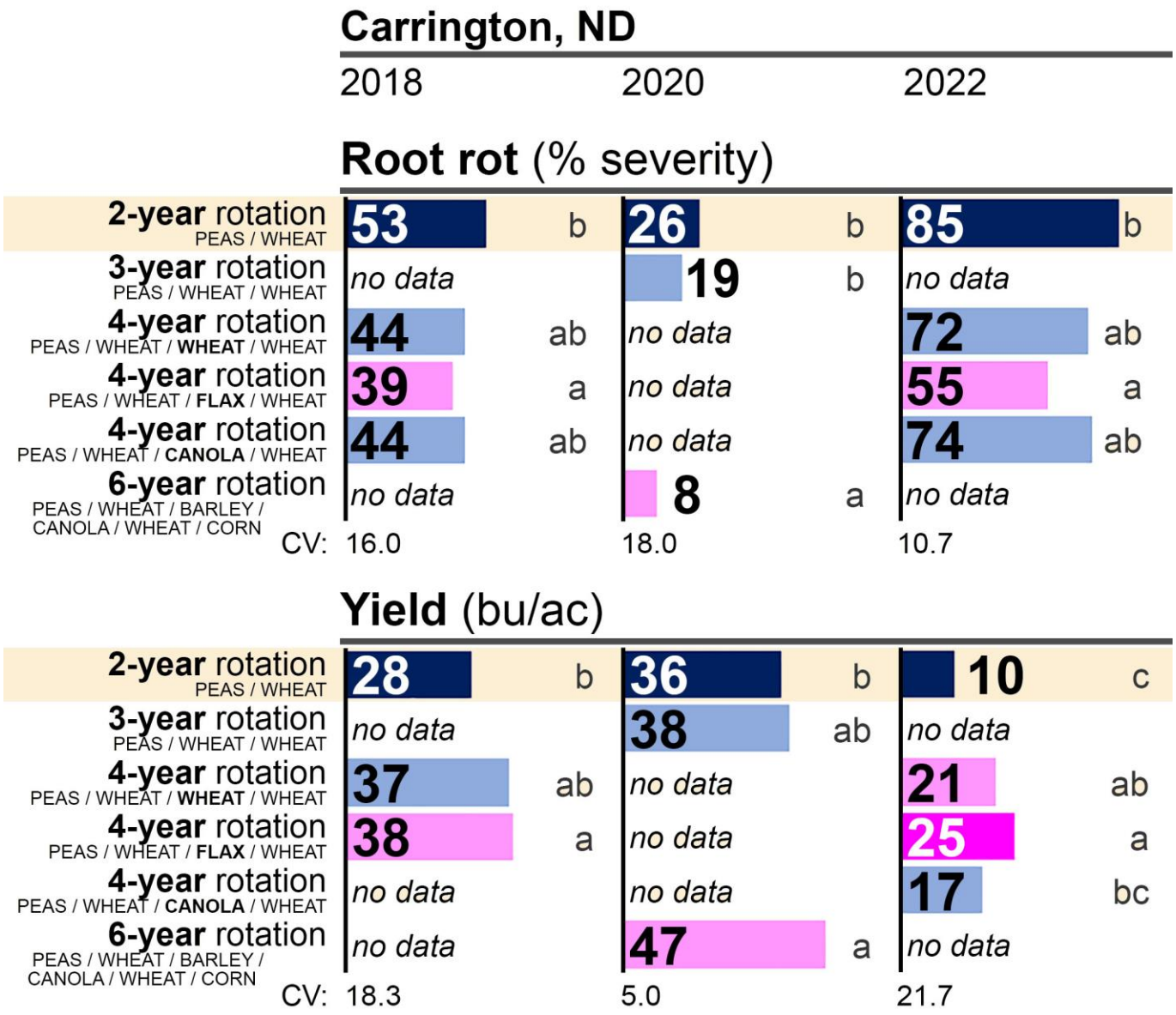
Fusarium and Aphanomyces root rot of field peas

Impact of crop rotation: Carrington, ND

field with a long history of field peas; elevated native root rot pressure

Root rot elevated by the 4th time peas were grown but impact on yield not yet observed

6-year rotation but not shorter rotations reduced root rot severity



Fusarium and Aphanomyces root rot of field peas

The results suggest that **integrating (1) early planting, (2) fungicide seed treatment**, and **(3) crop rotation** may confer satisfactory management of root rot in fields with high Fusarium and Aphanomyces root rot pressure

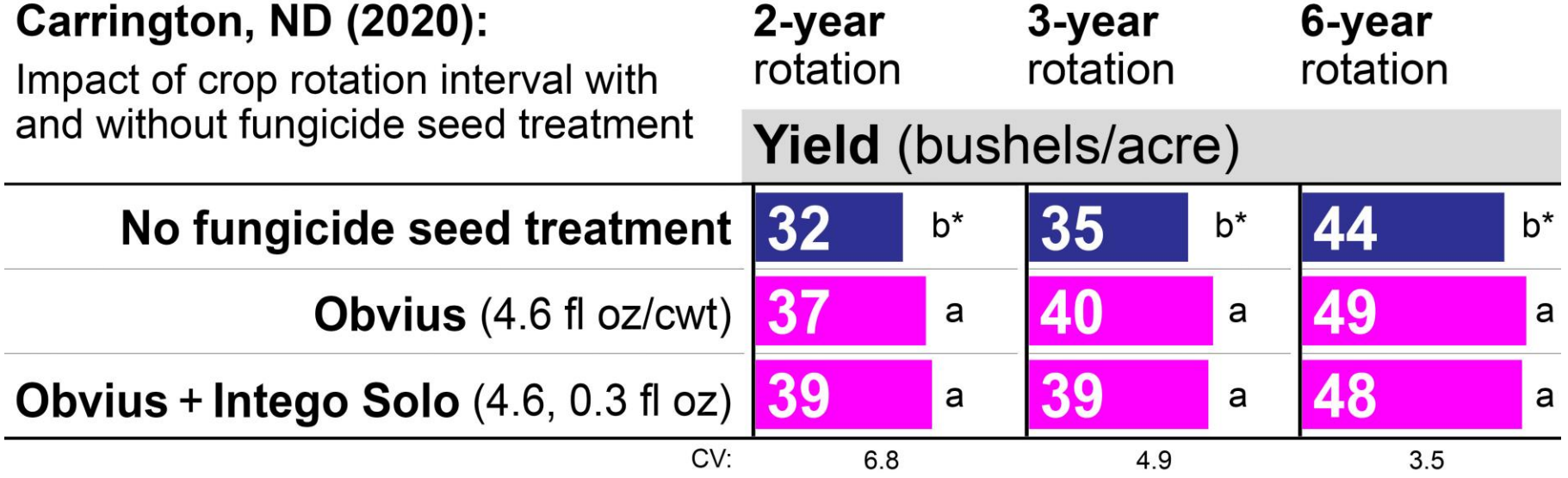
- None of these treatments confer satisfactory management on their own
- The additive effects of each management strategy appear to be needed
- These findings need to be verified.

