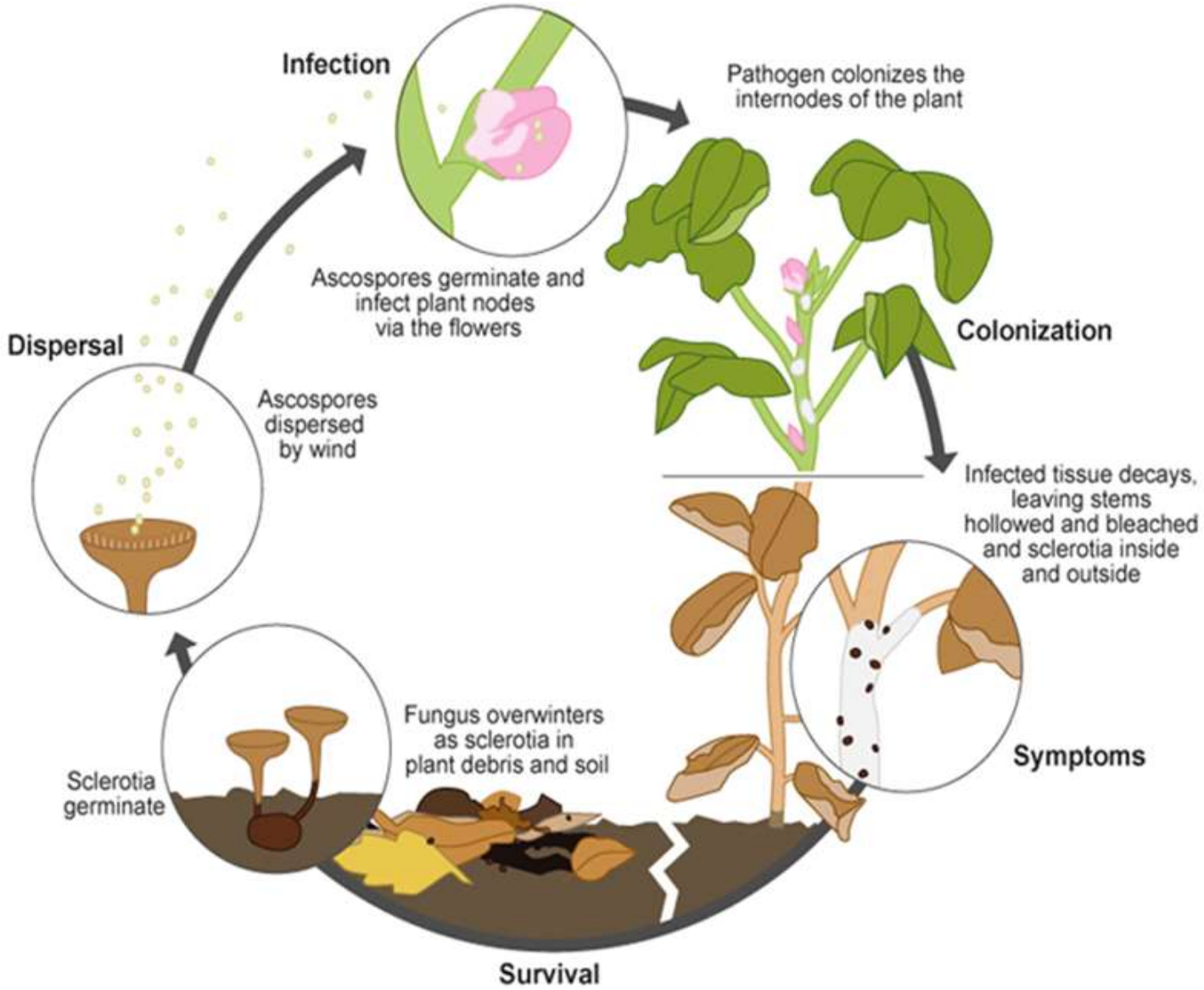
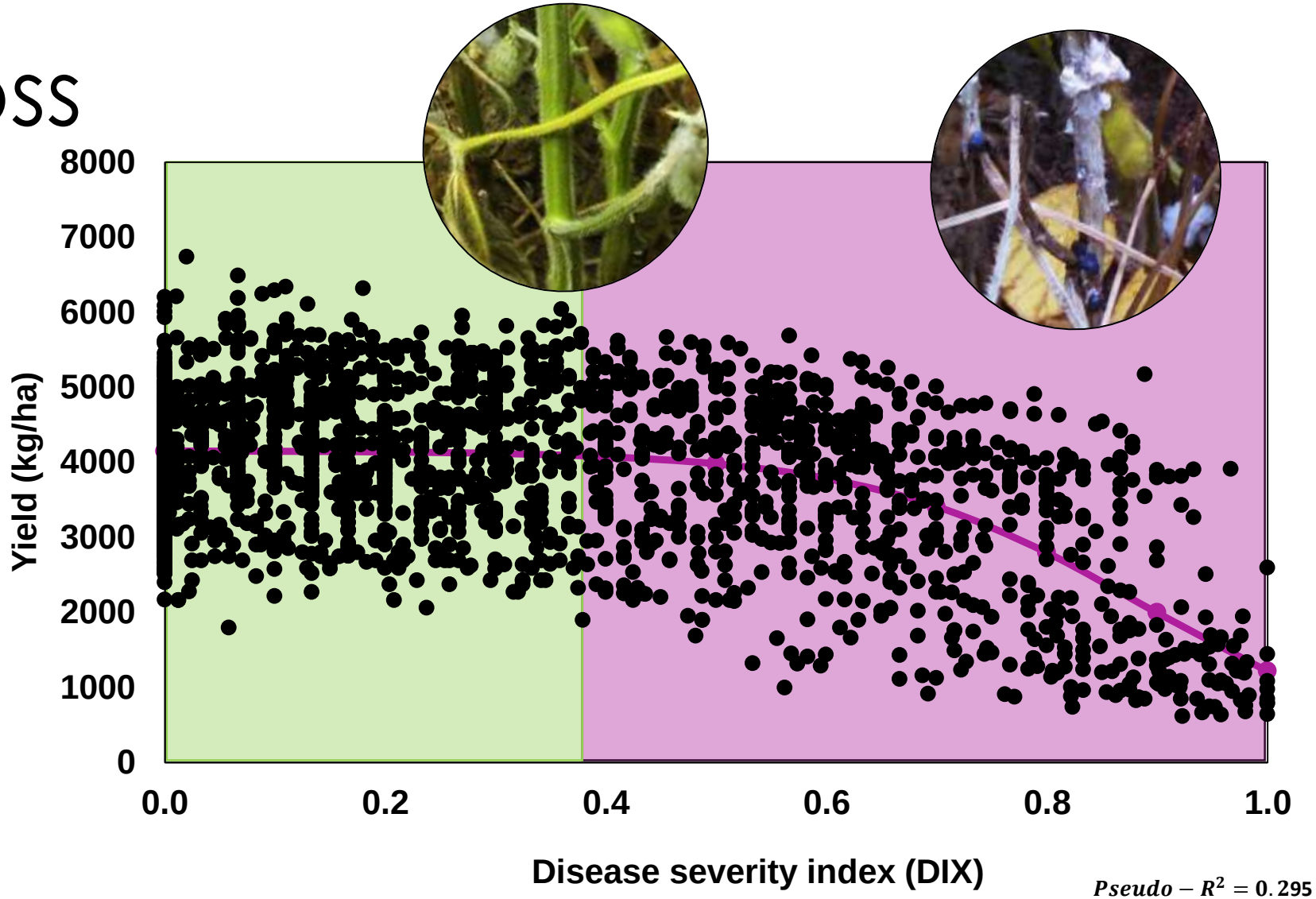
Integrated Approaches to White Mold Management

Damon L. Smith, Ph.D.
Field Crops Extension Pathologist
Department of Plant Pathology
University of Wisconsin-Madison

White Mold Cycle (Soybean)



Yield Loss



Willbur, J.F., Fall, M.L., Byrne, A.M., Chapman, S.A., Bradley, C.A., Chilvers, M.I., Kleczewski, N.M., Mueller, D.S., Malvick, D., Mitchell, P.D., Conley, S.P., and Smith, D.L. 2019. Phytopathology. Accepted.

