



Improving management of white mold in soybeans and dry beans:

Impact of fungicide application rate and application frequency; response to fungicides relative to the growth stage at which conditions favor white mold.

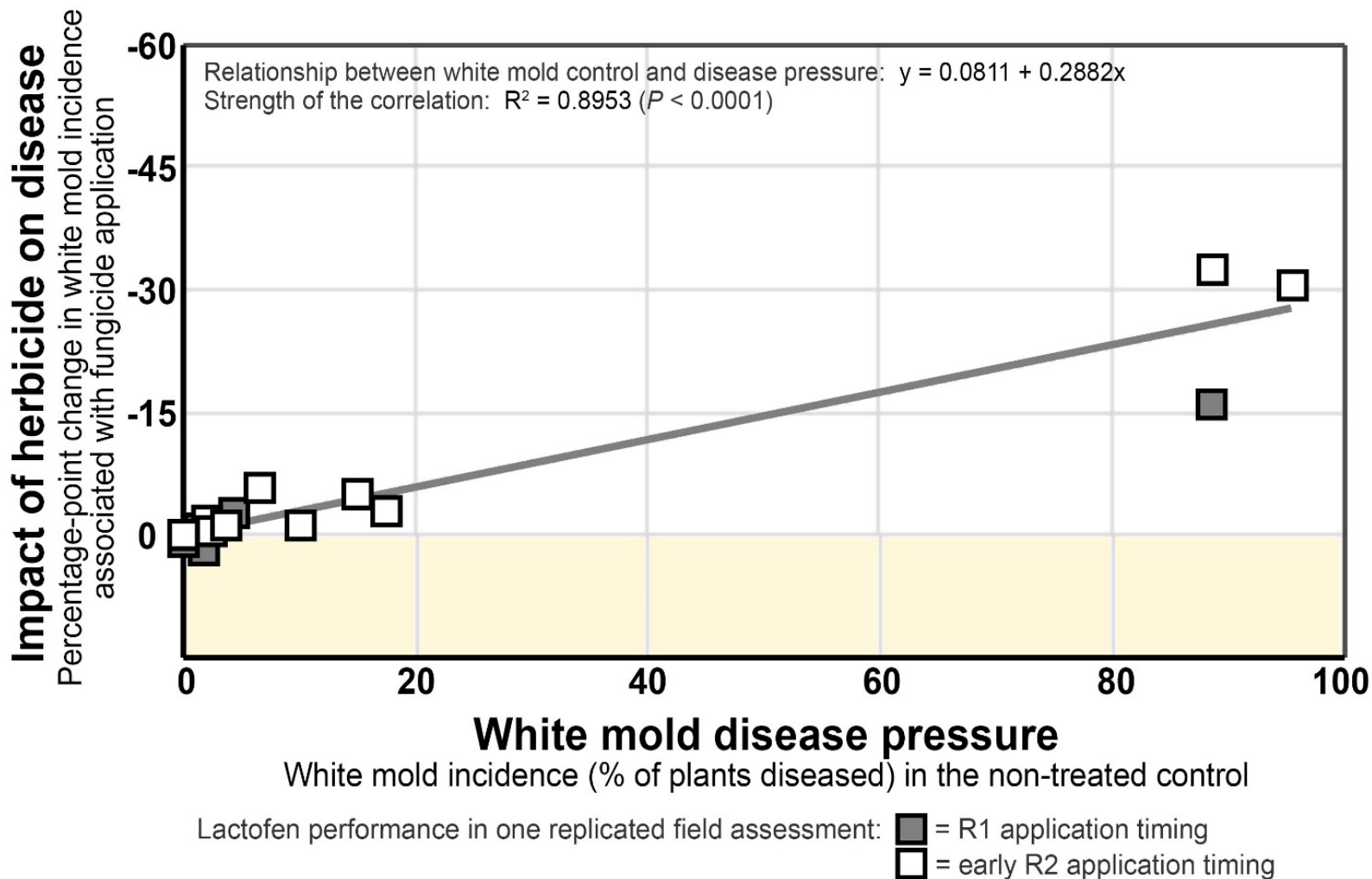
Michael Wunsch

North Dakota State University Carrington Research Extension Center

Efficacy of Cobra herbicide (lactofen)

Cobra herbicide 6.0 fl oz/ac: single application at late R1 to early R2

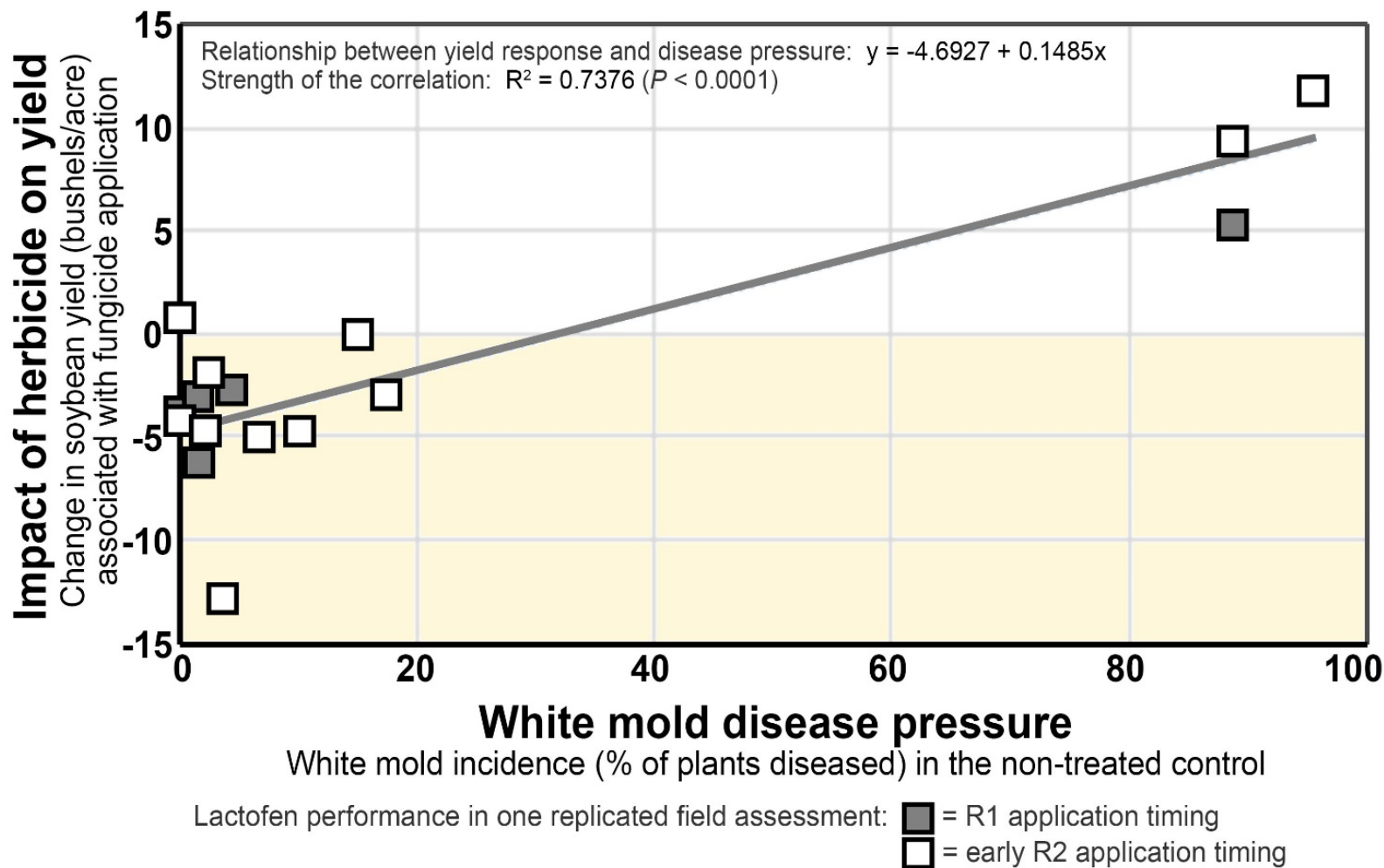
Active ingredient: **lactofen** 43 g ai/ac



Efficacy of Cobra herbicide (lactofen)

Cobra herbicide 6.0 fl oz/ac: single application at late R1 to early R2

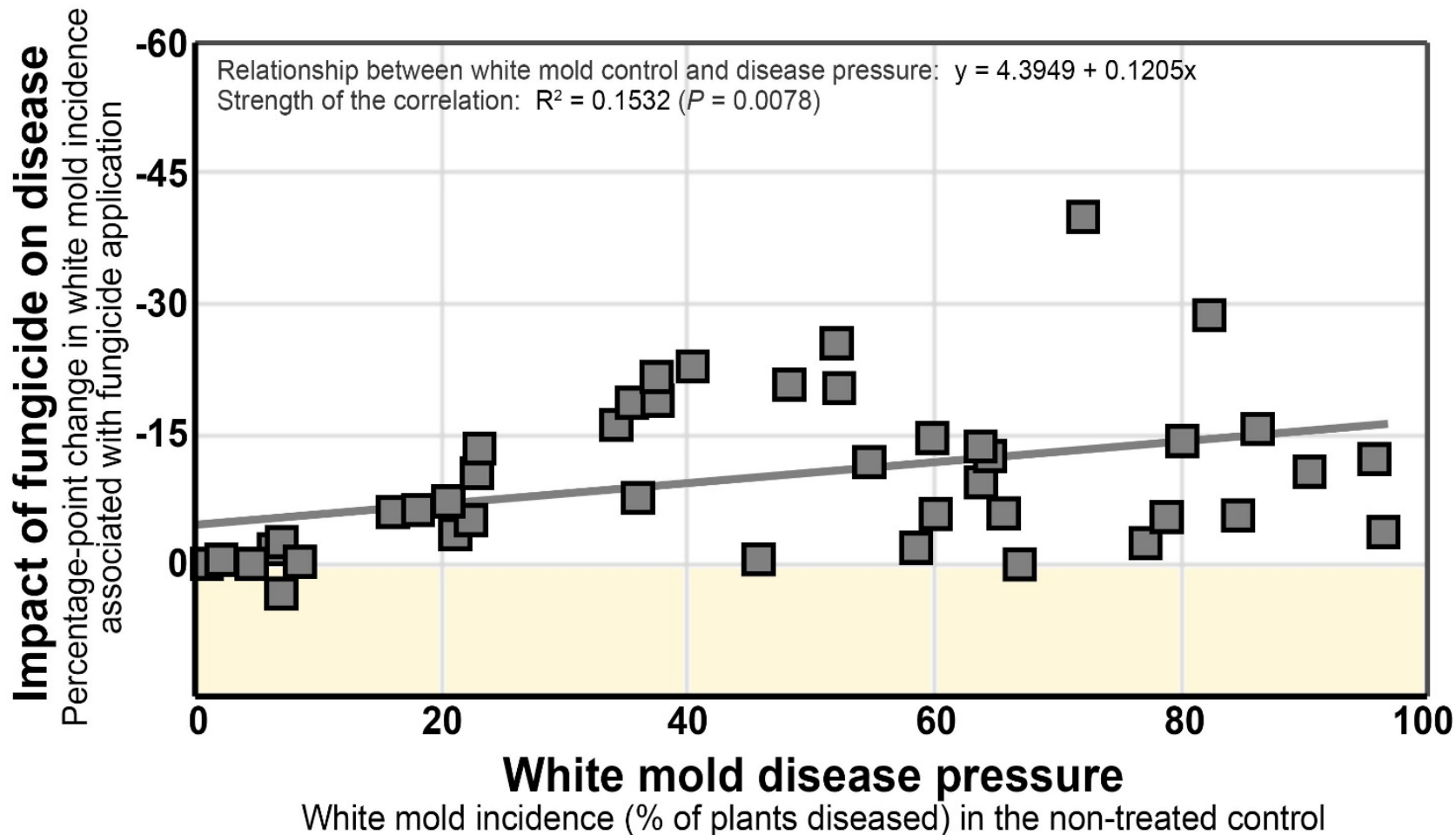
Active ingredient: **lactofen** 43 g ai/ac




Impact of fungicide application rate and application frequency

Endura 5.5 oz/ac: single application at late R1 to early/mid R2

Active ingredient: **boscalid** 109 g ai/ac



Fungicide performance in one replicated field trial: 