Carrington crop rotation study

Results when early planting (soil temperature 45.5-50°F at 2-inch deep in the 7 days after planting) was combined with fungicide seed treatment and crop rotation:

Carrington, ND (2020):

Impact of crop rotation interval with and without fungicide seed treatment



Improving the management of Fusarium and Aphanomyces root rot in **lentils**

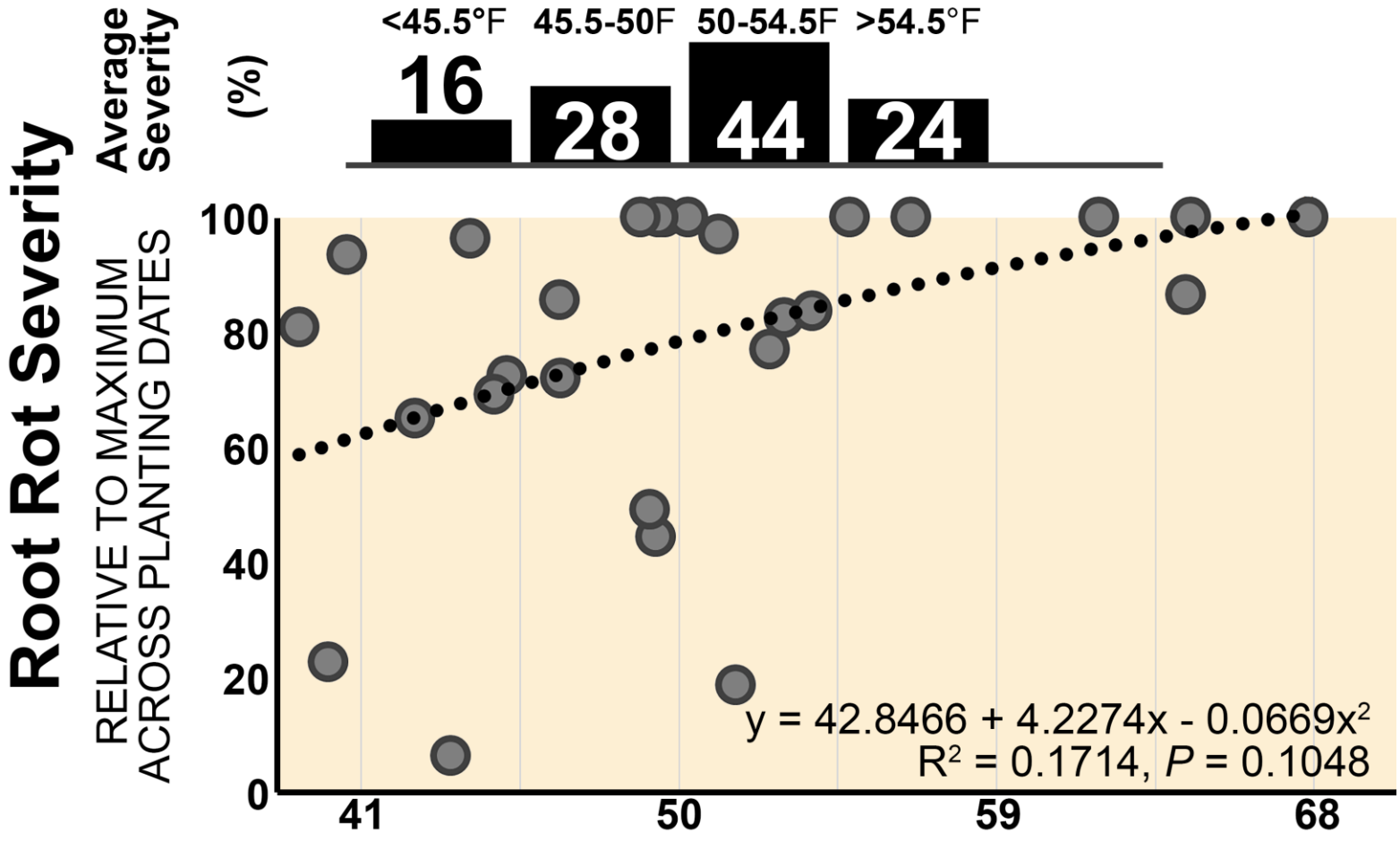
Optimizing planting date
and **fungicide seed treatment**

Fusarium and Aphanomyces root rot of lentils

Optimizing planting date:
Fields with elevated **native root rot pressure**

Fields with root rot caused by a long history of field pea and lentil production.
Williams, Mountrail and McLean Counties (2019, 2020); Foster County (2018-2020)

Root rot was minimized when soil temperature was < 50°F
(7 days after planting at 1.5" seeding depth).



Presented are average results for lentils grown without fungicide seed treatment or with various different seed treatments.

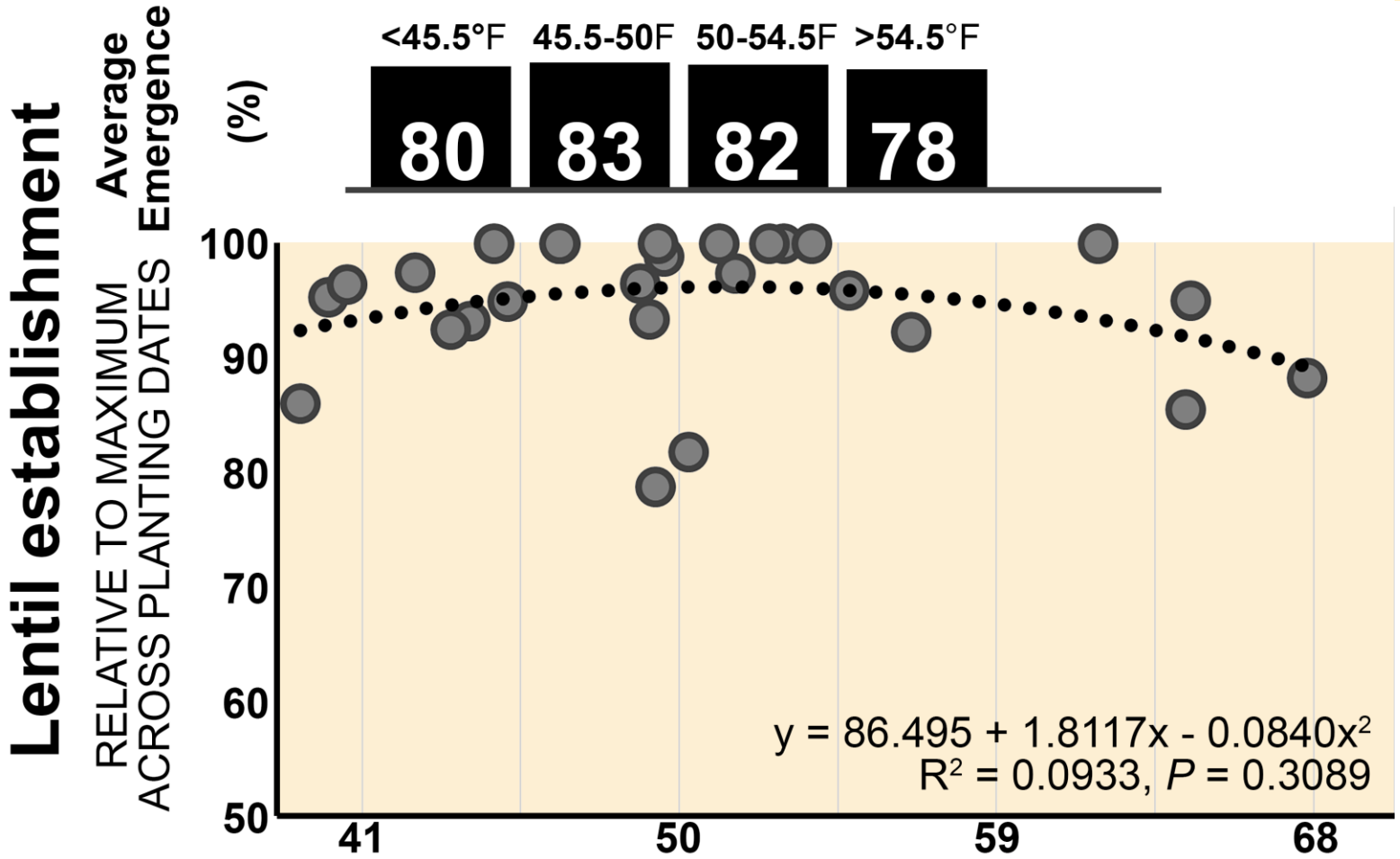
Fusarium and Aphanomyces root rot of lentils

Optimizing planting date:
Fields with elevated **native root rot pressure**

Fields with root rot caused by a long history of field pea and lentil production.
Williams, Mountrail and McLean Counties (2019, 2020); Foster County (2018-2020)

Establishment was not strongly influenced by soil temperature
(7 days after planting at 1.5" seeding depth).

Presented are average results for lentils grown without fungicide seed treatment or with various different seed treatments.