The Main Questions

- Is there genetic resistance to white mold?
- What fungicides work for managing white mold?
- When should I spray for white mold?
- What cultural practices should I use in my integrated management strategy?

Management

Function of:

- Field history
  - Mapping of field
  - Variety selection
    - Need improved breeding material
- Canopy row width and plant population
- Crop rotation
- Chemical and/or biological control
  - Incomplete control
    - Application issues
  - Timing of application critical
  - Need better disease predictions

Photo Credit: Daren Mueller, Iowa State University

Efforts to Improve White Mold Resistance in Soybean

Willbur, J. F., Ding, S., Marks, M. E., Lucas, H., Grau, C. R., Groves, C. L., Kabbage, M., and Smith, D. L. Comprehensive white mold screening of soybean germplasm requires multiple isolates of Sclerotinia sclerotiorum. 2017. Plant Disease.

McCaghey, M. and Willbur, J.F., Ranjan, A., Grau, C., Chapman, S., Diers, B., Groves, C., Kabbage, M., and Smith, D.L. 2017. Frontiers in Plant Science.

Variety response to white mold can be highly variable – Look for consistency

2017 Glyphosate Tolerant Soybean Trials				
Variety	**Yield Arlington (bu/a)**	**WM Arlington (%)**	**Yield Hancock (bu/a)**	**WM Hancock (%)**
DSR-1721/R2Y	90	5	67	24
DSR-1870/R2Y	88	13	62	15
GH2230X Brand	85	3	60	20
LS 23X632N	85	6	62	13
S21-W8X Brand	85	10	58	68
S23XT78	84	13	50	53

Conley et al., 2017 http://www.coolbean.info

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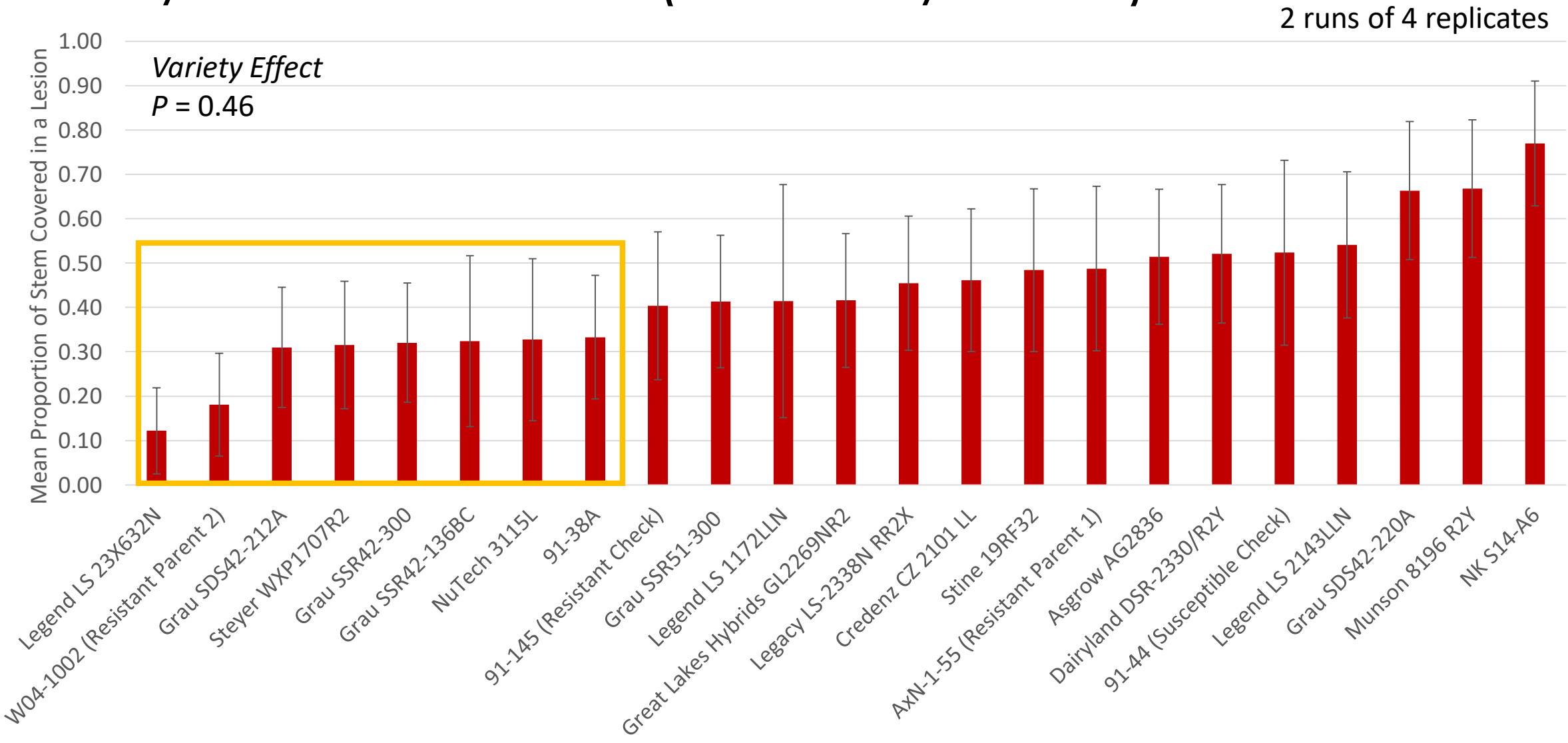
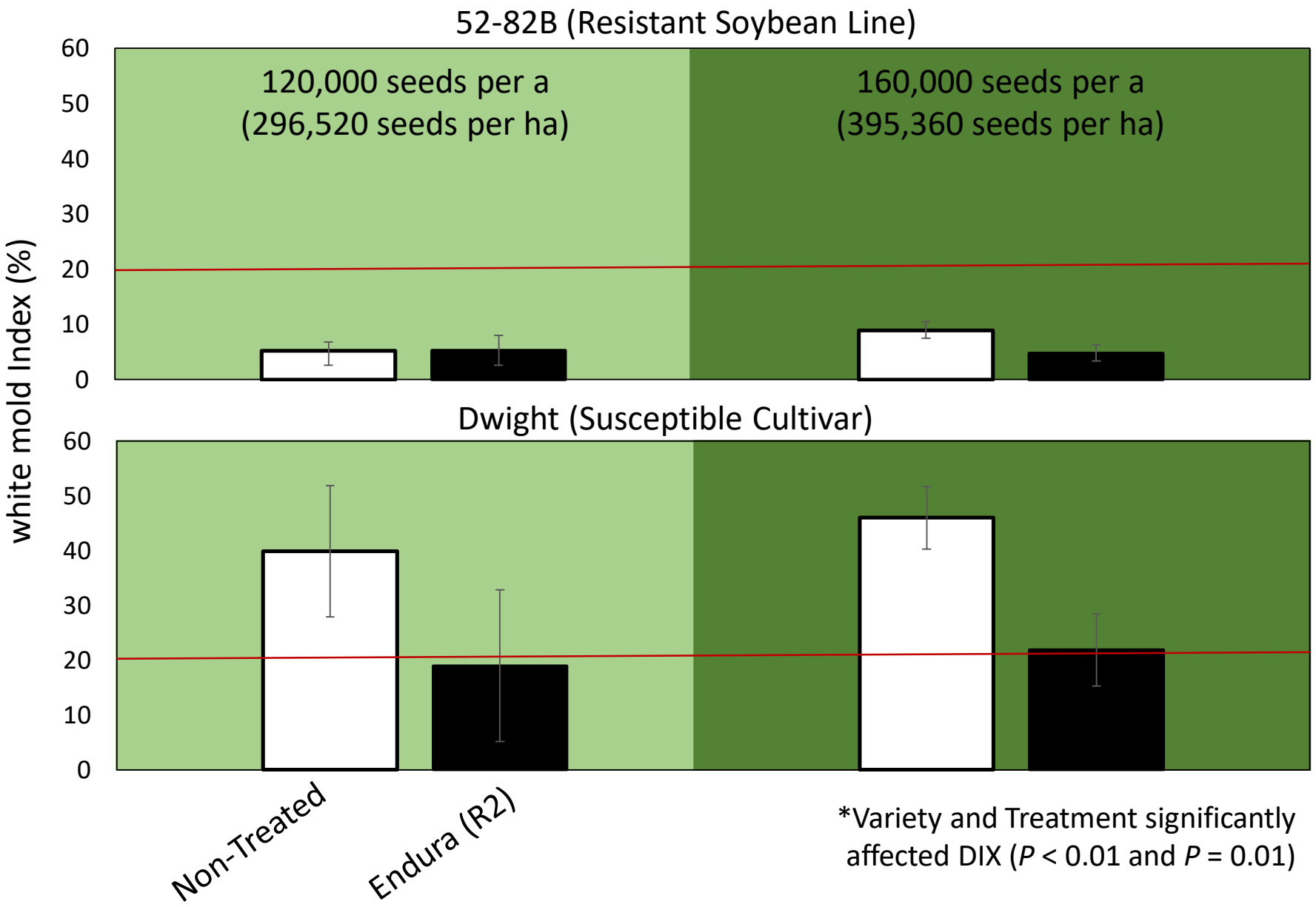
Commercial Variety Inoculations (February, 2018)