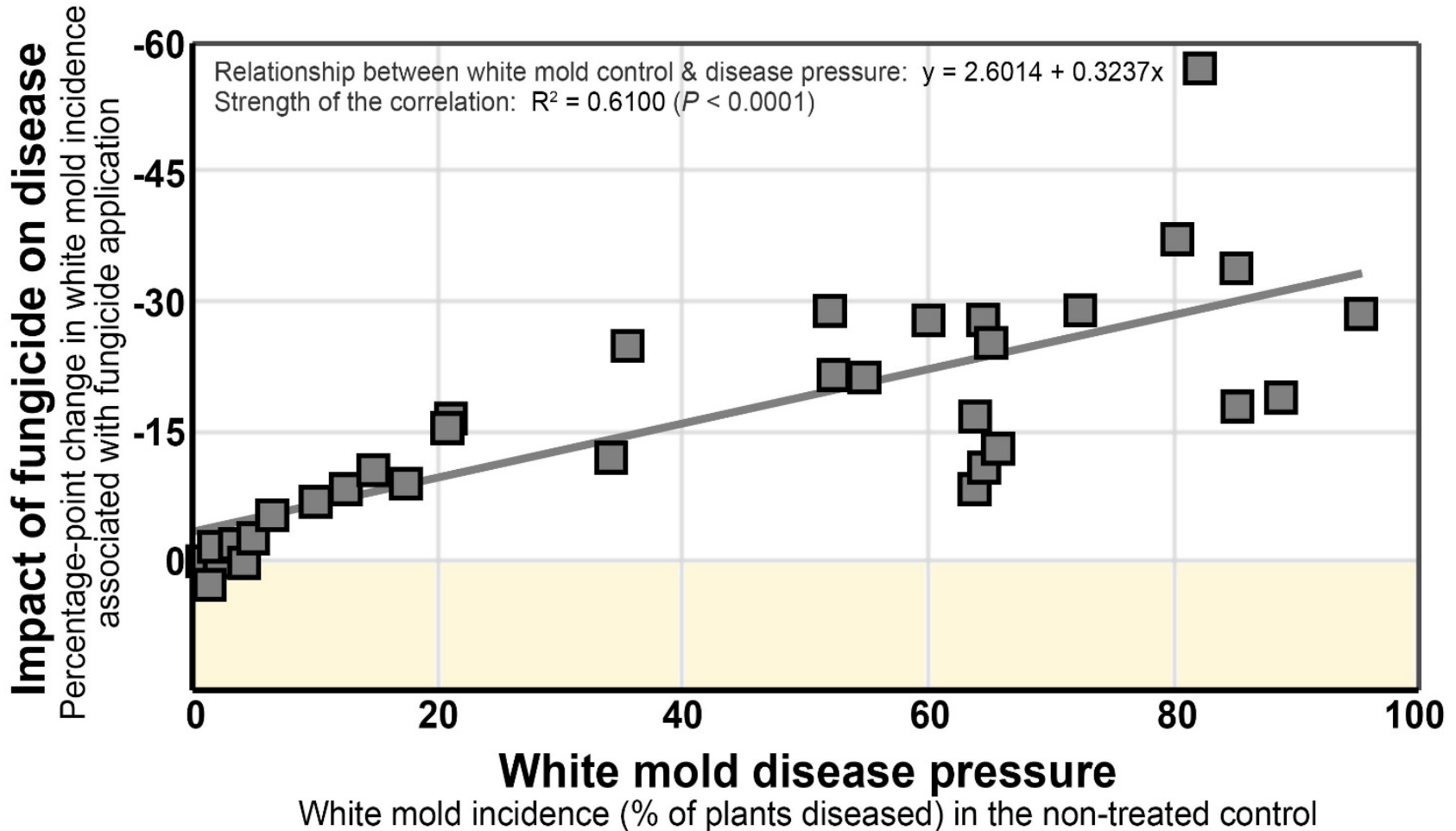
Fungicide application methods: 15 to 17.5 gal/ac, 35 or 40 psi, flat-fan nozzles with fine or medium droplets

Fungicide performance across 45 field trials conducted at three locations (Carrington, Langdon and Oakes, ND) across six years

Impact of fungicide application rate and application frequency

Endura 8.0 oz/ac: single application at late R1 to early/mid R2

Active ingredient: **boscalid** 159 g ai/ac



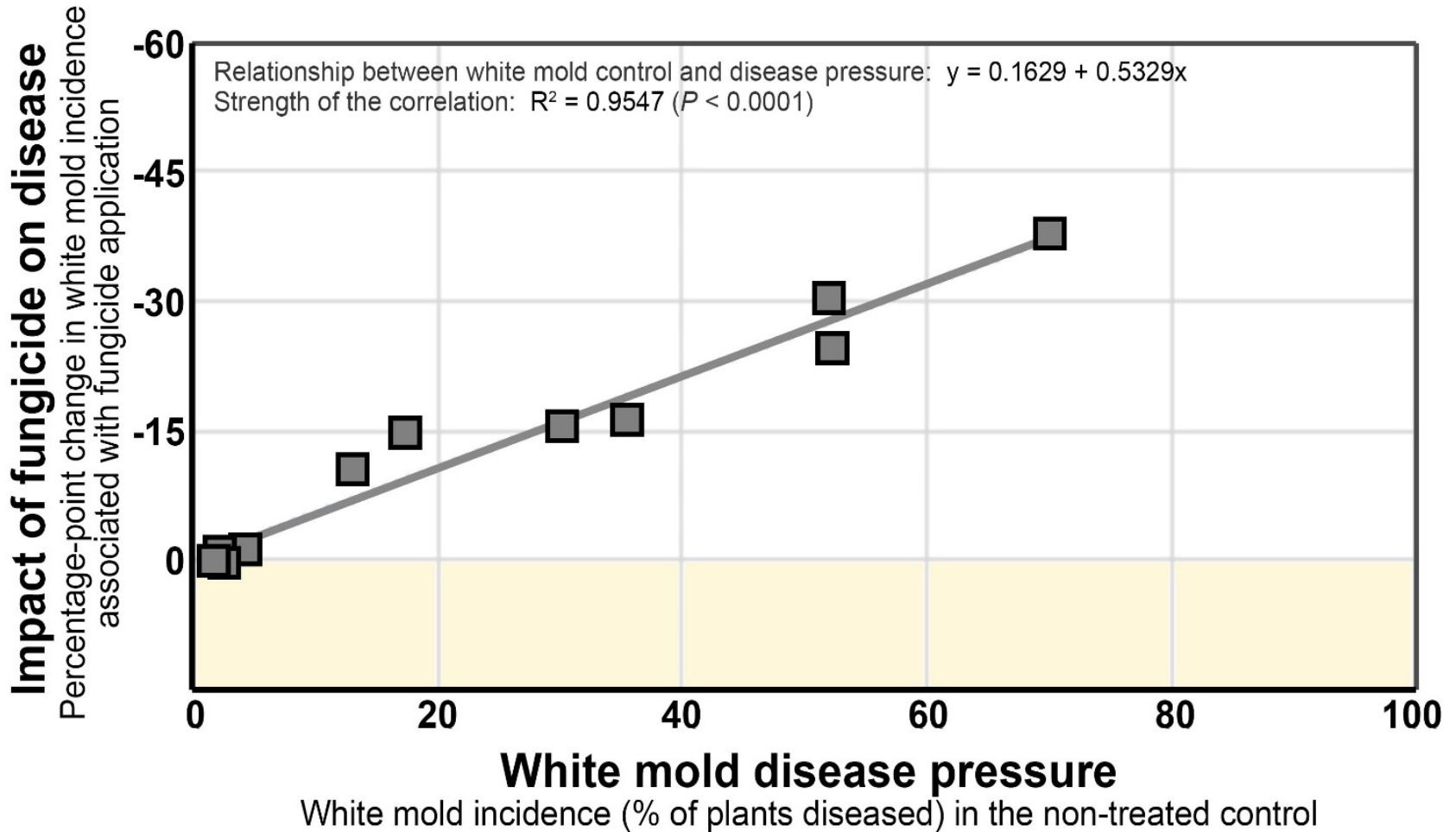
Fungicide performance in one replicated field trial:

Fungicide application methods: 15 to 17.5 gal/ac, 35 or 40 psi, flat-fan nozzles with fine or medium droplets
Fungicide performance across 33 field trials conducted at four locations (Carrington, Hofflund, Langdon and Oakes, ND) across six years

Impact of fungicide application rate and application frequency

Endura 8.0 oz/ac: two applications, late R1 to early/mid R2 + 10-14 days later

Active ingredient: **boscalid** 159 g ai/ac



Fungicide performance in one replicated field assessment: 

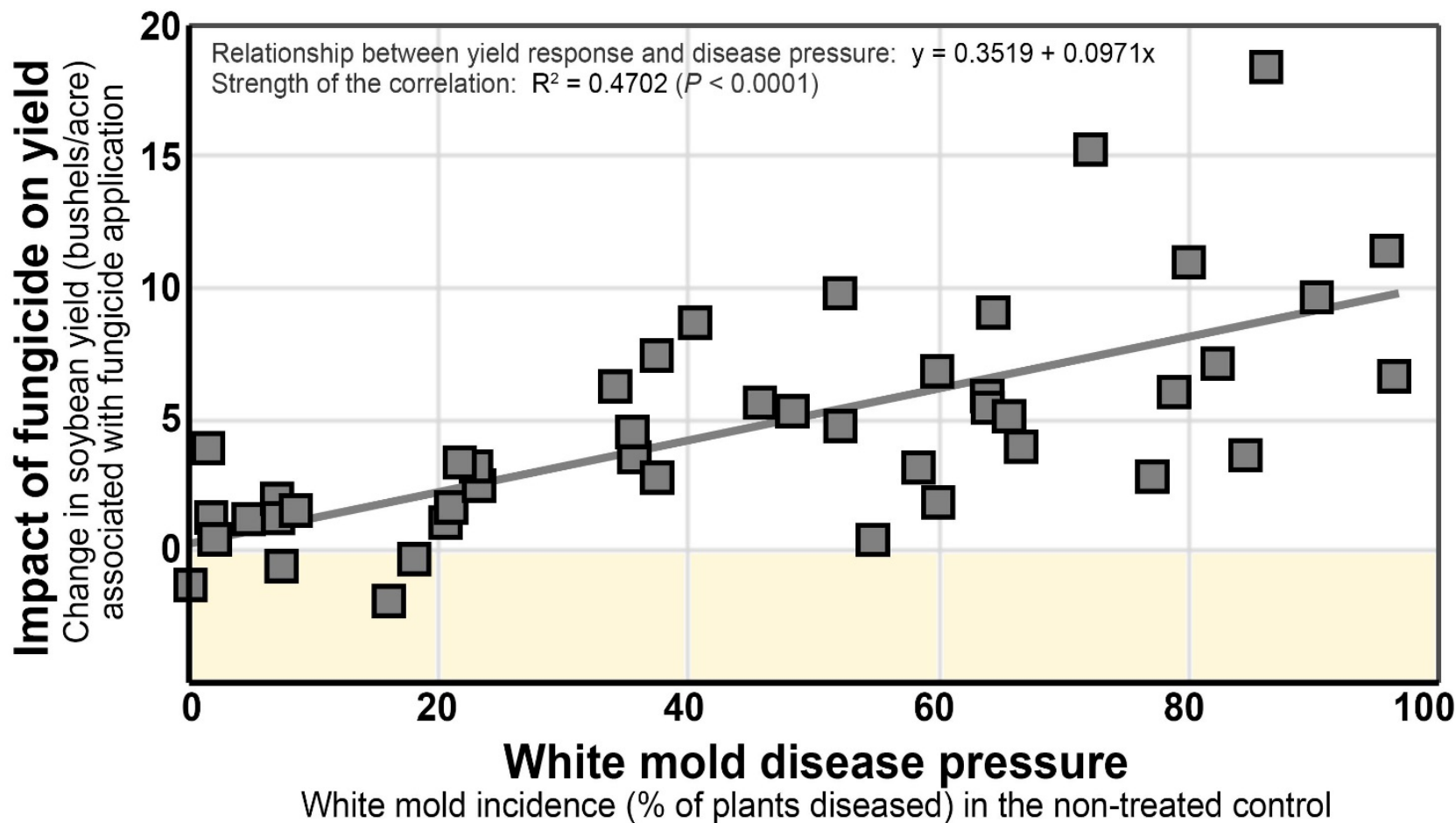
Fungicide application methods: 15 to 17.5 gal/ac, 35 or 40 psi, flat-fan nozzles with fine or medium droplets


Fungicide performance across 11 field trials conducted at one location (Carrington, ND) across four years

Impact of fungicide application rate and application frequency

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Active ingredient: **boscalid** 109 g ai/ac



Fungicide performance in one replicated field trial: 

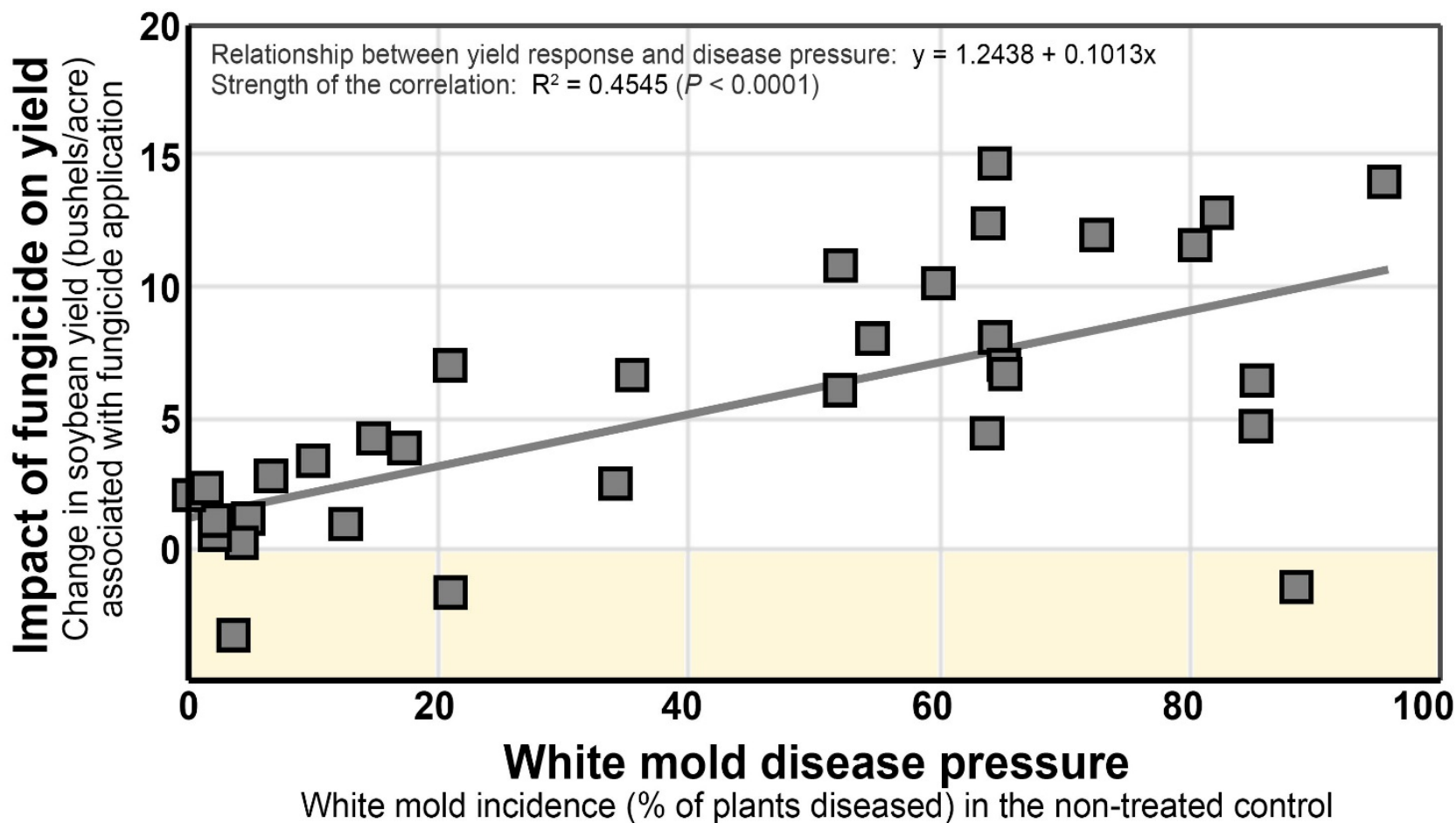
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Fungicide performance across 45 field trials conducted at three locations (Carrington, Langdon and Oakes, ND) across six years