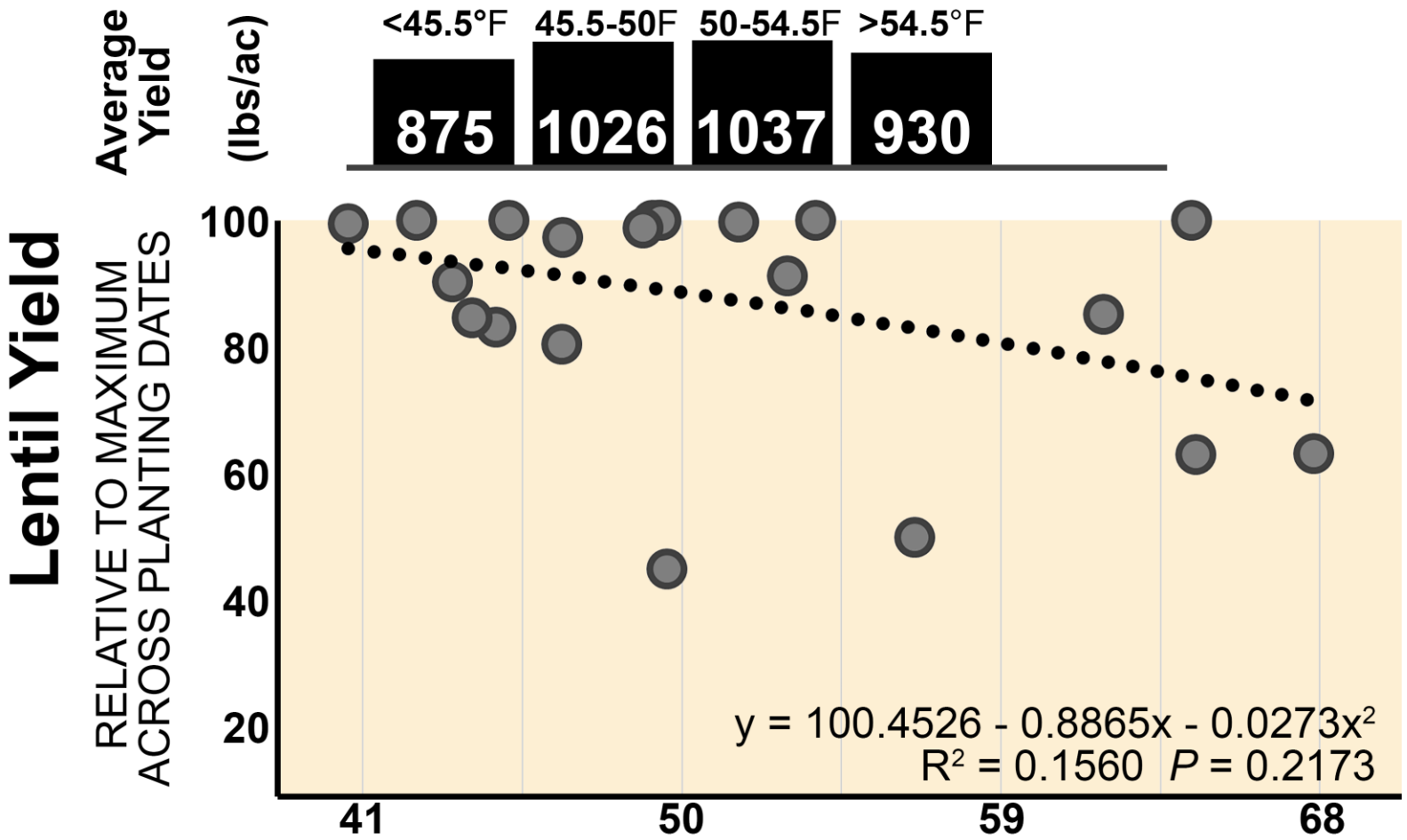
Fusarium and Aphanomyces root rot of lentils

Optimizing planting date:
Fields with elevated **native root rot pressure**

Fields with root rot caused by a long history of field pea and lentil production.
Williams, Mountrail and McLean Counties (2019, 2020); Foster County (2018-2020)

Yields were most consistently optimized when soil temperatures < 49°F
(7 days after planting at 1.5" seeding depth).

Presented are average results for lentils grown without fungicide seed treatment or with various different seed treatments.



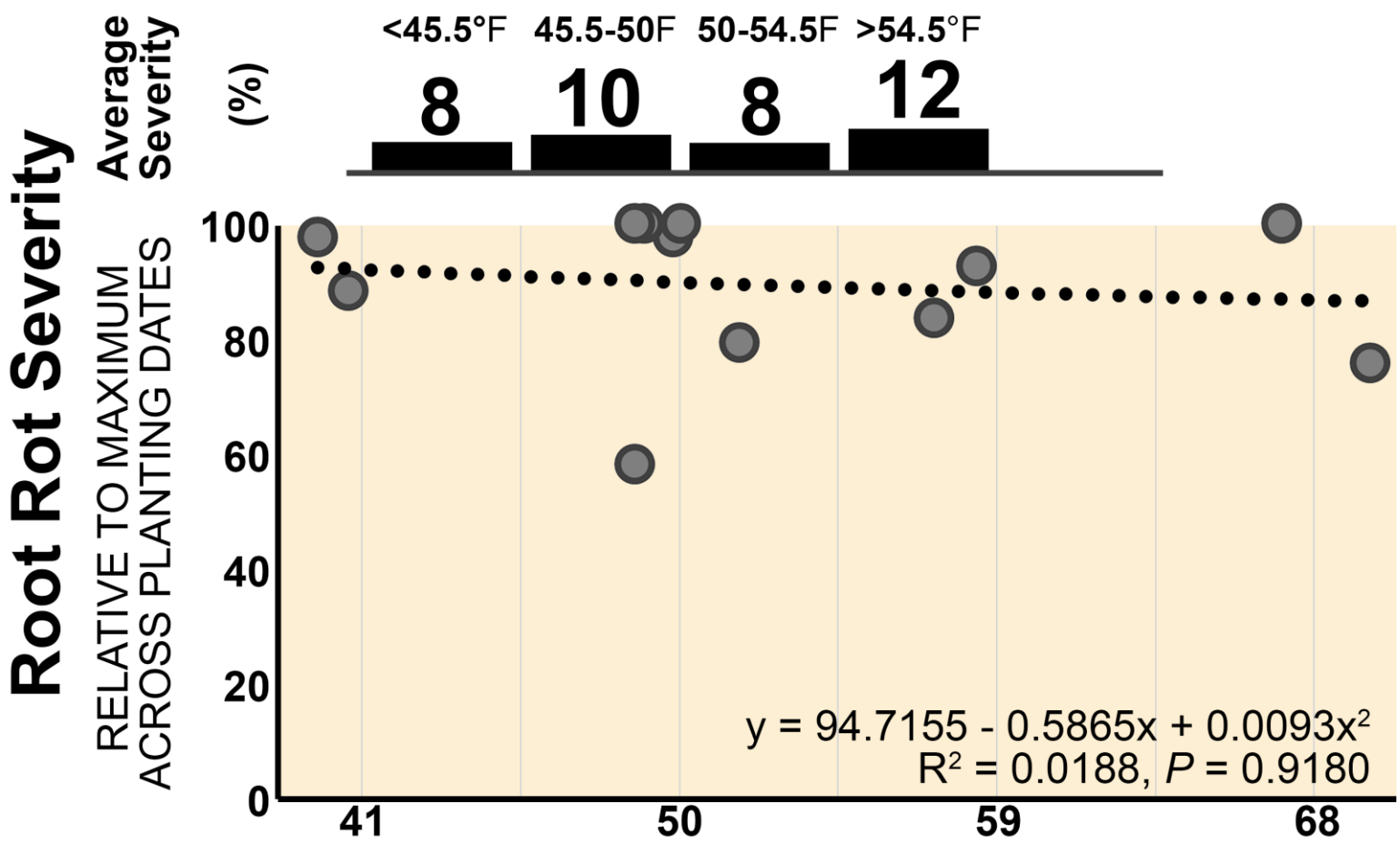
Fusarium and Aphanomyces root rot of lentils

Optimizing planting date:

Studies inoculated with the Fusarium root rot pathogen

Fields without a long history of field pea & lentil production and without native root rot pressure.
Williams and Foster County (2017-2019)

Root rot was low and not strongly influenced by soil temperatures
(7 days after planting at 1.5” seeding depth).



Presented are average results for lentils grown without fungicide seed treatment or with various different seed treatments.