Greenhouse Inoculations of Commercial Soybean Varieties (February, 2018)



What is the Real Value of Resistance?



*Variety and Treatment significantly affected DIX ($P < 0.01$ and $P = 0.01$)

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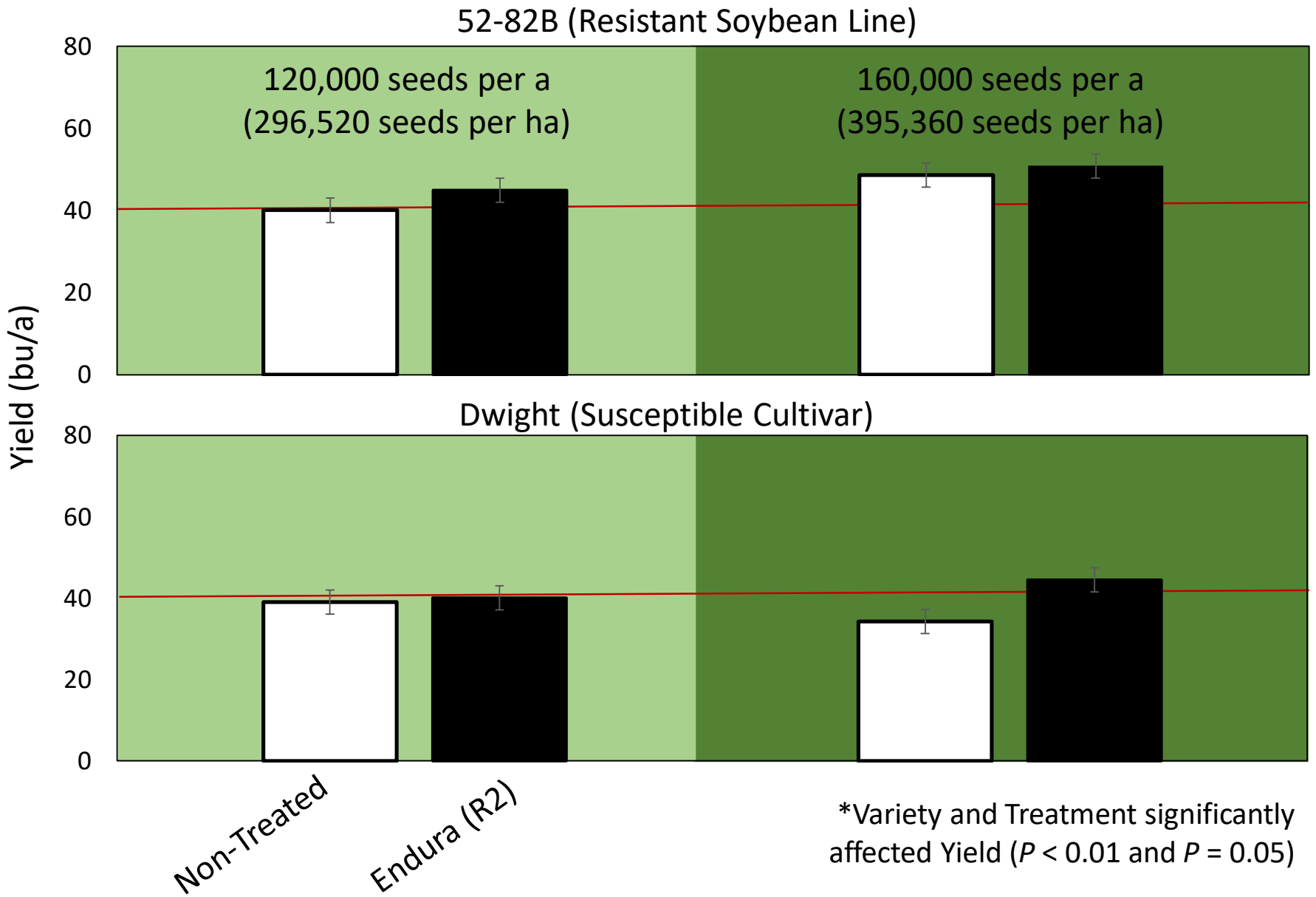


*Variety and Treatment significantly affected Yield ($P < 0.01$ and $P = 0.05$)

- Endura (8 oz/a) @ R2 = $40/a
- Application fee = $7/a
- 160K seeding rate = 4.0 bu/a advantage to 52-82B
- Total Value ($9/bu) = $83/a

What are the Best Fungicides and application timings?

