



## Improving management of white mold in soybeans and dry beans: Impact of row spacing

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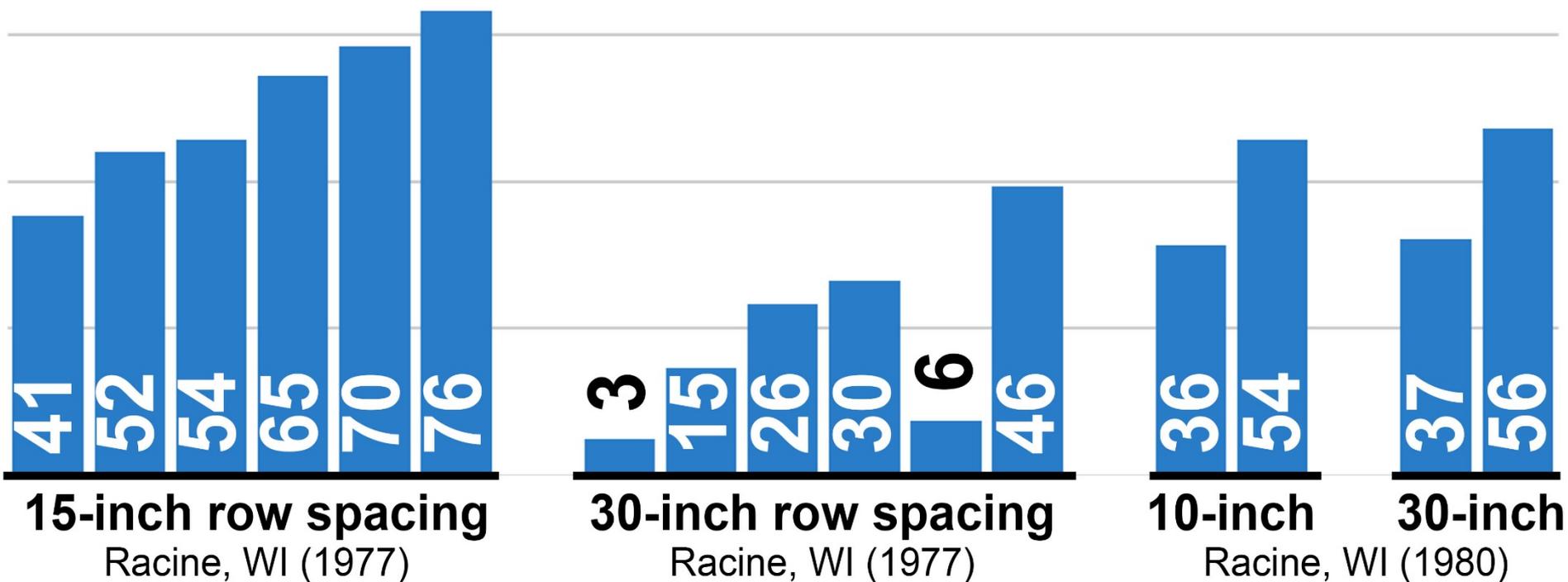
# Impact of row spacing on soybean agronomic performance under white mold pressure

Racine, Wisconsin (1977, 1980)

## White mold incidence (% of plants; R7 growth stage)

Seeding rates: 15-inch row: 213,000 seeds/ac 30-inch row: 160,000 seeds/ac

Grau and Radke 1984. Plant Dis. 68(1):56-58.



**15-inch row spacing**  
Racine, WI (1977)

SOYBEAN VARIETY:

Hodgson  
Corsoy  
SRF-200  
Wells  
Steele  
Asgrow 2656

**30-inch row spacing**  
Racine, WI (1977)

SOYBEAN VARIETY:

Hodgson  
Corsoy  
SRF-200  
Wells  
Steele  
Asgrow 2656

**10-inch 30-inch**  
Racine, WI (1980)

SOYBEAN VARIETY:

Corsoy Wells  
Corsoy Wells

# Impact of row spacing on soybean agronomic performance under white mold pressure

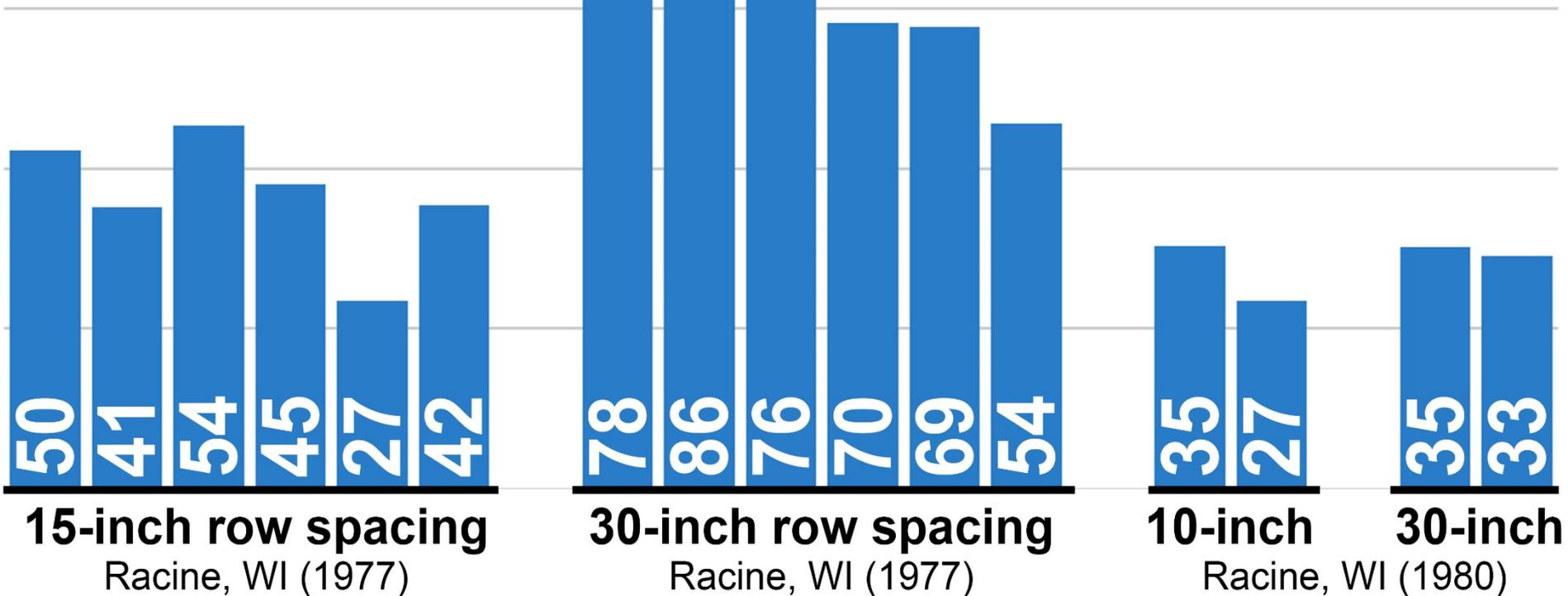
Racine, Wisconsin (1977, 1980)

## Soybean Yield (bushels/acre; 13% moisture)

Seeding rates: 15-inch row: 213,000 seeds/ac

30-inch row: 160,000 seeds/ac

Grau and Radke 1984. Plant Dis. 68(1):56-58.



SOYBEAN VARIETY:

Hodgson  
Corsoy  
SRF-200  
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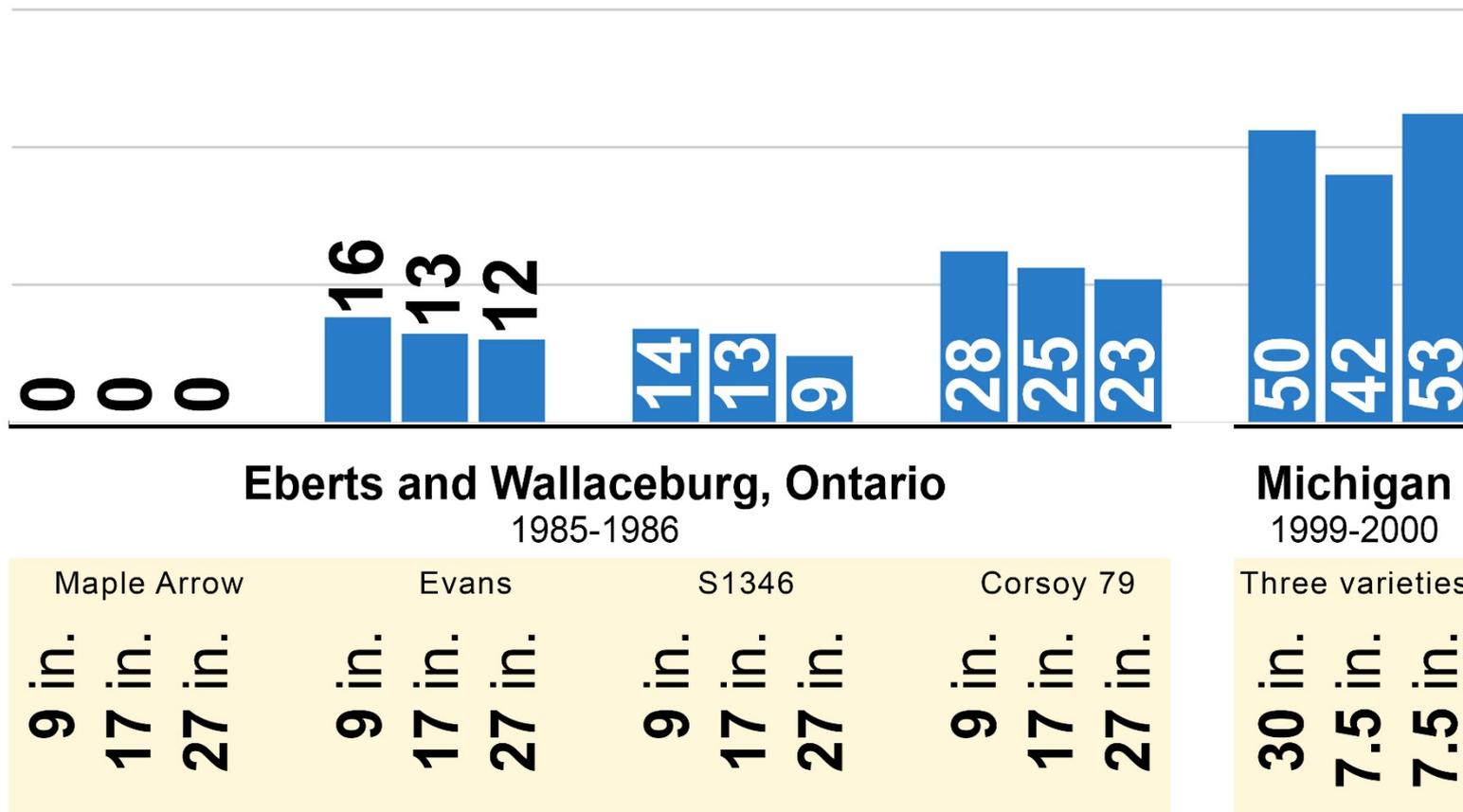
Corsoy  
Wells  
Corsoy  
Wells

# Impact of row spacing on soybean agronomic performance under white mold pressure

Eberts and Wallaceburg, Ontario (1985-1986)

Ingham County, Michigan (1999-2000)

## White mold incidence (% of plants; R7 growth stage)



**Ontario** - Seeding rates: 9-inch row: 264,000 seeds/ac 18-inch row: 180,000 seeds/ac 27-inch row: 147,000 seeds/ac  
 Buzzell et al. 1993. Can. J. Plant Sci. 73:1169-1175

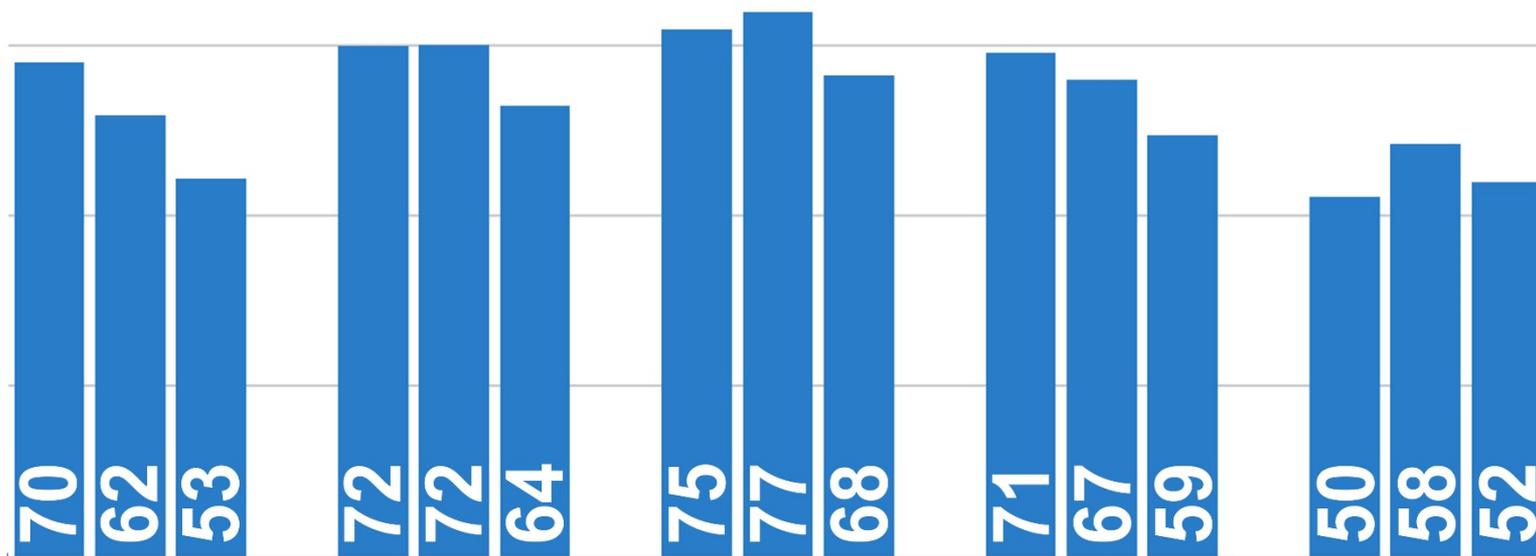
**Michigan** - Seeding rates: 30-inch row: 174,000 seeds/ac 7.5-inch row: 174,000 and 224,000 seeds/ac  
 Lee et al. 2005. Weed Technology 19:580-588.