Fusarium and Aphanomyces root rot of lentils

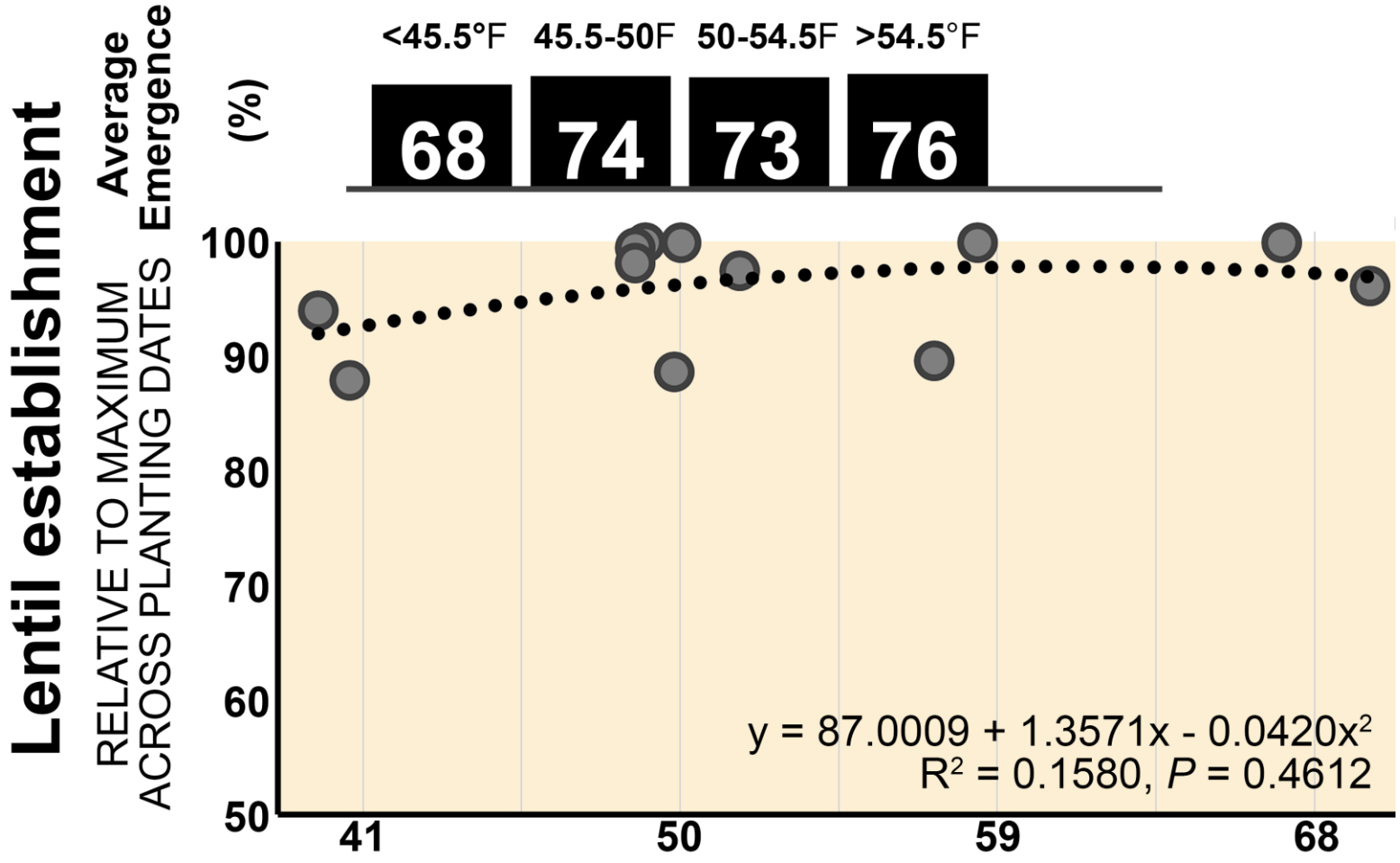
Optimizing planting date:

Studies inoculated with the Fusarium root rot pathogen

Fields without a long history of field pea & lentil production and without native root rot pressure.
Williams and Foster County (2017-2019)

Establishment was only slightly reduced in cold soils
(7 days after planting at 1.5" seeding depth).

Presented are average results for lentils grown without fungicide seed treatment or with various different seed treatments.



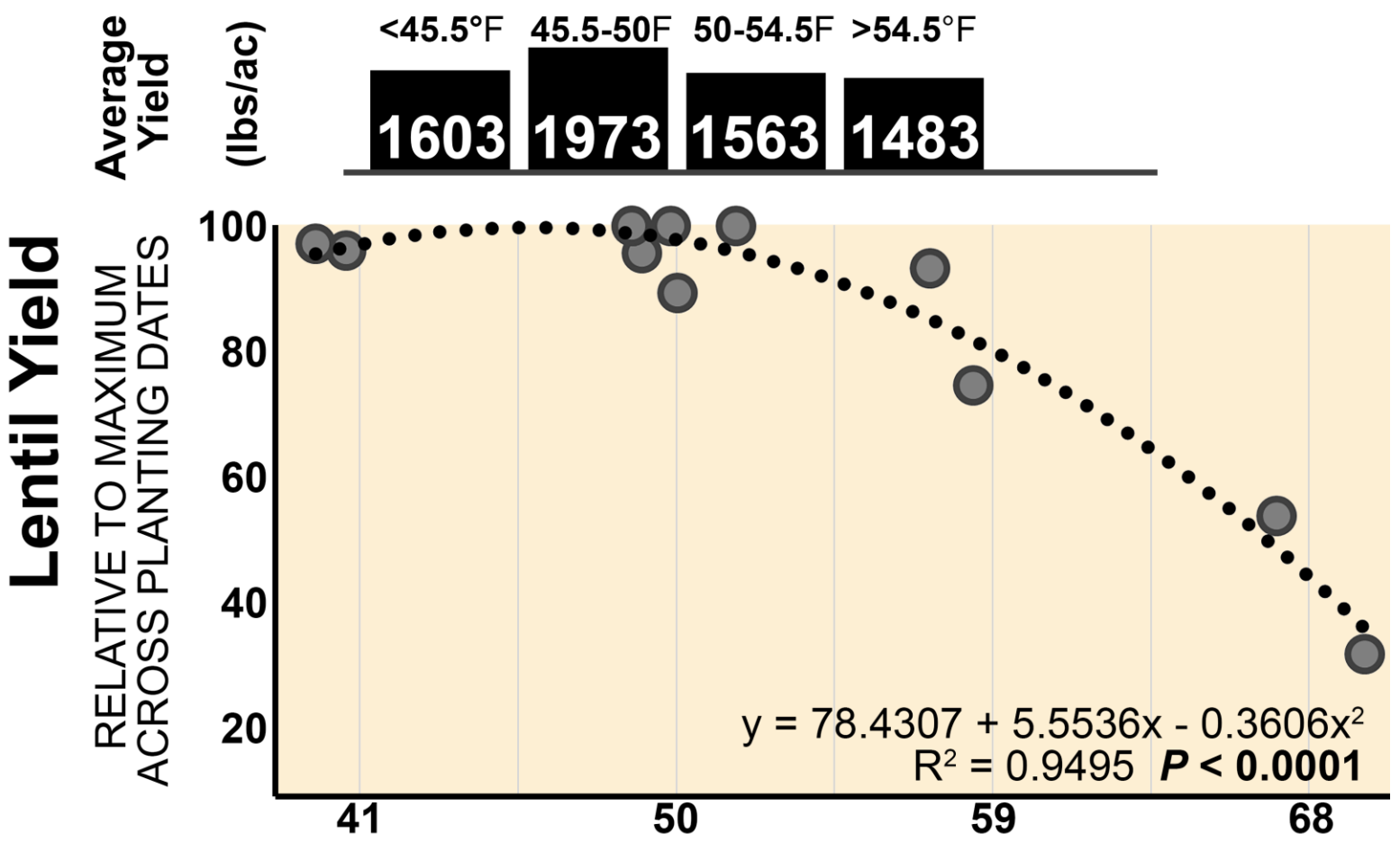
Fusarium and Aphanomyces root rot of lentils

Optimizing planting date:

Studies inoculated with the Fusarium root rot pathogen

Fields without a long history of field pea & lentil production and without native root rot pressure.
Williams and Foster County (2017-2019)