A Network Meta-Analysis

Willbur, J.F., Fall, M.L., Byrne, A.M., Chapman, S.A., Bradley, C.A., Chilvers, M.I., Kleczewski, N.M., Mueller, D.S., Malvick, D., Mitchell, P.D., Conley, S.P., and Smith, D.L. 2018. Phytopathology. Accepted.

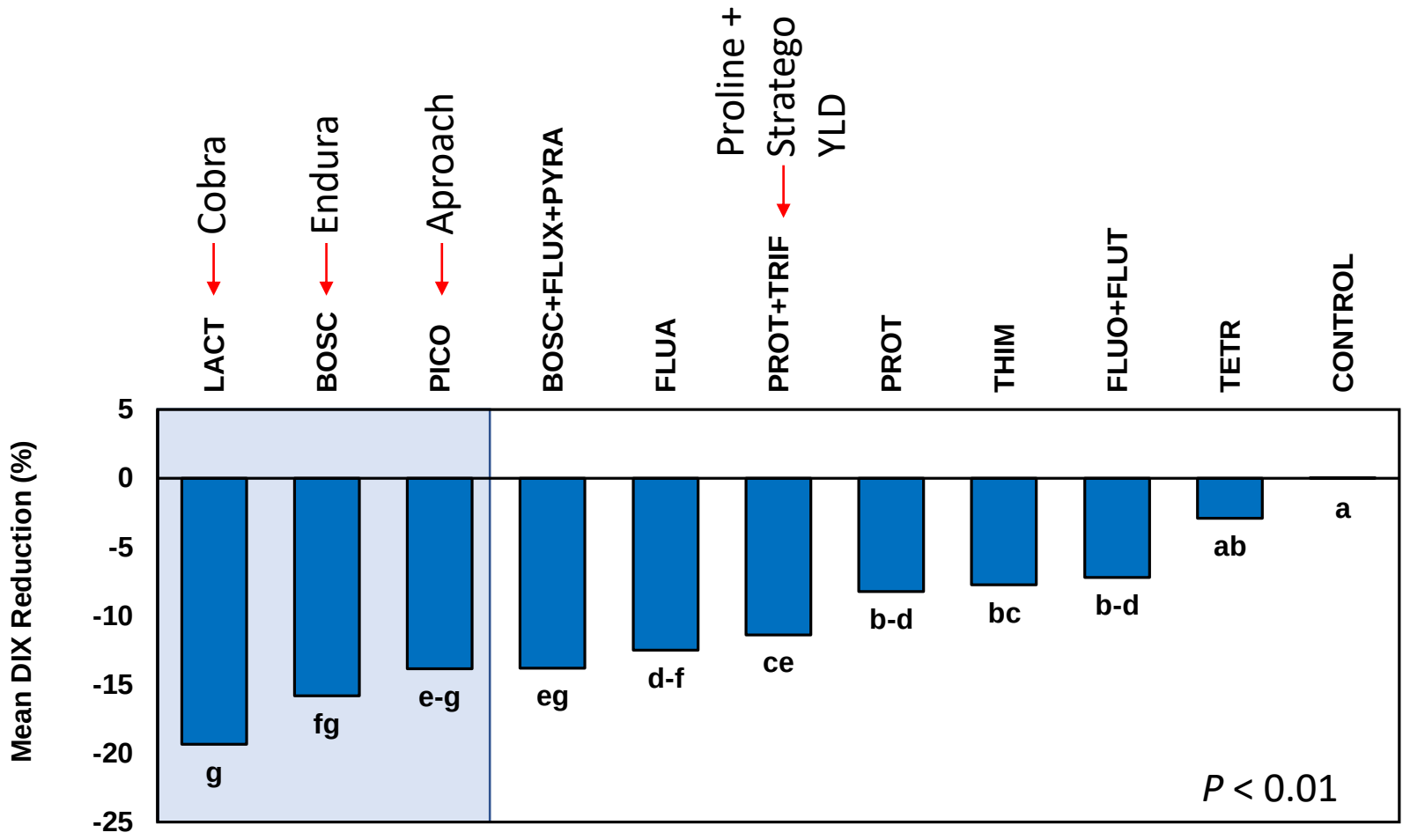
2009-16 North Central White Mold Trials

- Fungicide trials were conducted in Illinois, Iowa, Michigan, New Jersey, Minnesota, and Wisconsin from 2009 to 2016
  - **A total of 25 site years (n = 2057)**

- Different products, rates, and timings were evaluated using disease and yield
  - **Focused on 10 common active ingredients and 7 common timings**

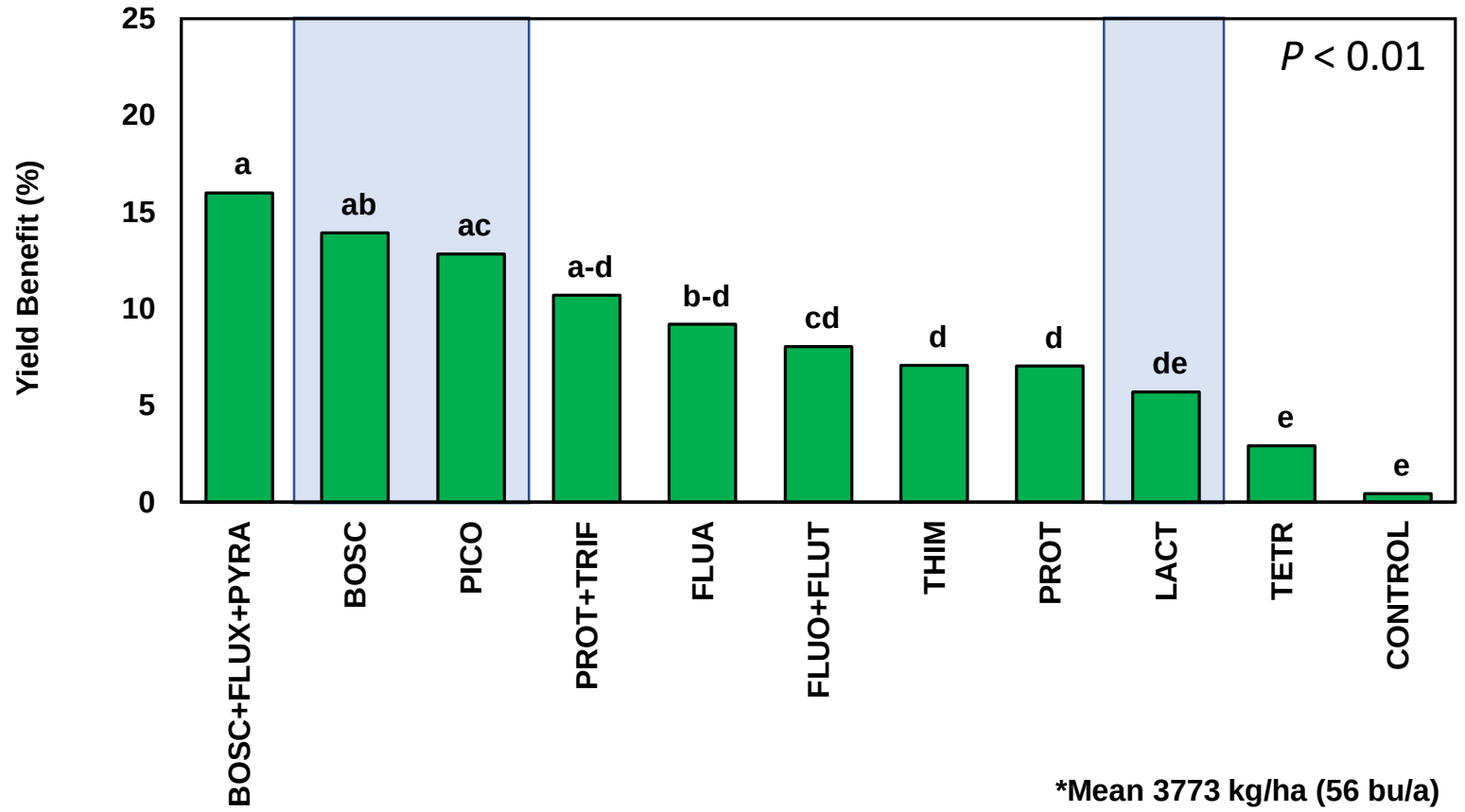
- Also, used this data to evaluate the effects of disease severity index (DIX) on soybean yield (Discussed this earlier)
  - **DIX (%) = Disease incidence (%) x Disease severity of symptomatic plants (0-3) / 3**
  - 0 = no disease; 1 = disease on lateral branches; 2 = disease on the main stem; 3 = disease on the main stem resulting in plant death (Grau et al. 1982)