Impact of fungicide application rate and application frequency

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Fungicide performance in one replicated field trial: 

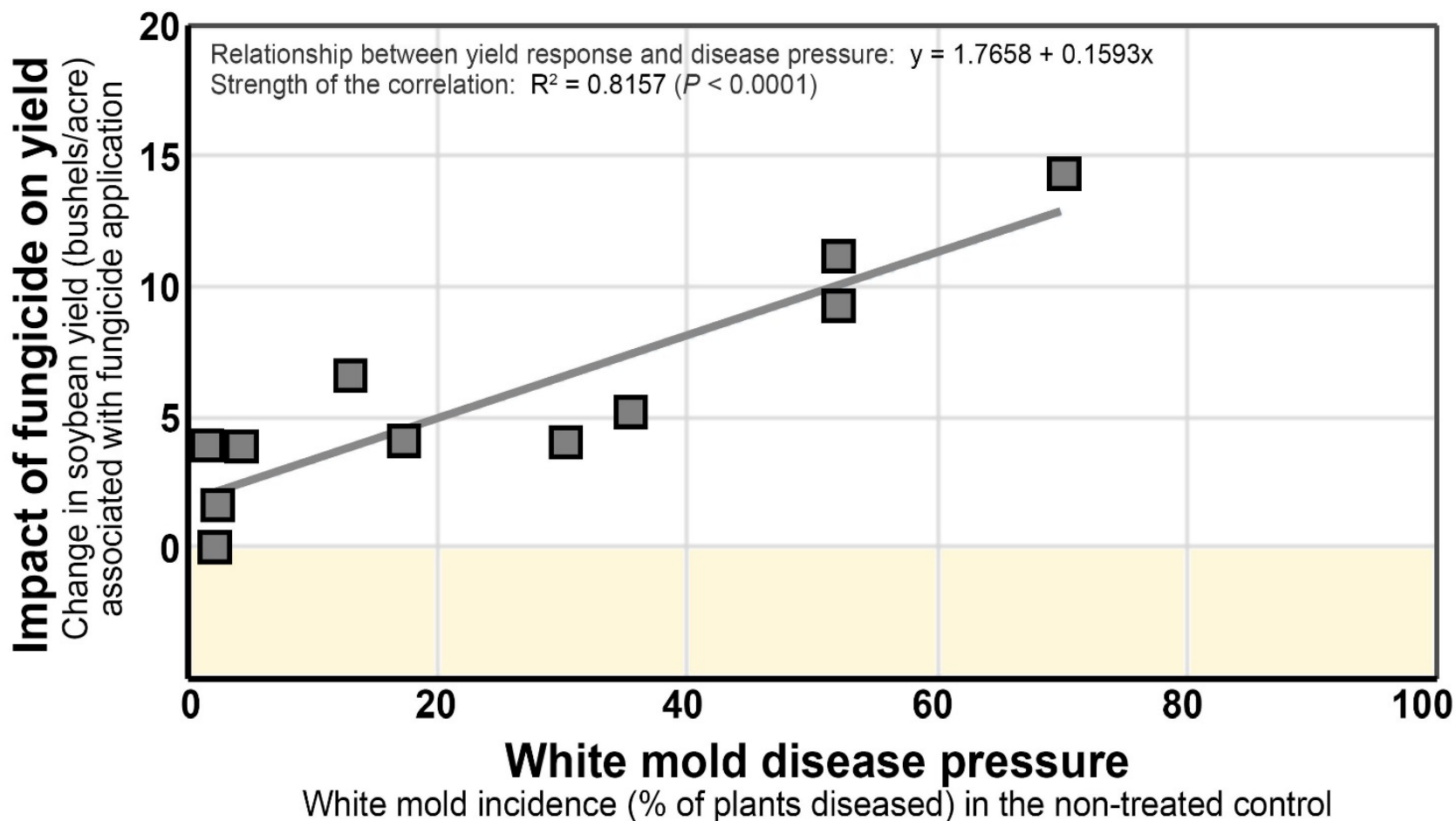
Fungicide application methods: 15 to 17.5 gal/ac, 35 or 40 psi, flat-fan nozzles with fine or medium droplets

Fungicide performance across 33 field trials conducted at four locations (Carrington, Hofflund, Langdon and Oakes, ND) across six years

Impact of fungicide application rate and application frequency

Endura 8.0 oz/ac: two applications, late R1 to early/mid R2 + 10-14 days later

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Fungicide performance in one replicated field assessment: 

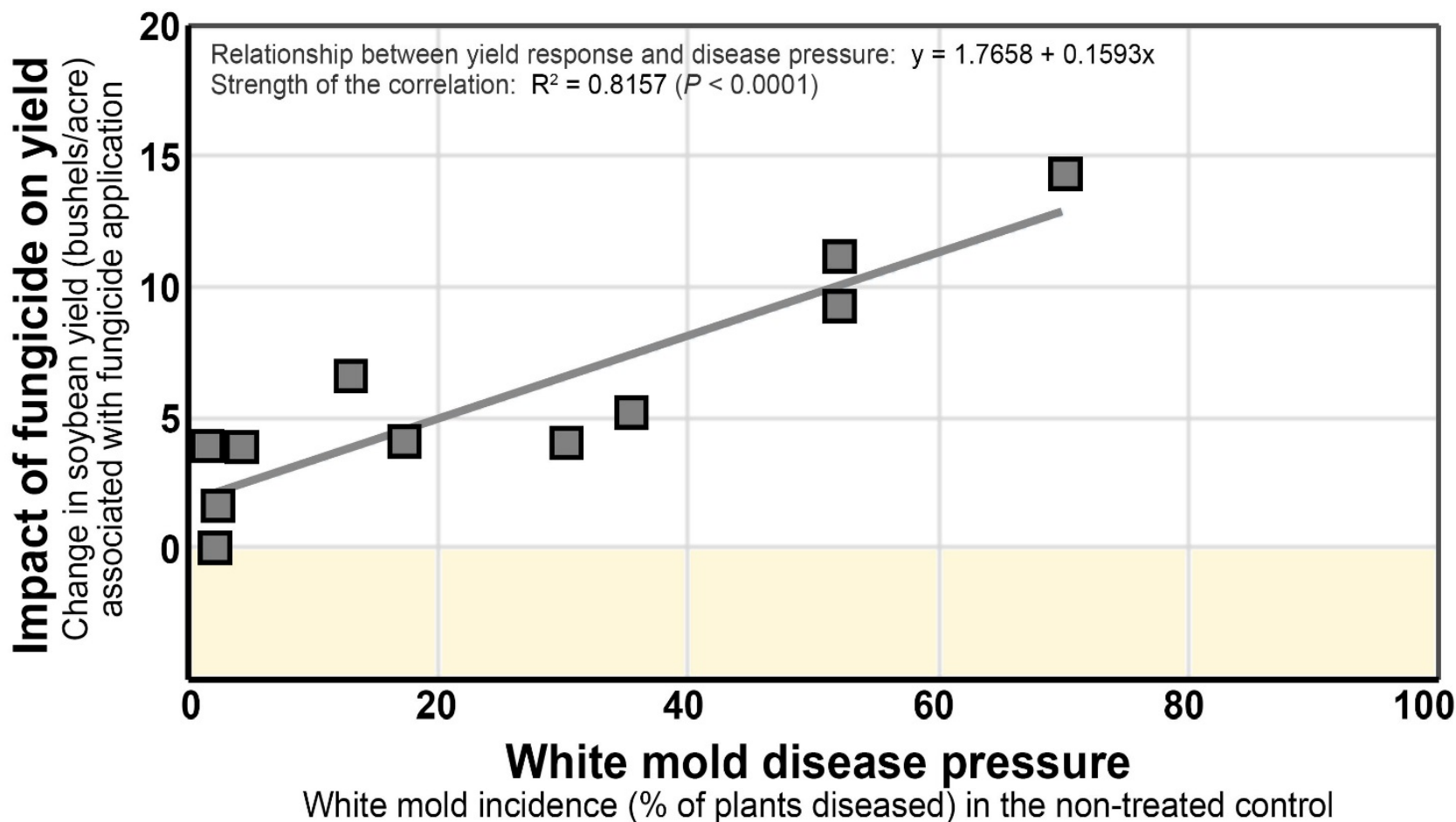
Fungicide application methods: 15 to 17.5 gal/ac, 35 or 40 psi, flat-fan nozzles with fine or medium droplets

Fungicide performance across 11 field trials conducted at one location (Carrington, ND) across four years

Impact of fungicide application rate and application frequency

Endura 8.0 oz/ac: two applications, late R1 to early/mid R2 + 10-14 days later

Active ingredient: **boscalid** 159 g ai/ac



Fungicide performance in one replicated field assessment:

Fungicide application methods: 15 to 17.5 gal/ac, 35 or 40 psi, flat-fan nozzles with fine or medium droplets

Fungicide performance across 11 field trials conducted at one location (Carrington, ND) across four years

ASSESSING RISK OF SCLEROTINIA

Rainfall frequency

Carrington, ND (2014) - SOYBEANS:

Using overhead irrigation as a proxy for rainfall: What is the impact of irrigation frequency on Sclerotinia disease development?

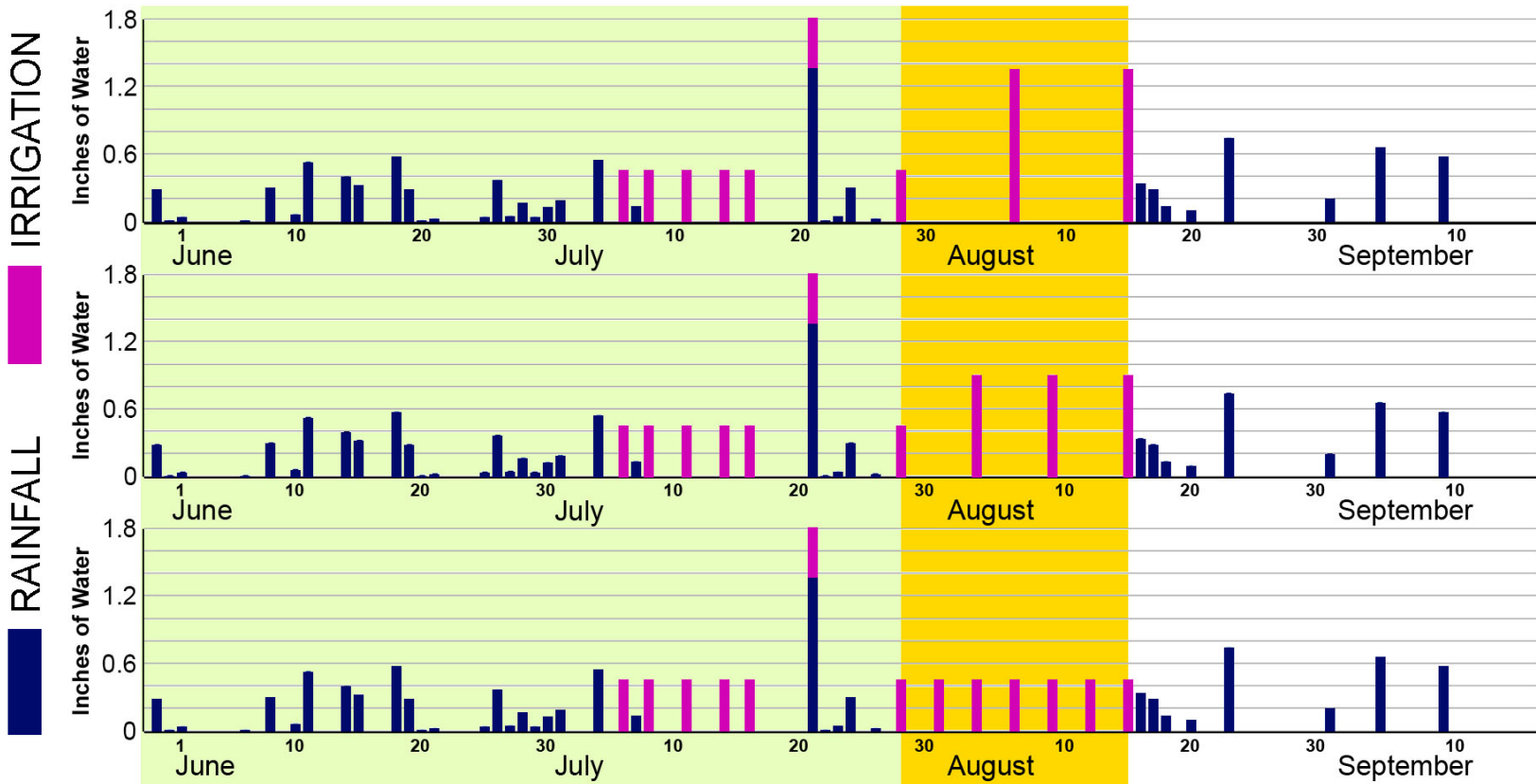
Vegetative growth and early bloom:

All treatments -

- Rainfall or irrigation every 1 to 4 days
- Favorable for apothecia production

Full bloom & early to mid pod:

- 1.35 in. every 9 days
- 0.90 in. every 6 days
- 0.45 in. every 3 days



ASSESSING RISK OF SCLEROTINIA

Rainfall frequency

Frequent, light irrigation: strong return to two fungicide applications

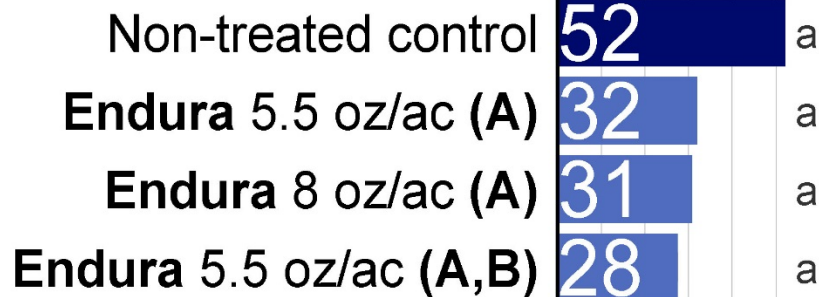
IRRIGATION TREATMENT

Quantity of water applied: 0.45 in.