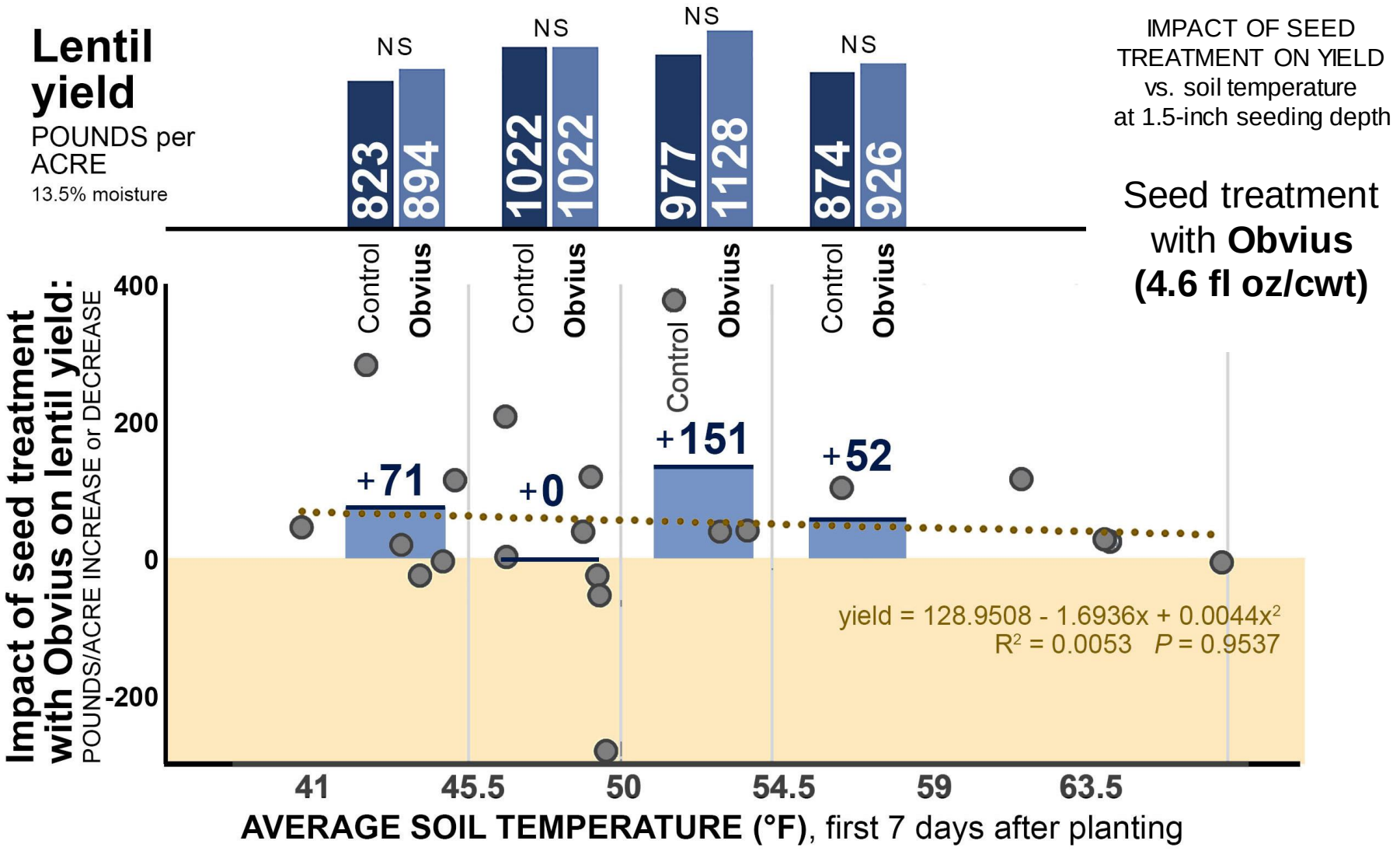
Yield optimized when soil temperature was 45.5-50°F
(7 days after planting at 1.5" seeding depth).



Presented are average results for lentils grown without fungicide seed treatment or with various different seed treatments.

Efficacy of fungicide seed treatments:
Fields with elevated **native root rot pressure**

Fields with root rot caused by a long history of field pea and lentil production.
Williams, Mountrail and McLean Counties (2019, 2020); Foster County (2018-2020)



Fusarium and Aphanomyces root rot of lentils

Efficacy of fungicide seed treatments:
Fields with elevated **native root rot pressure**

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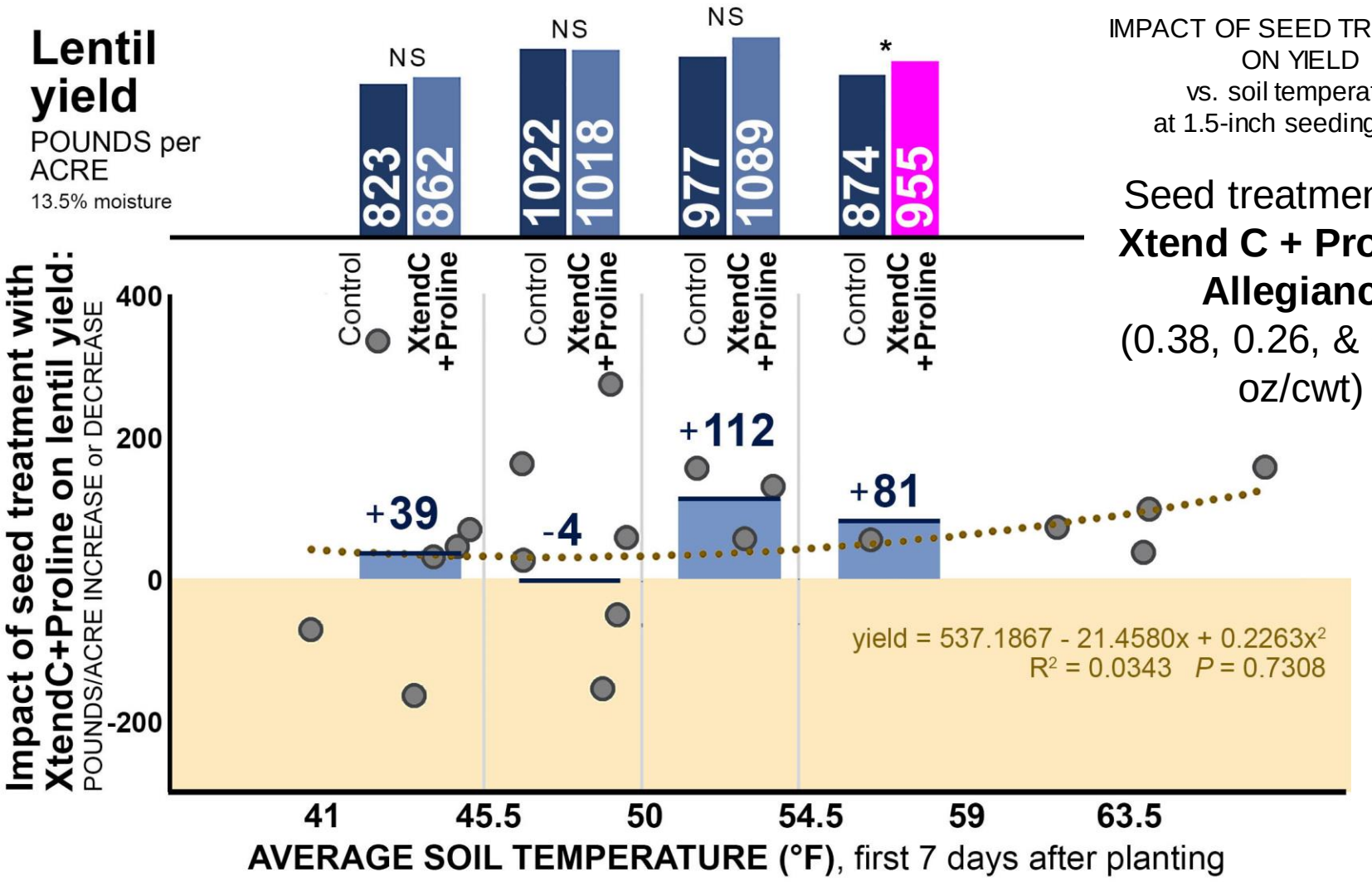
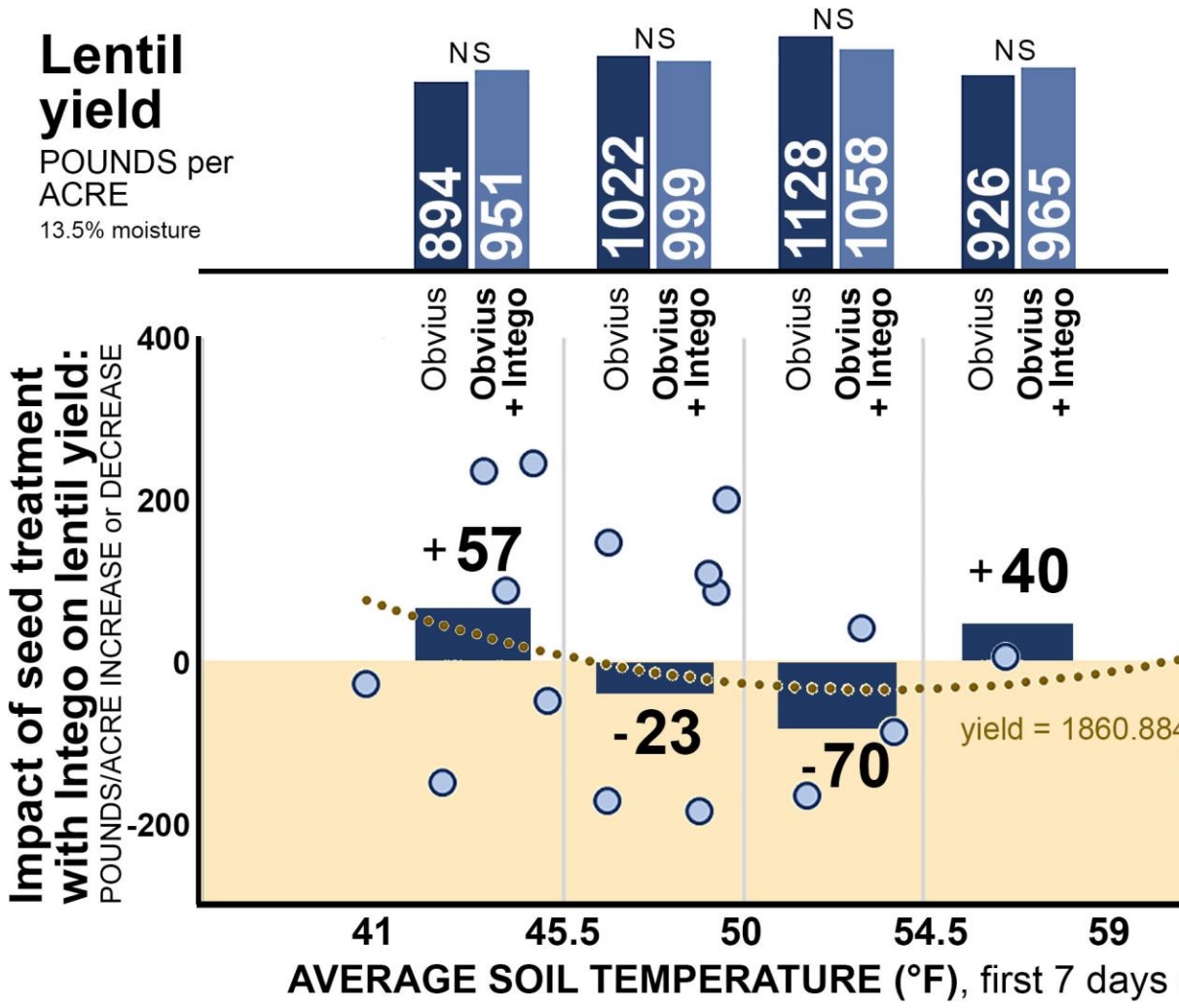