Common Active Ingredients Provide a Reduction in Disease Severity Index



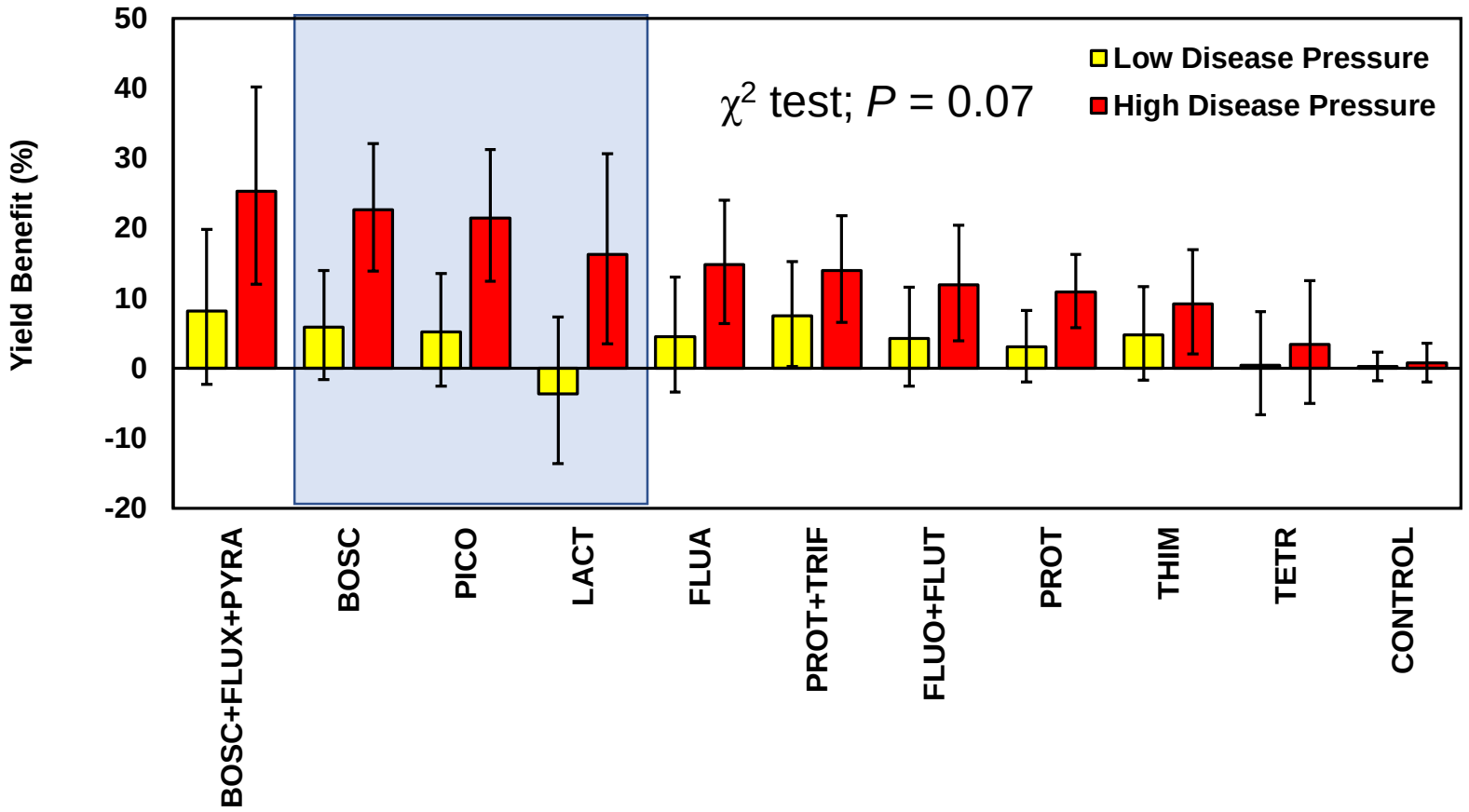
*Mean Severity Index = 40% (as high as 90%)