Frequency: every 3 days

SCLEROTINIA INCIDENCE (%)

assessed Sept. 16 (late R6 to early R7)



2.68
0.0842
47.0

Carrington, ND
(2014)

Dairyland 'DSR 0404 R2Y'

Seeding rate: 165,000 pls/ac

Row spacing: 14 inches

Fungicide applications:

A: July 31, early R2, 97% canopy closure

B: Aug. 12, R3 to R4

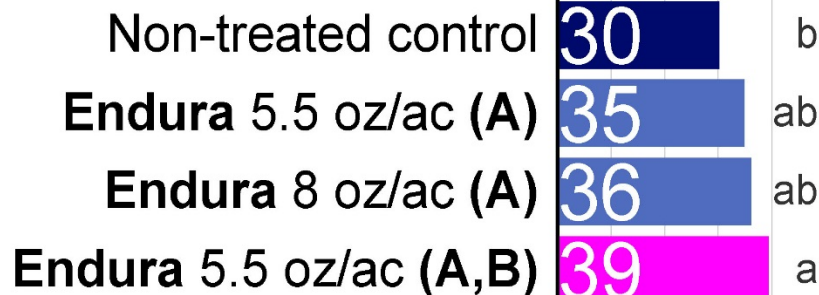
8001VS flat-fan nozzles

35 psi

15 gallons water/ac

YIELD

bushels / acre

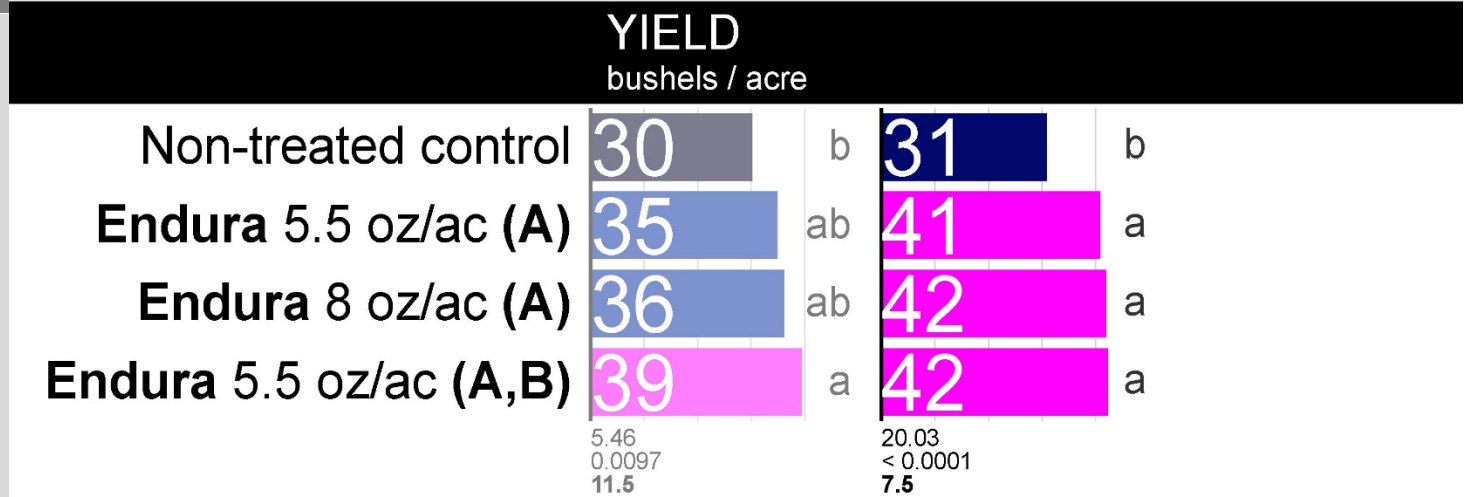
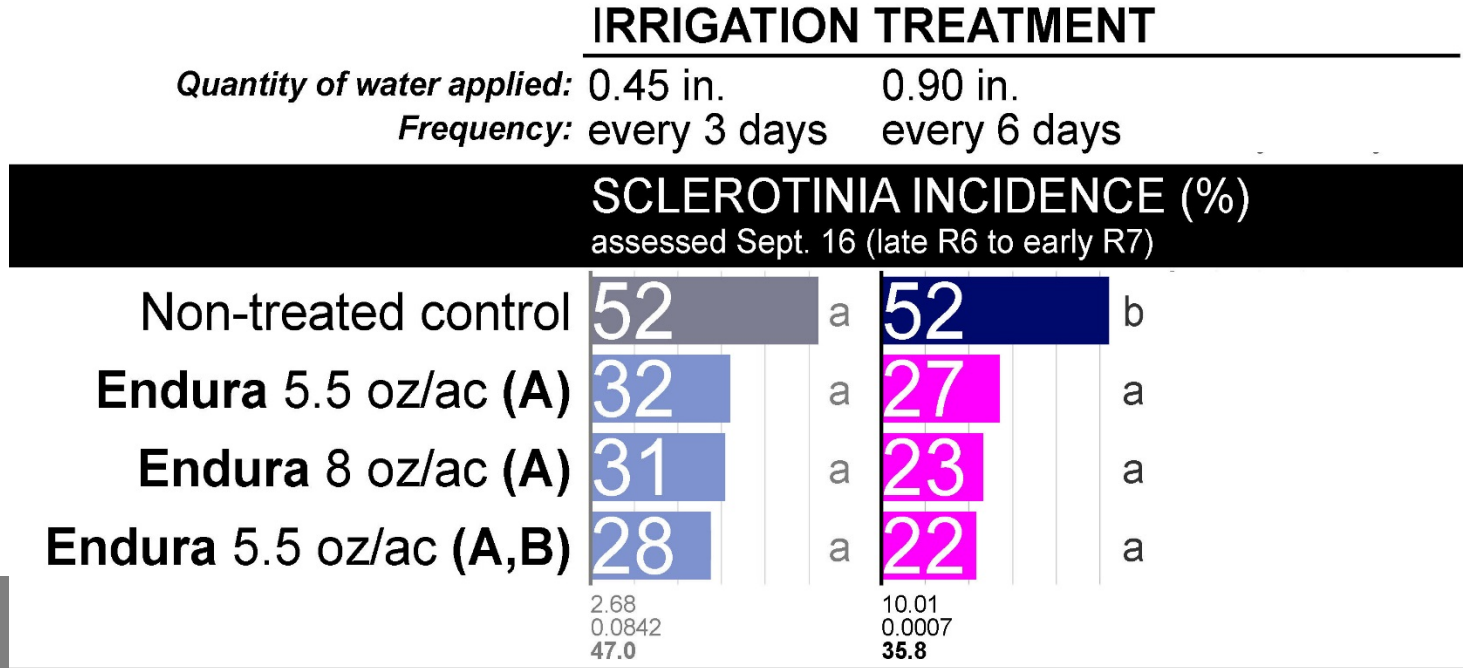


5.46
0.0097
11.5

ASSESSING RISK OF SCLEROTINIA

Rainfall frequency

Intermediate irrigation: a single fungicide application sufficient



Carrington, ND
(2014)

Dairyland 'DSR 0404 R2Y'

Seeding rate: 165,000 pls/ac

Row spacing: 14 inches

Fungicide applications:

A: July 31, early R2, 97% canopy closure

B: Aug. 12, R3 to R4

8001VS flat-fan nozzles

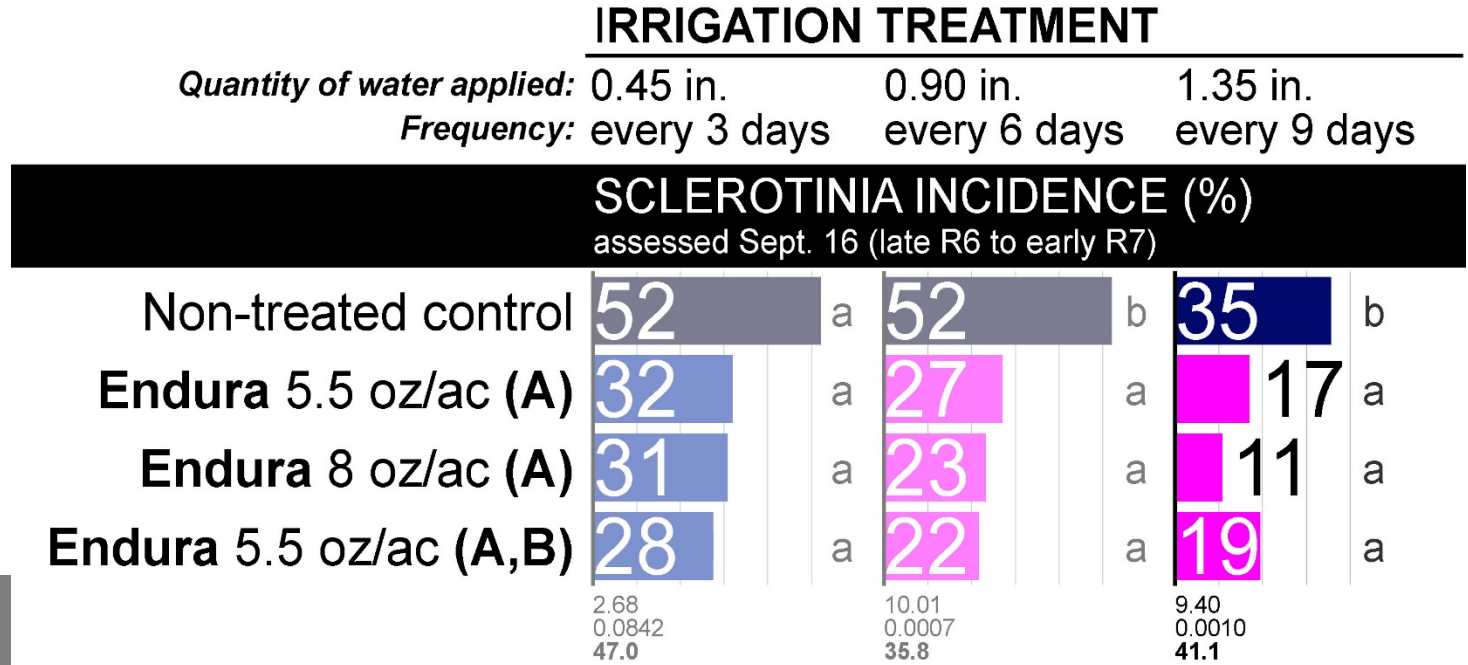
35 psi

15 gallons water/ac

ASSESSING RISK OF SCLEROTINIA

Rainfall frequency

Infrequent, heavy irrigation: single fungicide application sufficient

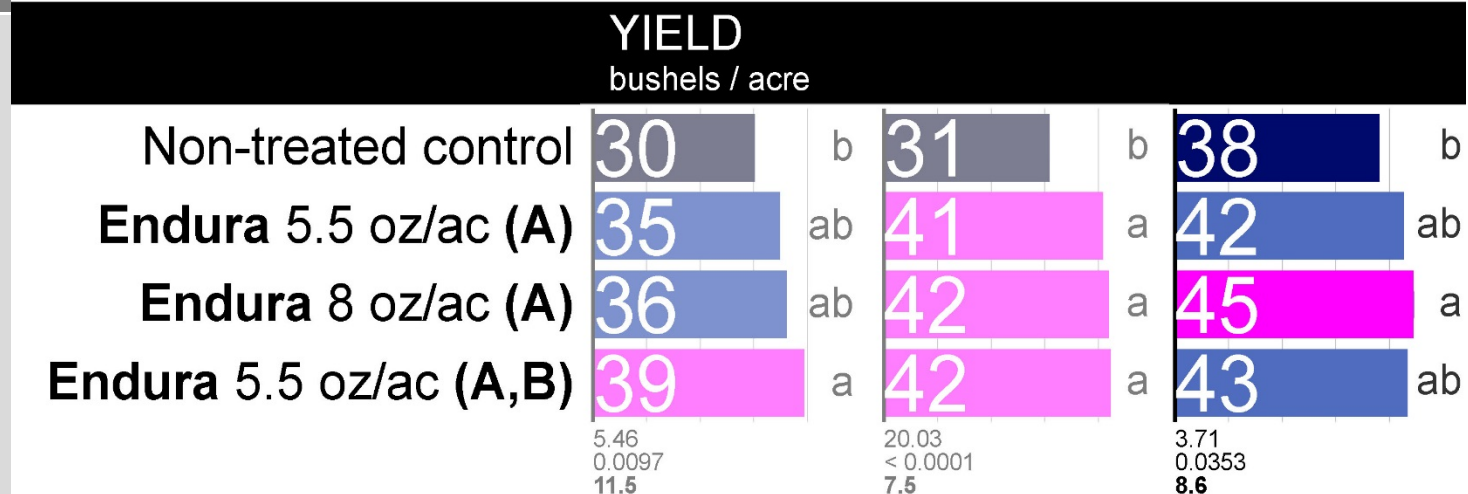


Carrington, ND
(2014)

