

# Improving the management of white mold in dry beans

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

# Fungicide efficacy summary: white mold in pinto beans Field trials conducted in 2009-2017

**Compiled by Michael Wunsch**, plant pathologist; **NDSU Carrington Research Extension Center**

Research conducted at **NDSU Carrington Res. Ext. Center** (M. Wunsch, M. Schaefer, B. Kraft, S. Kallis, B. Schatz)
**NDSU Langdon Research Extension Center** (A. Arens, V. Chapara, S. Halley)
**NDSU Robert Titus Research Farm, Oakes** (L. Besemann, K. Cooper, H. Eslinger)

**Row spacing:** 14”, 15”, 21”, 28” or 30”

**Pinto beans** – testing conducted on Lariat, Maverick, Stampede, La Paz, ND-307, Othello, or Palamino pintos.

## Application methods:

- 15 gal/ac (most studies); 17, 19, or 20 gal/ac (some studies)
- XR8001, XR80015, XR8002, or DGXR80015 TeeJet nozzles
- 35 or 40 psi
- Two sequential fungicide applications were made: early bloom to initial pin pods (<1”) + 10-14 days later

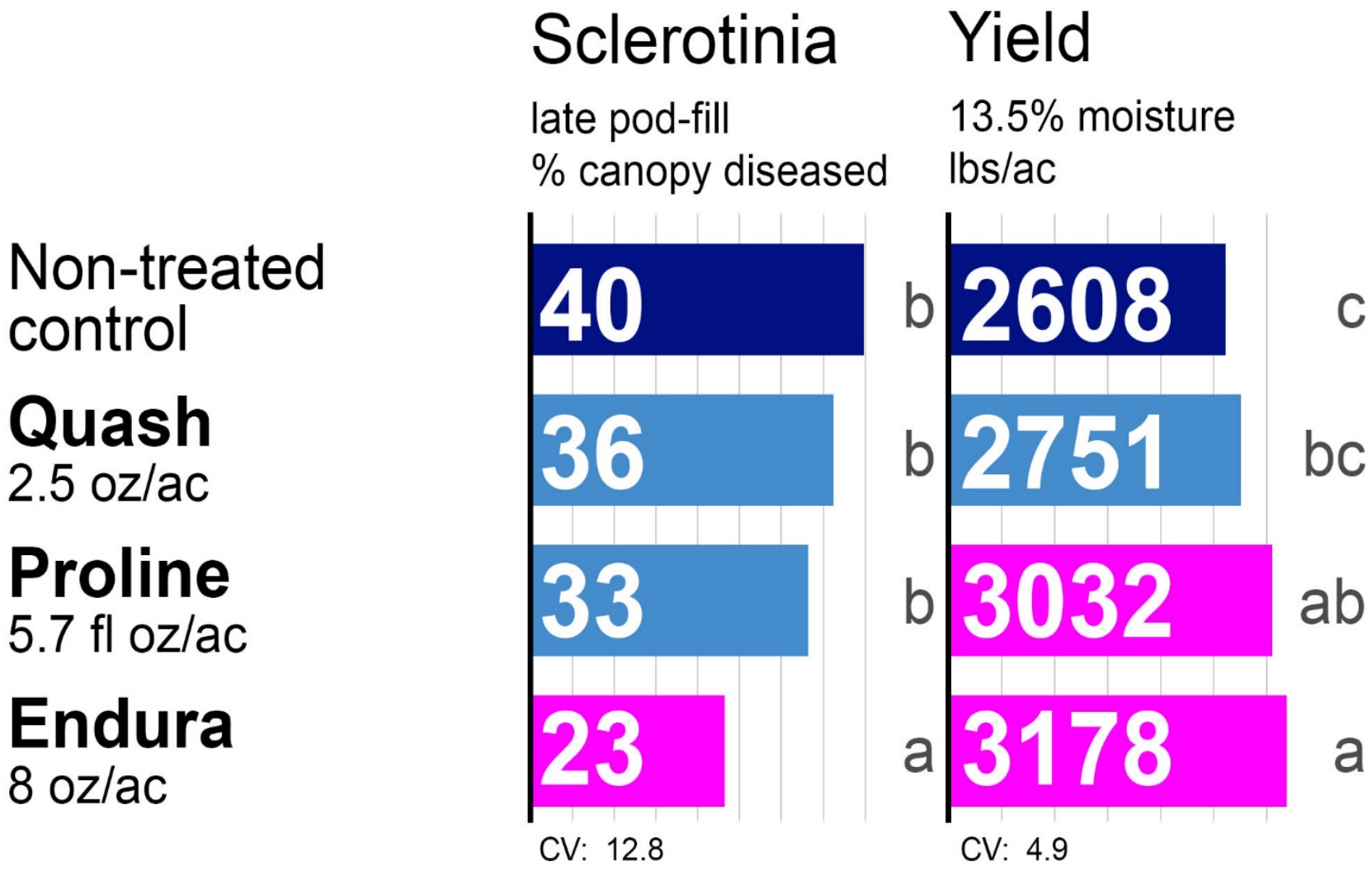
# Fungicide efficacy testing:

## Research methods

**(1) Comparative efficacy of different fungicides:** Relative performance of different registered products.

# Quash 2.5 oz/ac + NIS:

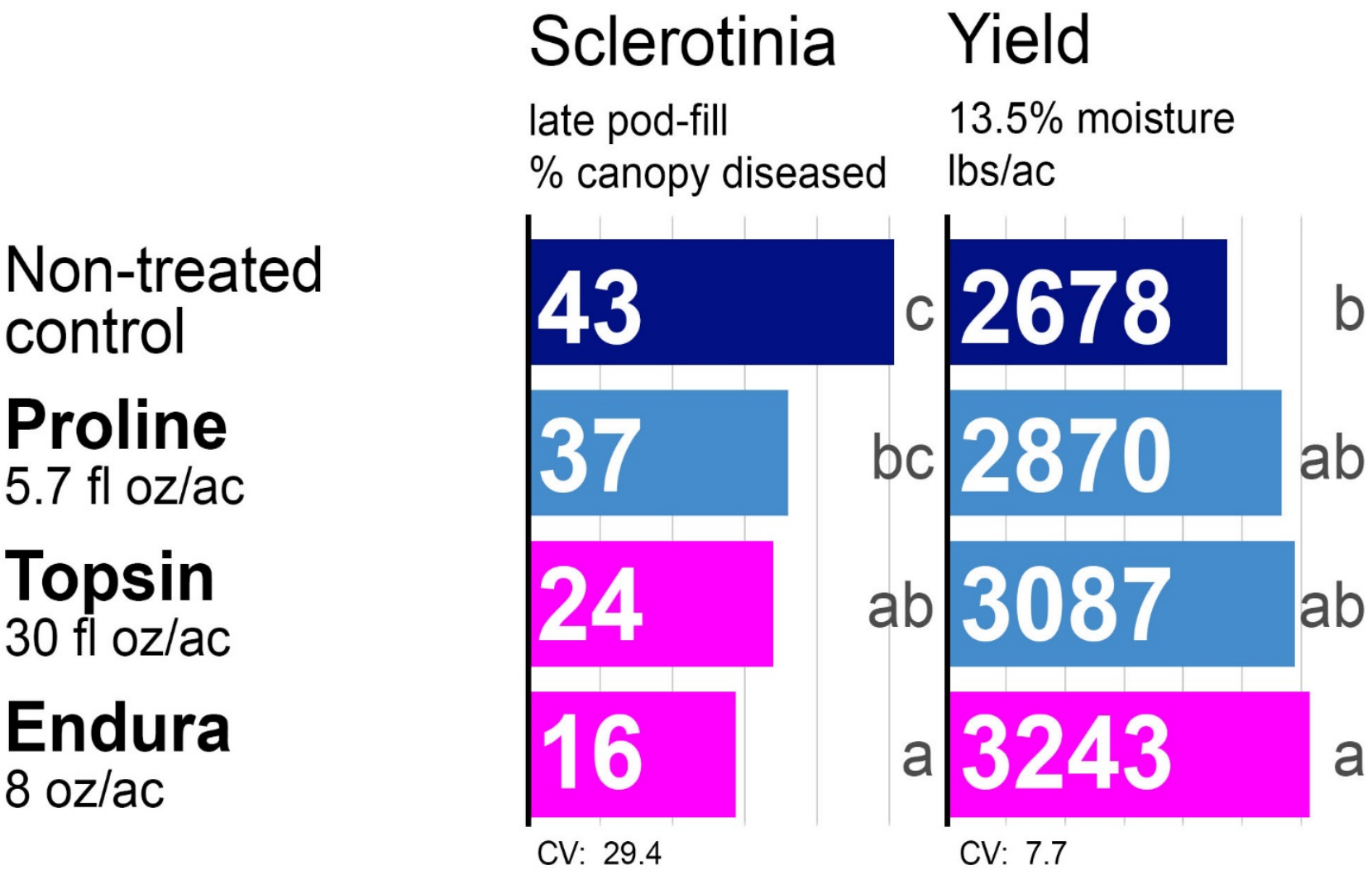
**metconazole** (FRAC 3)




Combined analysis, **4 field trials:** Carrington & Langdon, ND (2012, 2013)

# Proline 5.7 fl oz/ac + NIS

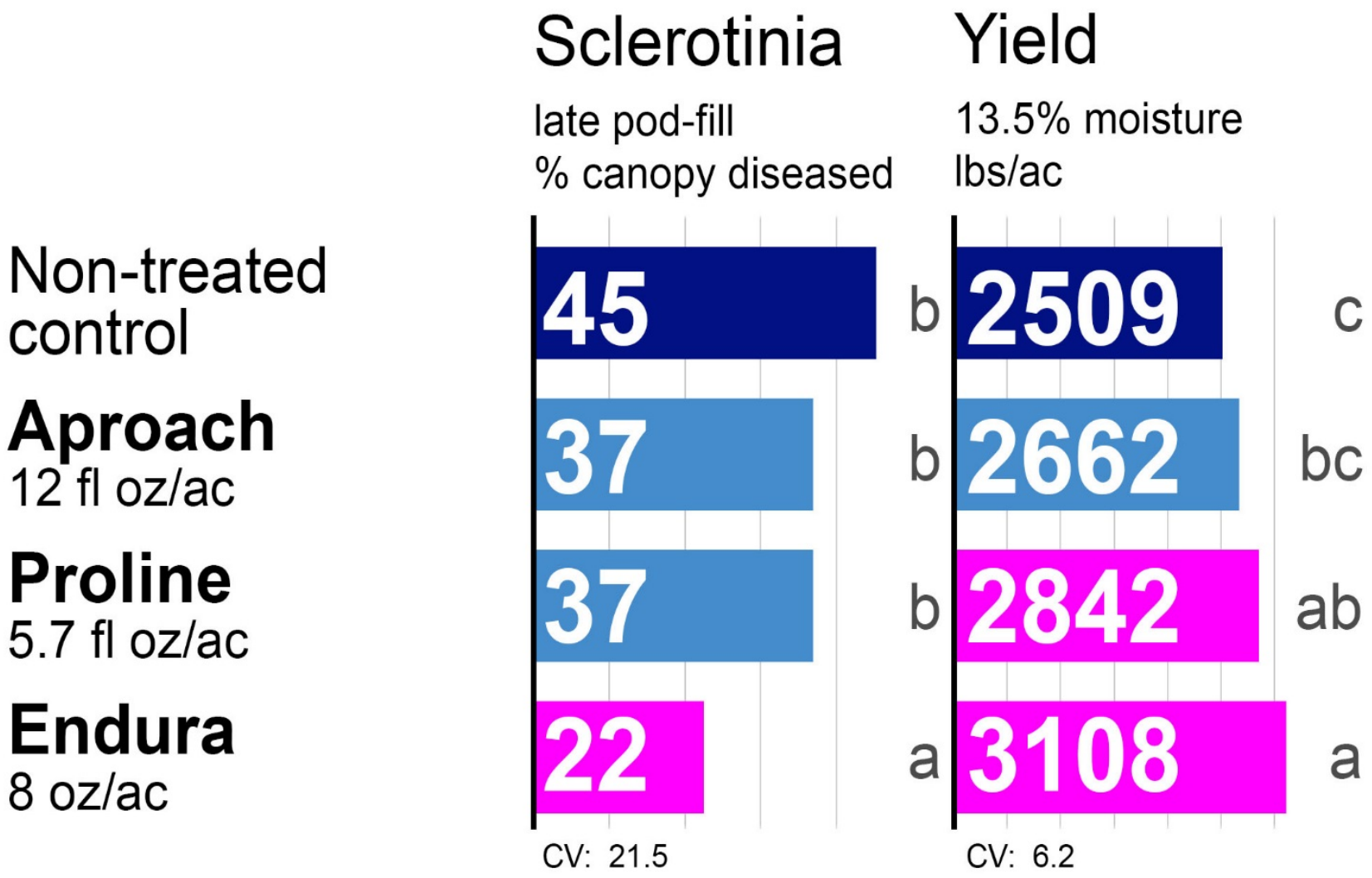
**prothioconazole** (FRAC 3)