Most Active Ingredients Resulted in a Positive Yield Benefit



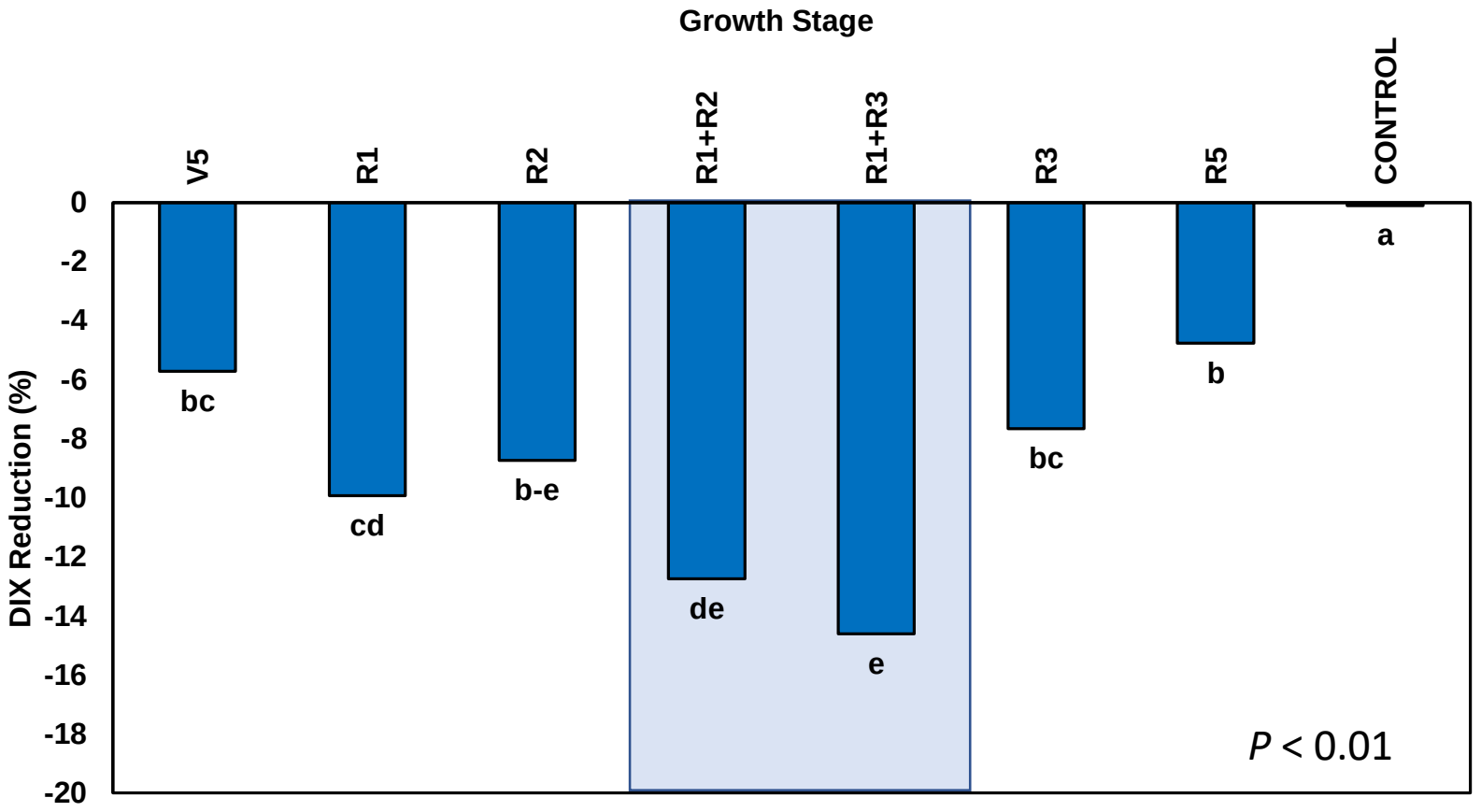
*Mean 3773 kg/ha (56 bu/a)

Evidence Suggests That Disease Pressure May Have a Marginal Influence on the Active Ingredient Effect of Yield Benefit

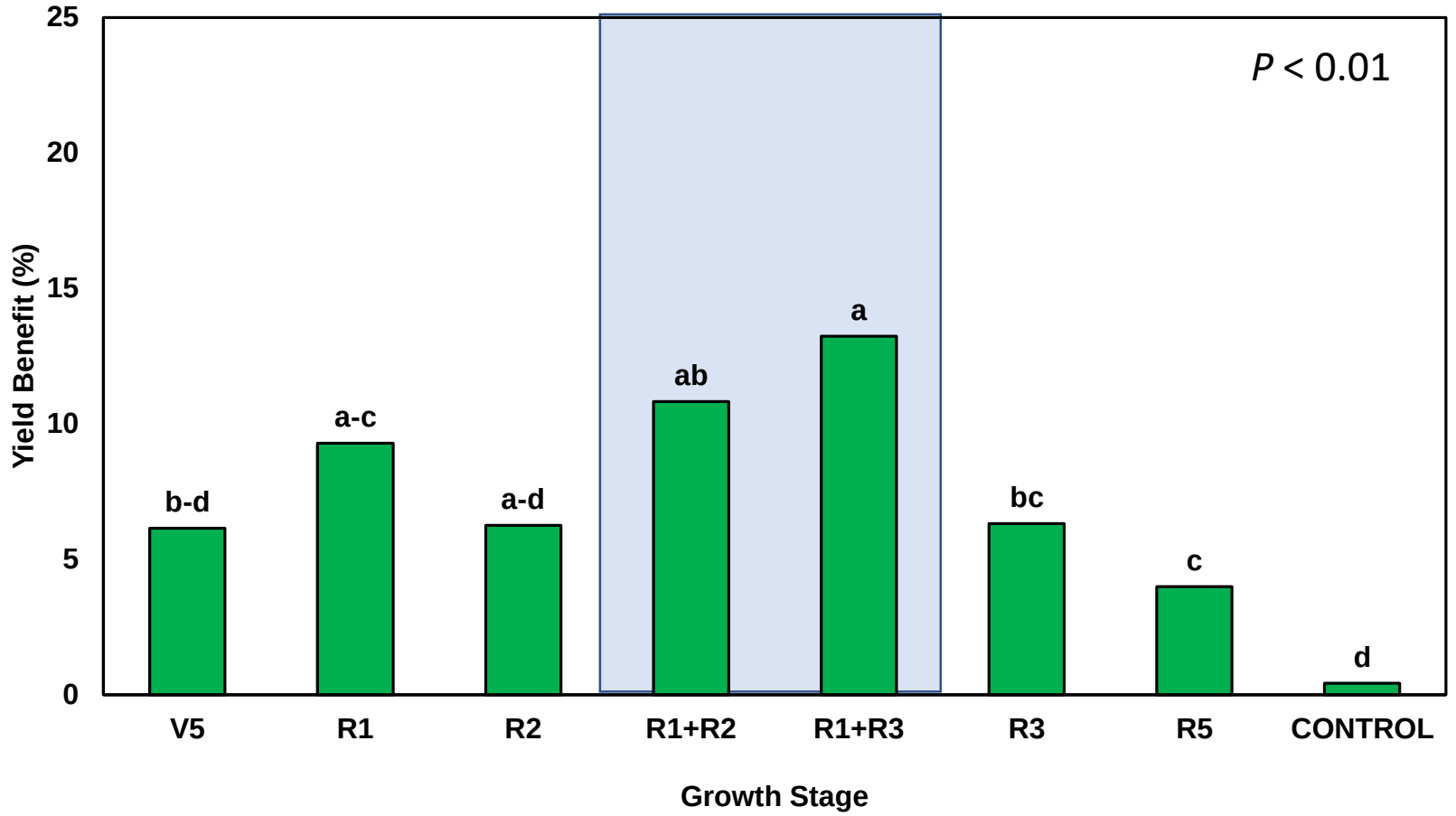


*Non-treated disease severity index <40% considered low pressure. DIXnt ≥ 40% considered high pressure.