IMPACT OF SEED TREATMENT ON YIELD
vs. soil temperature
at 1.5-inch seeding depth

Seed treatment with **Xtend C + Proline + Allegiance** (0.38, 0.26, & 0.25 fl oz/cwt)

Efficacy of fungicide seed treatments:
Fields with elevated **native root rot pressure**

Fields with root rot caused by a long history of field pea and lentil production.
Williams, Mountrail and McLean Counties (2019, 2020); Foster County (2017-2020)



IMPACT OF SEED TREATMENT ON YIELD
vs. soil temperature
at 1.5-inch seeding depth

Seed treatment with **base seed treatment** targeting Pythium, Rhizoctonia & Fusarium (Obvius @ 4.6 fl oz/cwt) **with and without Intego** (0.3 fl oz/cwt)

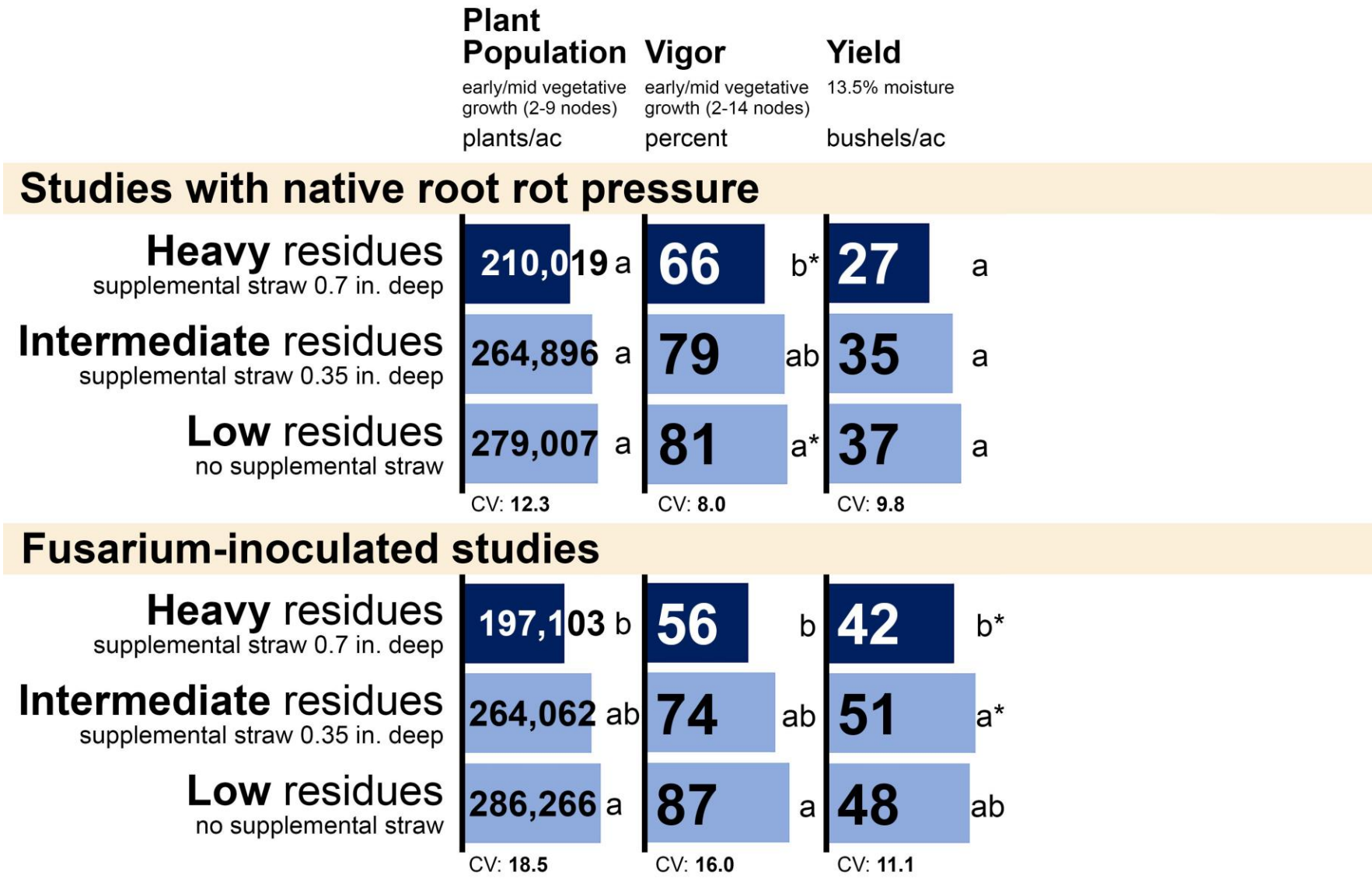
Impact of crop residues on Fusarium & Aphanomyces root rot in **field peas**