# Impact of row spacing on soybean agronomic performance under white mold pressure

Eberts and Wallaceburg, Ontario (1985-1986)

Ingham County, Michigan (1999-2000)

## Soybean Yield (bushels/acre; 13% moisture)



### Eberts and Wallaceburg, Ontario

1985-1986

### Michigan

1999-2000

Maple Arrow

Evans

S1346

Corsoy 79

Three varieties

9 in.  
17 in.  
27 in.

30 in.  
7.5 in.  
7.5 in.

**Ontario** - Seeding rates: 9-inch row: 264,000 seeds/ac 18-inch row: 180,000 seeds/ac 27-inch row: 147,000 seeds/ac

Buzzell et al. 1993. Can. J. Plant Sci. 73:1169-1175

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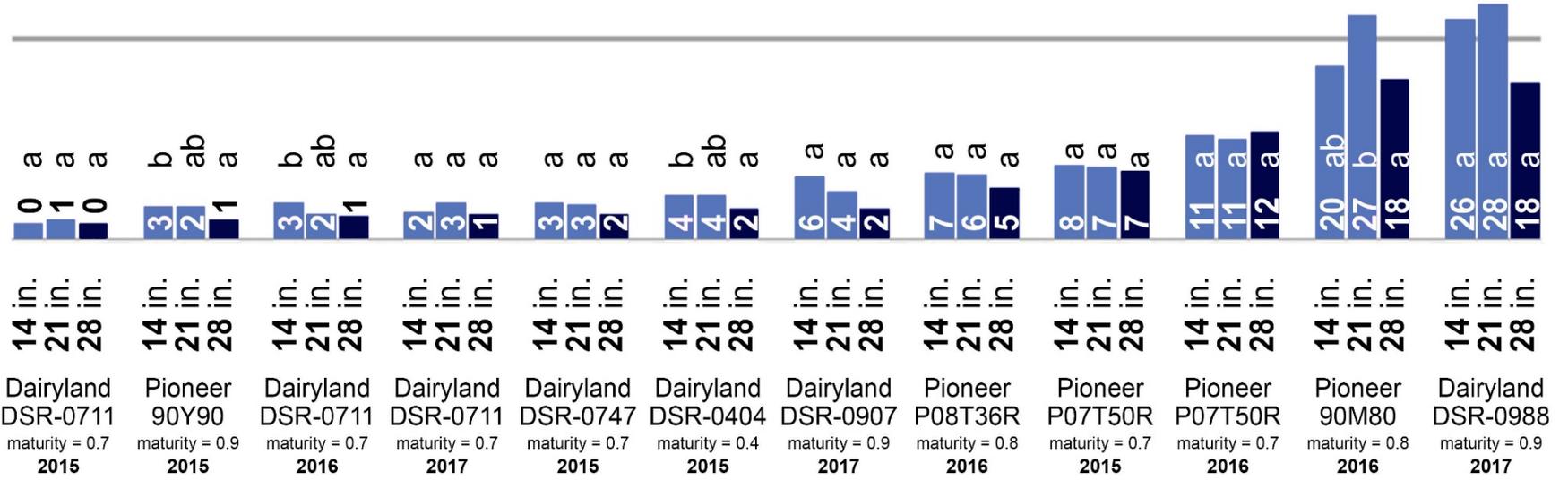
Lee et al. 2005. Weed Technology 19:580-588.



# Impact of seeding rate on soybean agronomic performance under white mold pressure

Oakes, ND (2015-2017) Combined analysis across three seeding rates: 132,000; 165,000; and 198,000 viable seeds/ac

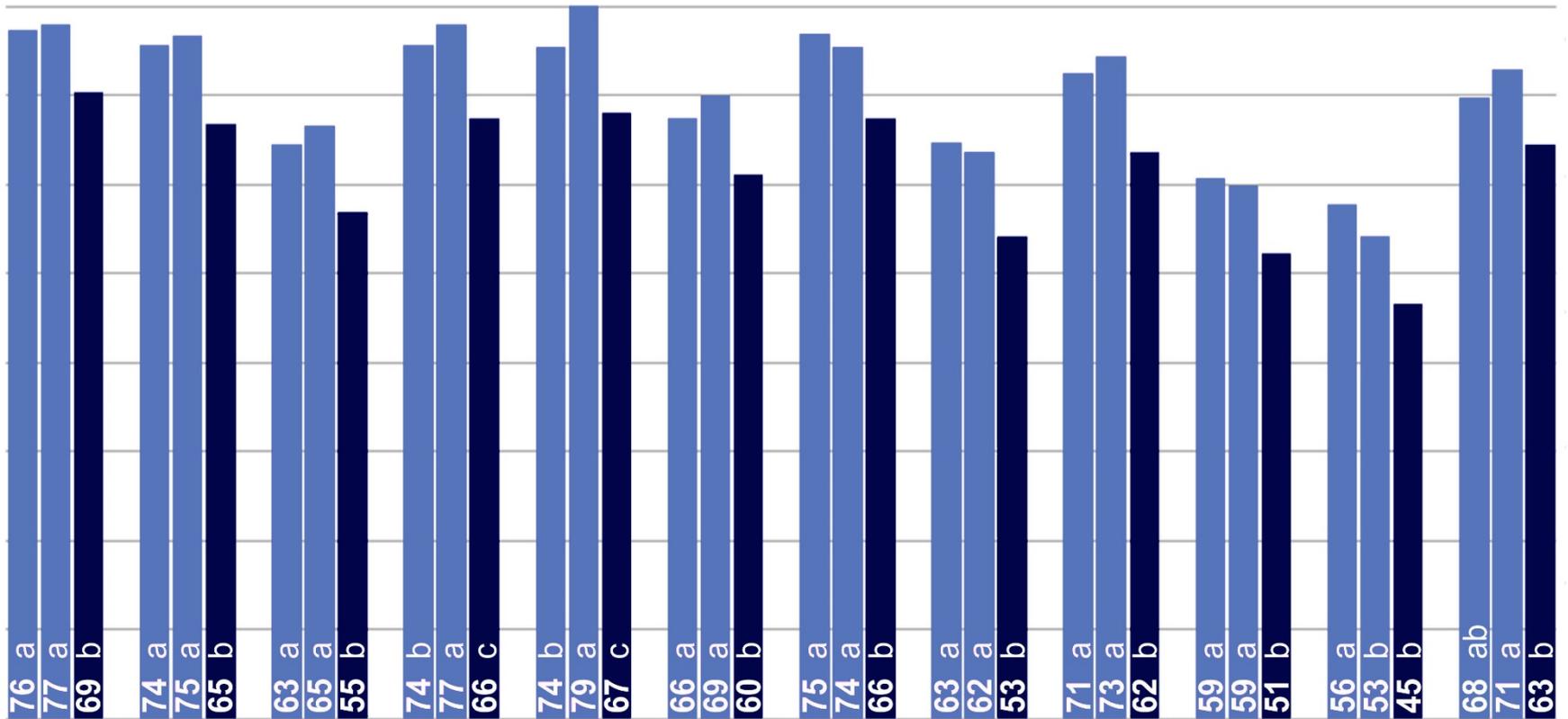
## White mold incidence (% of plants; R7 growth stage)



# Impact of seeding rate on soybean agronomic performance under white mold pressure

Oakes, ND (2015-2017) Combined analysis across three seeding rates: 132,000; 165,000; and 198,000 viable seeds/ac

## Soybean Yield (bushels/acre; 13% moisture)



Row Spacing

14 in.  
21 in.  
28 in.

Dairyland  
DSR-0711  
maturity = 0.7  
2015

14 in.  
21 in.  
28 in.

Pioneer  
90Y90  
maturity = 0.9  
2015

14 in.  
21 in.  
28 in.

Dairyland  
DSR-0711  
maturity = 0.7  
2016

14 in.  
21 in.  
28 in.

Dairyland  
DSR-0711  
maturity = 0.7  
2017

14 in.  
21 in.  
28 in.

Dairyland  
DSR-0747  
maturity = 0.7  
2015

14 in.  
21 in.  
28 in.

Dairyland  
DSR-0404  
maturity = 0.4  
2015

14 in.  
21 in.  
28 in.

Dairyland  
DSR-0907  
maturity = 0.9  
2017

14 in.  
21 in.  
28 in.

Pioneer  
P08T36R  
maturity = 0.8  
2016

14 in.  
21 in.  
28 in.

Pioneer  
P07T50R  
maturity = 0.7  
2015

14 in.  
21 in.  
28 in.

Pioneer  
P07T50R  
maturity = 0.7  
2016

14 in.  
21 in.  
28 in.

Pioneer  
90M80  
maturity = 0.8  
2016

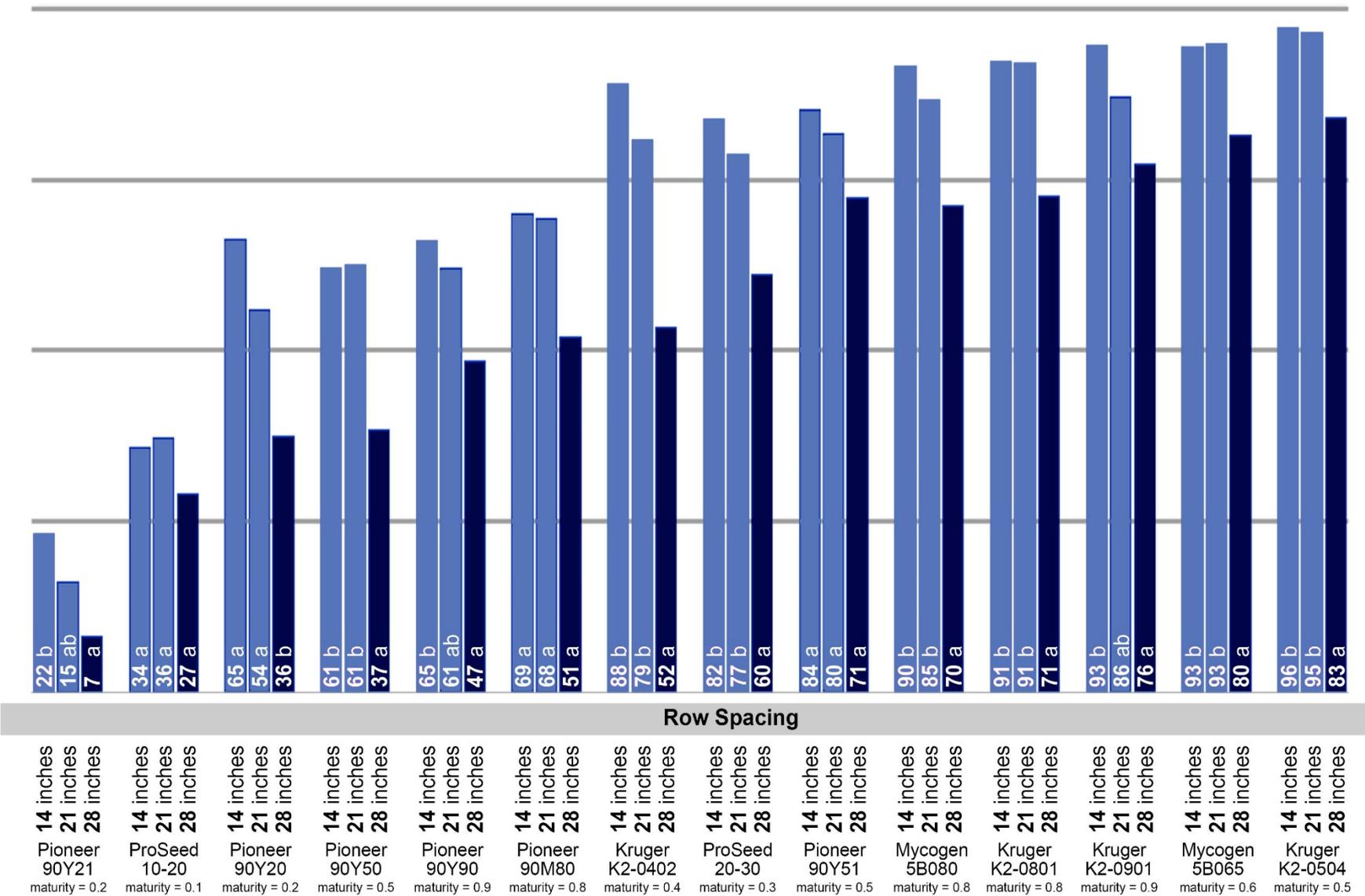
14 in.  
21 in.  
28 in.