Combined analysis, **5 field trials:** Carrington & Langdon, ND (2012, 2013)

# Aproach 12 fl oz/ac + NIS

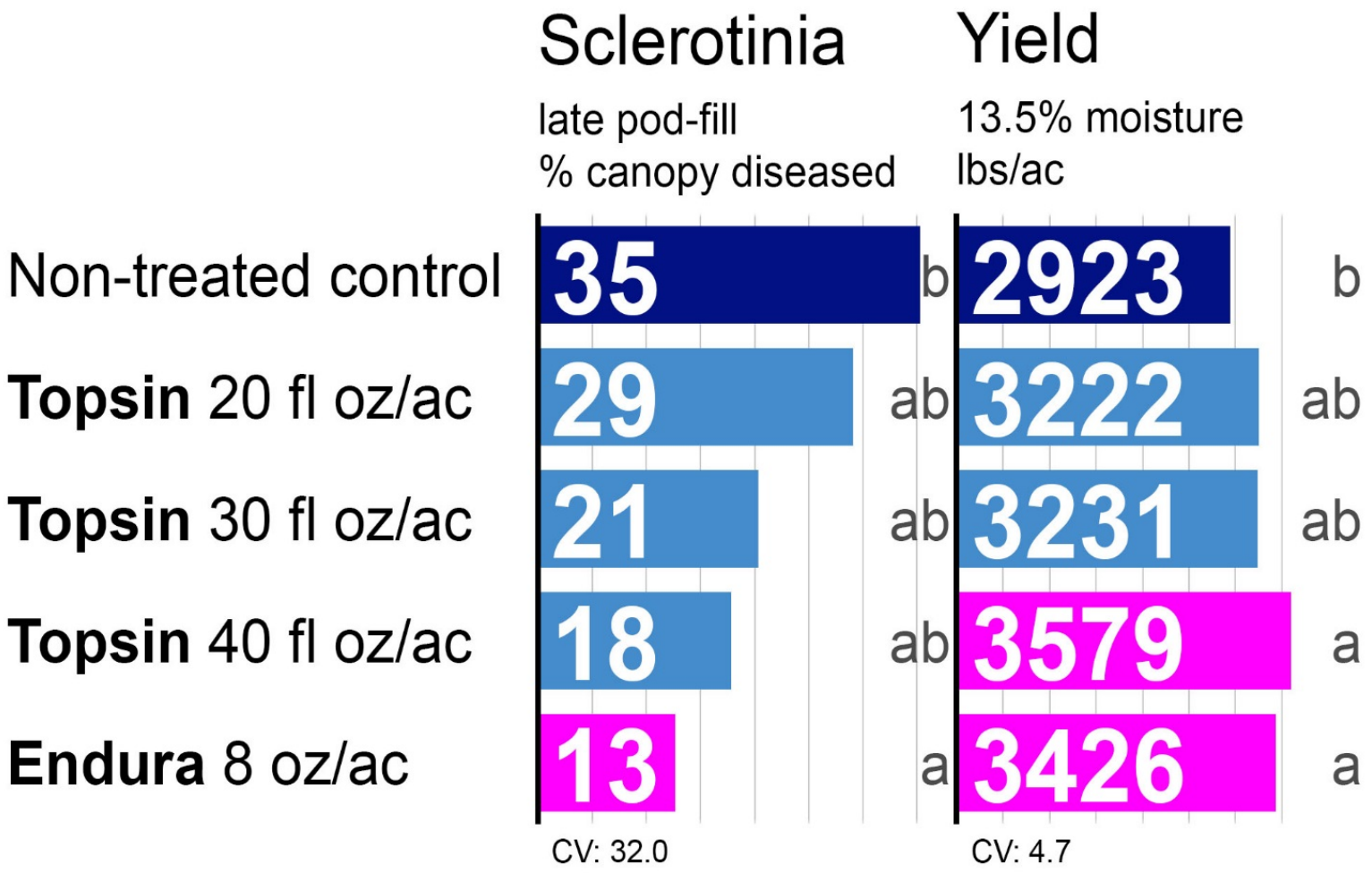
**picoxystrobin** (FRAC 11)




Combined analysis, **6 field trials:** Carrington & Langdon, ND (2012, 2013)

# Topsin 20, 30, or 40 fl oz/ac:

**thiophanate-methyl** (FRAC 1)

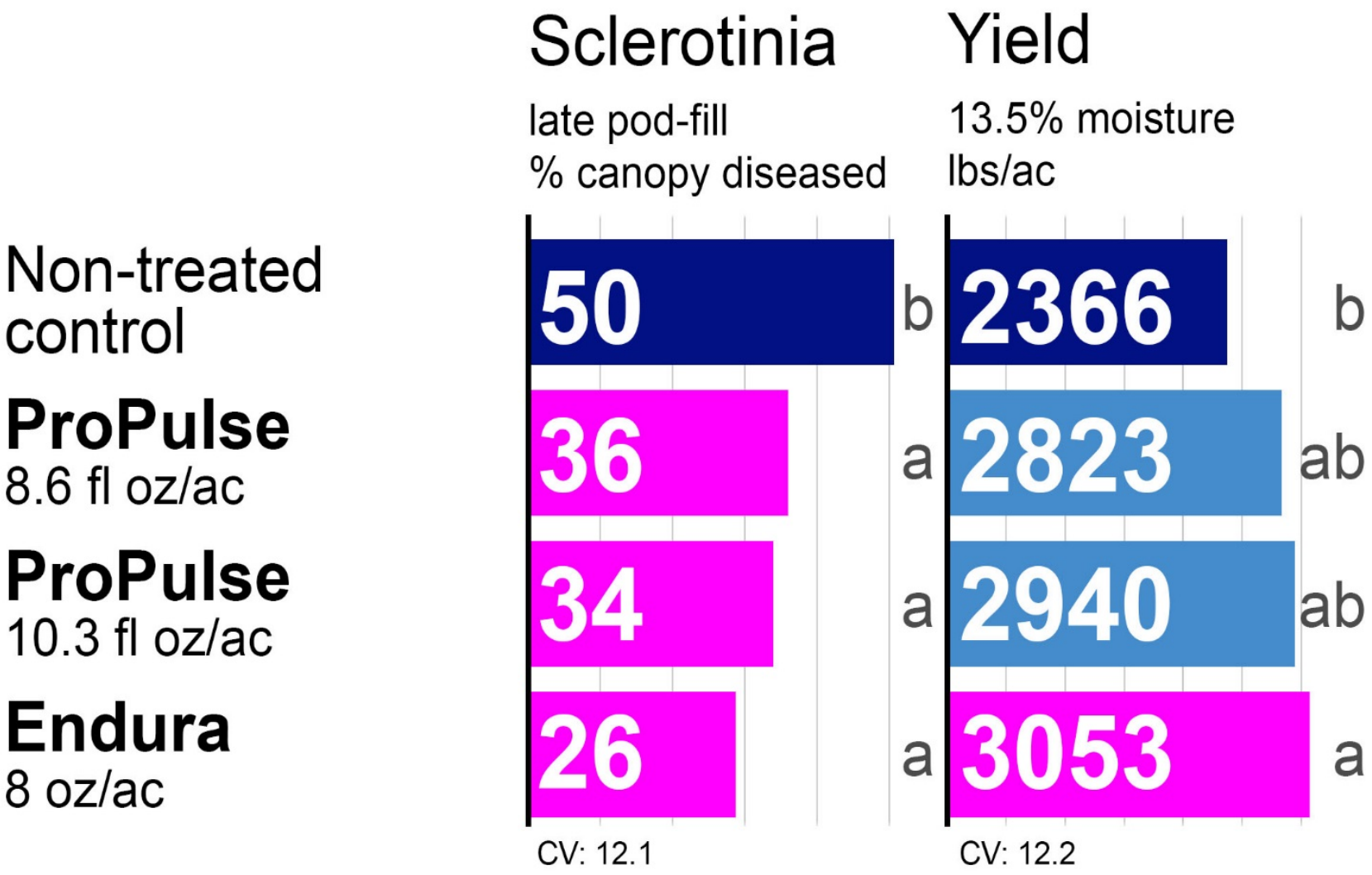



The Topsin label permits two sequential applications at 30 fl oz/ac but only one application at 40 fl oz/ac.