Dairyland 'DSR 0404 R2Y'
Seeding rate: 165,000 pls/ac
Row spacing: 14 inches

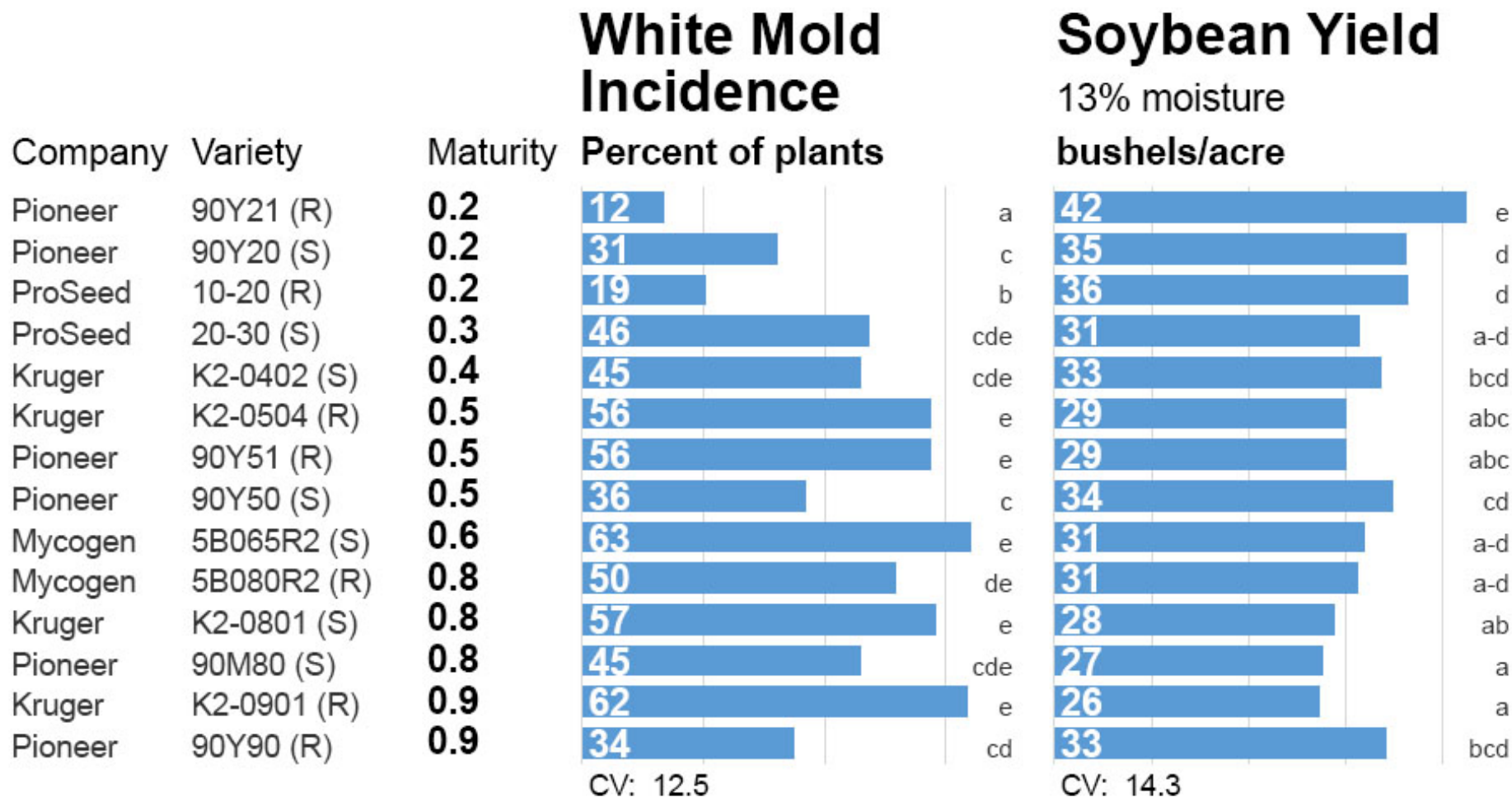
Fungicide applications:
A: July 31, early R2, 97% canopy closure
B: Aug. 12, R3 to R4

8001VS flat-fan nozzles
35 psi
15 gallons water/ac



Impact of soybean maturity on white mold

Carrington, ND (2014)



Differences in susceptibility to white mold across soybean varieties

White mold severity index and soybean yield averaged across fungicide-treated and non-treated soybeans.

**Carrington, ND
2018**

Soybean maturity rating

0.06
0.05
0.05
0.08
0.09
0.4
0.1
0.3
0.2
0.08
0.08
0.7
0.8
0.09
0.8
1.0
0.6
0.09
0.2
1.0
0.6
0.8
0.4
0.4
0.2
0.7
0.4
0.3
0.7
0.4
0.6
0.09
0.9
0.3
0.5
0.9
0.9
0.9

Completely randomized split-plot design

Main factor = Variety

Sub-factor = Fungicide treatment

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2. Endura 5.5 oz applied once at late R1 to early R2
3. Endura 5.5 oz applied twice R1/R2 + 10-12 days

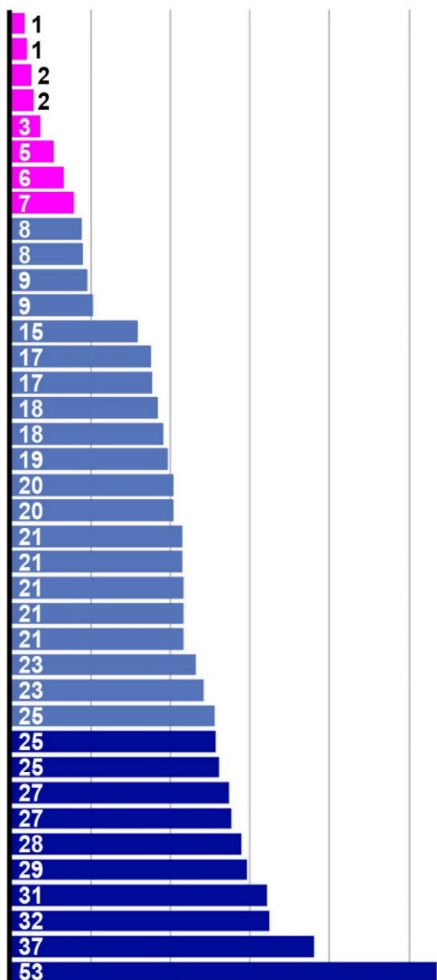
Fungicides applied with XR110015 flat-fan nozzles at 40 psi (fine droplets); spray volume = 15 gal/ac

Company	Variety
Pioneer	P006A37X
Pioneer	P005A27X
Dairyland	DSR-C506/R2Y
Pioneer	P008T22R2
Dairyland	DSR-C905/R2Y
Pioneer	P04A77X
Peterson Farms	16R01
Pioneer	P03T68R2
Dairyland	DSR-0225/R2Y
Peterson Farms	18X008N
Peterson Farms	16R008N
Dairyland	DSR-0711/R2Y
Pioneer	P08A72X
Dairyland	DSR-C918/R2Y
Peterson Farms	18X08N
Pioneer	P10A76X
Pioneer	P06A45X
Peterson Farms	17X009
Pioneer	P02A33X
Pioneer	P10T91R
Pioneer	P06T28R
Dairyland	DSR-0807/R2Y
Dairyland	DSR-0404/R2Y
Peterson Farms	17X04N
ProSeed	30-20
Peterson Farms	18X07N
Dairyland	DSR-0418/R2Y
Peterson Farms	13R03
Peterson Farms	15R07N
ProSeed	XT60-40RR2Y
Peterson Farms	18X06N
Peterson Farms	17R009
Dairyland	DSR-0988/R2Y
Dairyland	DSR-0305/R2Y
Pioneer	P05A93X
Dairyland	DSR-0904/R2Y
Peterson Farms	14R09N
Peterson Farms	17X09N

White mold (%)

average across all fungicide treatments

Percent of canopy; R8 growth stage

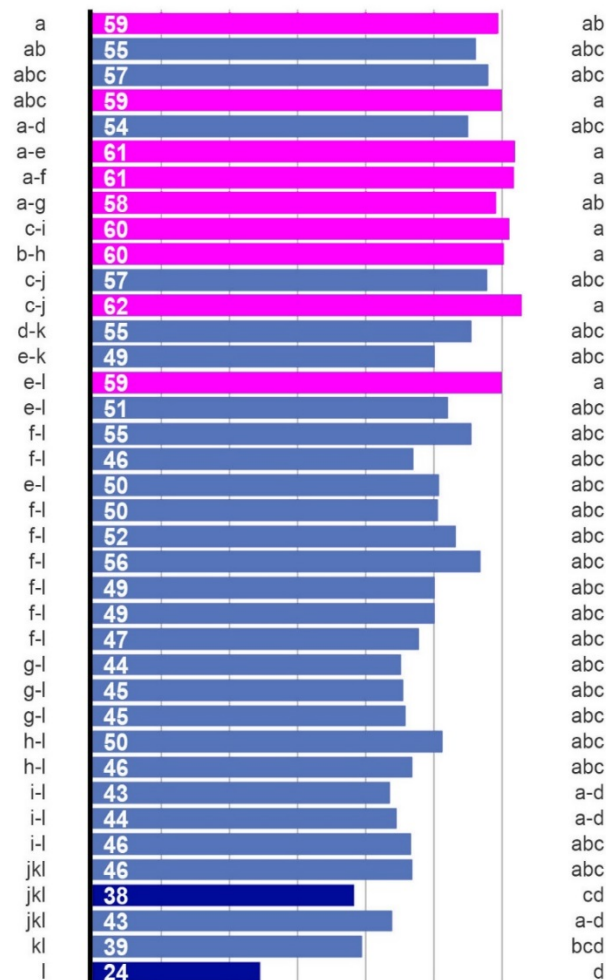


CV = 11.2

Yield (bu/ac)

average across all fungicide treatments

13% moisture



CV = 9.8

Within-column means followed by different, non-overlapping ranges of letters are significantly different ($P < 0.05$; Tukey procedure)

Relationship between soybean maturity and white mold susceptibility

White mold severity index and soybean yield averaged across fungicide-treated and non-treated soybeans.

**Carrington, ND
2018**

Soybean maturity rating

0.05
0.05
0.06
0.08
0.08
0.08
0.09
0.09
0.09
0.09
0.1
0.2
0.2
0.2
0.3
0.3
0.3
0.4
0.4
0.4
0.4
0.4
0.5
0.6
0.6
0.6
0.6
0.7
0.7
0.7
0.8
0.8
0.8
0.9
0.9
0.9
0.9
0.9
1.0
1.0

Completely randomized split-plot design

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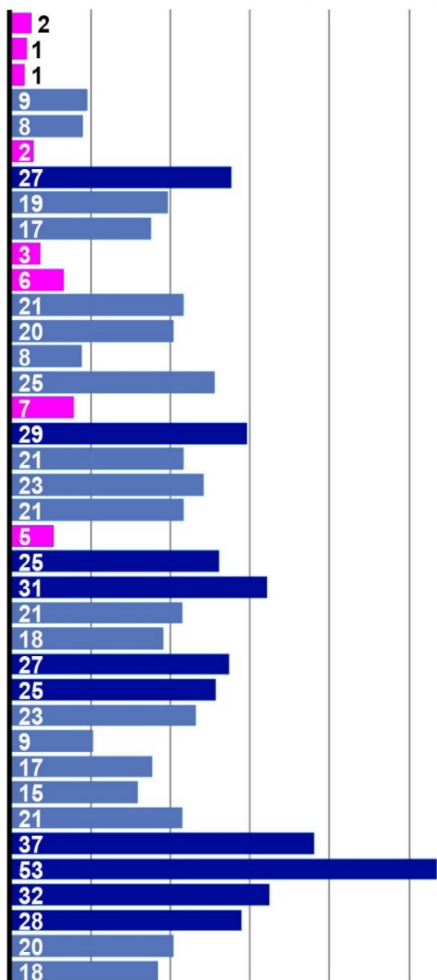
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Company	Variety
Dairyland	DSR-C506/R2Y
Pioneer	P005A27X
Pioneer	P006A37X
Peterson Farms	16R008N
Peterson Farms	18X008N
Pioneer	P008T22R2
Peterson Farms	17R009
Peterson Farms	17X009
Dairyland	DSR-C918/R2Y
Dairyland	DSR-C905/R2Y
Peterson Farms	16R01
ProSeed	30-20
Pioneer	P02A33X
Dairyland	DSR-0225/R2Y
Peterson Farms	13R03
Pioneer	P03T68R2
Dairyland	DSR-0305/R2Y
Dairyland	DSR-0404/R2Y
Dairyland	DSR-0418/R2Y
Peterson Farms	17X04N
Pioneer	P04A77X
ProSeed	XT60-40RR2Y
Pioneer	P05A93X
Pioneer	P06T28R
Pioneer	P06A45X
Peterson Farms	18X06N
Peterson Farms	15R07N
Peterson Farms	18X07N
Dairyland	DSR-0711/R2Y
Peterson Farms	18X08N
Pioneer	P08A72X
Dairyland	DSR-0807/R2Y
Peterson Farms	14R09N
Peterson Farms	17X09N
Dairyland	DSR-0904/R2Y
Dairyland	DSR-0988/R2Y
Pioneer	P10T91R
Pioneer	P10A76X