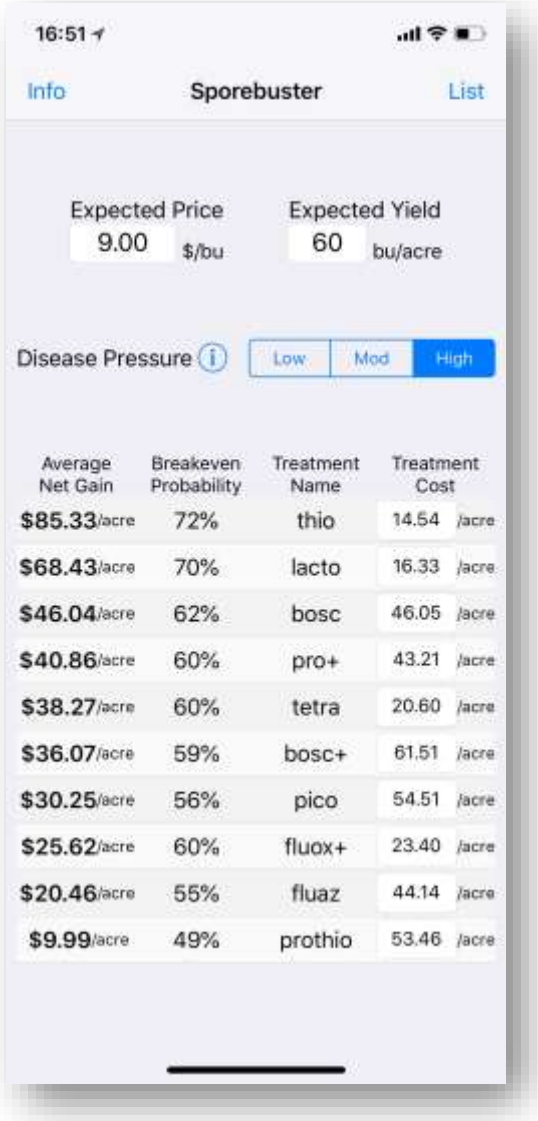
Timing of Fungicide Application Plays a Significant Role in Maximizing Disease Reduction



Fungicide Applications During the Major Flowering Period Result in the Best Yield Benefits



Sporebuster: Fungicide Calculator App



- Now that you know when to spray, how do you know what to spray?
- Sporebuster: fungicide return-on-investment app
- Use economic models generated by Dr. Paul Mitchell to determine breakeven probability, and average net gain when using 10 common fungicide programs
- Data that drives the models was generated by scientists in the upper Midwest

  Willbur, J.F., Mitchell, P.D., Fall, M.L., Byrne, A.M., Chapman, S.A., Floyd, C.M., Bradley, C.A., Ames, K.A., Chilvers, M.I., Kleczewski, N.M., Malvick, D.K., Mueller, B.D., Mueller, D.S., Kabbage, M., Conley, S.P., and Smith, D.L. (2018) Meta-analytic and economic approaches for evaluation of pesticide impact on Sclerotinia stem rot control and soybean yield in the North Central U.S. Phytopathology. *In-review*.

Efforts to Improve White Mold Prediction

Apothecial Modeling

Willbur, J.F., Fall, M.L., Bloomingdale, C., Byrne, A.M., Chapman, S.A., Isard, S.A., Magarey, R.D., McCaghey, M., Mueller, B.D., Russo, J.M., Schlegel, J., Chilvers, M.I., Mueller, D.S., Kabbage, M., and Smith, D.L. 2018. Plant Disease. doi.org/10.1094/PDIS-04-17-0504-RE.

How Important Are Apothecia?

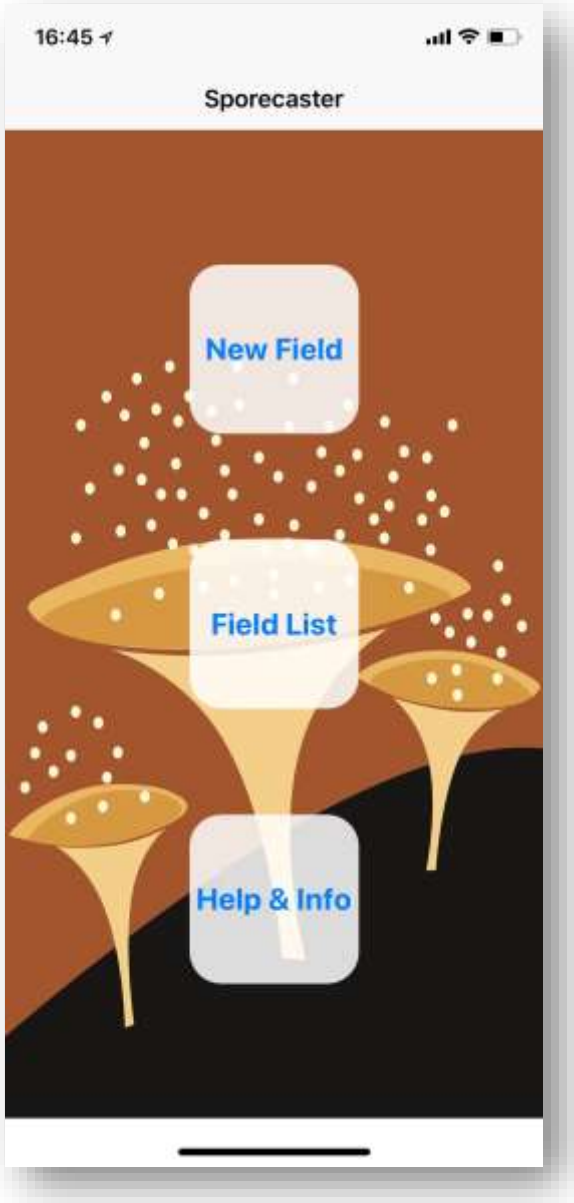
- Formation of apothecia critical for white mold in soybean

- Majority of infections in soybean occur due to ascospore release from apothecia within the field

Boland and Hall, 1988, Plant Pathology , 37:329-336
Wegulo, Sun, Martinson, and Yang, Can. J. Plant Sci., 80:389-402

iPhone and Android App - Sporecaster

- Uses same models as the iPiPE-tested version
- Available for the U.S. and Canada
- Can be run in the field or at the desk
- Uses a combination of user inputs and GPS-referenced weather information (DarkSky API) to provide a risk of white mold so you can make a spray decision
- As of November, 2018
  - -Downloaded over 1,600 times
  - -Averages 250 active users during the peak season (July and August)
- Awarded the 2018 American Society of Agronomy (ASA) Extension Education Community Educational Award in the category of digital decision aids (software, web-based, smartphone and tablet apps)