Combined analysis, **3 field trials:** Carrington & Langdon, ND (2012)

# ProPulse 8.6 or 10.3 fl oz/ac

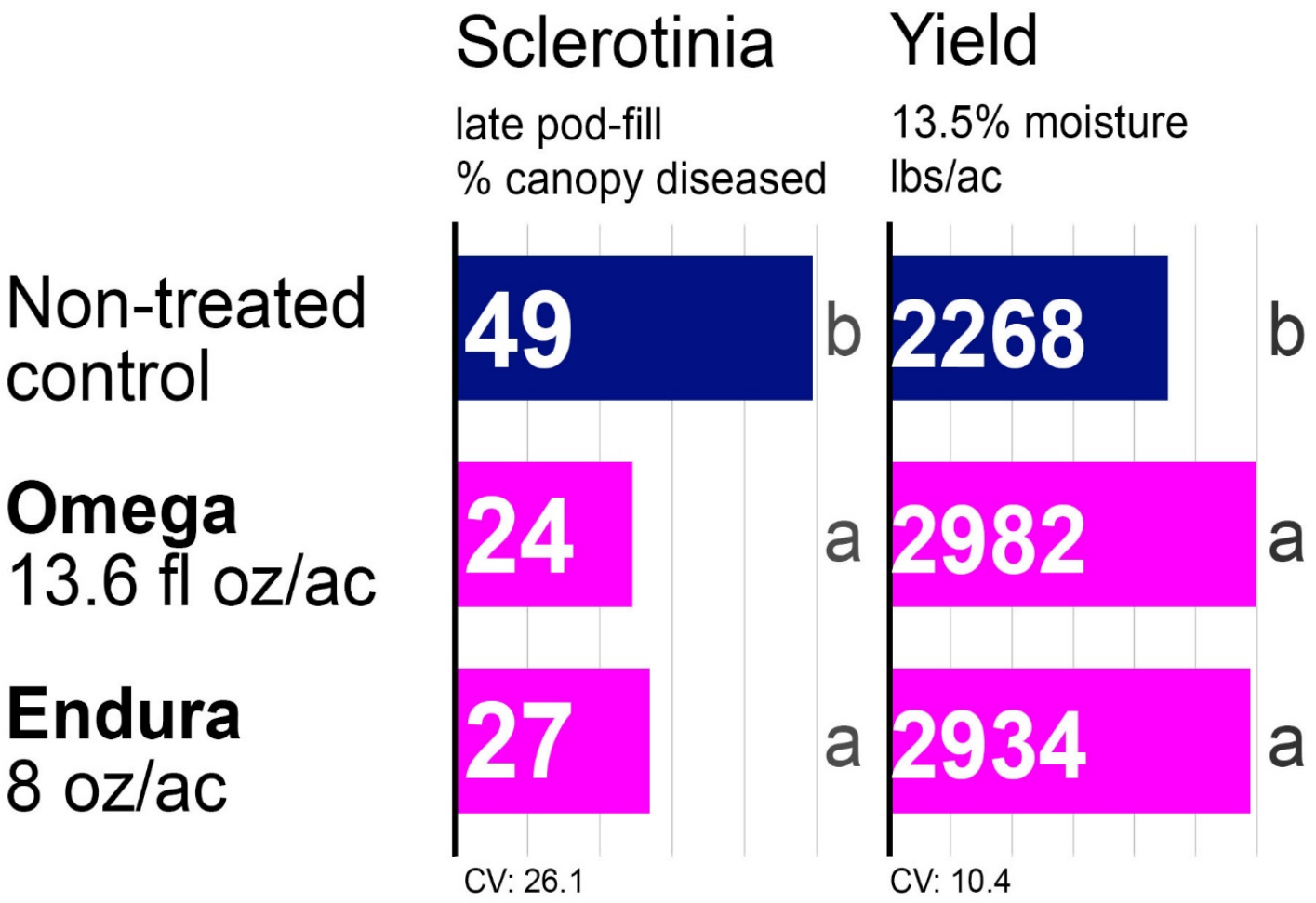
**prothioconazole + fluopyram** (FRAC 3, 7)




Combined analysis, **6 field trials:** Carrington & Langdon, ND (2012-2014)

# Omega 13.6 fl oz/ac

**fluazinam** (FRAC 29)




Combined analysis, **8 field trials:** Carrington & Langdon, ND (2012-2014)

# Omega 13.6 fl oz/ac

**fluazinam** (FRAC 29) – efficacy vs. non-treated control

Caution:

- Omega is a contact fungicide and requires good deposition to the interior of the canopy.
- In our trials, Omega has sometimes shown unsatisfactory performance when applied to dense dry bean canopies.

# Fungicide efficacy testing:
## Research methods

**(2) Efficacy of individual fungicides relative to the non-treated control:** Disease and yield responses (relative to the non-treated control) across all trials in which each product was evaluated

# Quash 2.5 to 4.0 oz/ac + NIS

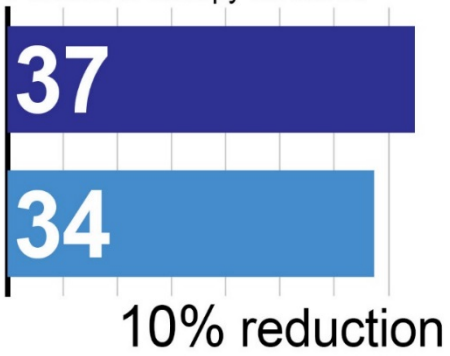
**metconazole** (FRAC 3) – efficacy vs. non-treated control

**Evaluated in 9 field trials:** Carrington and Langdon, ND (2010-2015)

**AVERAGE EFFICACY:**

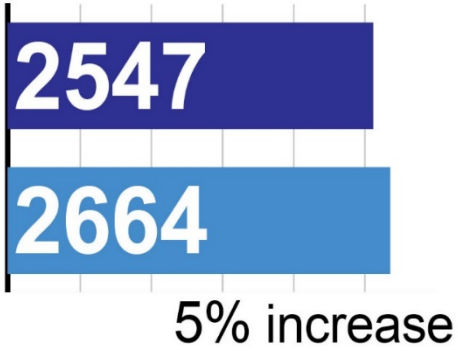
**Sclerotinia sev. index**

Percent of canopy diseased




**Yield**

pounds/acre



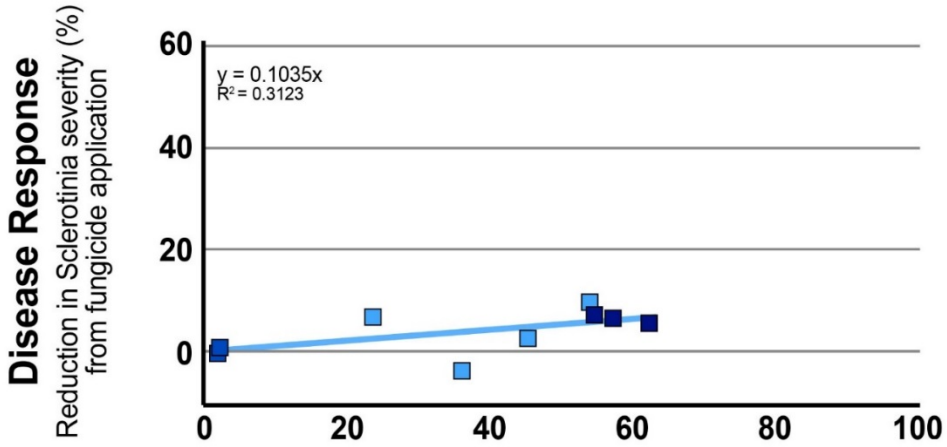

DARK BLUE: **Non-treated**
LIGHT BLUE: **Quash 2.5-4.0 oz**

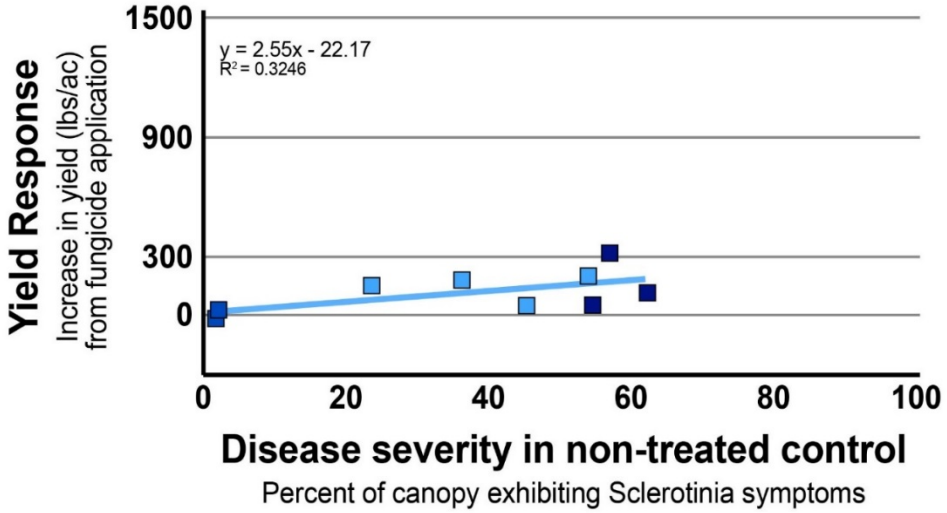
**Quash 50WDG**

- 2.5 oz/ac
- 3.0 oz/ac
- 4.0 oz/ac

early bloom + 10-14 days later

**EFFICACY ACROSS INDIVIDUAL TRIALS:** each dot represents one field trial



# Proline 5.7 fl oz/ac + NIS

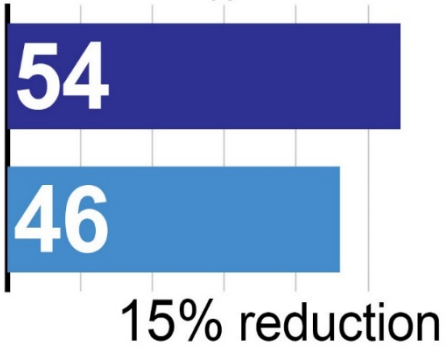
**prothioconazole** (FRAC 3) – efficacy vs. non-treated control