White mold (%)

average across all fungicide treatments

Percent of canopy; R8 growth stage

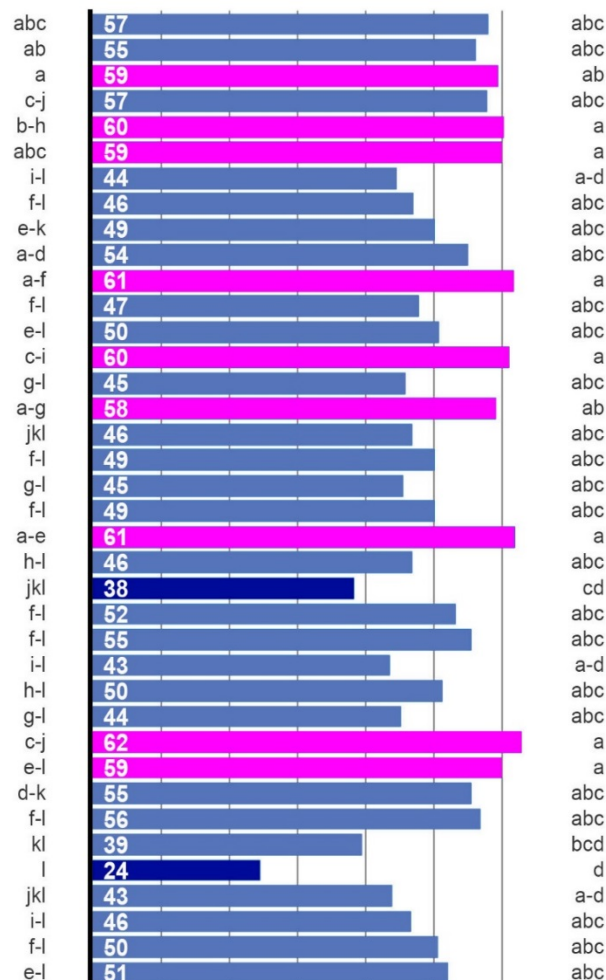


CV = 11.2

Yield (bu/ac)

average across all fungicide treatments

13% moisture



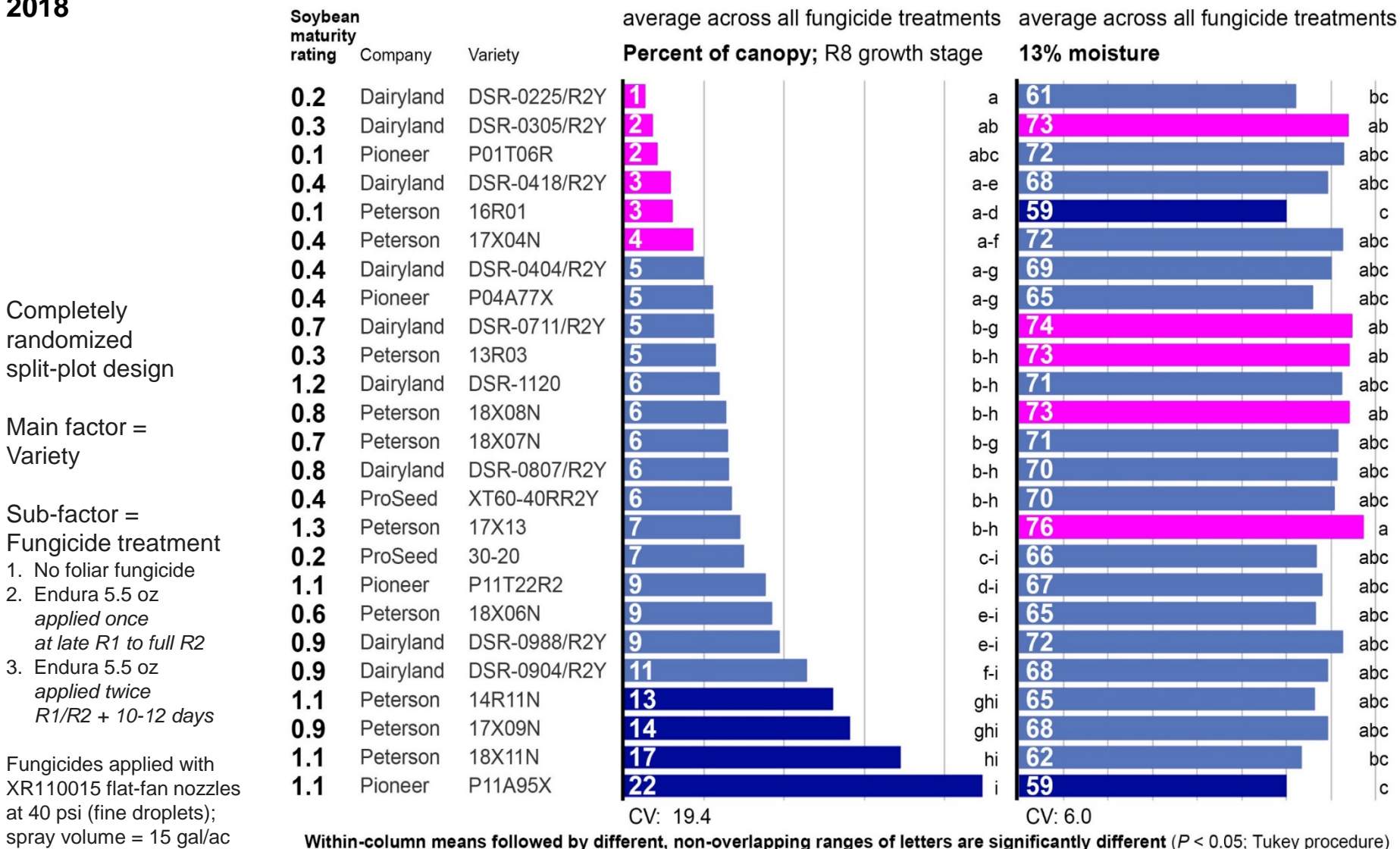
CV = 9.8

Within-column means followed by different, non-overlapping ranges of letters are significantly different ($P < 0.05$; Tukey procedure)

Differences in susceptibility to white mold across soybean varieties

White mold severity index and soybean yield averaged across fungicide-treated and non-treated soybeans.

Oakes, ND
2018



Completely randomized split-plot design

Main factor = Variety

Sub-factor = Fungicide treatment

1. No foliar fungicide
2. Endura 5.5 oz applied once at late R1 to full R2
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Relationship between soybean maturity and white mold susceptibility

White mold severity index and soybean yield averaged across fungicide-treated and non-treated soybeans.

**Oakes, ND
2018**

Completely randomized split-plot design

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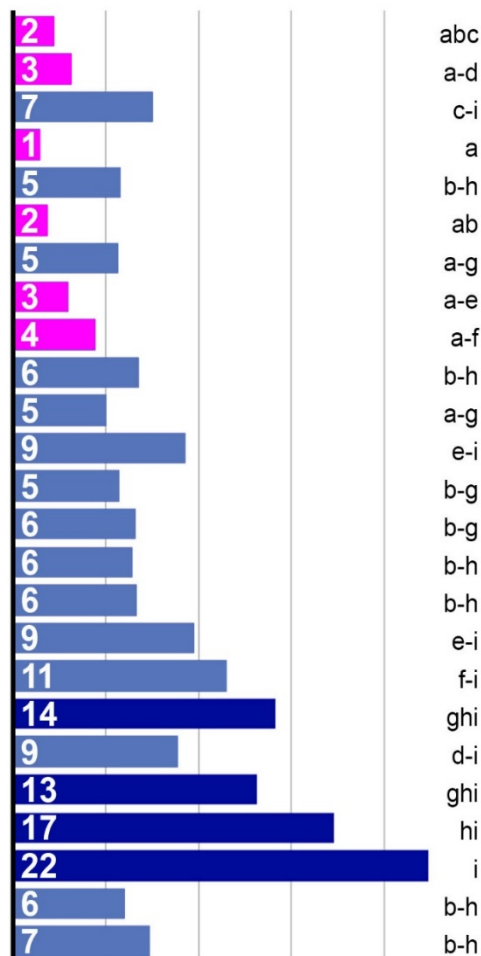
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White mold (%)

average across all fungicide treatments

Percent of canopy; R8 growth stage

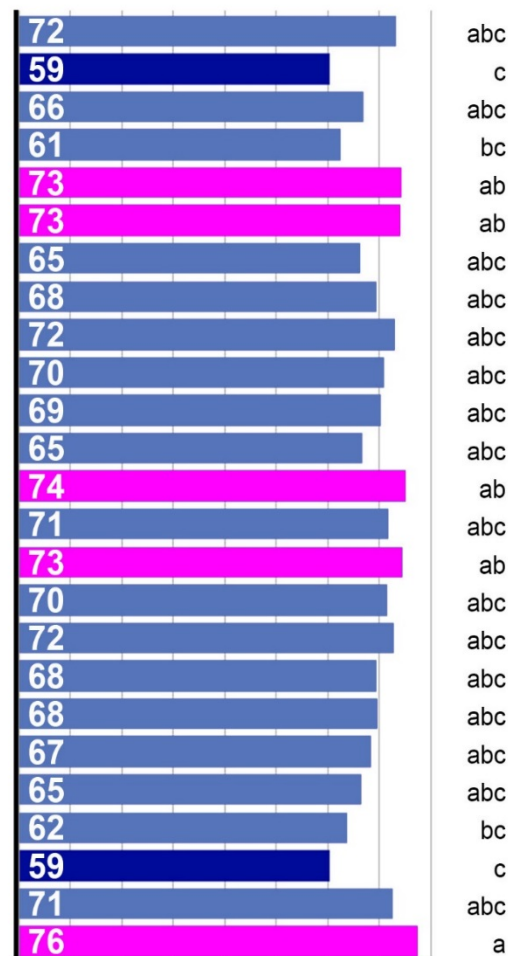


CV: 19.4

Yield (bu/ac)

average across all fungicide treatments

13% moisture



CV: 6.0

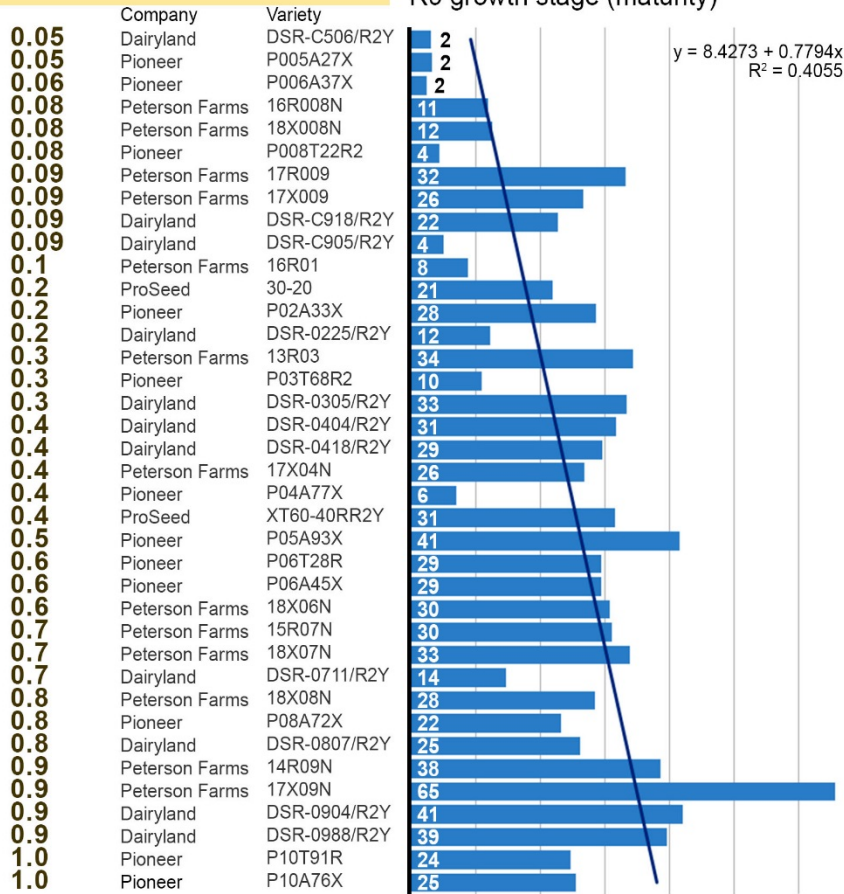
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Response to fungicide applications relative to soybean maturity

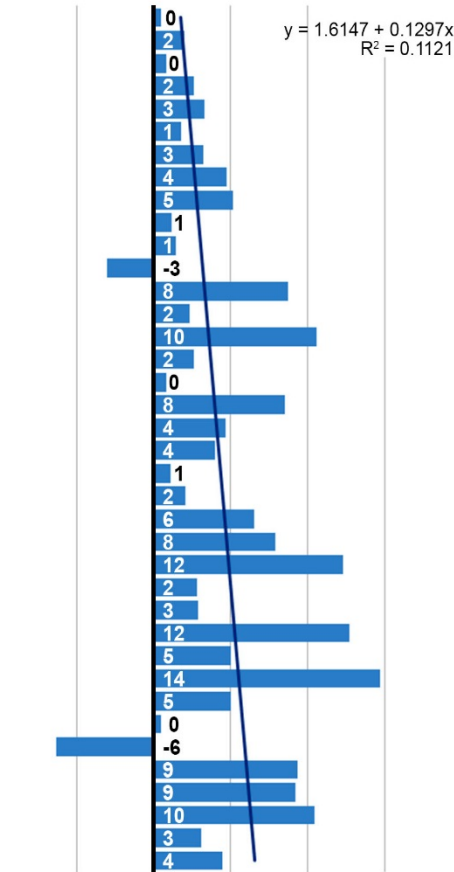
Carrington, ND (2018)

Soybean maturity rating

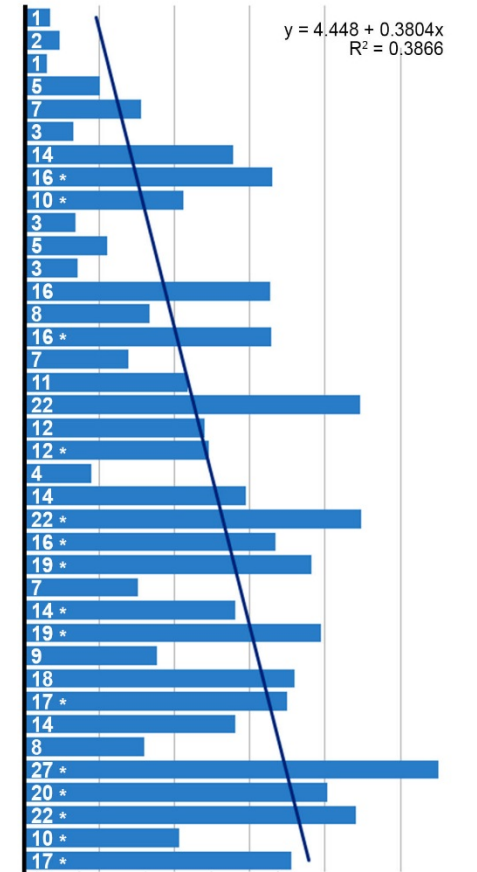
Assigned by the breeder



White mold reduction (%) Single fungicide application late R1 / early R2 growth stage