Dairyland  
DSR-0988  
maturity = 0.9  
2017

# Impact of row spacing on soybean agronomic performance under white mold pressure

Carrington, ND (2014) Seeding rate: 165,000 viable seeds/ac

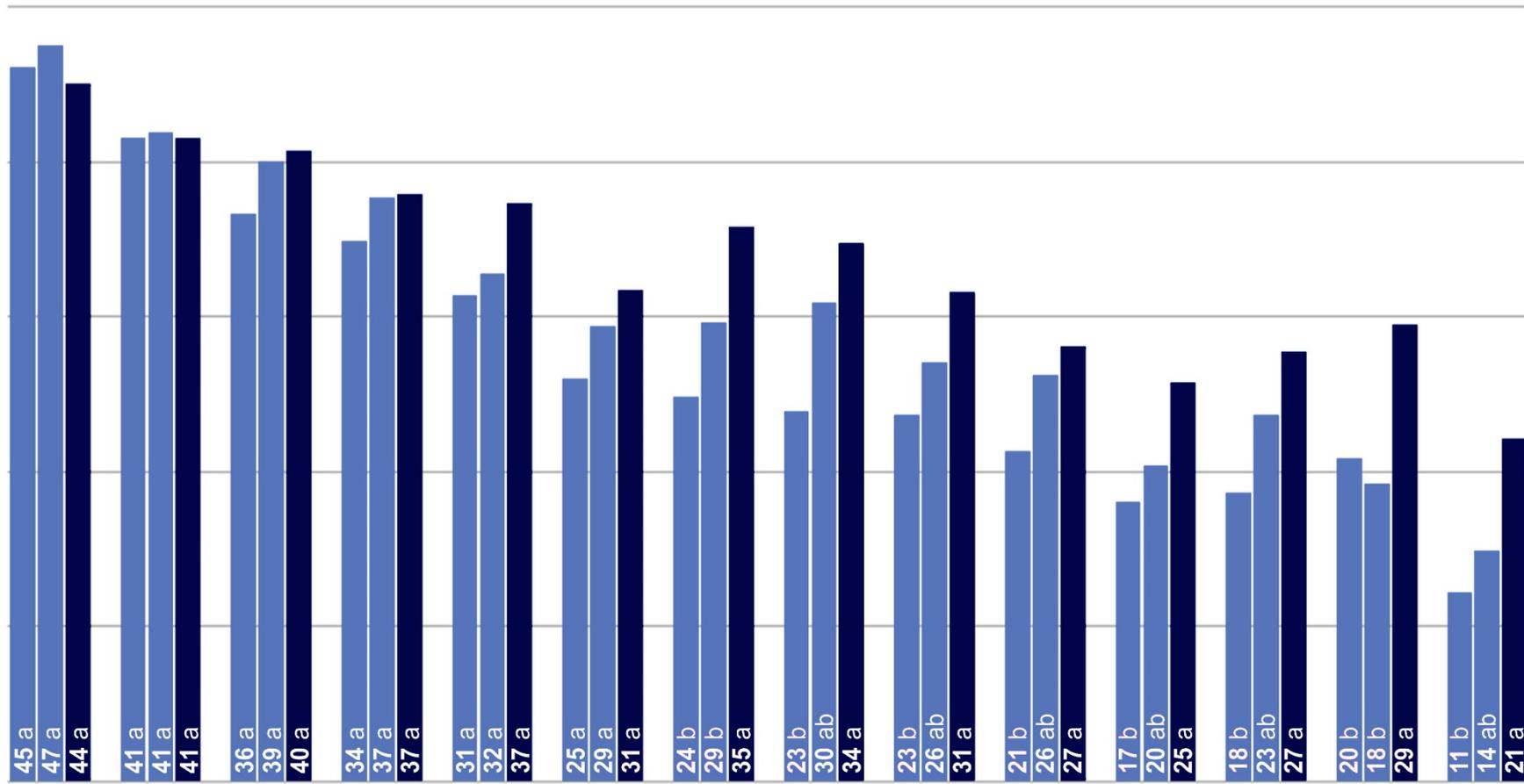
## White mold incidence (% of plants; R7 growth stage)



# Impact of row spacing on soybean agronomic performance under white mold pressure

Carrington, ND (2014) Seeding rate: 165,000 viable seeds/ac

## Soybean Yield (bushels/acre; 13% moisture)



Row Spacing

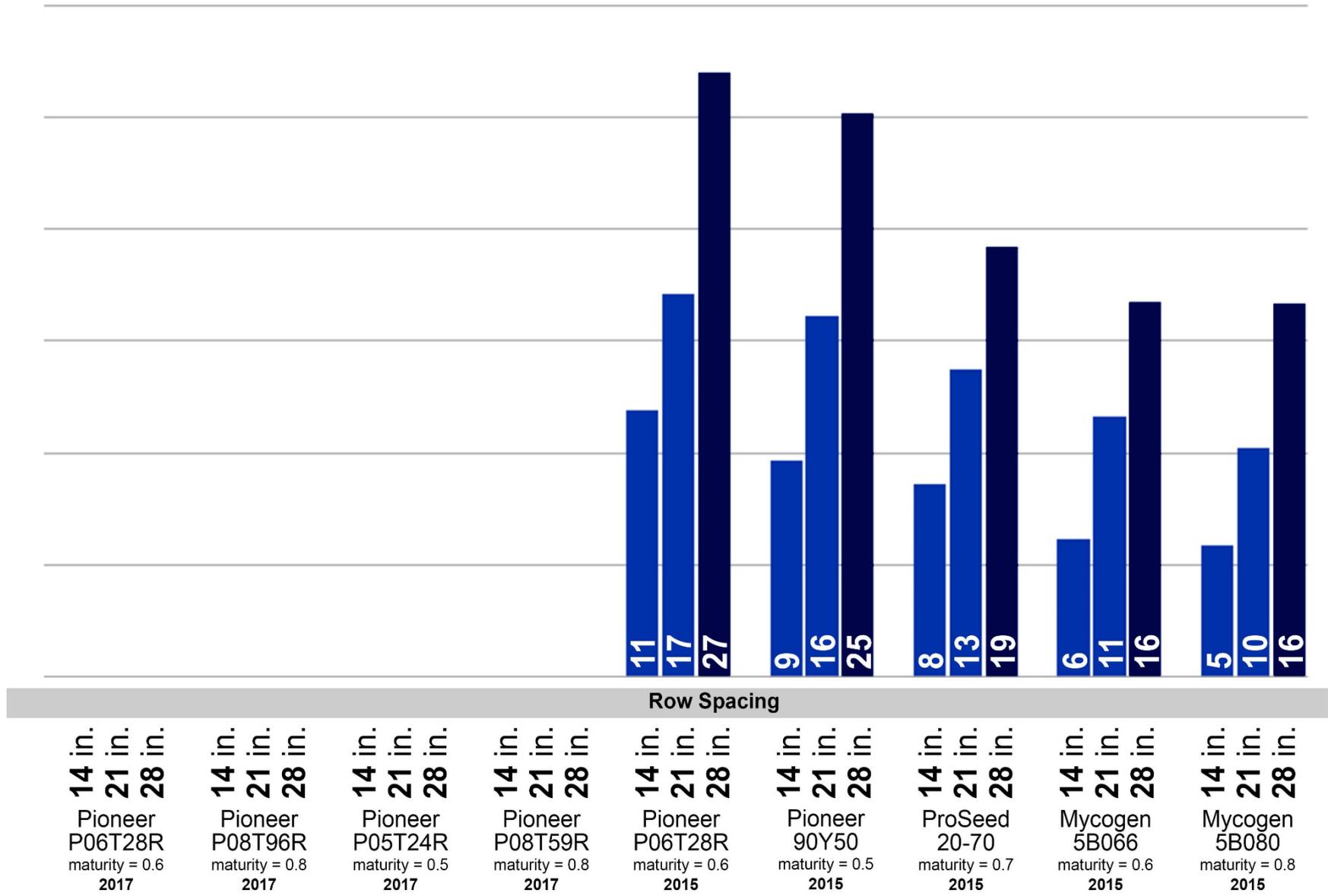
14 inches 21 inches 28 inches  
 Pioneer 90Y21 ProSeed 10-20 Pioneer 90Y20 Pioneer 90Y50 Pioneer 90Y90 Pioneer 90M80 Kruger K2-0402 ProSeed 20-30 Pioneer 90Y51 Mycogen 5B080 Kruger K2-0801 Kruger K2-0901 Mycogen 5B065 Kruger K2-0504  
 maturity = 0.2 maturity = 0.1 maturity = 0.2 maturity = 0.5 maturity = 0.9 maturity = 0.8 maturity = 0.4 maturity = 0.3 maturity = 0.5 maturity = 0.8 maturity = 0.8 maturity = 0.9 maturity = 0.6 maturity = 0.5

# Impact of seeding rate on soybean agronomic performance under white mold pressure

Carrington, ND (2015, 2017)

Combined analysis across three seeding rates: 132,000; 165,000; and 198,000 viable seeds/ac

## Canopy closure (days before or after bloom initiation - 90% of plants at R1)

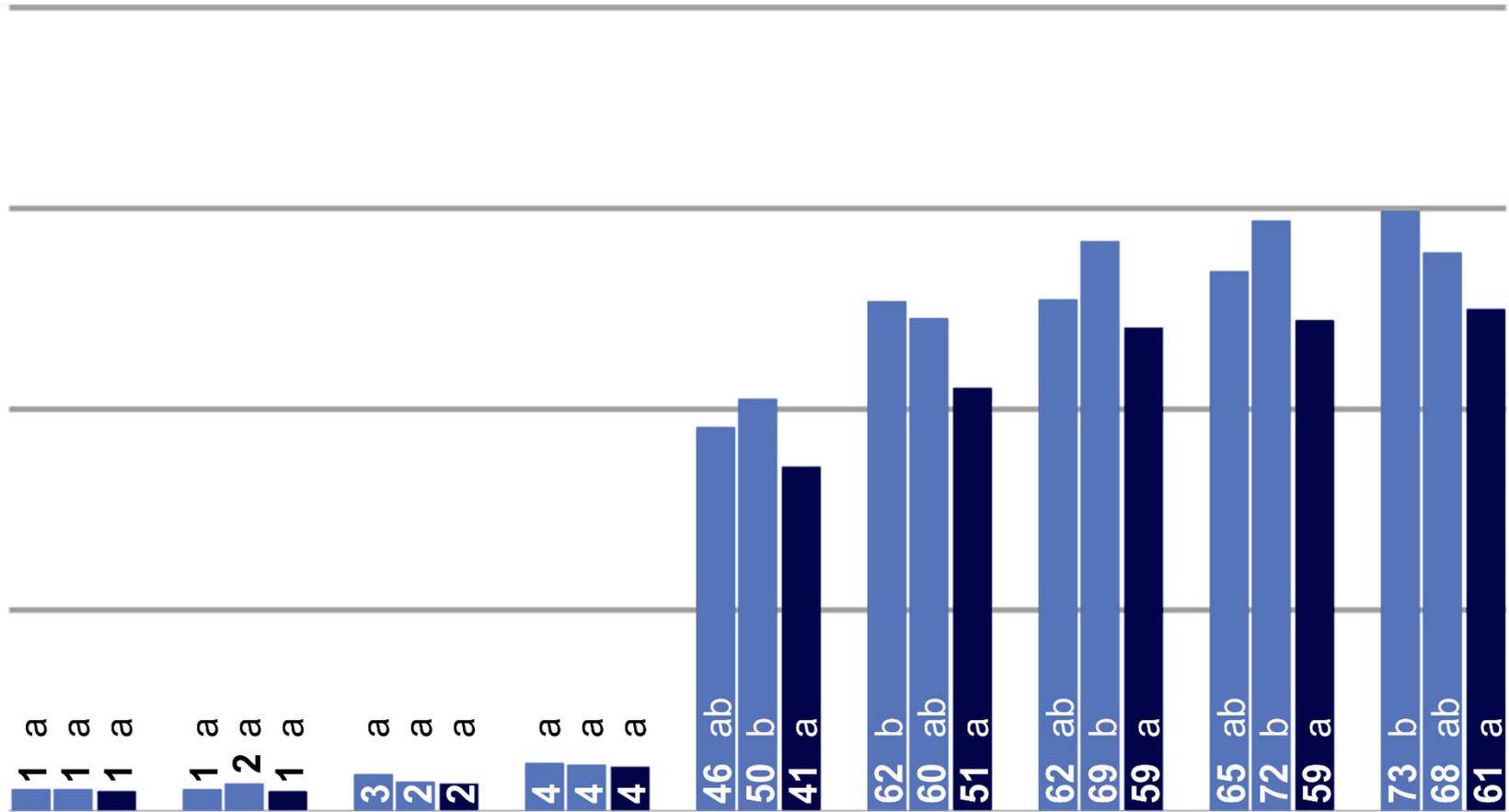


# Impact of seeding rate on soybean agronomic performance under white mold pressure

Carrington, ND (2015, 2017)

Combined analysis across three seeding rates: 132,000; 165,000; and 198,000 viable seeds/ac

## White mold incidence (% of plants; R7 growth stage)



Row Spacing

14 in.  
21 in.  
28 in.