**Evaluated in 14 field trials:** Carrington, Langdon, Oakes, ND (2009-2016)

**AVERAGE EFFICACY:**

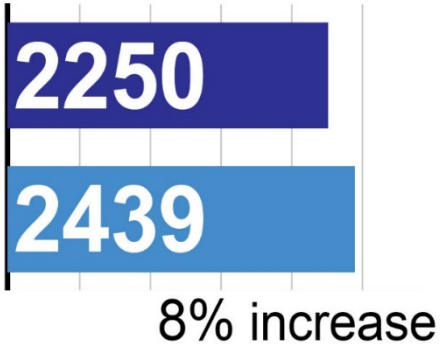
**Sclerotinia sev. index**

Percent of canopy diseased




**Yield**

pounds/acre



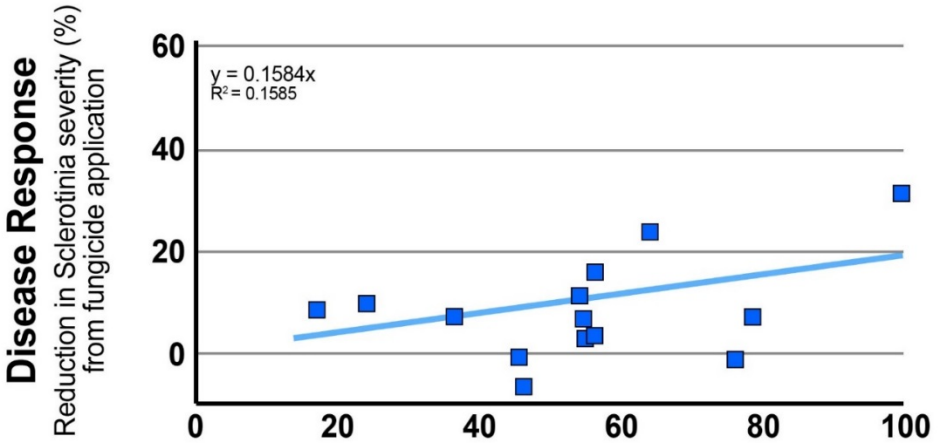

DARK BLUE: **Non-treated**
LIGHT BLUE: **Proline 5.7 fl oz**

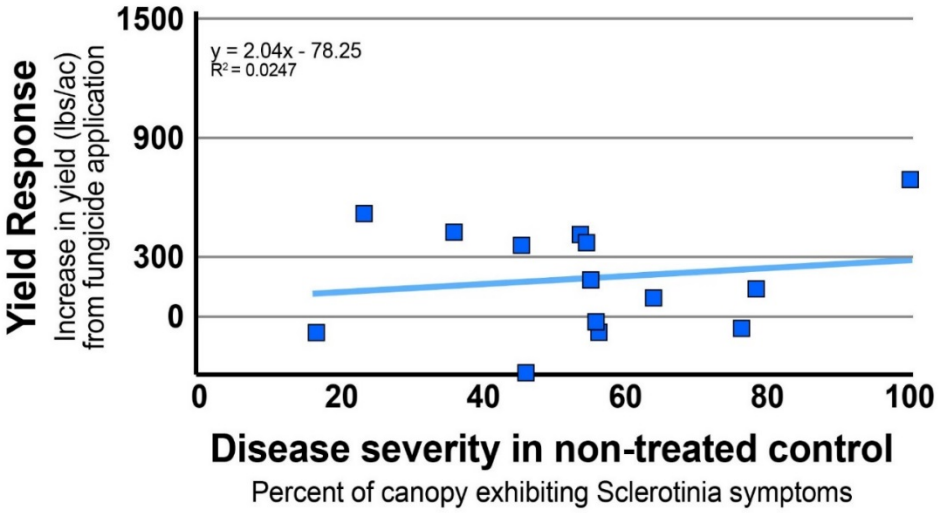
## Proline 480SC

5.7 fl oz/ac

early bloom + 10-14 days later

**EFFICACY ACROSS INDIVIDUAL TRIALS:** each dot represents one field trial



# Aproach 12 fl oz/ac + NIS:

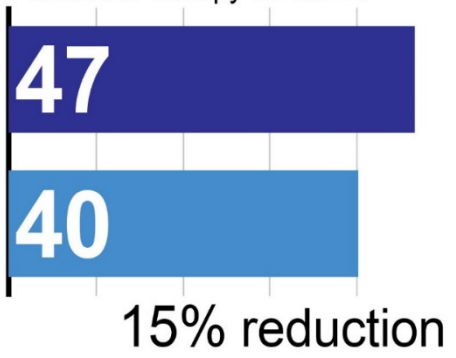
**picoxystrobin** (FRAC 11) – efficacy vs. non-treated control

**Evaluated in 8 field trials:** Carrington and Langdon, ND (2010-2014)

**AVERAGE EFFICACY:**

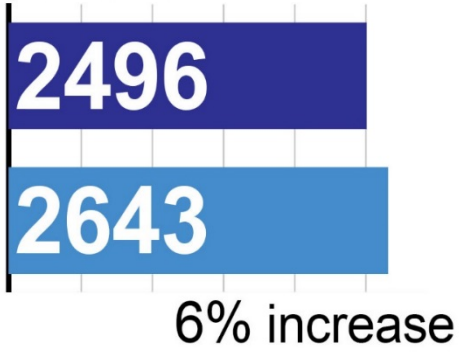
**Sclerotinia sev. index**

Percent of canopy diseased




**Yield**

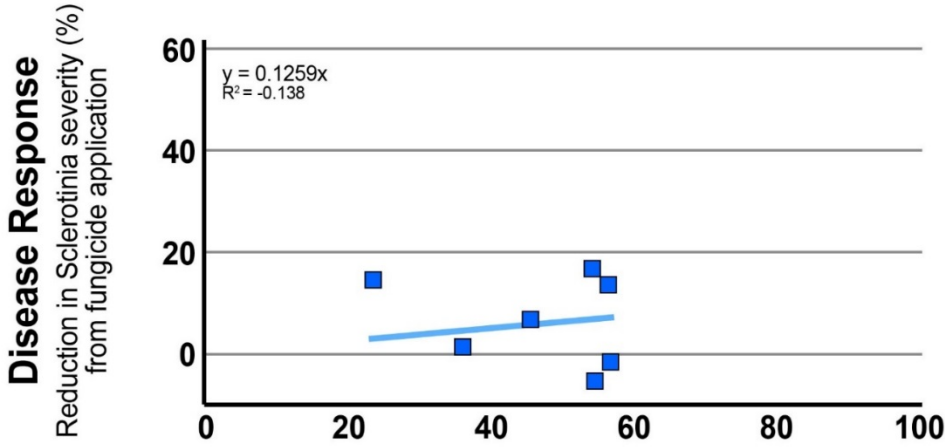
pounds/acre

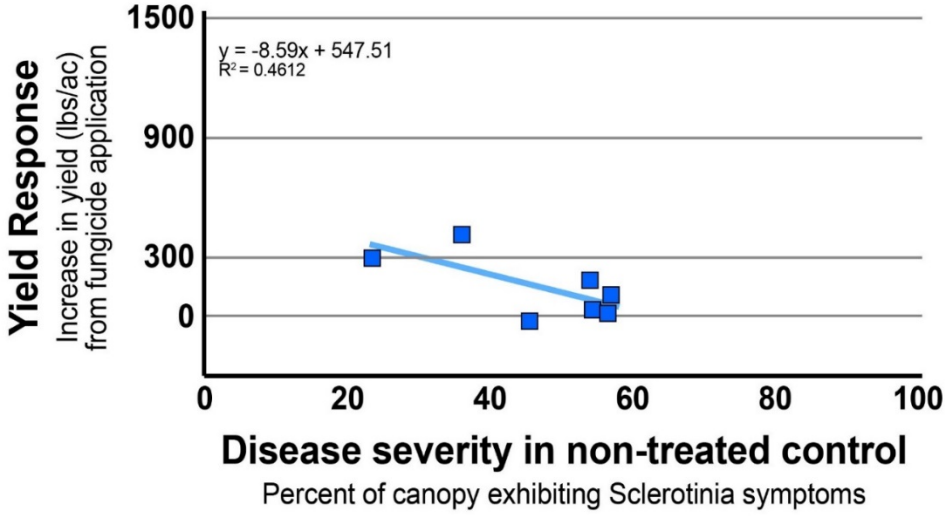



DARK BLUE: **Non-treated**
LIGHT BLUE: **Aproach 12 fl oz**

**Aproach 250SC**
12.0 fl oz/ac
early bloom + 10-14 days later

**EFFICACY ACROSS INDIVIDUAL TRIALS:** each dot represents one field trial



# Topsin 30 fl oz/ac

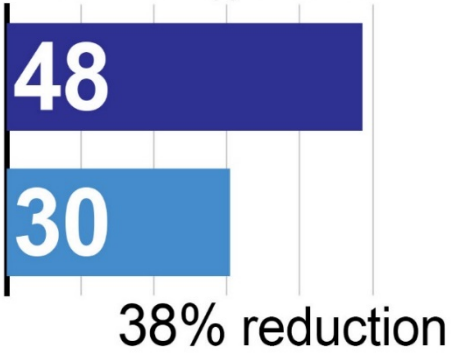
**thiophanate-methyl** (FRAC 1) – efficacy vs. non-treated control

**Evaluated in 17 field trials:** Carrington and Langdon, ND (2012-2015)

**AVERAGE EFFICACY:**

**Sclerotinia sev. index**

Percent of canopy diseased



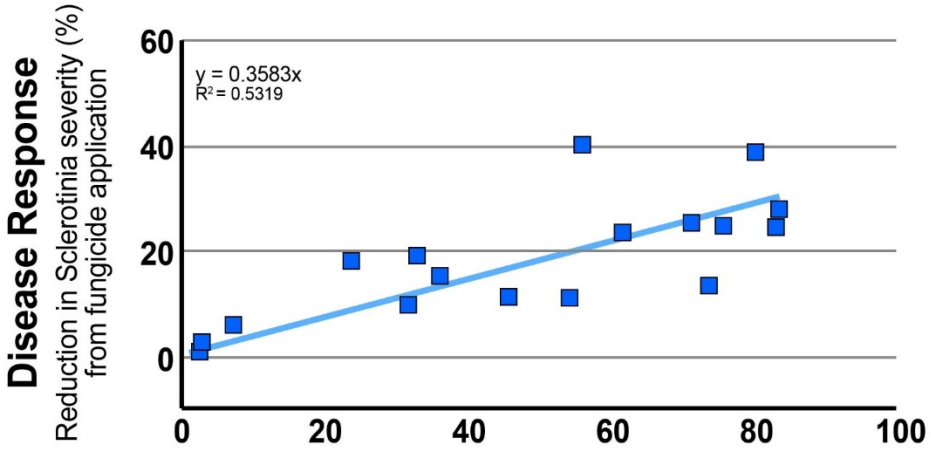

**Yield**

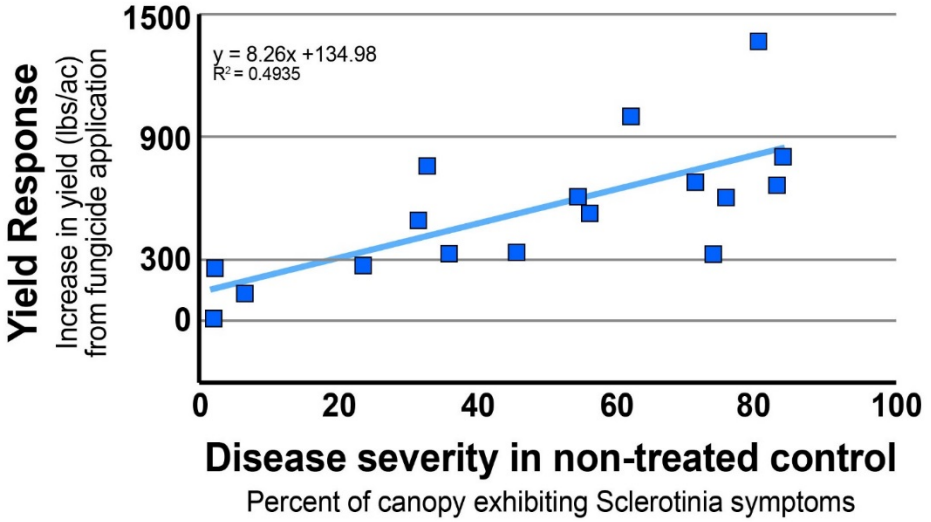
pounds/acre


DARK BLUE: **Non-treated**
LIGHT BLUE: **Topsin 30 fl oz**

**Topsin 4.5FL**
30.0 fl oz/ac
early bloom + 10-14 days later

**EFFICACY ACROSS INDIVIDUAL TRIALS:** each dot represents one field trial



# ProPulse 8.6 or 10.3 fl oz/ac

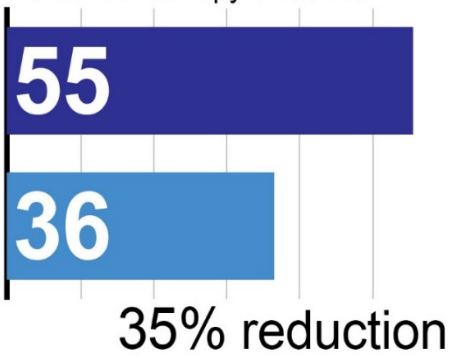
**prothioconazole + fluopyram** (FRAC 3, 7) – efficacy vs. non-treated control