White mold reduction (%) Two fungicide applications late R1 / early R2 + 10-12 days later



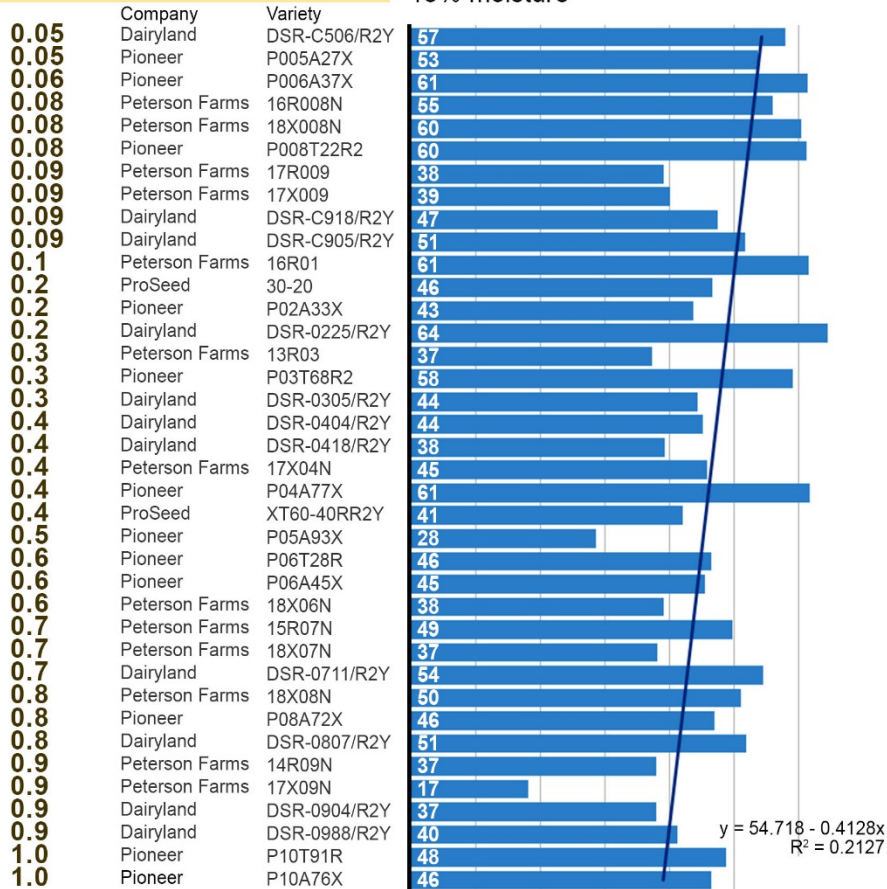
* Asterisk: denotes a significant ($P < 0.05$) disease reduction relative to the no-fungicide treatment

Response to fungicide applications relative to soybean maturity

Carrington, ND (2018)

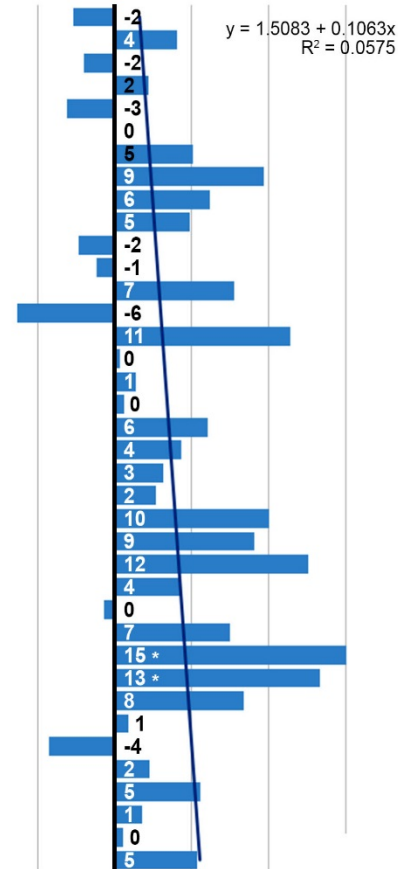
Soybean maturity rating

Assigned by the breeder

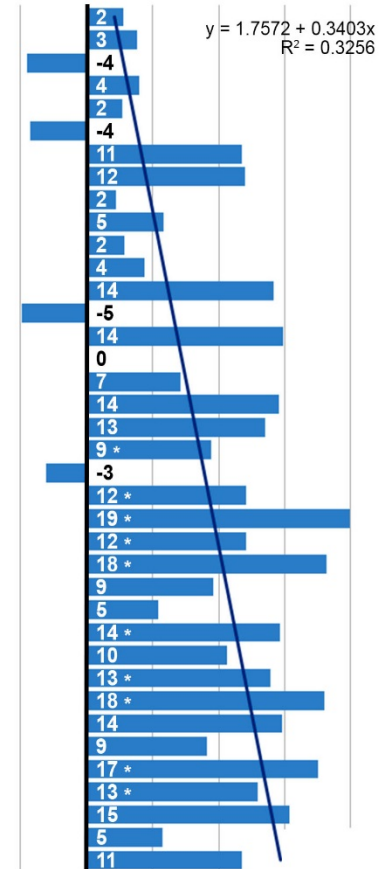


Soybean Yield (bu/ac)
No fungicide applied
13% moisture

Yield Gain (bu/ac)
Single fungicide application
late R1 / early R2 growth stage



Yield Gain (bu/ac)
Two fungicide applications
late R1 / early R2 + 10-12 days later



* Asterisk: denotes a significant ($P < 0.05$) yield increase relative to the no-fungicide treatment

Response to fungicide applications relative to soybean maturity

Oakes, ND (2018)

Soybean maturity rating

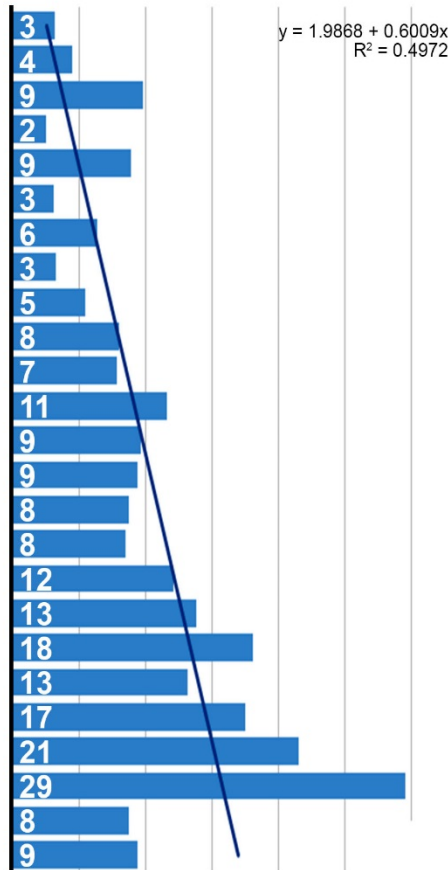
Assigned by the breeder

Maturity Rating	Company	Variety
0.1	Pioneer	P01T06R
0.1	Peterson	16R01
0.2	ProSeed	30-20
0.2	Dairyland	DSR-0225/R2Y
0.3	Peterson	13R03
0.3	Dairyland	DSR-0305/R2Y
0.4	Pioneer	P04A77X
0.4	Dairyland	DSR-0418/R2Y
0.4	Peterson	17X04N
0.4	ProSeed	XT60-40RR2Y
0.4	Dairyland	DSR-0404/R2Y
0.6	Peterson	18X06N
0.7	Dairyland	DSR-0711/R2Y
0.7	Peterson	18X07N
0.8	Peterson	18X08N
0.8	Dairyland	DSR-0807/R2Y
0.9	Dairyland	DSR-0988/R2Y
0.9	Dairyland	DSR-0904/R2Y
0.9	Peterson	17X09N
1.1	Pioneer	P11T22R2
1.1	Peterson	14R11N
1.1	Peterson	18X11N
1.1	Pioneer	P11A95X
1.2	Dairyland	DSR-1120
1.3	Peterson	17X13

White mold (% of canopy)

No fungicide applied

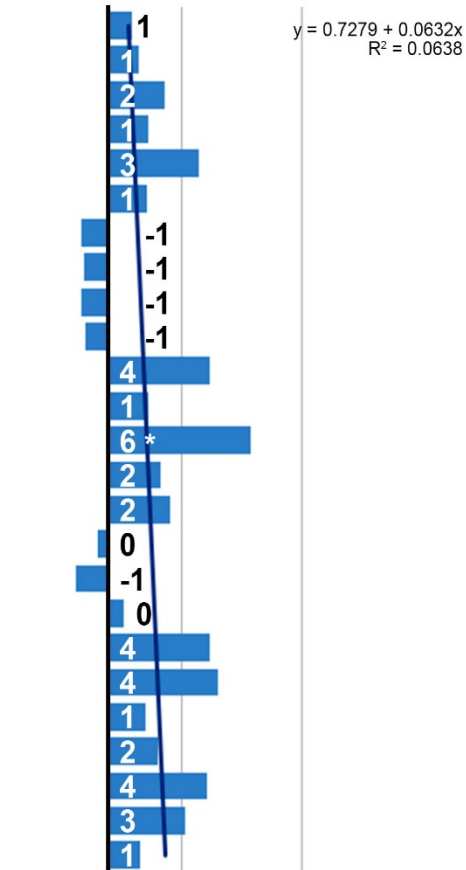
R8 growth stage



White mold reduction (%)

Single fungicide application

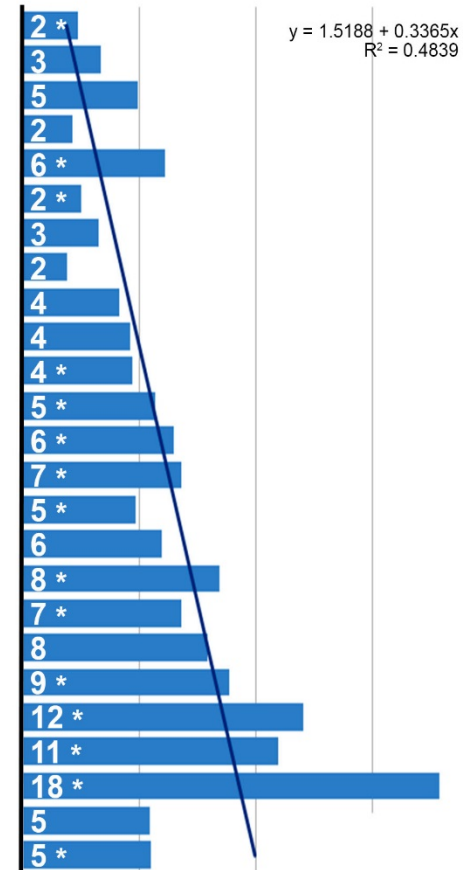
late R1 / early R2 growth stage



White mold reduction (%)

Two fungicide applications

late R1 / early R2 + 10-12 days later



* Asterisk: denotes a significant ($P < 0.05$) disease reduction relative to the no-fungicide treatment

Response to fungicide applications relative to soybean maturity

Oakes, ND (2018)

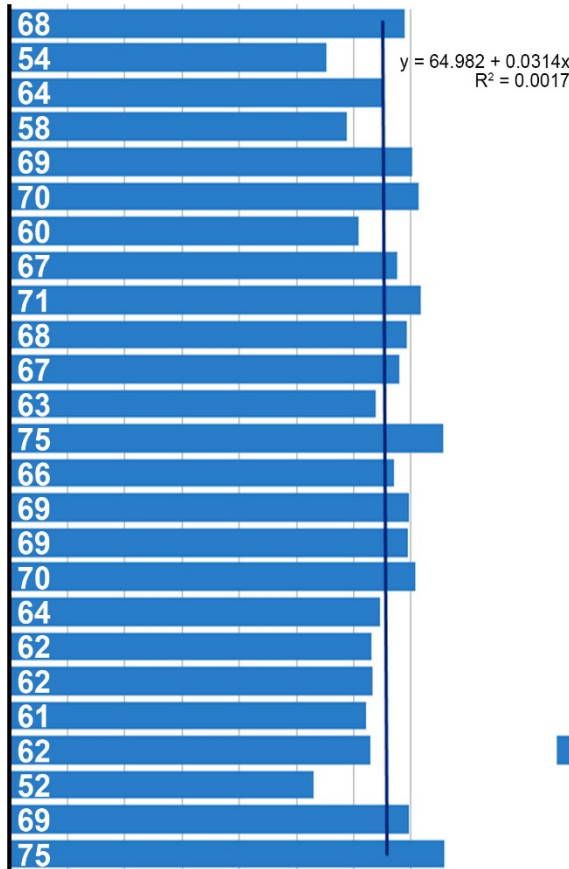
Soybean maturity rating

Assigned by the breeder

Maturity Rating	Company	Variety
0.1	Pioneer	P01T06R
0.1	Peterson	16R01
0.2	ProSeed	30-20
0.2	Dairyland	DSR-0225/R2Y
0.3	Peterson	13R03
0.3	Dairyland	DSR-0305/R2Y
0.4	Pioneer	P04A77X
0.4	Dairyland	DSR-0418/R2Y
0.4	Peterson	17X04N
0.4	ProSeed	XT60-40RR2Y
0.4	Dairyland	DSR-0404/R2Y
0.6	Peterson	18X06N
0.7	Dairyland	DSR-0711/R2Y
0.7	Peterson	18X07N
0.8	Peterson	18X08N
0.8	Dairyland	DSR-0807/R2Y
0.9	Dairyland	DSR-0988/R2Y
0.9	Dairyland	DSR-0904/R2Y
0.9	Peterson	17X09N
1.1	Pioneer	P11T22R2
1.1	Peterson	14R11N
1.1	Peterson	18X11N
1.1	Pioneer	P11A95X
1.2	Dairyland	DSR-1120
1.3	Peterson	17X13