Pioneer  
P06T28R  
maturity = 0.6  
2017

14 in.  
21 in.  
28 in.

Pioneer  
P08T96R  
maturity = 0.8  
2017

14 in.  
21 in.  
28 in.

Pioneer  
P05T24R  
maturity = 0.5  
2017

14 in.  
21 in.  
28 in.

Pioneer  
P08T59R  
maturity = 0.8  
2017

14 in.  
21 in.  
28 in.

Pioneer  
P06T28R  
maturity = 0.6  
2015

14 in.  
21 in.  
28 in.

Pioneer  
90Y50  
maturity = 0.5  
2015

14 in.  
21 in.  
28 in.

ProSeed  
20-70  
maturity = 0.7  
2015

14 in.  
21 in.  
28 in.

Mycogen  
5B066  
maturity = 0.6  
2015

14 in.  
21 in.  
28 in.

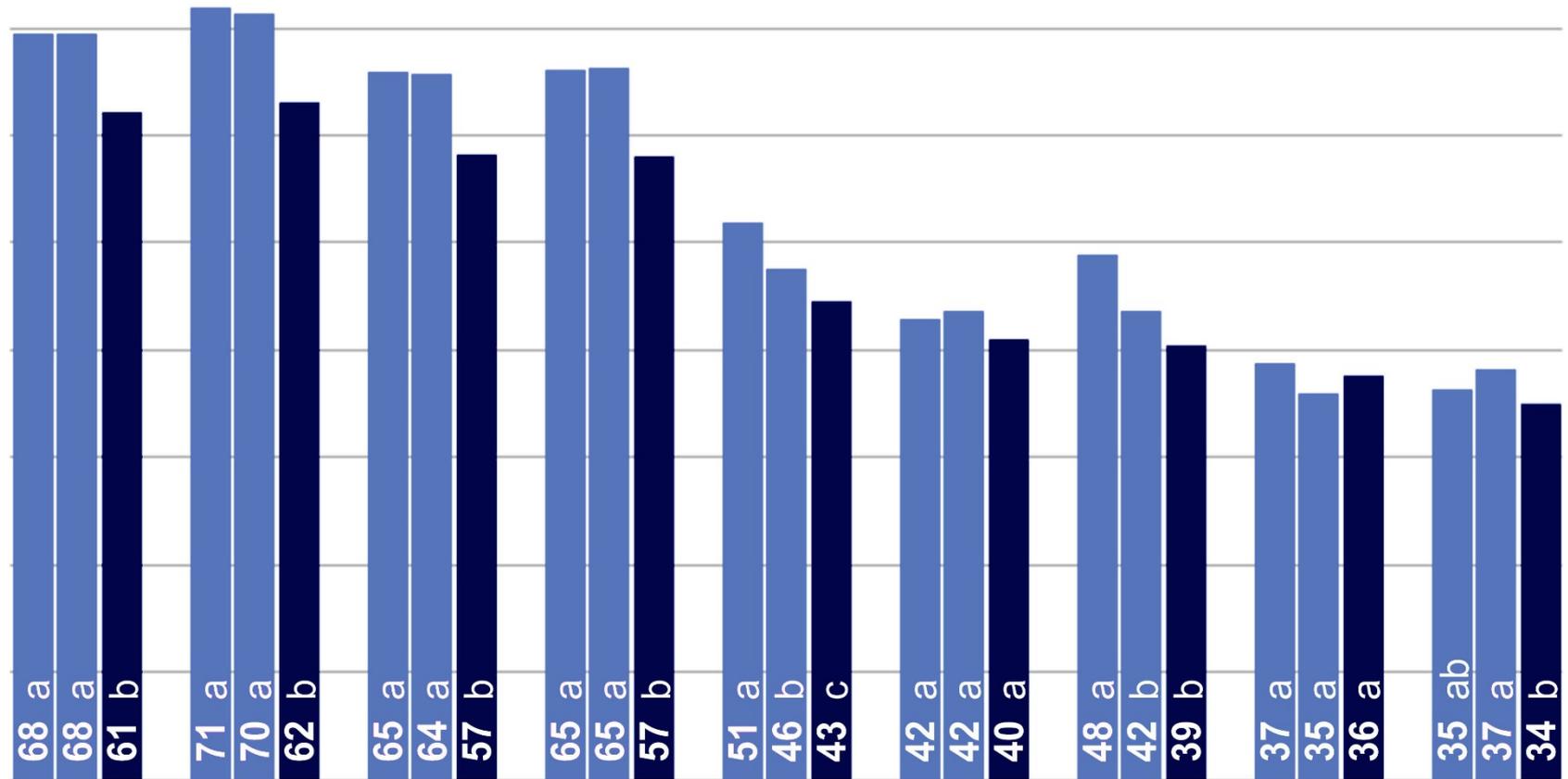
Mycogen  
5B080  
maturity = 0.8  
2015

# Impact of seeding rate on soybean agronomic performance under white mold pressure

Carrington, ND (2015, 2017)

Combined analysis across three seeding rates: 132,000; 165,000; and 198,000 viable seeds/ac

## Soybean Yield (bushels/acre; 13% moisture)



Row Spacing

14 in.  
21 in.  
28 in.

Pioneer  
P06T28R  
maturity = 0.6  
2017

14 in.  
21 in.  
28 in.

Pioneer  
P08T96R  
maturity = 0.8  
2017

14 in.  
21 in.  
28 in.

Pioneer  
P05T24R  
maturity = 0.5  
2017

14 in.  
21 in.  
28 in.

Pioneer  
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21 in.  
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14 in.  
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Pioneer  
90Y50  
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ProSeed  
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maturity = 0.7  
2015

14 in.  
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28 in.

Mycogen  
5B066  
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14 in.  
21 in.  
28 in.

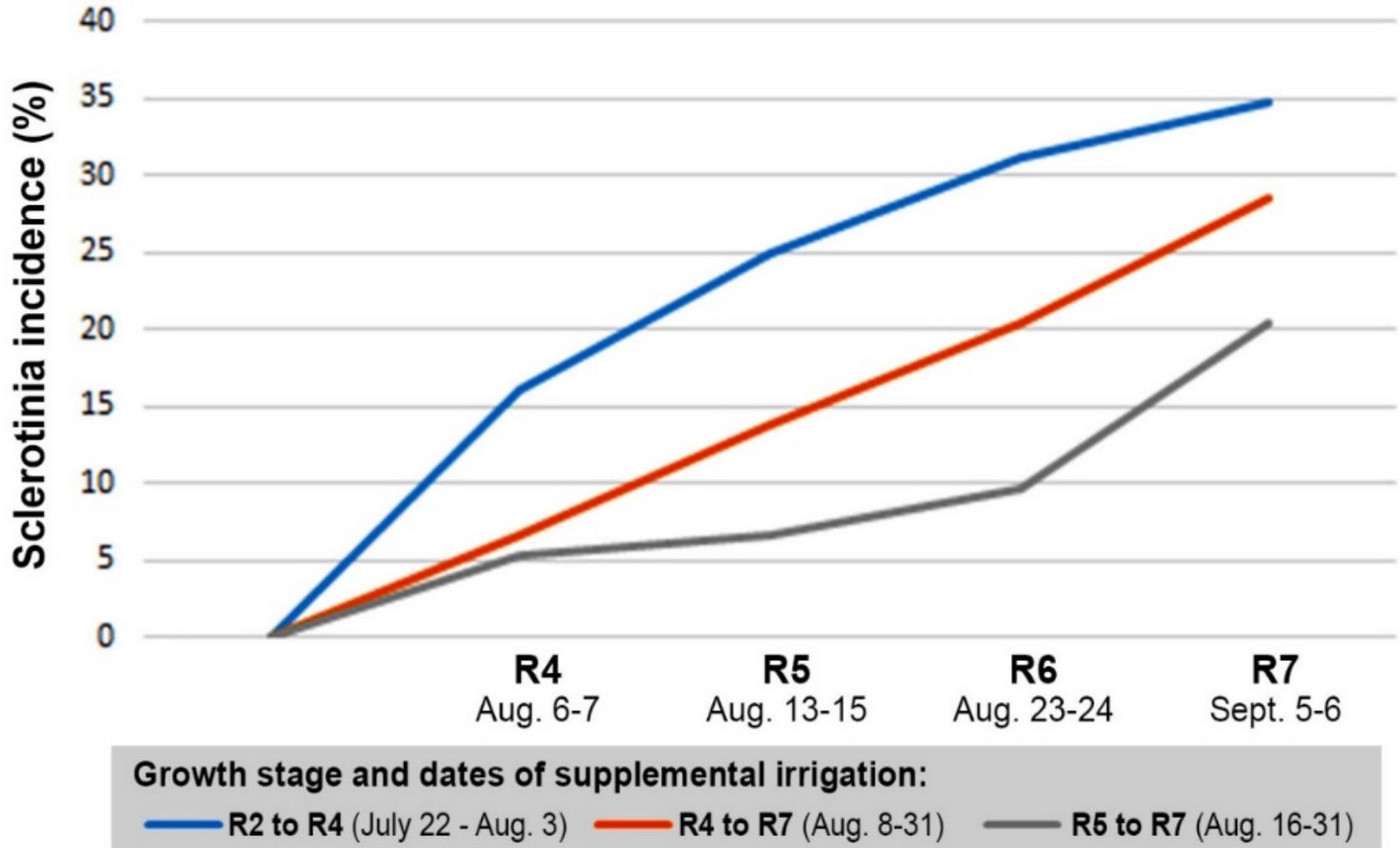
Mycogen  
5B080  
maturity = 0.8  
2015

# SCLEROTINIA MANAGEMENT

## Row spacing

### Carrington, ND 2015: 0.3-maturity soybean variety

Combined analysis, three seeding rates (132,000; 165,000; 198,000 viable seeds/ac) and four row spacings



# SCLEROTINIA MANAGEMENT

## Row spacing

### Carrington, ND 2015: 0.3-maturity soybean variety

Combined analysis across three seeding rates (132,000; 165,000; 198,000 viable seeds/ac)