**Evaluated in 12 field trials:** Carrington and Langdon, ND (2009-2017)

**AVERAGE EFFICACY:**

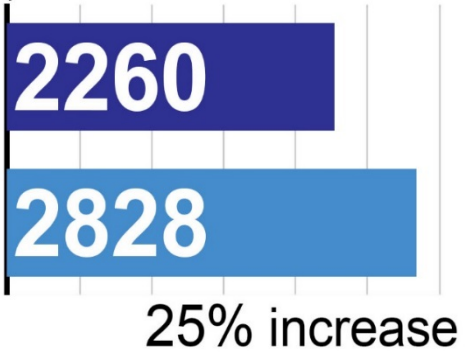
**Sclerotinia sev. index**

Percent of canopy diseased




**Yield**

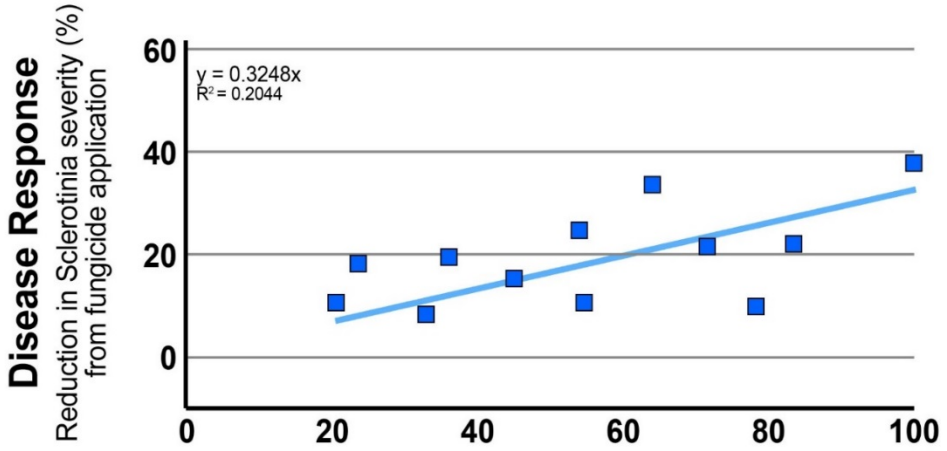
pounds/acre

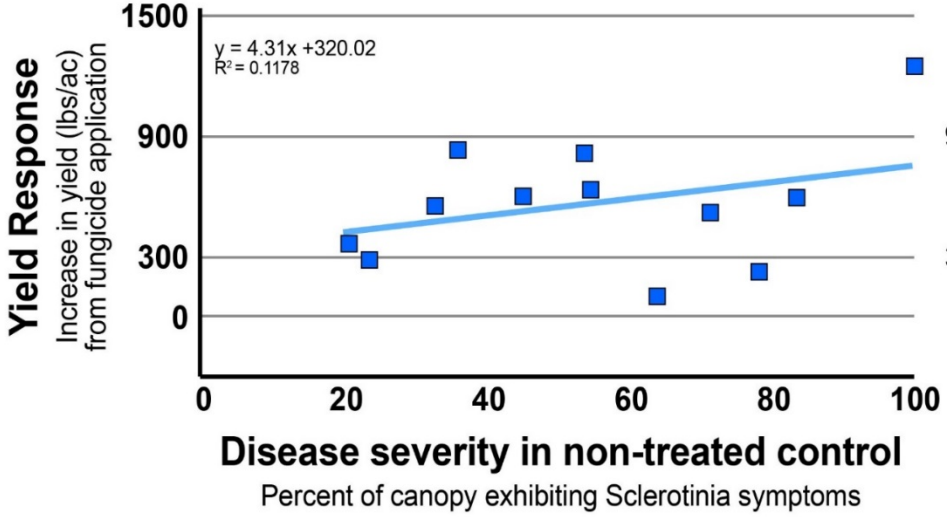



DARK BLUE: **Non-treated**
LIGHT BLUE: **ProPulse 10.3 fl oz**

**ProPulse 400SC**
10.3 fl oz/ac
early bloom + 10-14 days later

**EFFICACY ACROSS INDIVIDUAL TRIALS:** each dot represents one field trial



# Endura 8 oz/ac

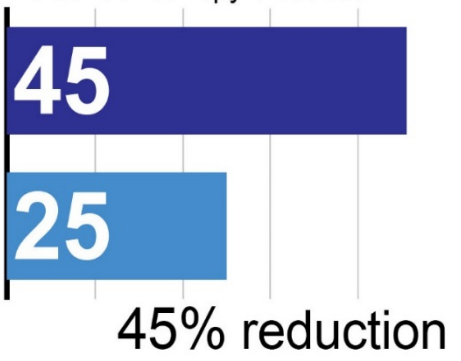
**boscalid** (FRAC 7) – efficacy vs. non-treated control

**Evaluated in 46 field trials:** Carrington and Langdon, ND (2010-2017)

**AVERAGE EFFICACY:**

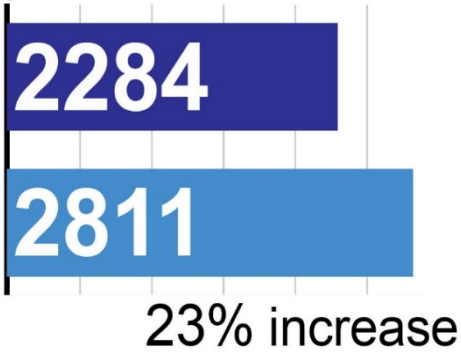
**Sclerotinia sev. index**

Percent of canopy diseased




**Yield**

pounds/acre



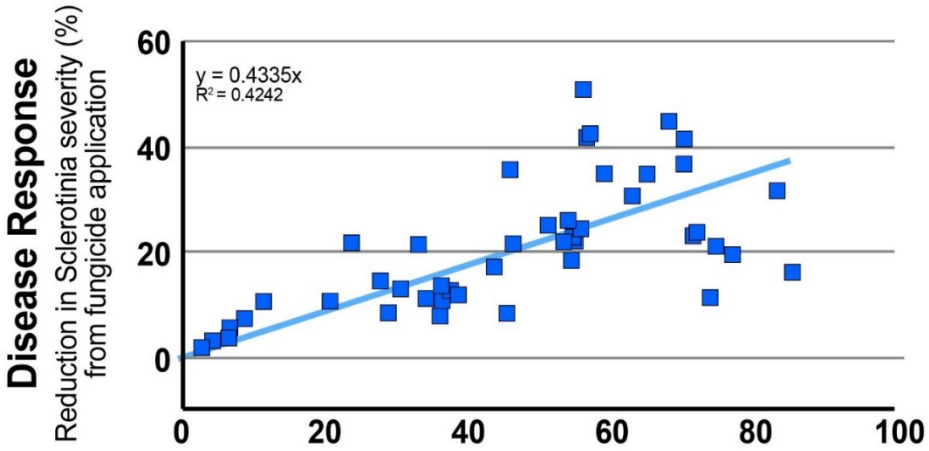

DARK BLUE: **Non-treated**
LIGHT BLUE: **Endura 8 oz**

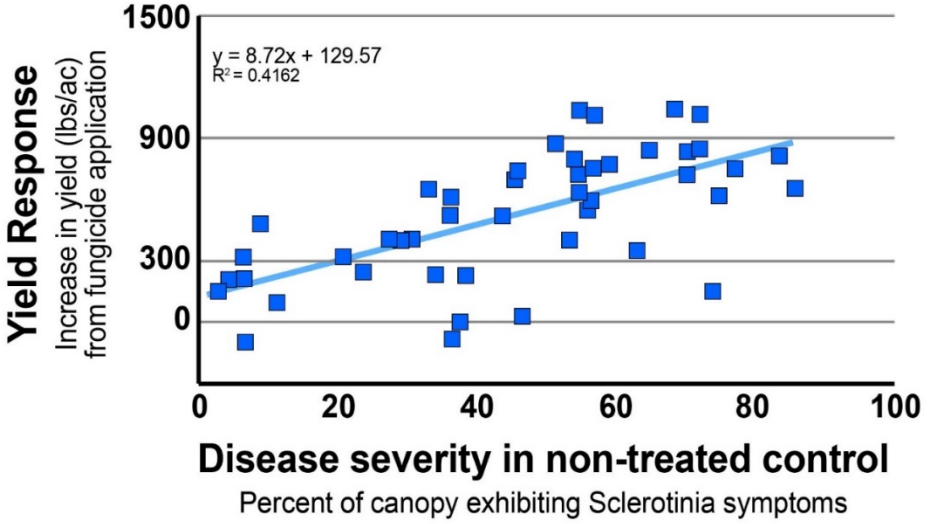
## Endura 70WG

8.0 oz/ac

early bloom + 10-14 days later

**EFFICACY ACROSS INDIVIDUAL TRIALS:** each dot represents one field trial



# Omega 13.6 fl oz/ac

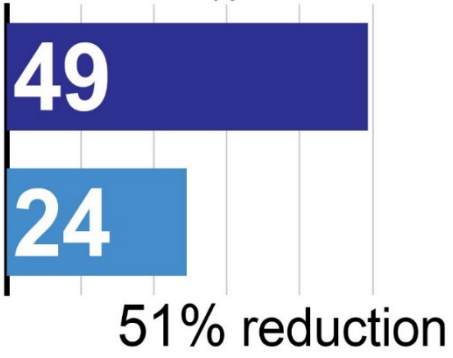
**fluazinam** (FRAC 29) – efficacy vs. non-treated control