Data from replicated field studies conducted in Carrington and Williston, ND from 2017-2019

Fusarium and Aphanomyces root rot of field peas

Impact of crop residue levels

Replicated field studies - Carrington (2017, 2018, 2019); Williston (2018, 2019)

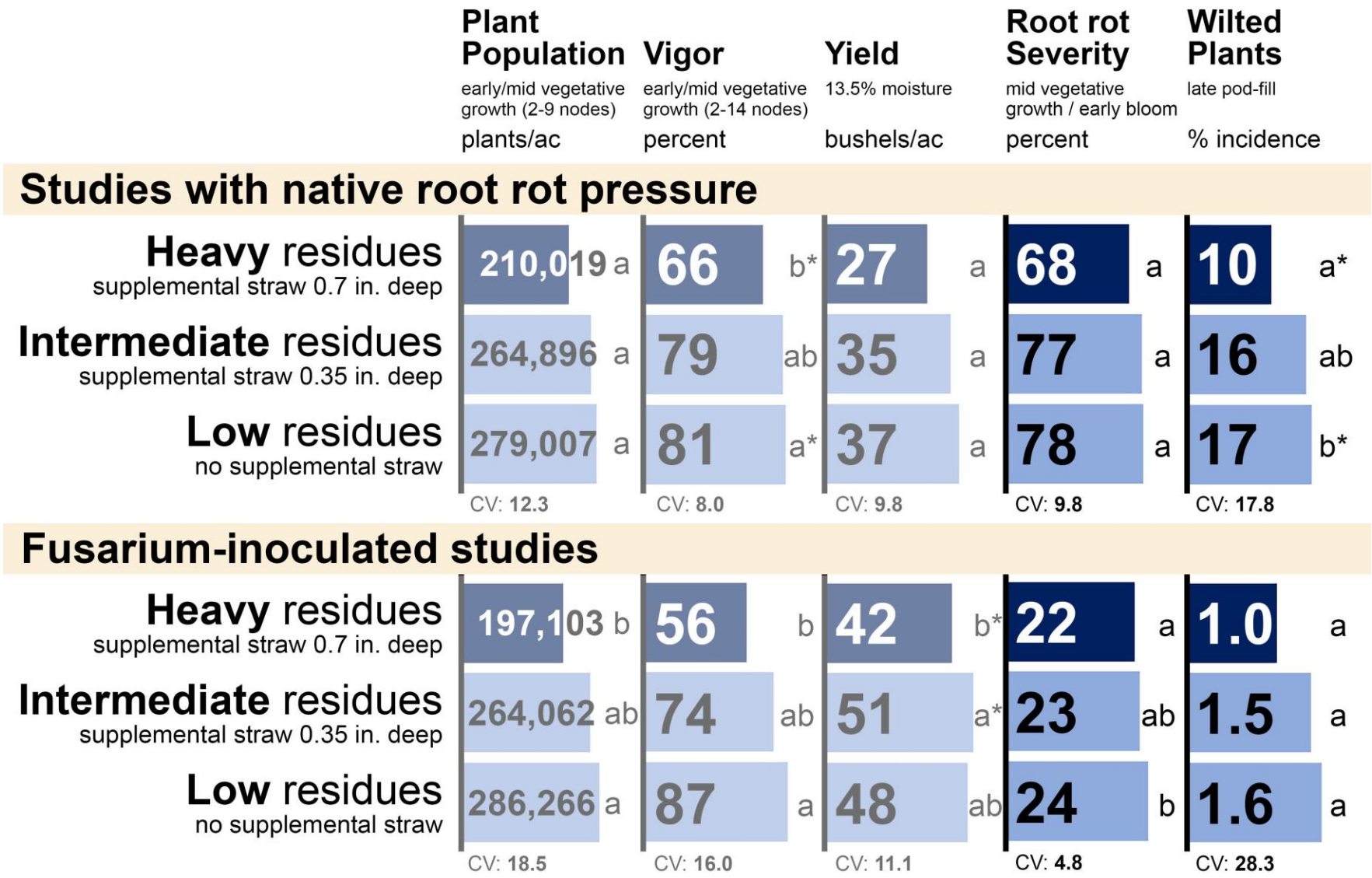


Within-column means followed by different letters are significantly different ($P < 0.05$) or ($P < 0.10$) when followed by an asterisk

Fusarium and Aphanomyces root rot of field peas

Impact of crop residue levels

Replicated field studies - Carrington (2017, 2018, 2019); Williston (2018, 2019)



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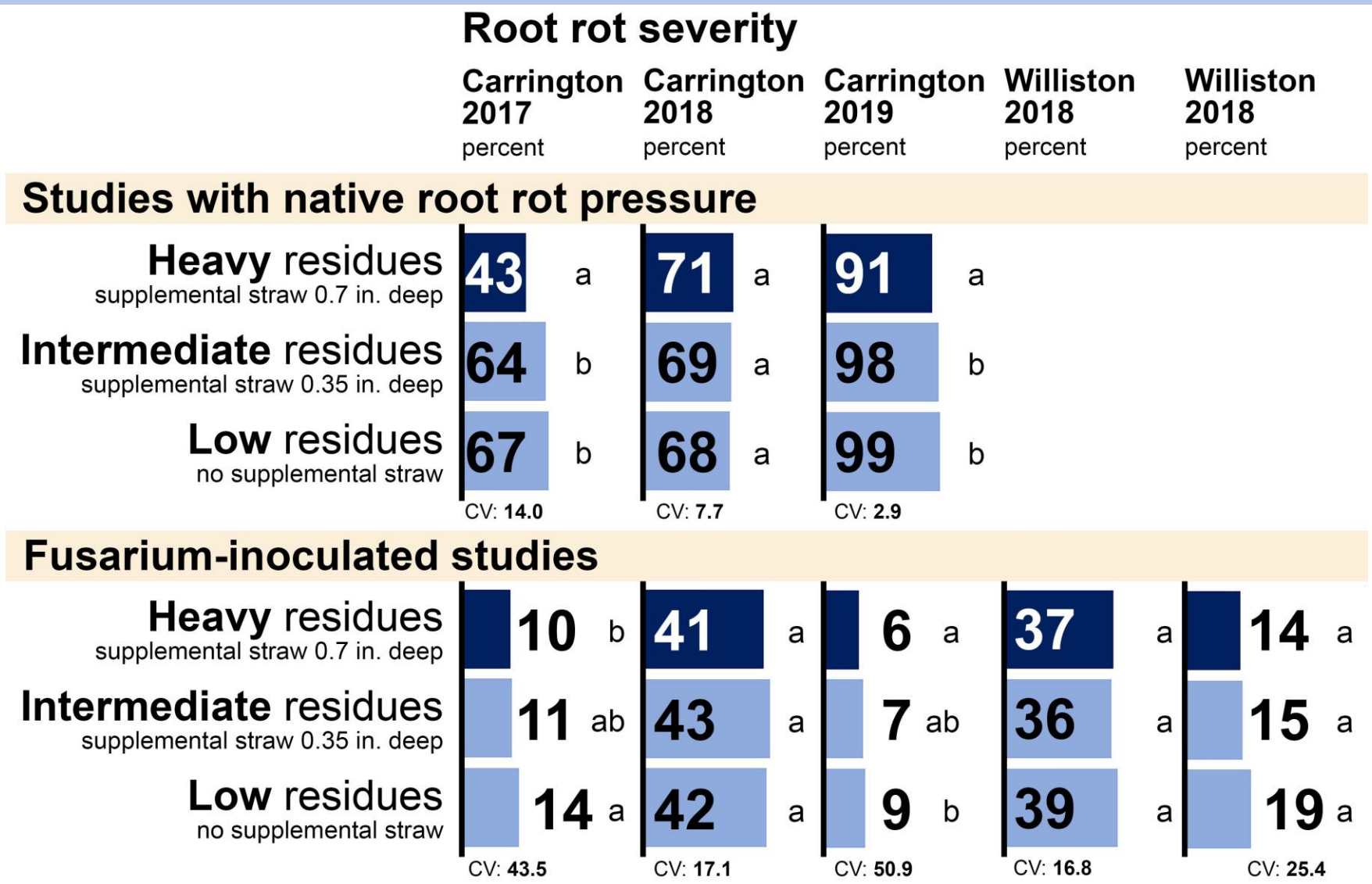
Fusarium and Aphanomyces root rot of field peas