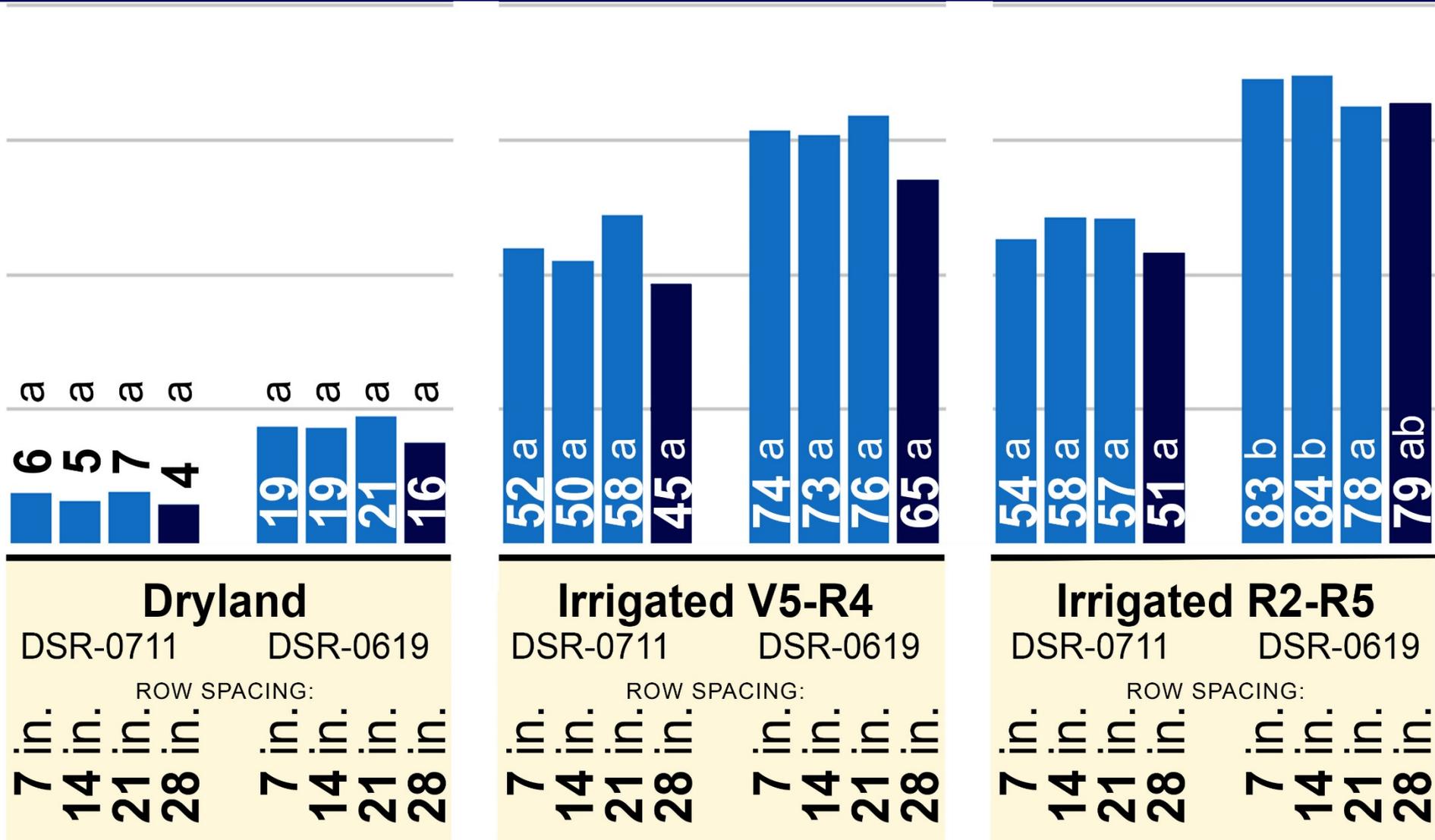
Row spacing	Canopy Closure <i>Days after 90% bloom</i>	Sclerotinia Incidence <i>Sept. 5-6; R7 %</i>	Soybean Yield <i>13% moisture bu/ac</i>	Sclerotia in Grain <i>% by weight</i>
<b>IRRIGATION: R2 to R4 growth stage (July 22 - Aug. 3)</b>				
7-inch	<b>5</b>	<b>37</b> b	<b>40</b> ab	<b>1.25</b> a
14-inch	<b>6</b>	<b>38</b> b	<b>43</b> ab	<b>1.42</b> a
21-inch	<b>14</b>	<b>35</b> ab	<b>44</b> a	<b>1.26</b> a
28-inch	<b>19</b>	<b>29</b> a	<b>39</b> b	<b>1.02</b> a
		CV: 22.0	CV: 10.0	CV: 22.7
<b>IRRIGATION: R4 to R7 growth stage (Aug. 8 - 31)</b>				
7-inch	<b>4</b>	<b>31</b> b	<b>51</b> ab	<b>0.77</b> a
14-inch	<b>5</b>	<b>33</b> b	<b>54</b> a	<b>0.72</b> a
21-inch	<b>14</b>	<b>28</b> ab	<b>51</b> ab	<b>0.57</b> a
28-inch	<b>21</b>	<b>23</b> a	<b>48</b> b	<b>0.51</b> a
		CV: 19.8	CV: 32.1	CV: 6.2
<b>IRRIGATION: R5 to R7 growth stage (Aug. 16 - 31)</b>				
7-inch	<b>4</b>	<b>23</b> b	<b>49</b> bc	<b>0.53</b> a
14-inch	<b>6</b>	<b>24</b> b	<b>53</b> a	<b>0.42</b> a
21-inch	<b>12</b>	<b>19</b> ab	<b>52</b> ab	<b>0.42</b> a
28-inch	<b>23</b>	<b>15</b> a	<b>47</b> c	<b>0.36</b> a
		CV: 19.8	CV: 32.1	CV: 6.2

# Impact of seeding rate on soybean agronomic performance under white mold pressure

Carrington, ND (2017)

Combined analysis across three seeding rates: 132,000; 165,000; and 198,000 viable seeds/ac

## White mold incidence (% of plants; R7 growth stage)

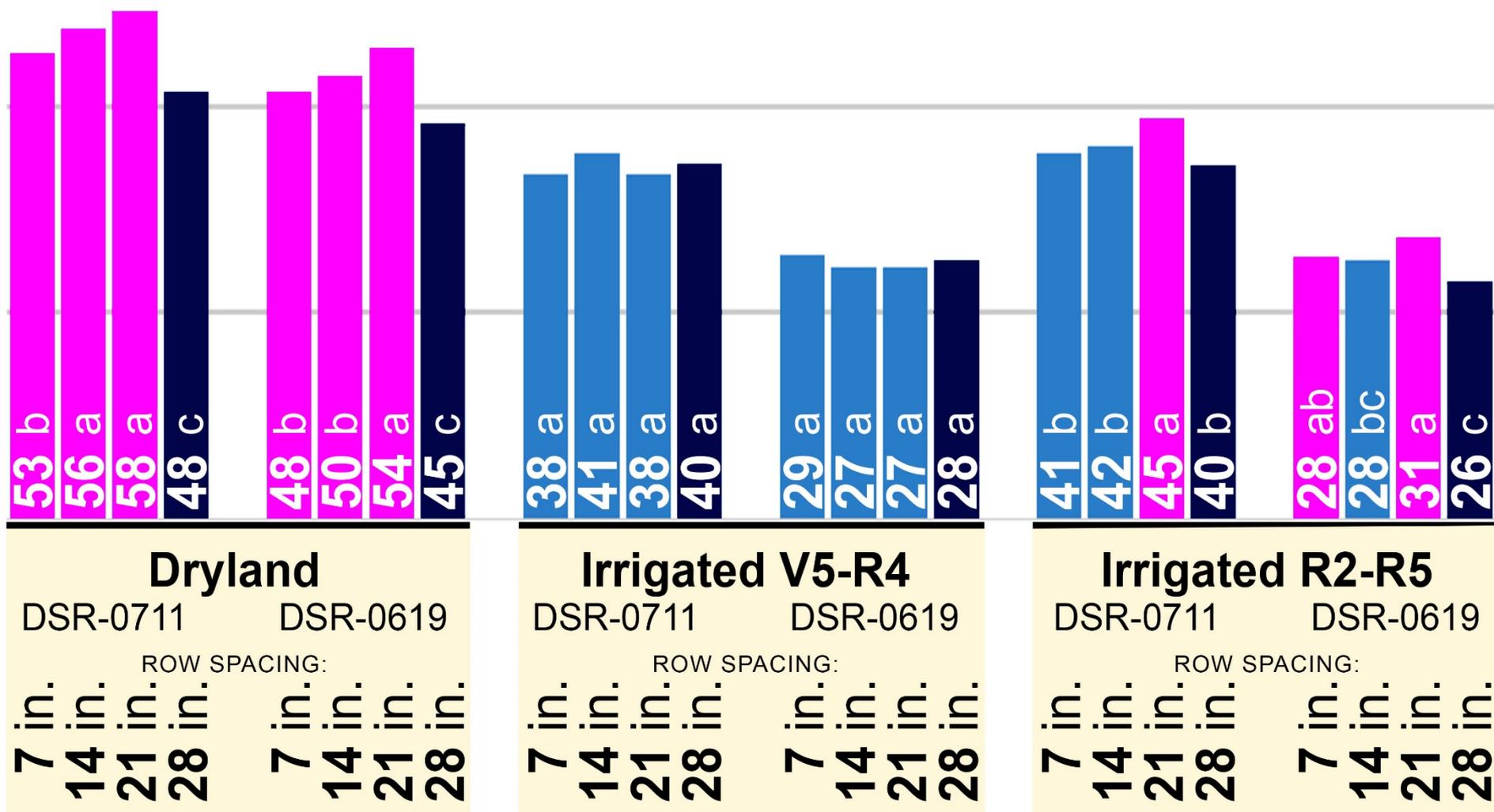


# Impact of seeding rate on soybean agronomic performance under white mold pressure

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## Soybean Yield (bushels/acre; 13% moisture)



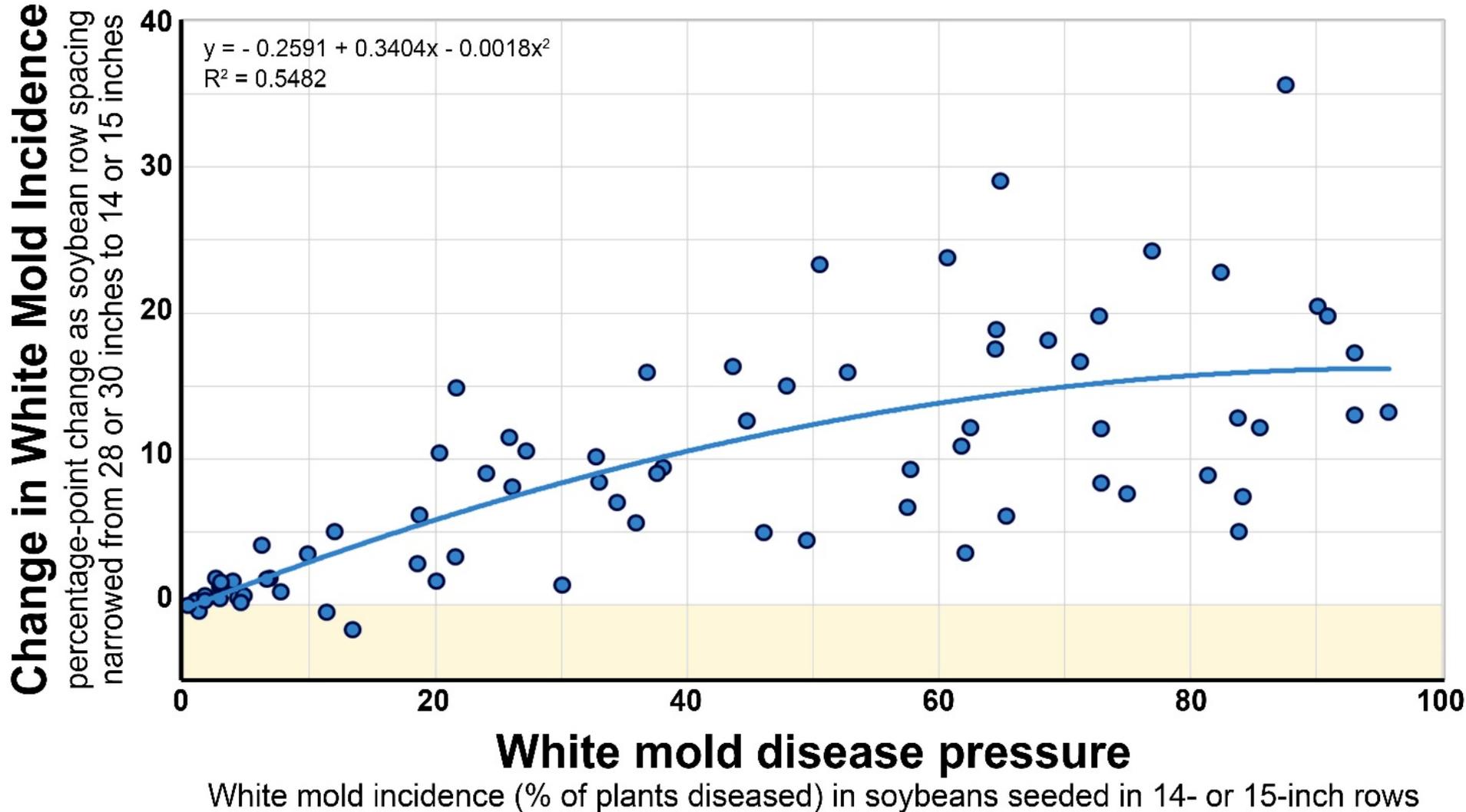
# White mold incidence:

## Wide (28- to 30-inch) vs. Narrow (14- or 15-inch) rows

**Soybean maturity:** 00 and 0      **Locations:** Carrington, Hofflund, Langdon, and Oakes, ND      **Years:** 2013-2017

•**2013-2014:** Single seeding rate (165,000 viable seeds/ac)

•**2015-2017:** Combined analysis across three seeding rates (132,000; 165,000; 198,000 viable seeds/ac)