**Evaluated in 9 field trials:** Carrington and Langdon, ND (2010-2015)

**AVERAGE EFFICACY:**

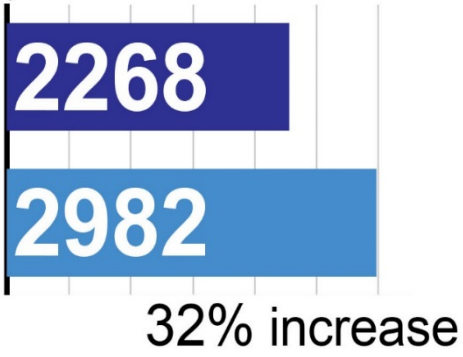
**Sclerotinia sev. index**

Percent of canopy diseased




**Yield**

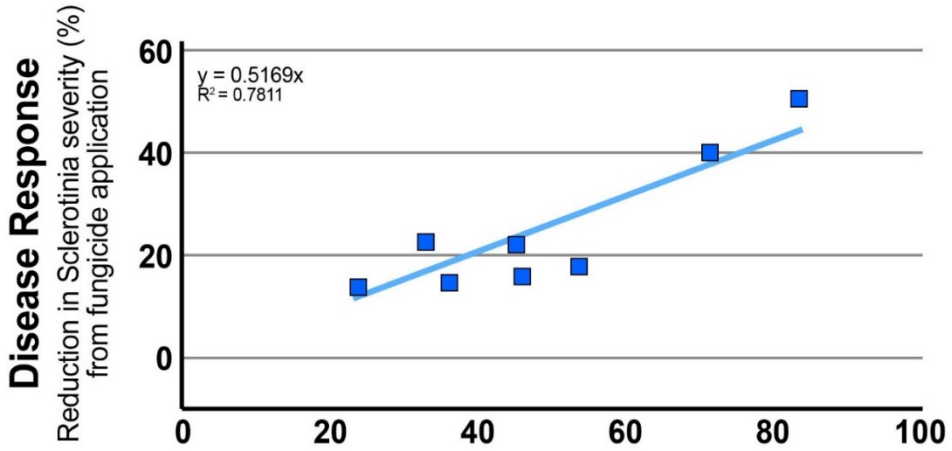
pounds/acre

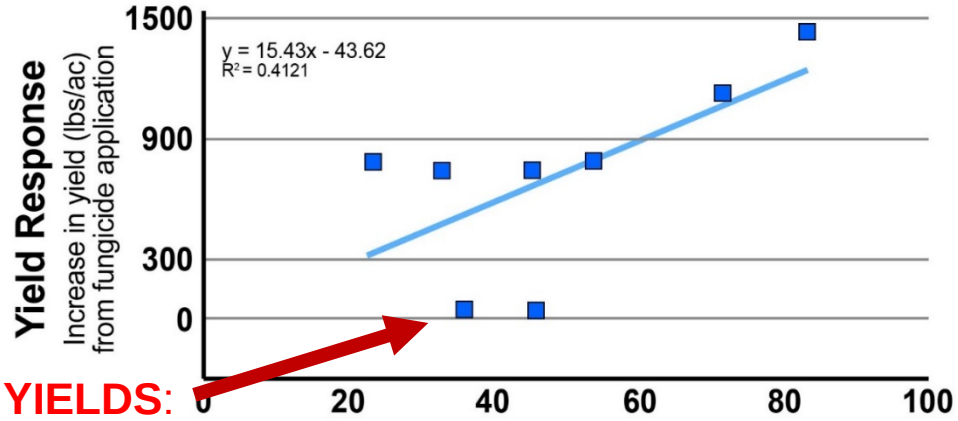



DARK BLUE: **Non-treated**
LIGHT BLUE: **Omega 13.6 fl oz**

**Omega 500F**
13.6 fl oz/ac
early bloom + 10-14 days later

**EFFICACY ACROSS INDIVIDUAL TRIALS:** each dot represents one field trial



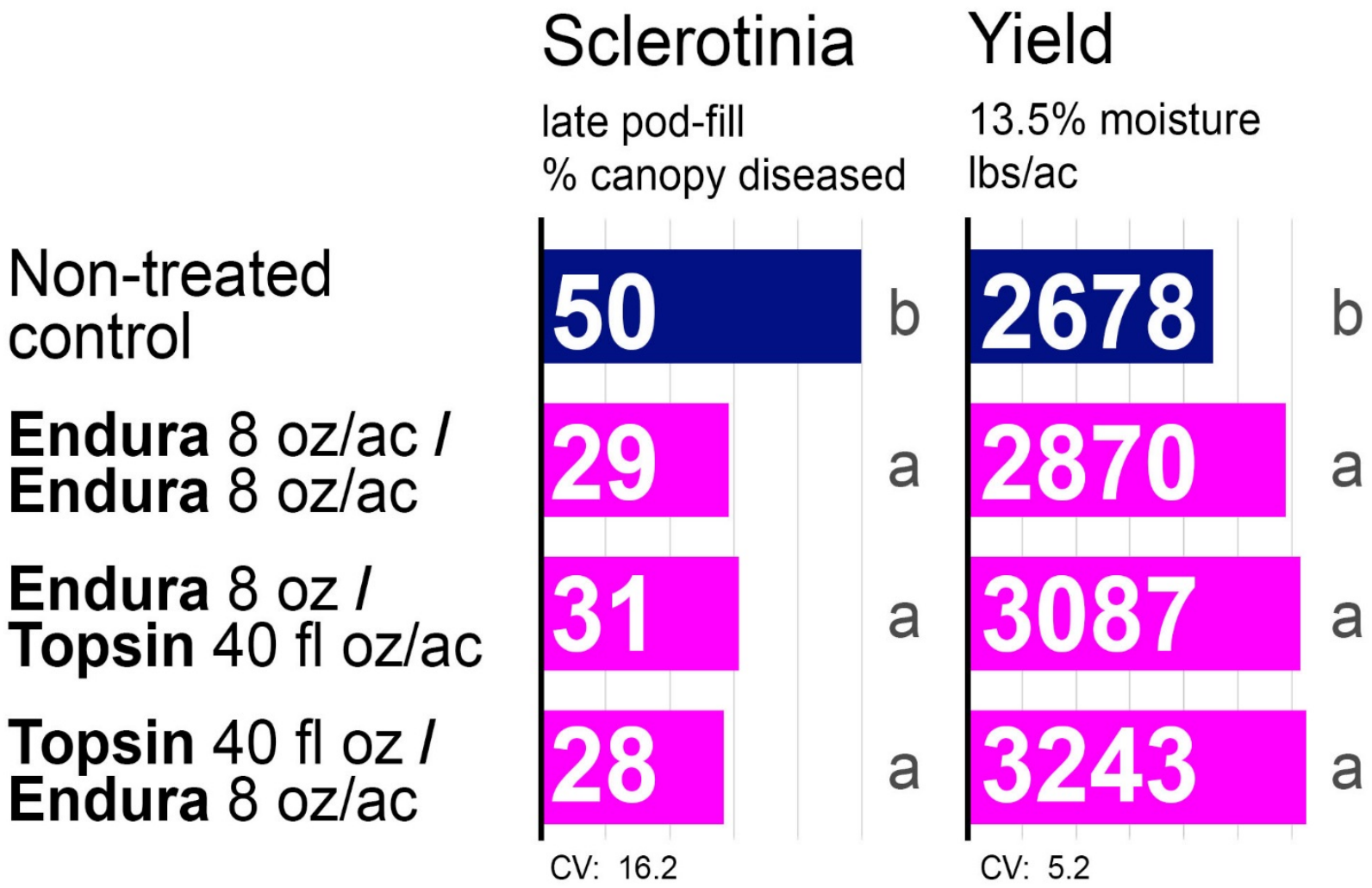

**TRIALS WITH UNSATISFACTORY YIELDS**: APPLICATIONS MADE TO A DENSE CANOPY

# Fungicide efficacy testing:
## Research methods

**(3) Efficacy of fungicide rotation strategies**

# Fungicide rotation strategies

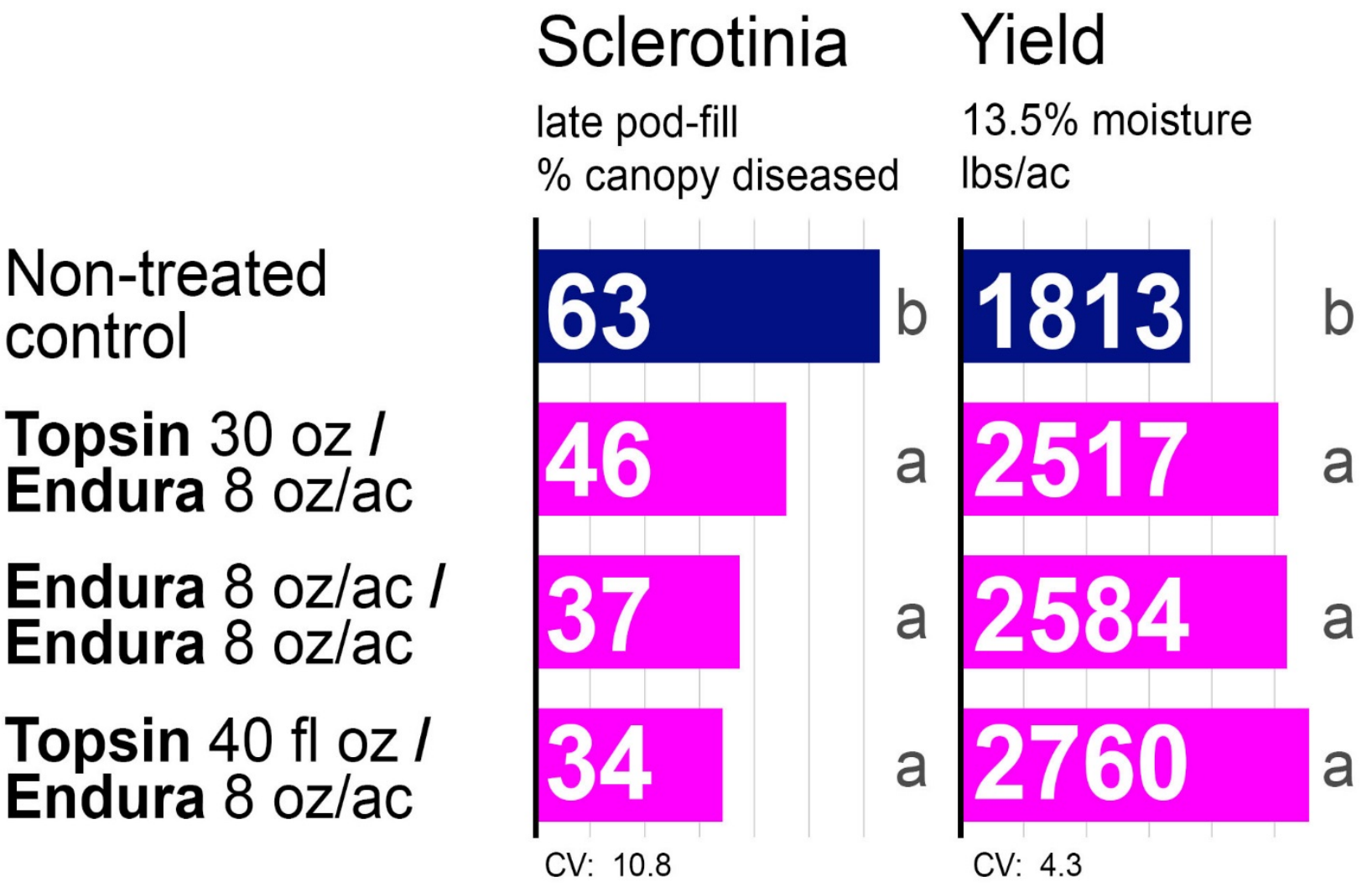
## Topsin and Endura – impact of application sequence




Combined analysis, **7 field trials:** Carrington & Langdon, ND (2012-2014)

# Fungicide rotation strategies

Topsin and Endura – impact of 30 fl oz vs. 40 fl oz of Topsin




Combined analysis, **3 field trials:** Carrington & Langdon, ND (2014)

# Fungicide rotation strategies

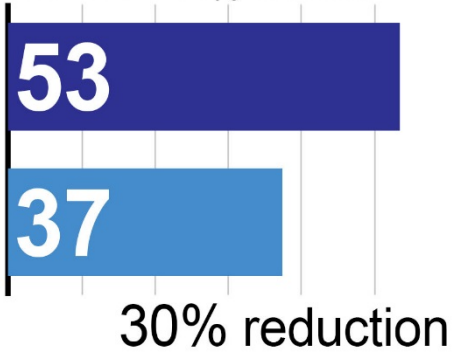
## Topsin (30 fl oz) followed by Endura (8 oz) – efficacy vs. non-treated control