Impact of crop residue levels

Replicated field studies - Carrington (2017, 2018, 2019); Williston (2018, 2019)



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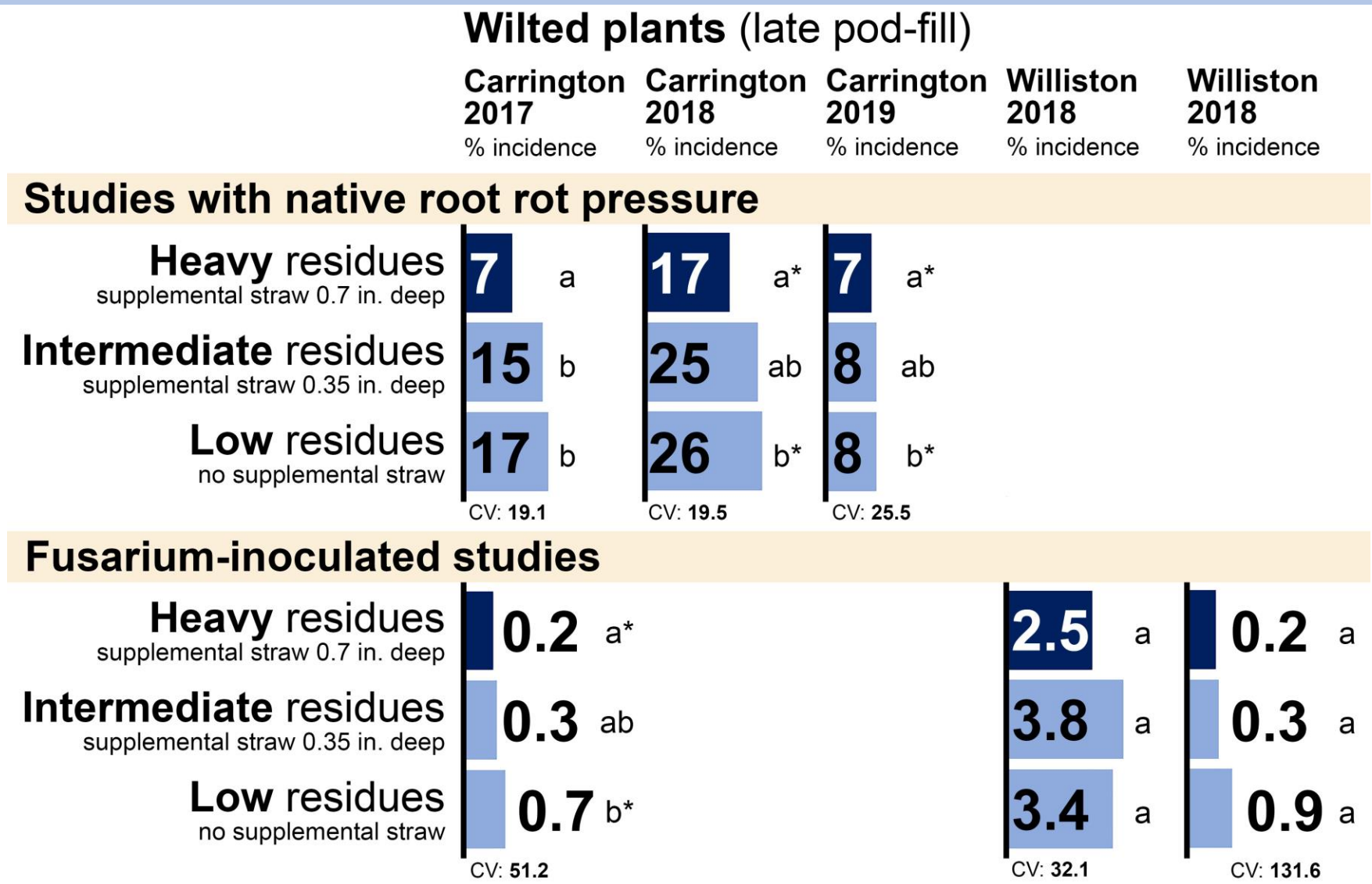
Fusarium and Aphanomyces root rot of field peas

Impact of crop residue levels

Replicated field studies - Carrington (2017, 2018, 2019); Williston (2018, 2019)



Within-column means followed by different letters are significantly different ($P < 0.05$) or ($P < 0.10$) when followed by an asterisk

Fusarium and Aphanomyces root rot of field peas

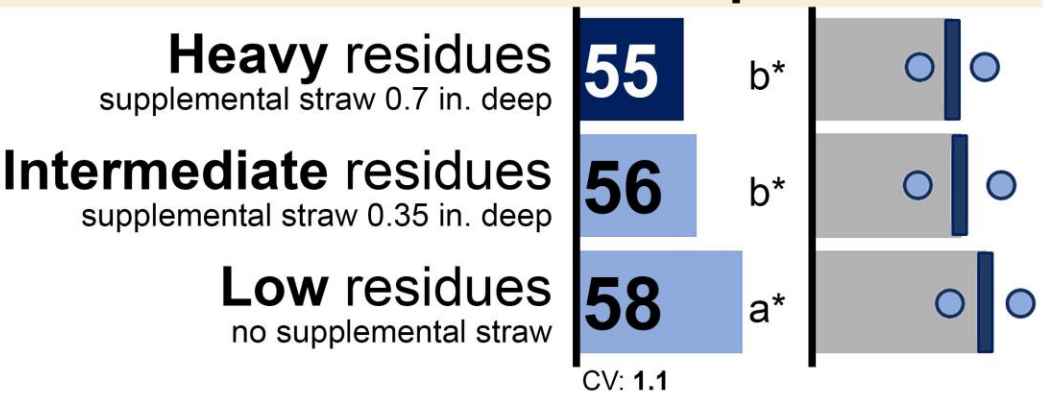
Impact of crop residue levels

Replicated field studies - Carrington (2017, 2018, 2019); Williston (2018, 2019)

Soil temperature (°F)

at seeding depth (2 inches)
average, first 42 days after planting
soil temperature recorded every 2 hours

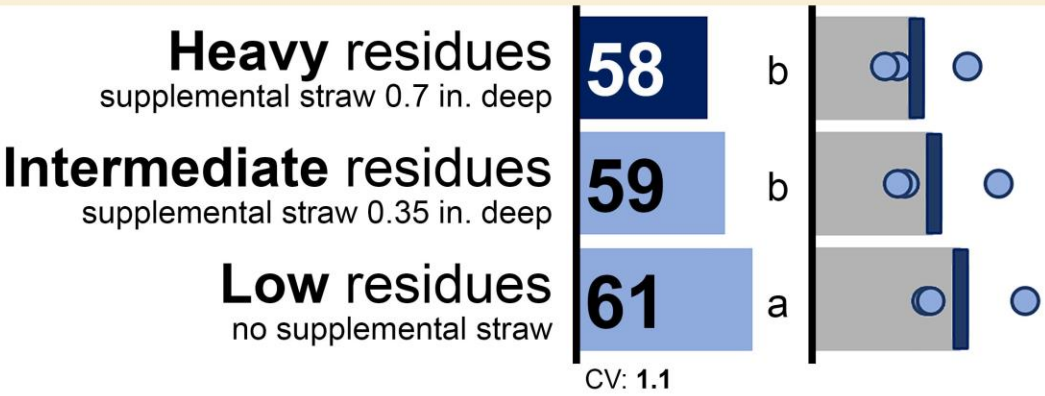
Studies with native root rot pressure



CIRCLE = result from one study
BAR = average across studies

Data from studies conducted in Carrington (2018, 2019)

Fusarium-inoculated studies



CIRCLE = result from one study
BAR = average across studies

Data from studies conducted in Carrington (2019) and Williston (2018, 2019)

Within-column means followed by different letters are significantly different ($P < 0.05$) or ($P < 0.10$) when followed by an asterisk

Thank you!

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