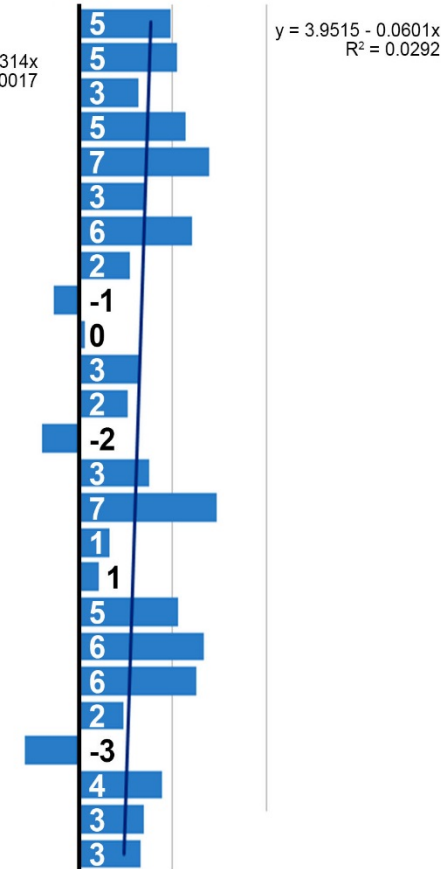
Yield (bu/ac)

No fungicide applied
13% moisture



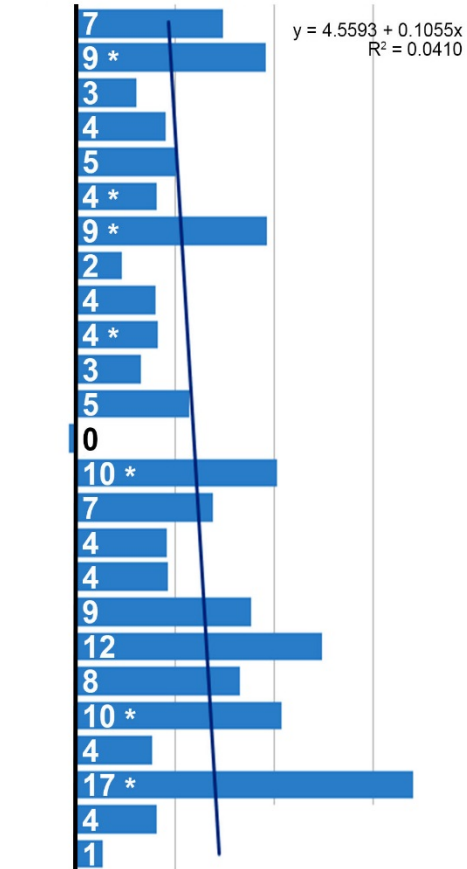
Yield Gain (bu/ac)

Single fungicide application
late R1 / early R2 growth stage



Yield Gain (bu/ac)

Two fungicide applications
late R1 / early R2 + 10-12 days later

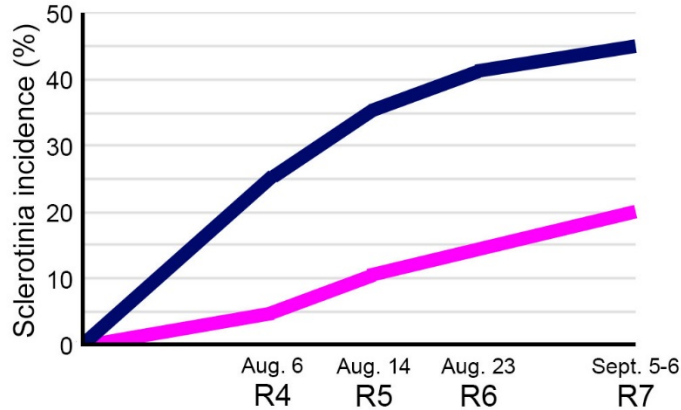


* Asterisk: denotes a significant ($P < 0.05$) yield increase relative to the no-fungicide treatment

Impact of Sclerotinia infection timing on disease levels and yield

CARRINGTON (2015)

Dairyland 'DSR0305 / R2Y'
0.3 maturity



■ Irrigated Jul. 22 - Aug. 3 (R2-R4)
■ Irrigated Aug. 8 - Aug. 31 (R4-R6)

Disease and yield - no fungicide:

Growth stages in which soybeans received intensive irrigation favoring white mold

White Mold Incidence

Percent of plants

R2 to R4

48

R4 to R6

18

Soybean Yield

bu/ac (13% moisture)

42

59

Response to a single fungicide application:

Endura 5.5 oz/ac applied at 100% R2

Growth stages in which soybeans received intensive irrigation favoring white mold

Decrease in White Mold

Percent of plants

R2 to R4

27

R4 to R6

6

Increase in Yield

bu/ac (13% moisture)

7

1

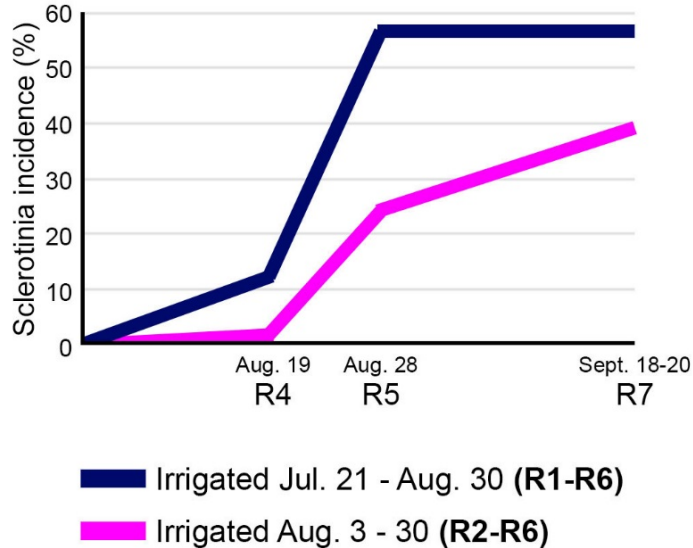
Fungicide application methods:

XR8001 flat-fan nozzles, 35 psi (fine droplets); 15 gal/ac

Response to fungicide applications relative to Sclerotinia infection timing

CARRINGTON (2014)

Dairyland 'DSR0404 / R2Y'
0.4 maturity



Disease and yield - no fungicide:

Growth stages in which soybeans received intensive irrigation favoring white mold

White Mold Incidence

Percent of plants

R1 to R6

56

R2 to R6

41

Soybean Yield

bu/ac (13% moisture)

37

43

Response to a single fungicide application:

Endura 5.5 oz/ac applied at 100% R2

Growth stages in which soybeans received intensive irrigation favoring white mold

Decrease in White Mold

Percent of plants

R1 to R6

21

R2 to R6

19

Increase in Yield

bu/ac (13% moisture)

9

7

Fungicide application methods:

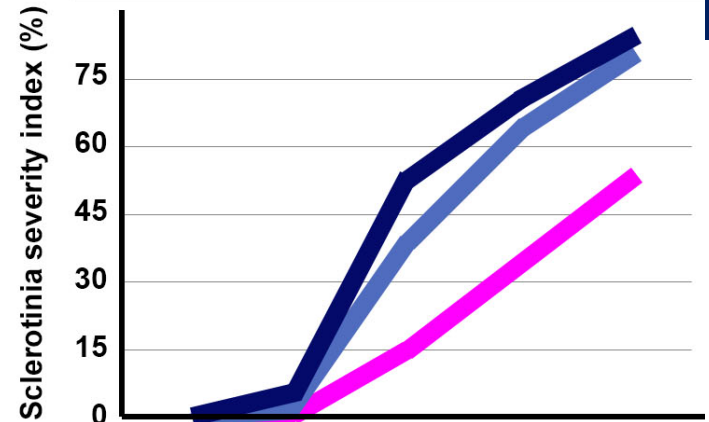
XR8001 flat-fan nozzles, 35 psi (fine droplets); 15 gal/ac

SCLEROTINIA INFECTION TIMING: DRY EDIBLE (PINTO) BEANS

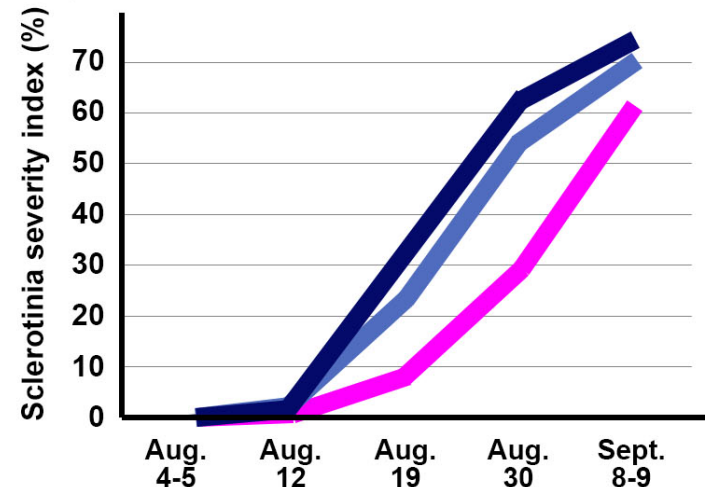
2014:
Disease
progression
relative to
intensive irrigation

Carrington, ND (2014)
'Lariat' pinto

14-INCH ROW SPACING



28-INCH ROW SPACING



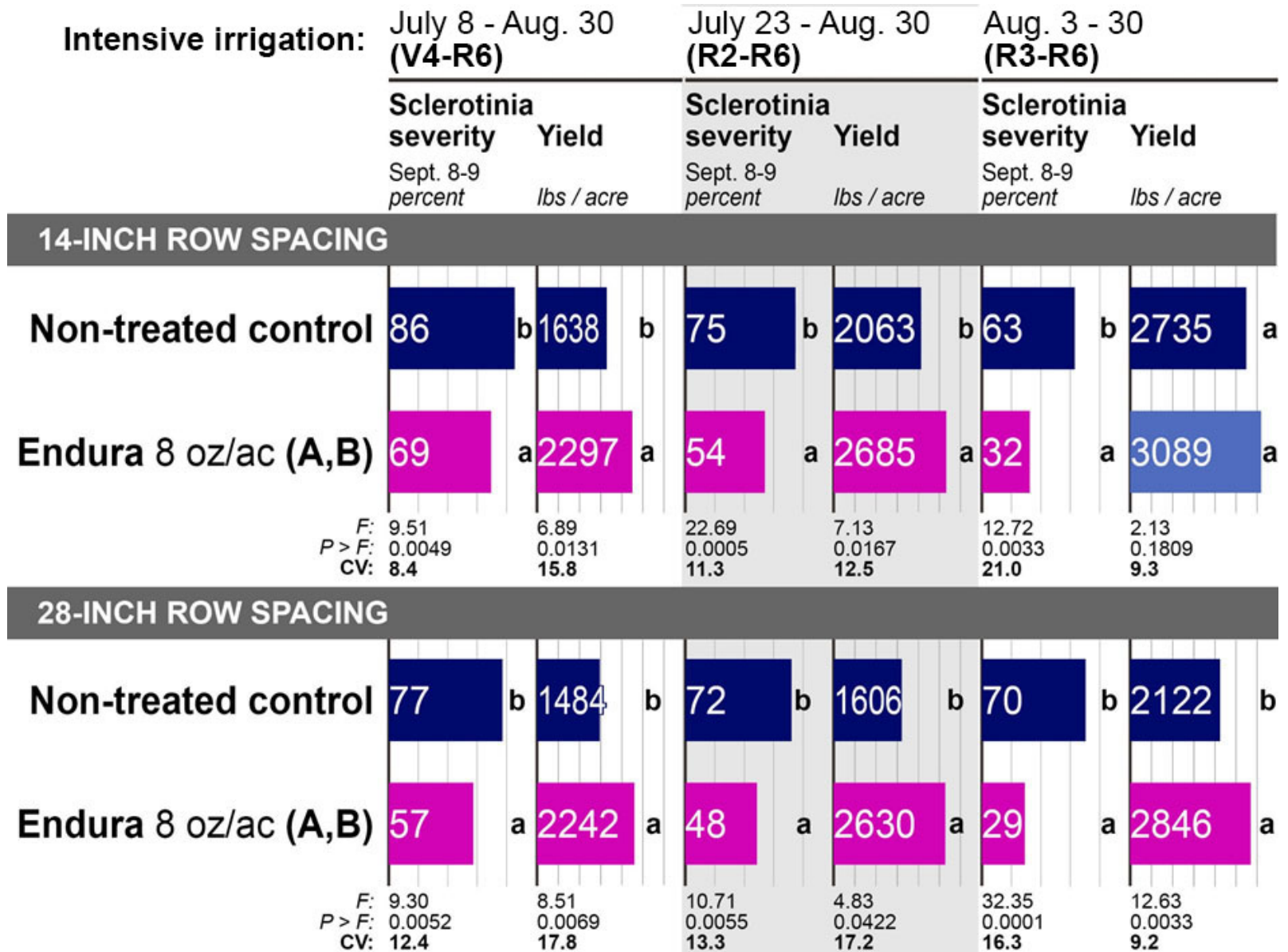
- Irrigated July 8 - Aug. 30
(V4 - R6 growth stage)
- Irrigated July 23 - Aug. 30
(R2 - R6 growth stage)
- Irrigated Aug. 3 - 30
(R3 - R6 growth stage)

SCLEROTINIA INFECTION TIMING: **DRY EDIBLE (PINTO) BEANS**

2014:
 Apothecia
 production
 relative to
 intensive irrigation

	INTENSIVE IRRIGATION	APOTHECIA / m ²	
		July 30 (R2)	Aug. 19 (R5)
14-inch rows			
July 8 - Aug. 30 (V4-R6)	0.2	0.2	2.3
July 23 - Aug. 30 (R2-R6)	0.1	0.1	1.6
Aug. 3-30 (R3-R6)	0.06	0.06	0.7
28-inch rows			
July 8 - Aug. 30 (V4-R6)	0	0	1.5
July 23 - Aug. 30 (R2-R6)	0.05	0.05	1.9
Aug. 3-30 (R3-R6)	0	0	0.3

2014: Response to fungicides





Thank You!

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Northharvest Bean Growers Association

North Dakota Crop Protection Product Registration and Harmonization Board



NDSU NORTH DAKOTA AGRICULTURAL EXPERIMENT STATION