**Evaluated in 11 field trials:** Carrington, Oakes and Langdon, ND (2012-2017)

**AVERAGE EFFICACY:**

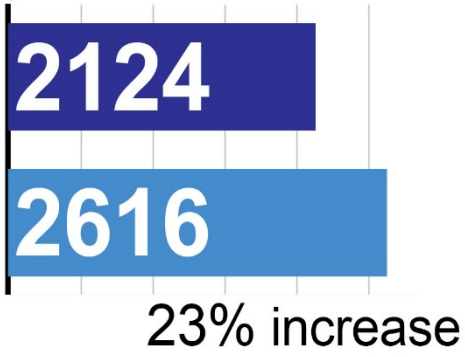
**Sclerotinia sev. index**

Percent of canopy diseased




**Yield**

pounds/acre

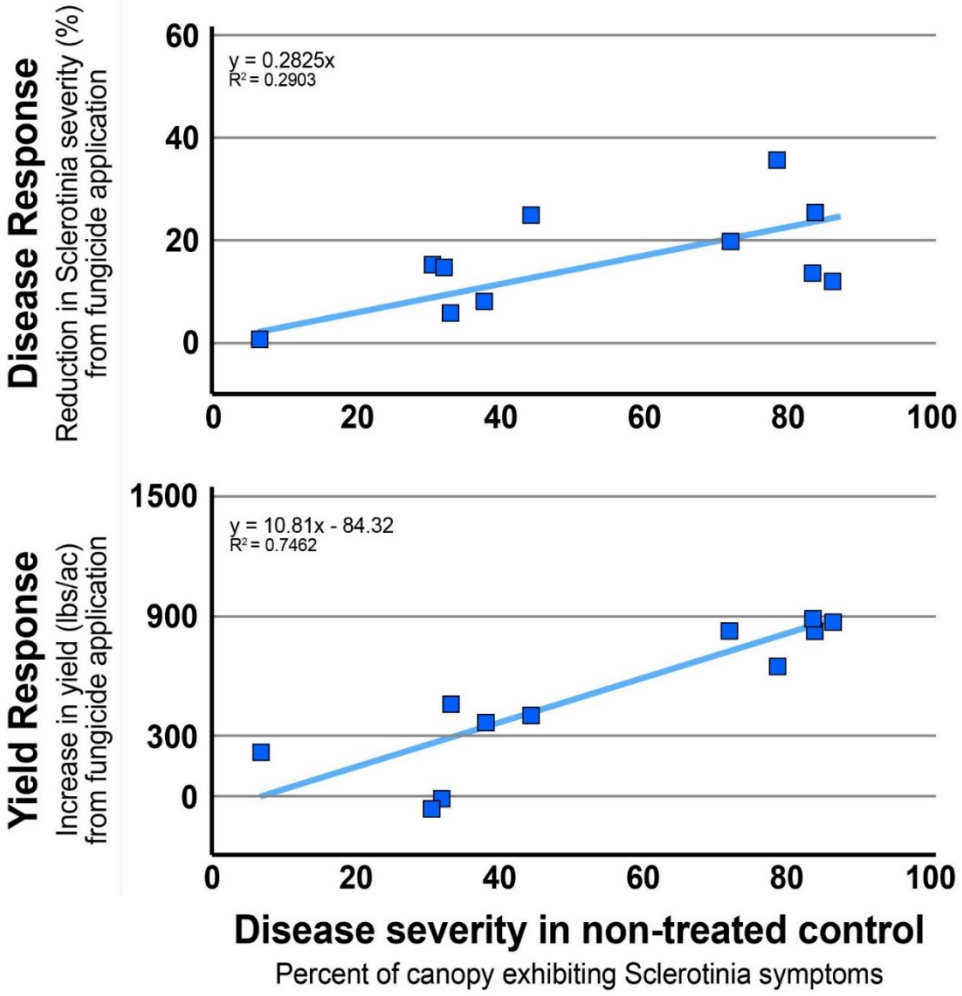



DARK BLUE: **Non-treated**

**Topsin 30 fl oz / Endura 8 oz**

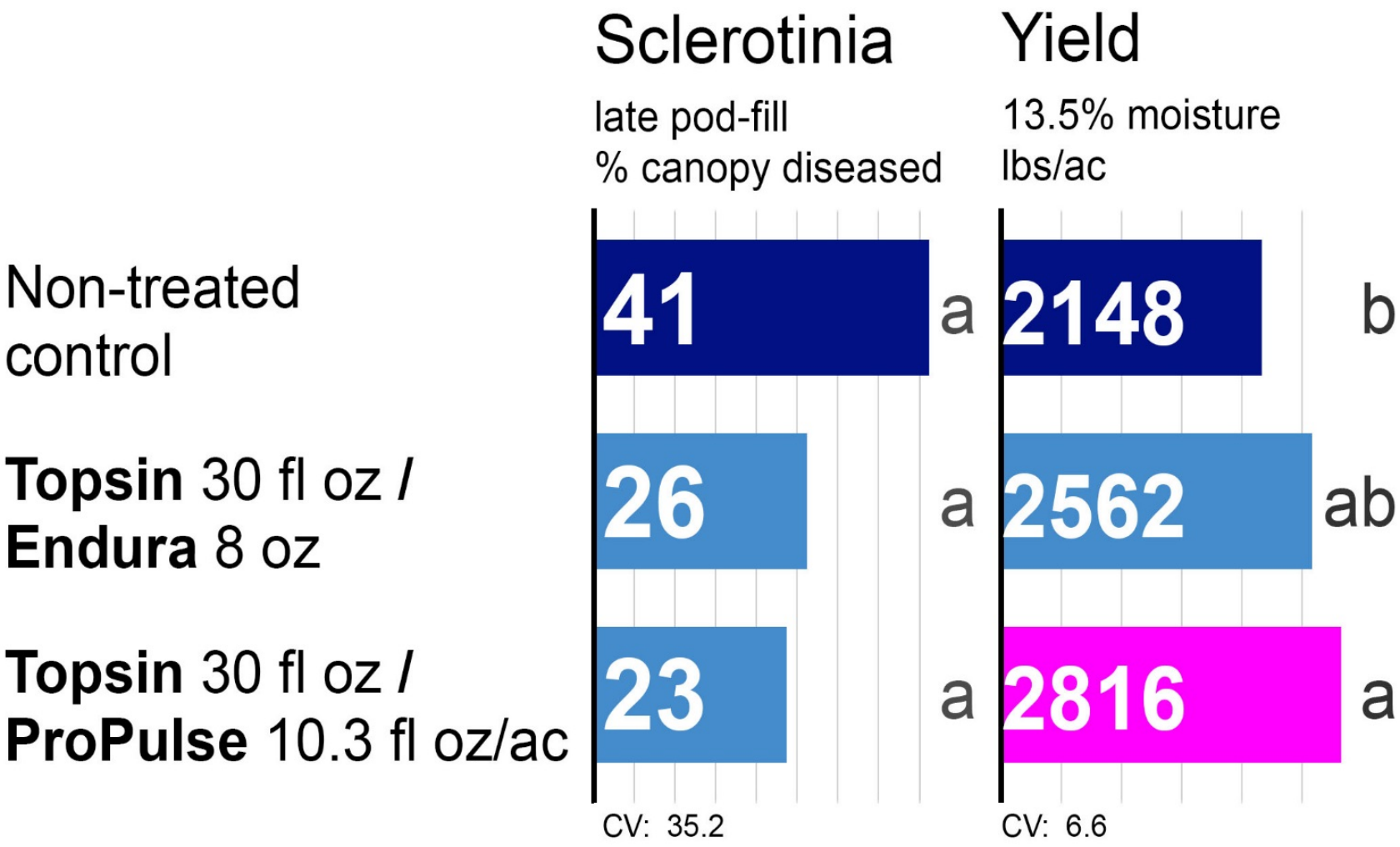
**Topsin** 30.0 fl oz/ac
early bloom *followed by*
**Endura** 8.0 oz/ac
10-14 days later

**EFFICACY ACROSS INDIVIDUAL TRIALS:** each dot represents one field trial



# Fungicide rotation strategies

Topsin and ProPulse vs. Topsin and Endura




Combined analysis, **3 field trials:** Carrington, ND (2014, 2015, 2017)

# Fungicide application timing

Carrington and Oakes, ND (2017)

Treatments with a single application**:**

- **Topsin 30 fl oz/ac**

Treatments with two sequential applications:

- **Topsin 30 fl oz/ac** followed by **Endura** 8 oz/ac

Application methods:

- Carrington: **15** gal/ac, **DGXR110015** flat-fan nozzles, **35** psi
- Oakes: **19** gal/ac, **XR80015** flat-fan nozzles, **35** psi

# Fungicide application timing – pinto beans

‘La Paz’ pintos - Carrington, ND (2017)

| Fungicide Timing<br>Application dates | FIRST FUNGICIDE APPLICATION: Percent Bloom<br>plants with open blossom | Pod Length<br>maximum length (inch) | Canopy Closure<br>narrow / wide row spacing | Sclerotinia stem rot<br>late R7 / early R8 growth stage<br>% of canopy diseased<br>14-inch row spacing | 28-inch row spacing |
|---|---|---|---|---|---|
| **Non-treated control** | | | | 83 cd | 86 bc |
| July 20 | **80%** | **-** | 95%, 70% | 85 d | 88 c |
| July 22 | **100%** | **1.0”** | 99%, 95% | 75 abc | 80 abc |
| July 25 | **100%** | **3.0”** | 100%, 98% | 77 a-d | 81 abc |
| July 27 | **100%** | **4.0”** | 100%, 100% | 75 a-d | 80 abc |
| Aug. 1 | **100%** | full length | 100%, 100% | 81 bcd | 83 abc |
| July 20, Aug. 1 | **80%** | **-** | 95%, 70% | 75 abc | 79 abc |
| July 22, Aug. 3 | **100%** | **1.0”** | 99%, 95% | 70 a | 74 a |
| July 25, Aug. 6 | **100%** | **3.0”** | 100%, 98% | 70 ab | 74 a |
| July 27, Aug. 8 | **100%** | **4.0”** | 100%, 100% | 77 a-d | 78 ab |
| | | | | CV: 11.5 | CV: 9.8 |

Single application: **Topsin 30 fl oz** Sequential applications: **Topsin 30 fl oz** followed by **Endura 8 oz/ac**