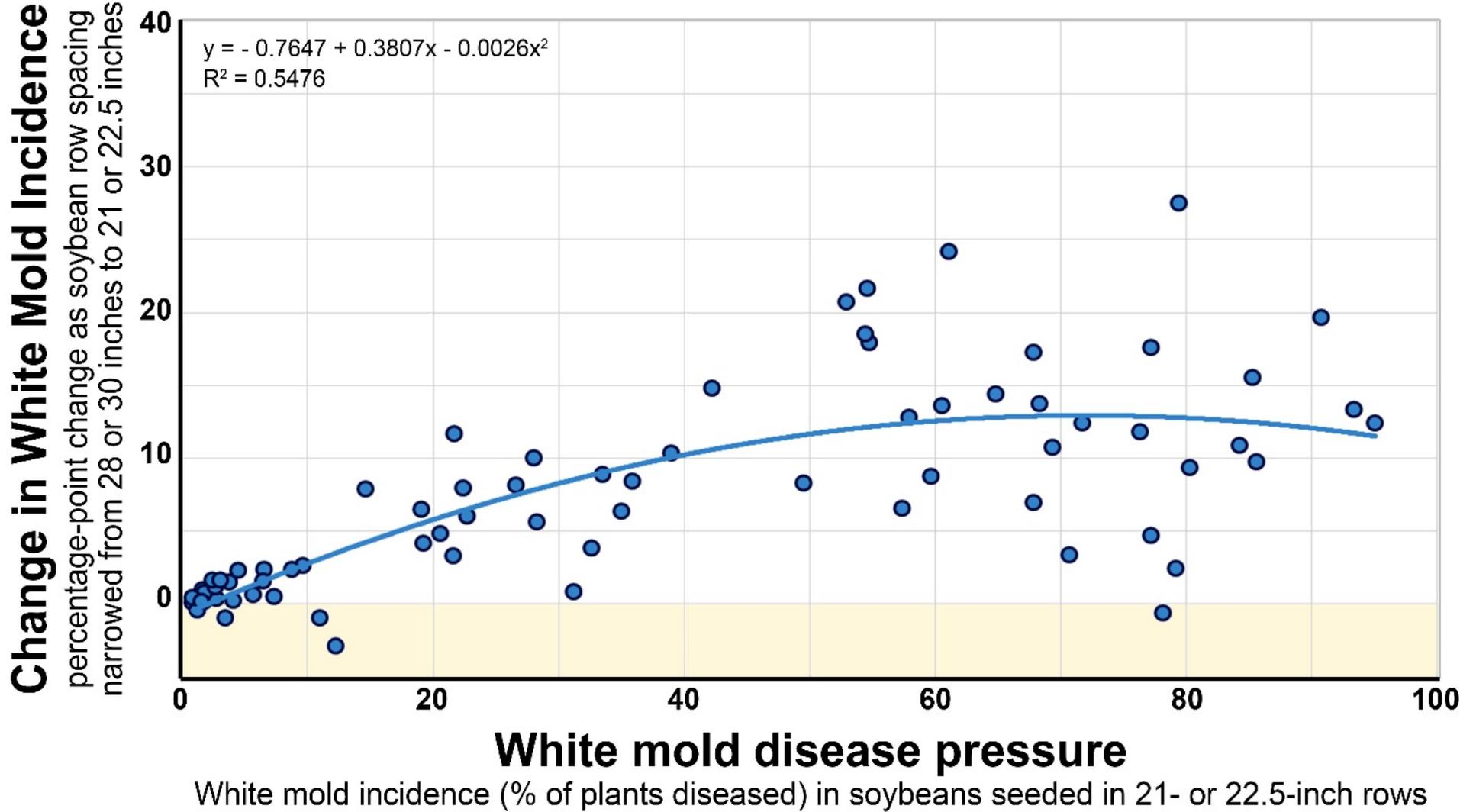
# White mold incidence:

Wide (28- to 30-inch) vs. Intermediate (21- or 22.5-inch) rows

**Soybean maturity:** 00 and 0      **Locations:** Carrington, Hofflund, Langdon, and Oakes, ND      **Years:** 2013-2017

•2013-2014: **Single seeding rate** (165,000 viable seeds/ac)

•2015-2017: **Combined analysis across three seeding rates** (132,000; 165,000; 198,000 viable seeds/ac)



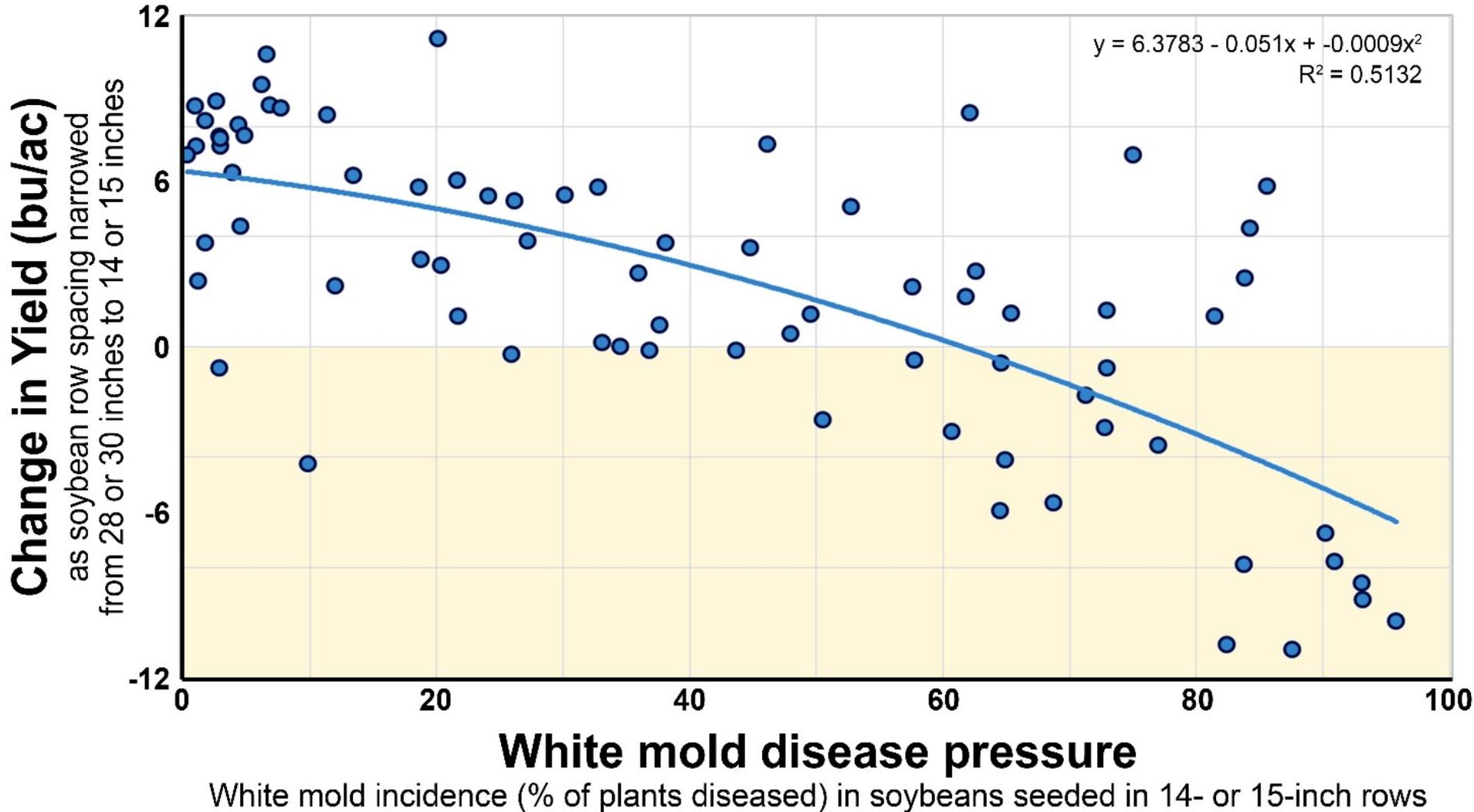
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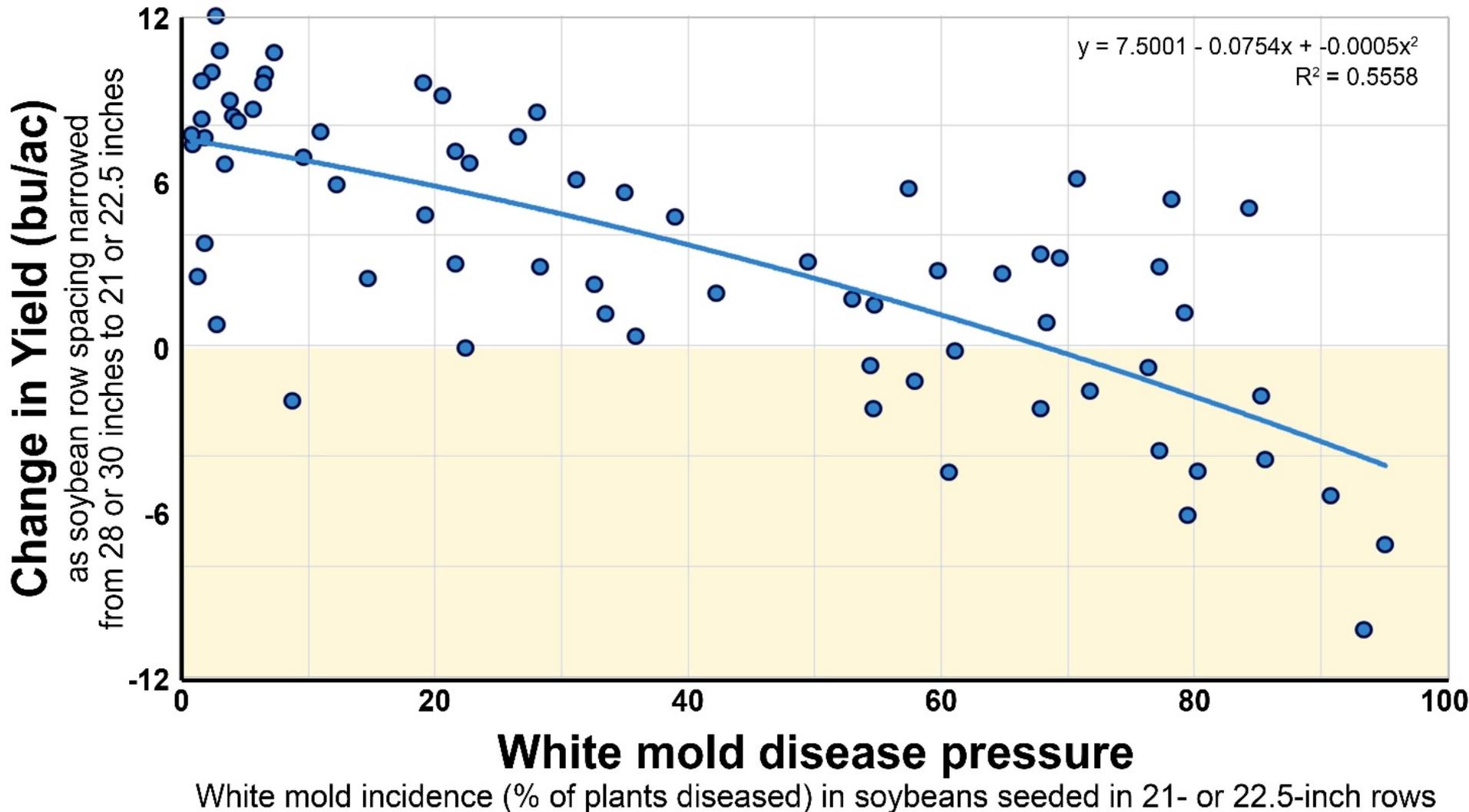
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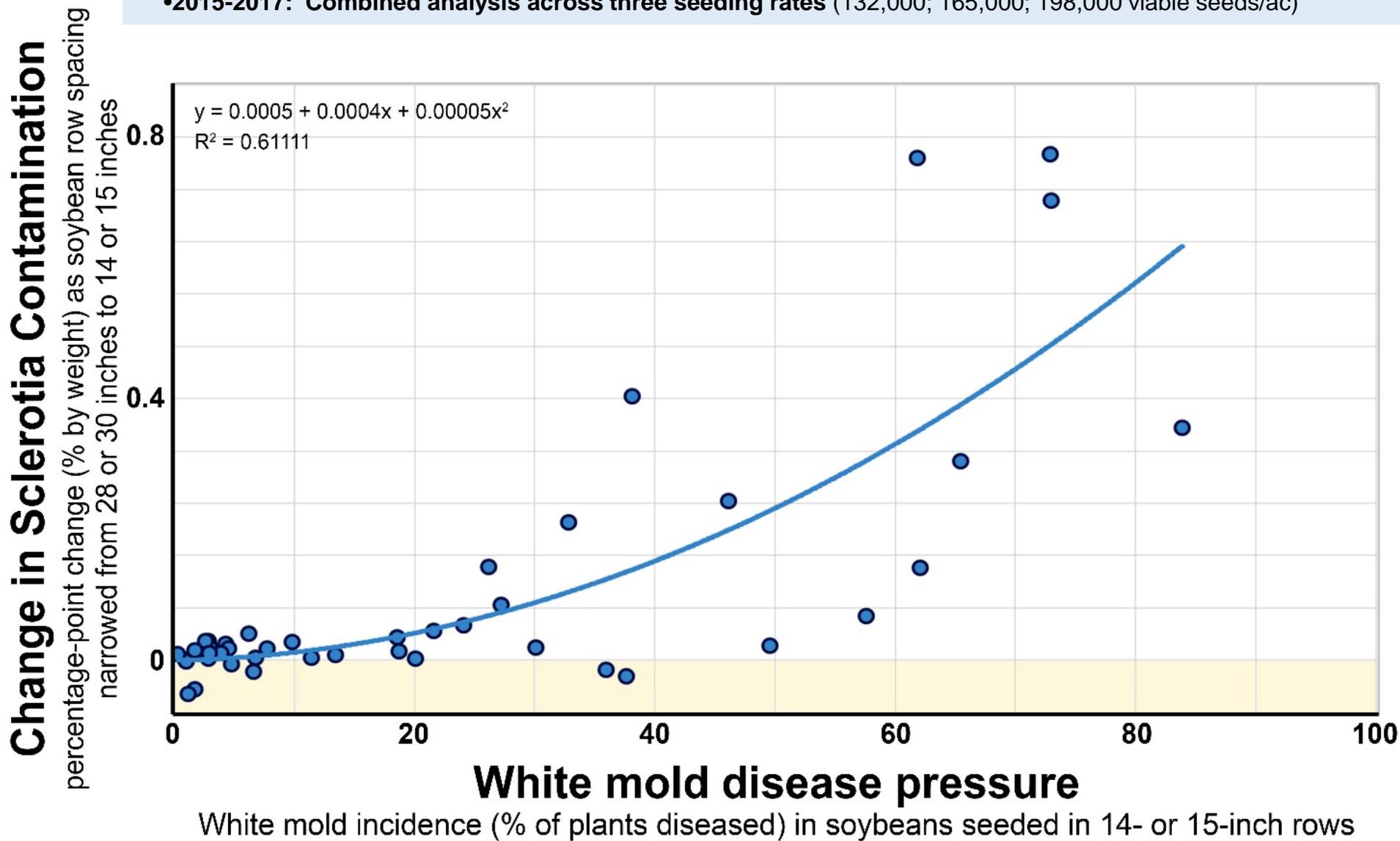
# Sclerotia contamination of the grain:

## Wide (28- to 30-inch) vs. Narrow (14- or 15-inch) rows

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•**2013-2014:** Single seeding rate (165,000 viable seeds/ac)

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# Sclerotia contamination of the grain:

Wide (28- to 30-inch) vs. Intermediate (21- or 22.5-inch) rows

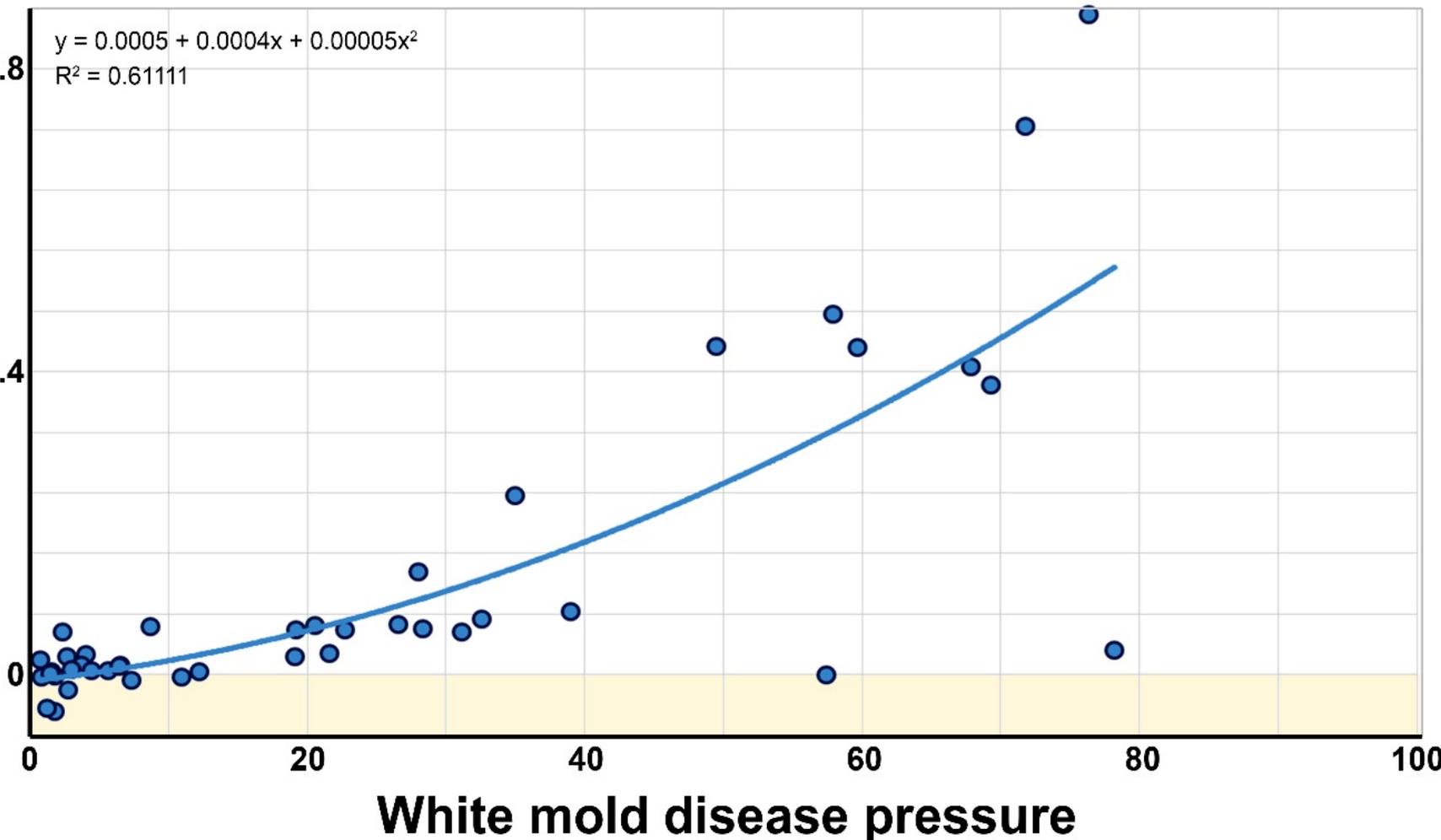
**Soybean maturity:** 00 and 0    **Locations:** Carrington, Hofflund, Langdon, and Oakes, ND    **Years:** 2013-2017

•**2013-2014:** Single seeding rate (165,000 viable seeds/ac)

•**2015-2017:** Combined analysis across three seeding rates (132,000; 165,000; 198,000 viable seeds/ac)

## Change in Sclerotia Contamination

percentage-point change (% by weight) as soybean row spacing narrowed from 28 or 30 inches to 21 or 22.5 inches



White mold incidence (% of plants diseased) in soybeans seeded in 21- or 22.5-inch rows

### Optimizing row spacing

#### Impact of row spacing on white mold:

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- When end-of-season white mold incidence was less than 50%, soybean yield was maximized when soybeans were grown in narrow (14- or 15-inch) or intermediate (21- or 22.5-inch) rows.
- **Intermediate row spacing was optimal.** Soybeans seeded to 21- or 22.5-inch rows generally developed less white mold and had higher yields than soybeans seeded to 14- or 15-inch rows.
- The **increase in sclerotia contamination of grain** associated with planting to narrow or intermediate rows was negligible when end-of-season white mold incidence was less than 30% and moderate when white mold incidence was less than 50%.



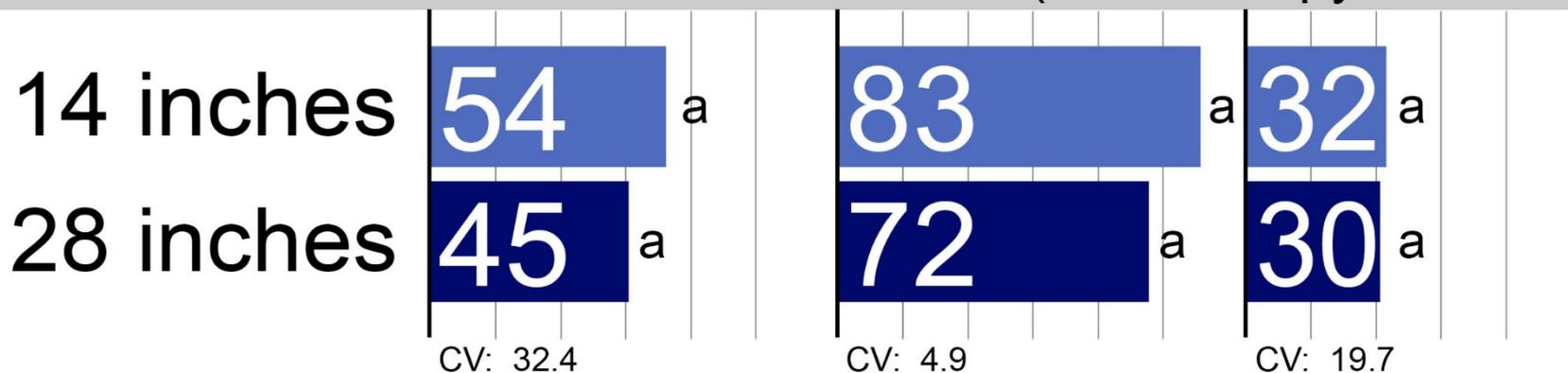
# Dry bean performance in narrow vs. wide rows under white mold pressure

- Carrington (2013, 2014, 2015)
- Oakes (2016)
- 'Lariat' pinto beans
- Seeding rate: 85,000 or 92,000 pure live seeds/ac
- Supplemental irrigation applied to facilitate disease pressure

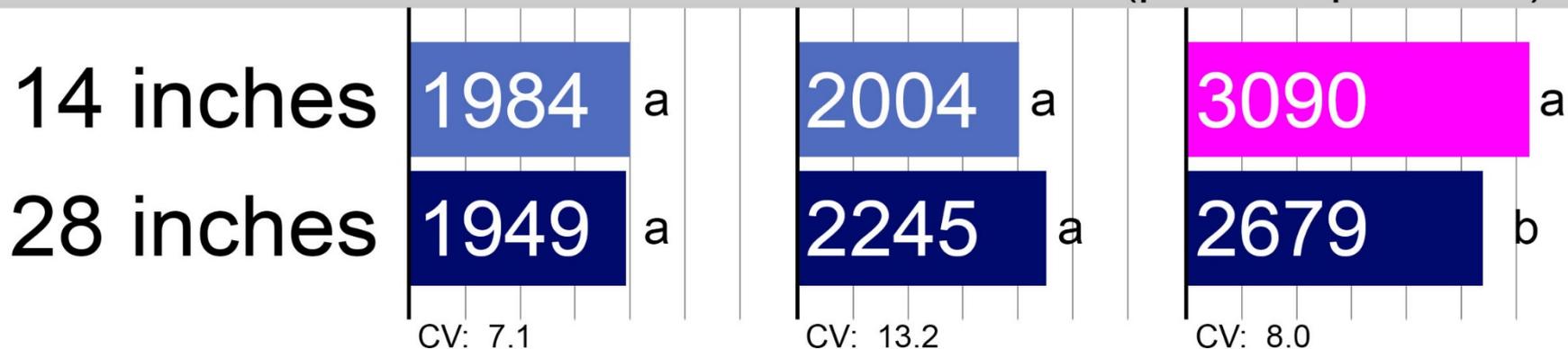


Row	2013	2014	2016
Spacing:	Carrington	Carrington	Oakes

**SCLEROTINIA SEVERITY INDEX (% of canopy diseased)**



**YIELD (pounds per acre)**

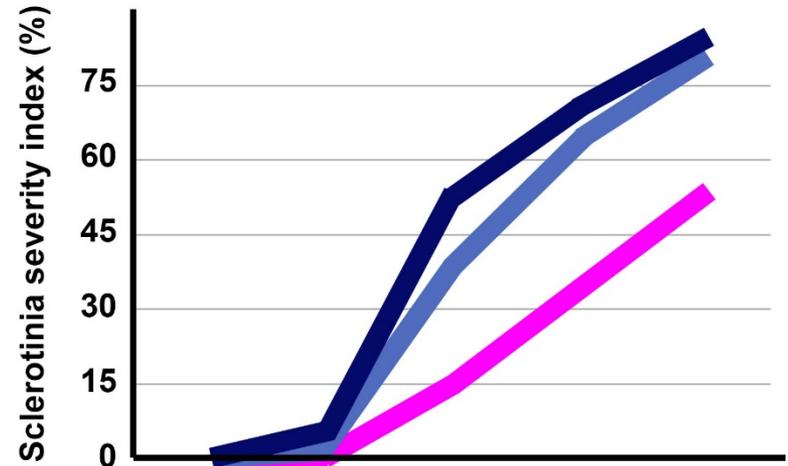


**Carrington, ND (2014)**  
**'Lariat' pinto**

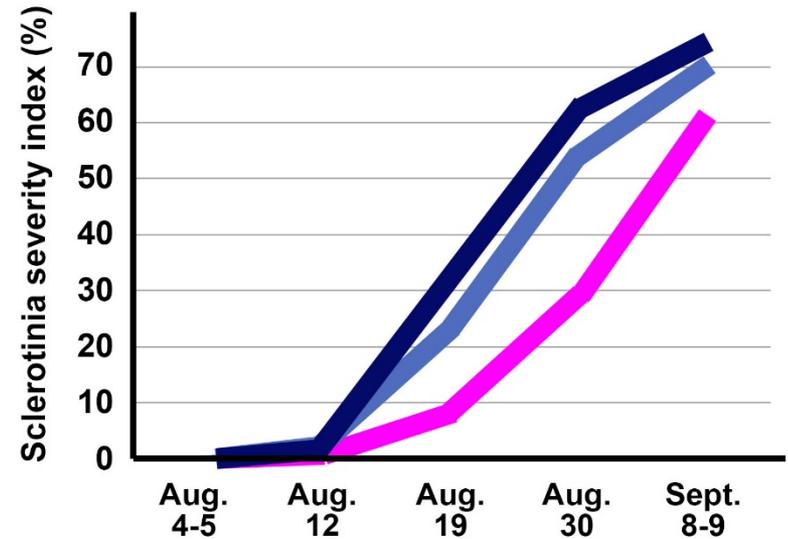
-  Irrigated July 8 - Aug. 30  
**(V4 - R6 growth stage)**
-  Irrigated July 23 - Aug. 30  
**(R2- R6 growth stage)**
-  Irrigated Aug. 3 - 30  
**(R3 - R6 growth stage)**