# Fungicide application timing – pinto beans

‘La Paz’ pintos - Carrington, ND (2017)

| Fungicide Timing<br>Application dates | FIRST FUNGICIDE APPLICATION: Percent Bloom<br>plants with open blossom | Pod Length<br>maximum length (inch) | Canopy Closure<br>narrow / wide row spacing | Sclerotia in harvested grain<br>contamination with resting structures of the Sclerotinia fungus<br>Percent by weight<br>14-inch row spacing | | 28-inch row spacing | |
|---|---|---|---|---|---|---|---|
| **Non-treated control** | | | | 4.2 | c | 3.9 | bc |
| July 20 | **80%** | **-** | 95%, 70% | 4.1 | bc | 4.4 | c |
| July 22 | **100%** | **1.0”** | 99%, 95% | 2.4 | a | 3.1 | ab |
| July 25 | **100%** | **3.0”** | 100%, 98% | 2.9 | a | 3.2 | abc |
| July 27 | **100%** | **4.0”** | 100%, 100% | 3.0 | ab | 3.0 | ab |
| Aug. 1 | **100%** | full length | 100%, 100% | 2.8 | a | 3.0 | ab |
| July 20, Aug. 1 | **80%** | **-** | 95%, 70% | 2.9 | a | 2.8 | ab |
| July 22, Aug. 3 | **100%** | **1.0”** | 99%, 95% | 2.2 | a | 2.2 | a |
| July 25, Aug. 6 | **100%** | **3.0”** | 100%, 98% | 2.4 | a | 2.4 | a |
| July 27, Aug. 8 | **100%** | **4.0”** | 100%, 100% | 2.5 | a | 2.4 | a |
| | | | | CV: 32.3 | | CV: 34.2 | |

Single application: **Topsin 30 fl oz** Sequential applications: **Topsin 30 fl oz** followed by **Endura 8 oz/ac**

# Fungicide application timing – pinto beans

'La Paz' pintos - Carrington, ND (2017)

| Fungicide Timing<br>Application dates | FIRST FUNGICIDE APPLICATION: Percent Bloom<br>plants with open blossom | Pod Length<br>maximum length (inch) | Canopy Closure<br>narrow / wide row spacing | Yield<br>13.5% moisture<br>Pounds/acre<br>14-inch row spacing | | 28-inch row spacing | |
|---|---|---|---|---|---|---|---|
| **Non-treated control** | | | | 1285 | c | 1297 | de |
| July 20 | **80%** | **-** | 95%, 70% | 1209 | c | 1215 | e |
| July 22 | **100%** | **1.0"** | 99%, 95% | 1908 | ab | 1739 | a-d |
| July 25 | **100%** | **3.0"** | 100%, 98% | 1864 | ab | 1595 | b-e |
| July 27 | **100%** | **4.0"** | 100%, 100% | 1671 | abc | 1691 | a-d |
| Aug. 1 | **100%** | full length | 100%, 100% | 1552 | bc | 1416 | cde |
| July 20, Aug. 1 | **80%** | **-** | 95%, 70% | 1719 | abc | 1686 | a-e |
| July 22, Aug. 3 | **100%** | **1.0"** | 99%, 95% | 2163 | a | 2158 | a |
| July 25, Aug. 6 | **100%** | **3.0"** | 100%, 98% | 1974 | ab | 1997 | ab |
| July 27, Aug. 8 | **100%** | **4.0"** | 100%, 100% | 1729 | abc | 1825 | abc |
| | | | | CV: 25.9 | | CV: 24.2 | |

Single application: **Topsin 30 fl oz** Sequential applications: **Topsin 30 fl oz** followed by **Endura 8 oz/ac**

# Fungicide application timing – black beans

## ‘Eclipse’ blacks - Oakes, ND (2017)

| Fungicide Timing<br>Application dates | FIRST FUNGICIDE APPLICATION: Percent Bloom<br>plants with open blossom | Pod Length<br>maximum length (inch) | Canopy Closure<br>narrow / wide row spacing | Sclerotinia<br>late R7 / early R8 growth stage<br>**Percent of canopy diseased**<br>14-inch row spacing | Sclerotia in grain<br>fungal resting structures in grain<br>**Percent by weight**<br>14-inch row spacing |
|---|---|---|---|---|---|
| **Non-treated control** | | | | 74 f | 1.2 d |
| July 22 | **68%** | **-** | 75-95% | 64 ef | 1.0 d |
| July 24 | **100%** | **-** | 75-100% | 56 de | 0.8 cd |
| July 26 | **100%** | **0.5”** | 85-100% | 49 cd | 0.7 bc |
| July 28 | **100%** | **1.0”** | 95-100% | 42 bc | 0.5 ab |
| July 22, Aug. 3 | **68%** | **-** | 75-95% | 42 bc | 0.5 ab |
| July 24, Aug. 5 | **100%** | **-** | 75-100% | 39 abc | 0.5 ab |
| July 26, Aug. 7 | **100%** | **0.5”** | 85-100% | 28 a | 0.3 a |
| July 26, Aug. 8 | **100%** | **1.0”** | 95-100% | 36 ab | 0.4 ab |
| | | | | CV: 21.1 | CV: 34.1 |

Single application: **Topsin 30 fl oz** Sequential applications: **Topsin 30 fl oz** followed by **Endura 8 oz/ac**

# Fungicide application timing – black beans

'Eclipse' blacks - Oakes, ND (2017)

| Fungicide Timing<br>Application dates | FIRST FUNGICIDE APPLICATION: Percent Bloom<br>plants with open blossom | Pod Length<br>maximum length (inch) | Canopy Closure<br>narrow / wide row spacing | Yield<br>13.5% moisture<br>Pounds/acre<br>14-inch row spacing | |
|---|---|---|---|---|---|
| **Non-treated control** | | | | 2897 | fd |
| July 22 | **68%** | - | 75-95% | 3197 | cd |
| July 24 | **100%** | - | 75-100% | 3509 | bc |
| July 26 | **100%** | **0.5"** | 85-100% | 3924 | ab |
| July 28 | **100%** | **1.0"** | 95-100% | 4122 | a |
| July 22, Aug. 3 | **68%** | - | 75-95% | 3943 | ab |
| July 24, Aug. 5 | **100%** | - | 75-100% | 4302 | a |
| July 26, Aug. 7 | **100%** | **0.5"** | 85-100% | 4441 | a |
| July 26, Aug. 8 | **100%** | **1.0"** | 95-100% | 4184 | a |

CV: 11.8

Single application: **Topsin 30 fl oz** Sequential applications: **Topsin 30 fl oz** followed by **Endura 8 oz/ac**

# Fungicide application timing

Carrington and Oakes, ND (2017)

The advantage to delaying fungicide applications until initial pod development was likely due to weather conditions in 2017:

- Weather was hot and dry during early bloom and early pod-fill, reducing disease pressure during early bloom
- Weather was cool and wet during late pod-fill, resulting in elevated disease pressure late in the season

Making the first fungicide application prior to initial pod development is likely to be advantageous when conditions are cool and wet during early bloom.

# Fungicide application methods – drop nozzles

Carrington, ND (2017)

Treatments with a single application**:**

- **Topsin 30 fl oz/ac**

Treatments with two sequential applications:

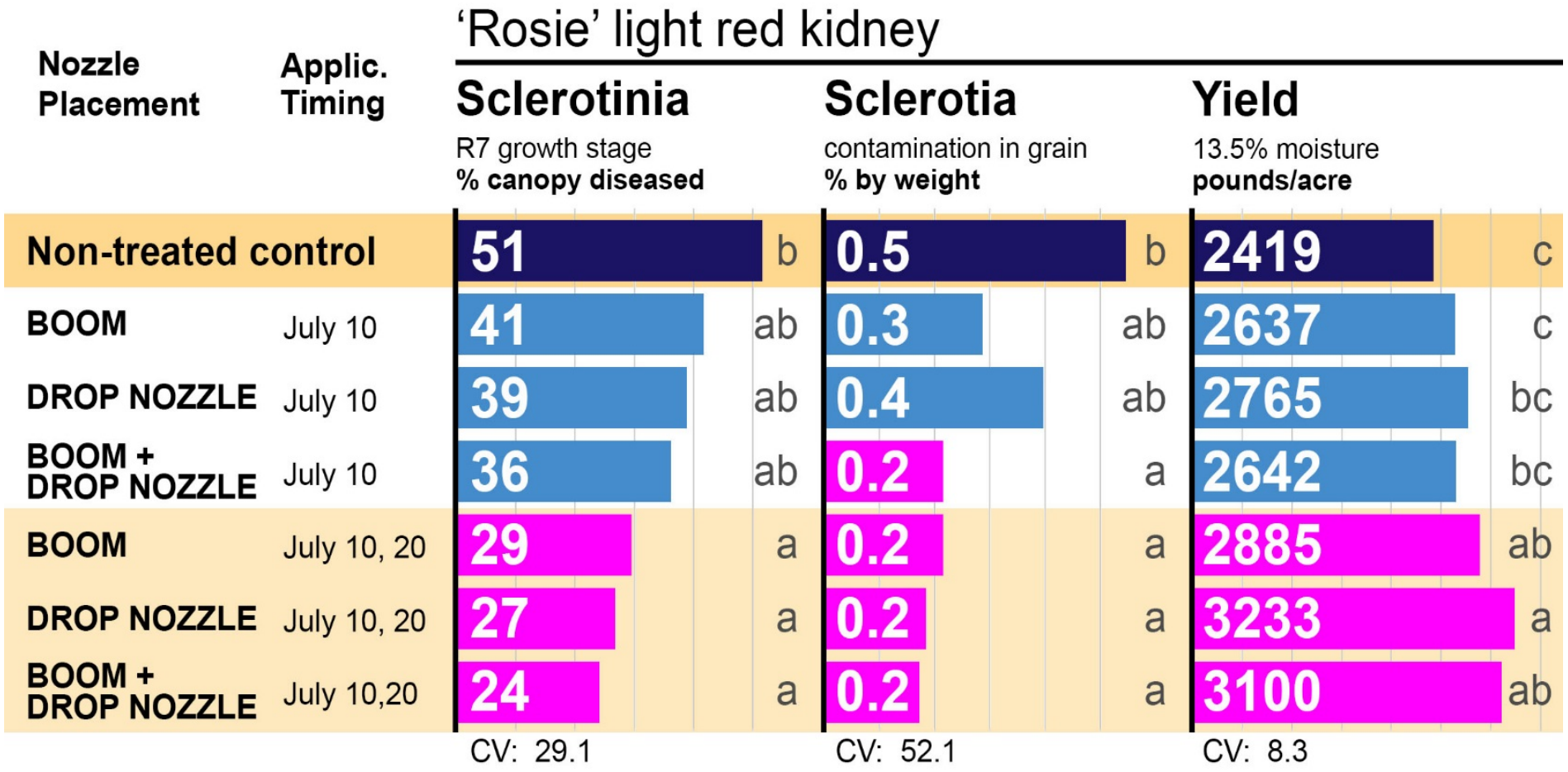
- **Topsin 30 fl oz/ac** followed by **Endura** 8 oz/ac

Application methods:

- Tractor-mounted boom
- **Pulse-width modulation system** from Capstan AG
- **‘360 Undercover’ drop nozzles** (360 Yield Center; Morton, IL)
- Spray volume: **15** gal/ac
- Driving speed: **4.0** mph

# Fungicide application methods – drop nozzles

Carrington, ND (2017)





# Research funding:

**Northarvest Bean Growers, ND Crop Protection Product Harmonization Board & Registration Board**

**USDA Specialty Crop Block Grant Program, USDA National Sclerotinia Initiative**

**BASF, Bayer, Arysta, DuPont, Valent**