Carrington (2014):  
Differential irrigation  
utilized to facilitate early  
vs. late disease onset

**14-INCH ROW SPACING**

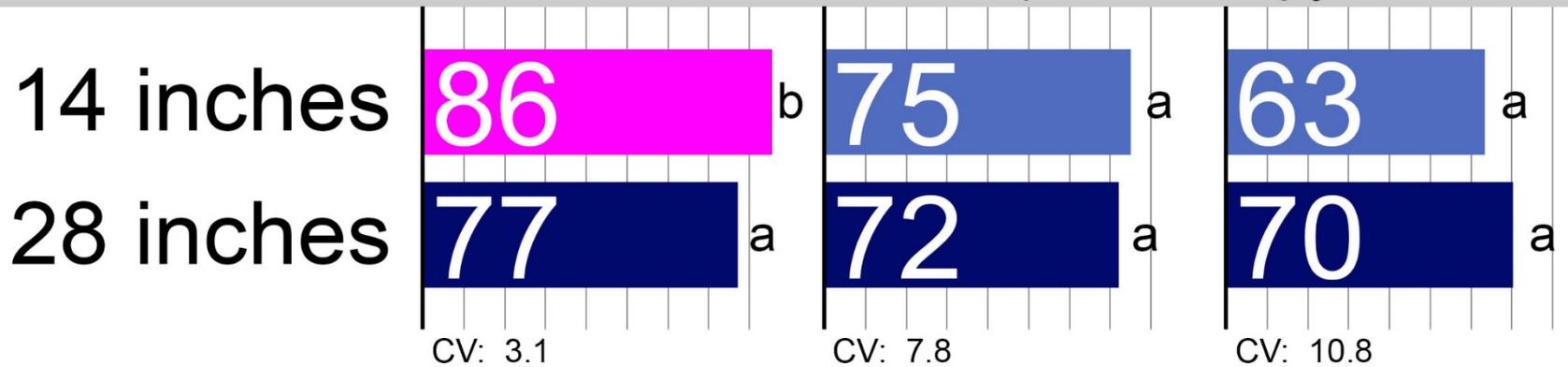


**28-INCH ROW SPACING**

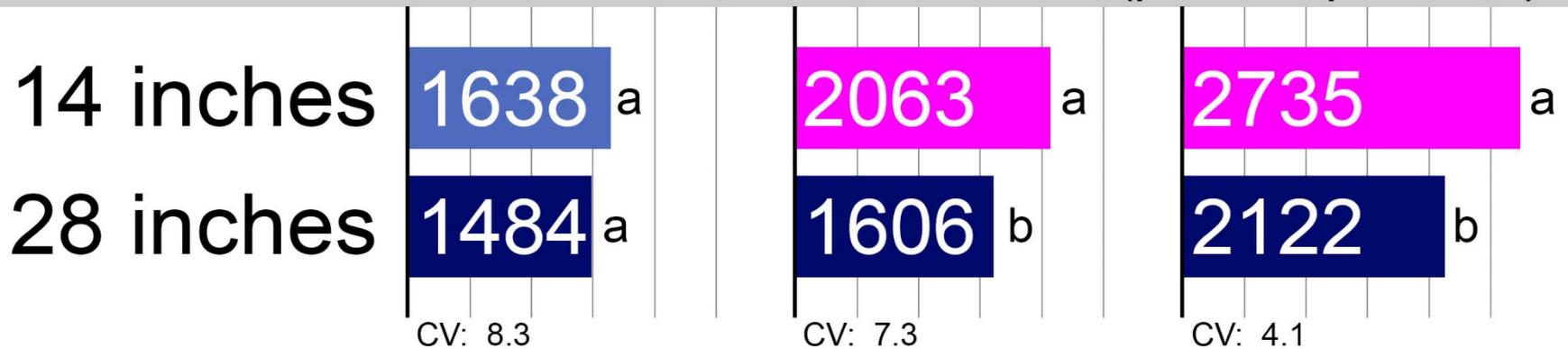


Row Spacing: Growth stages at which intensive irrigation was applied:  
**V4 to R6      R2 to R6      R3 to R6**

**SCLEROTINIA SEVERITY INDEX (% of canopy diseased)**



**YIELD (pounds per acre)**

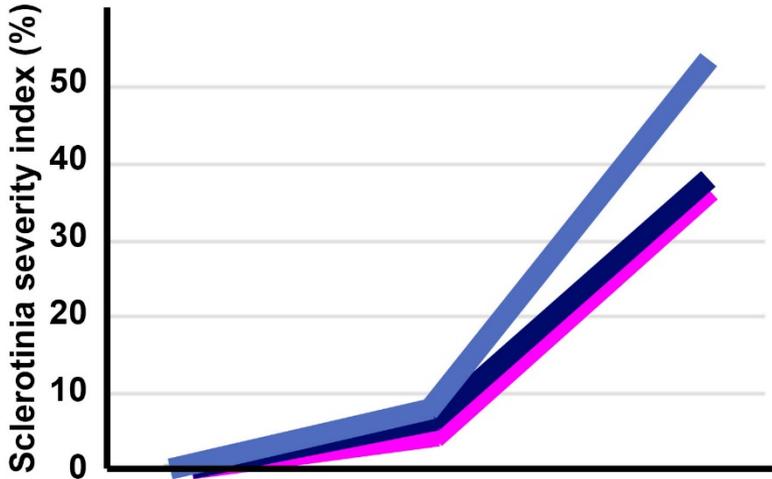


**Carrington, ND (2015)**

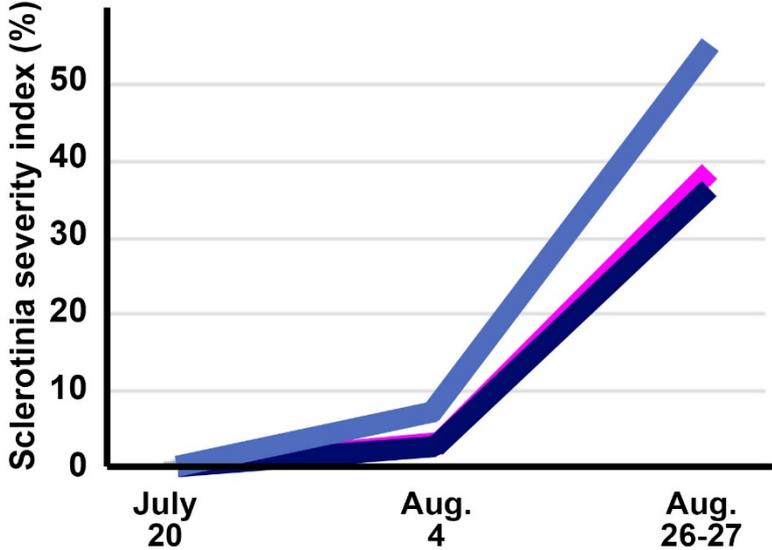
'Lariat' pinto

-  Irrigated June 29 - July 17 (V3 - R1 growth stage)
-  Irrigated June 29 - July 31 (V3- R3 growth stage)
-  Irrigated June 29 - July 17, Aug. 8 - 18 (V3 - R1, R4-R6 growth stage)

**14-INCH ROW SPACING**



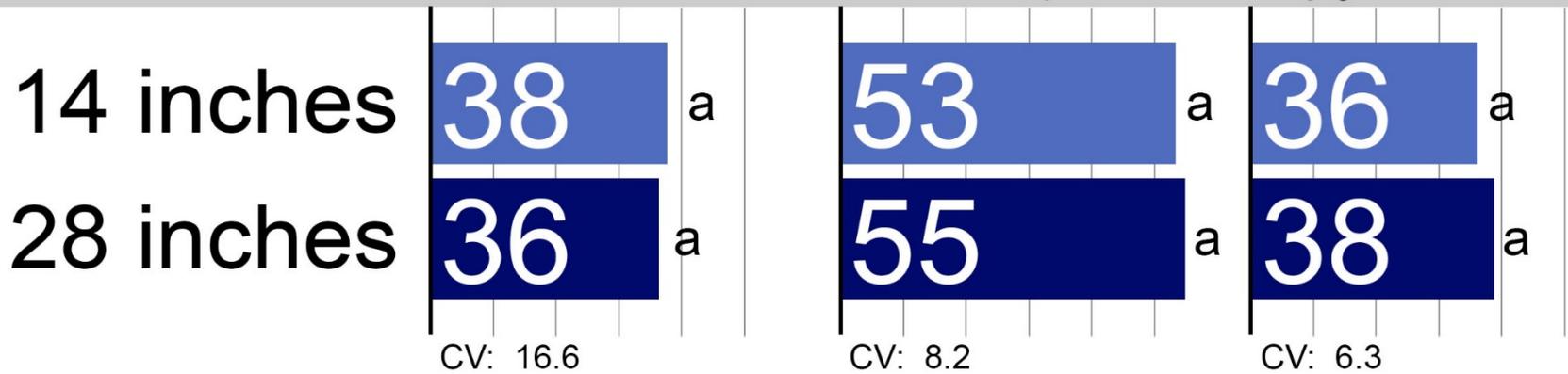
**28-INCH ROW SPACING**



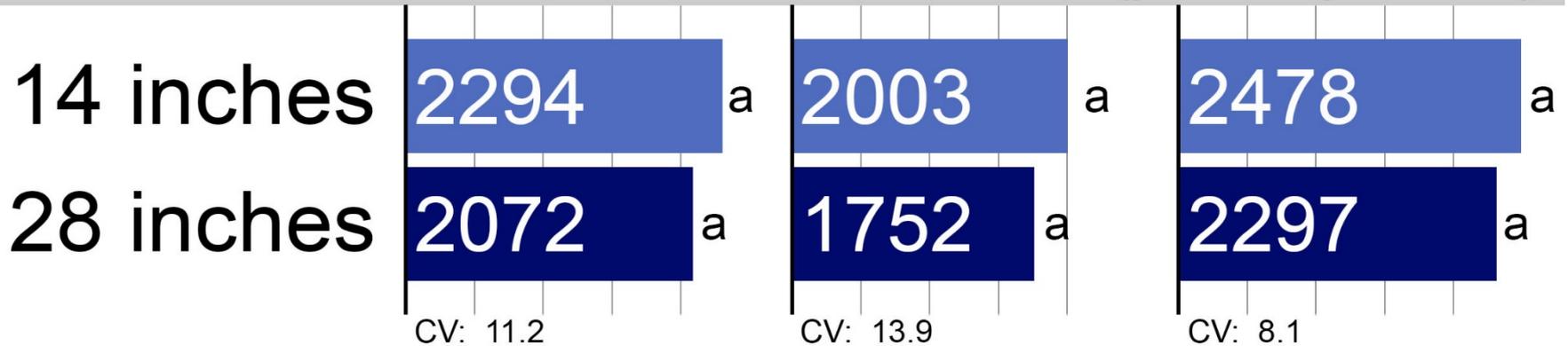
Carrington (2015):  
Differential irrigation  
utilized to facilitate early  
vs. late disease onset

Row Spacing: Growth stages at which intensive irrigation was applied:  
**V3 to R1      V3 to R3      V3-R1, R4-R6**

**SCLEROTINIA SEVERITY INDEX (% of canopy diseased)**



**YIELD (pounds per acre)**



# Dry bean performance in narrow vs. wide rows under white mold pressure

**Except under very high disease pressure, yields were optimized in 14-inch rows.**

## **Cautionary notes:**

- Impact on seed quality is unclear.
- A single variety ('Lariat') from a single market class (pinto) was evaluated.



# Thank You!

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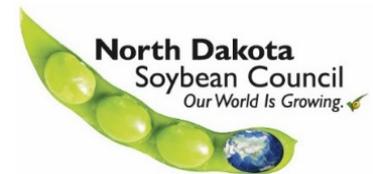
## Research funding:

North Dakota Soybean Council

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North Dakota Crop Protection Product Registration and Harmonization Board



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