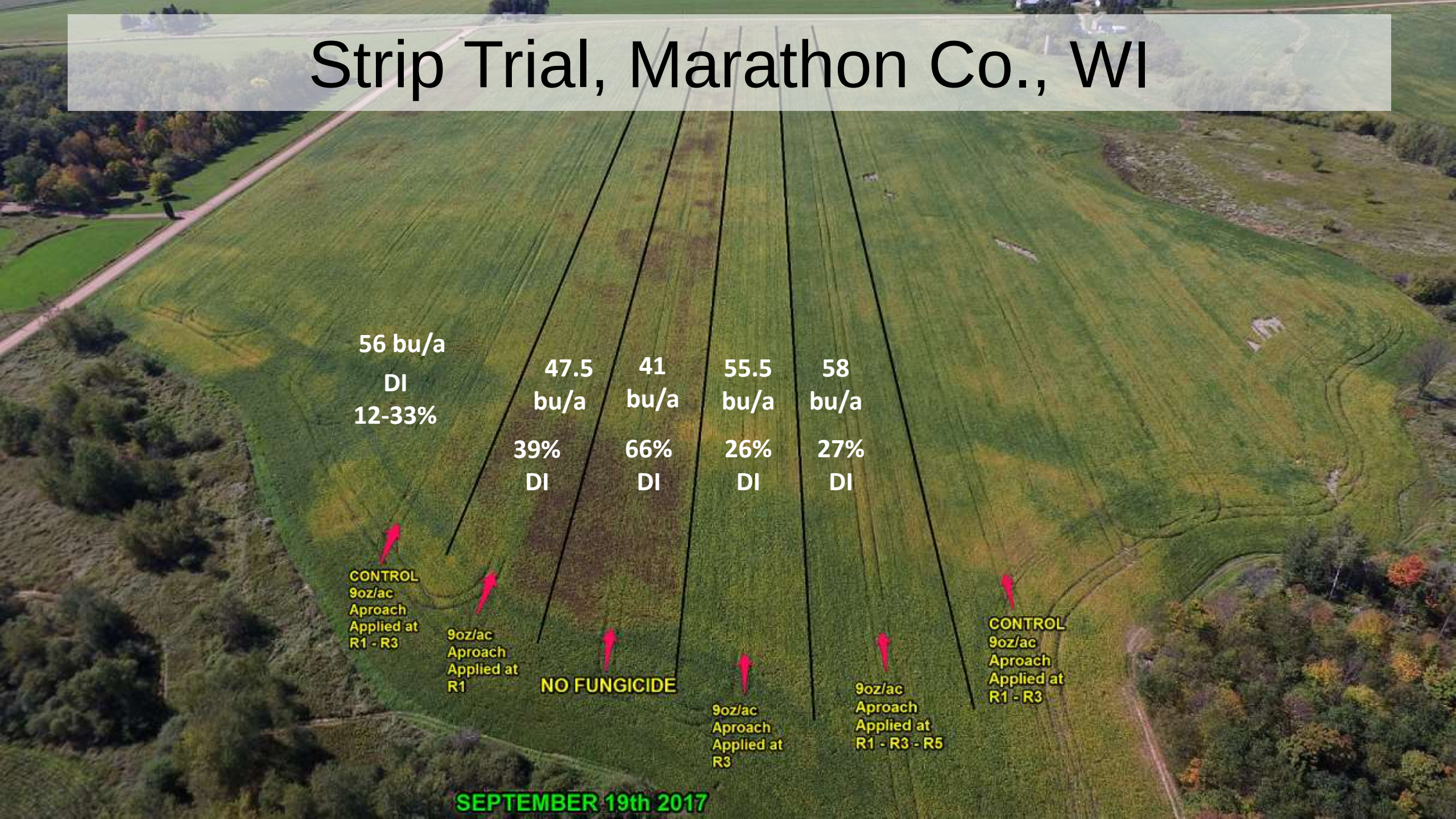


Model Validation Results (60 Farmer Fields – Multiple States)

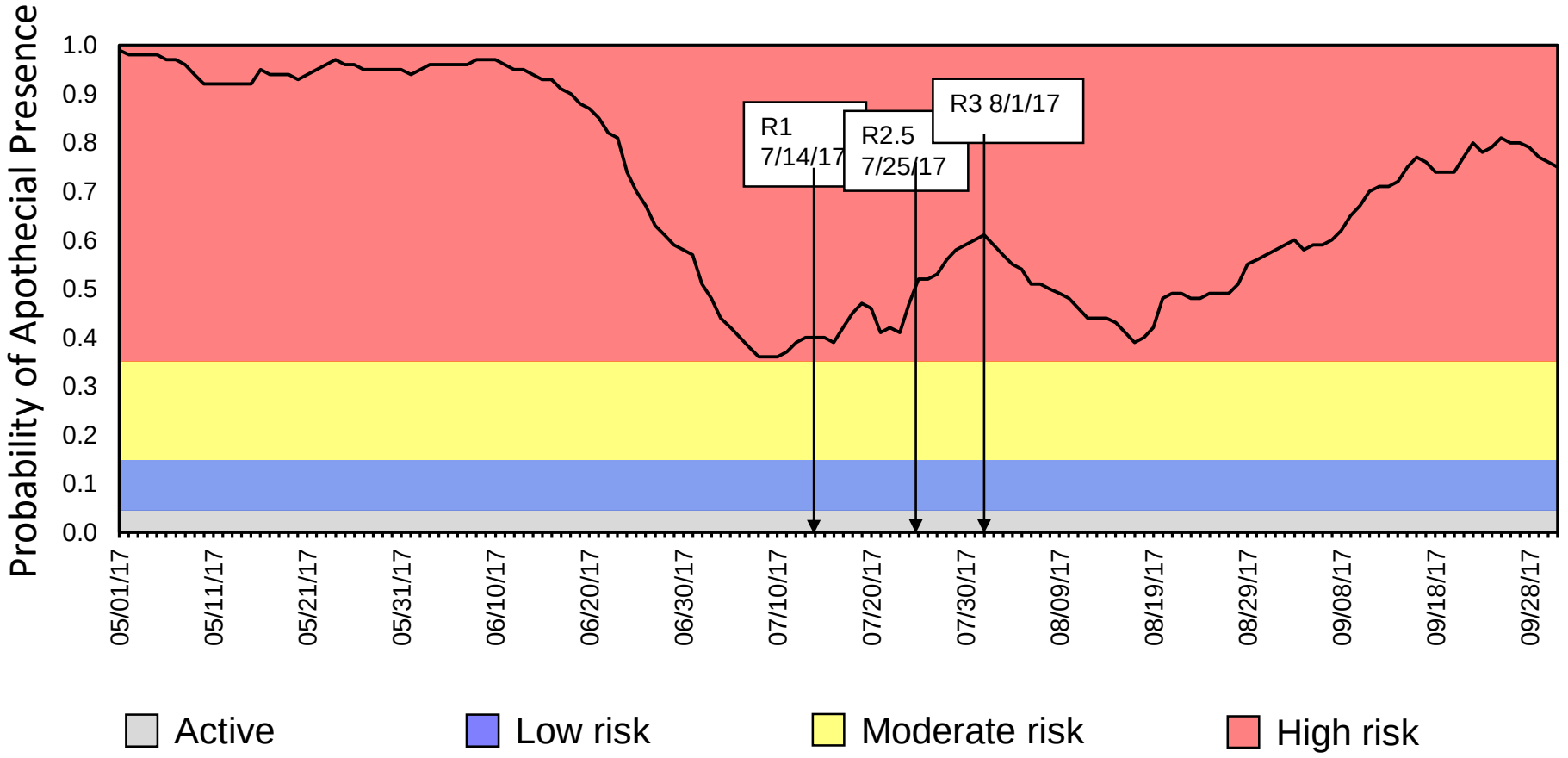
Accuracy (%)[a]	Success (1) or Failure (0) @ DI 5%				Success (1) or Failure (0) @ DI 10%		
Action Threshold	30	35	40		30	35	40
Research trials, 2017 (n=6)	83.3	83.3	83.3		83.3	83.3	83.3
Commercial fields, 2016-17 (n=60)	63.3	76.7	73.3		68.3	81.7	78.3
Total	65.2	77.3	74.2		69.7	81.8	78.8

[a]Binary model successes (1) or failures (0), for each model action threshold (30, 35, or 40%) using disease incidence thresholds of 5 or 10% (Tables 5.9 and 5.10), were used to determine model accuracy across all locations and years. The number of successes were divided by the total number of field validations and multiplied by 100.

Strip Trial, Marathon Co., WI



2017 Risk Probabilities Based on the Model, Marathon Co. Strip Trial

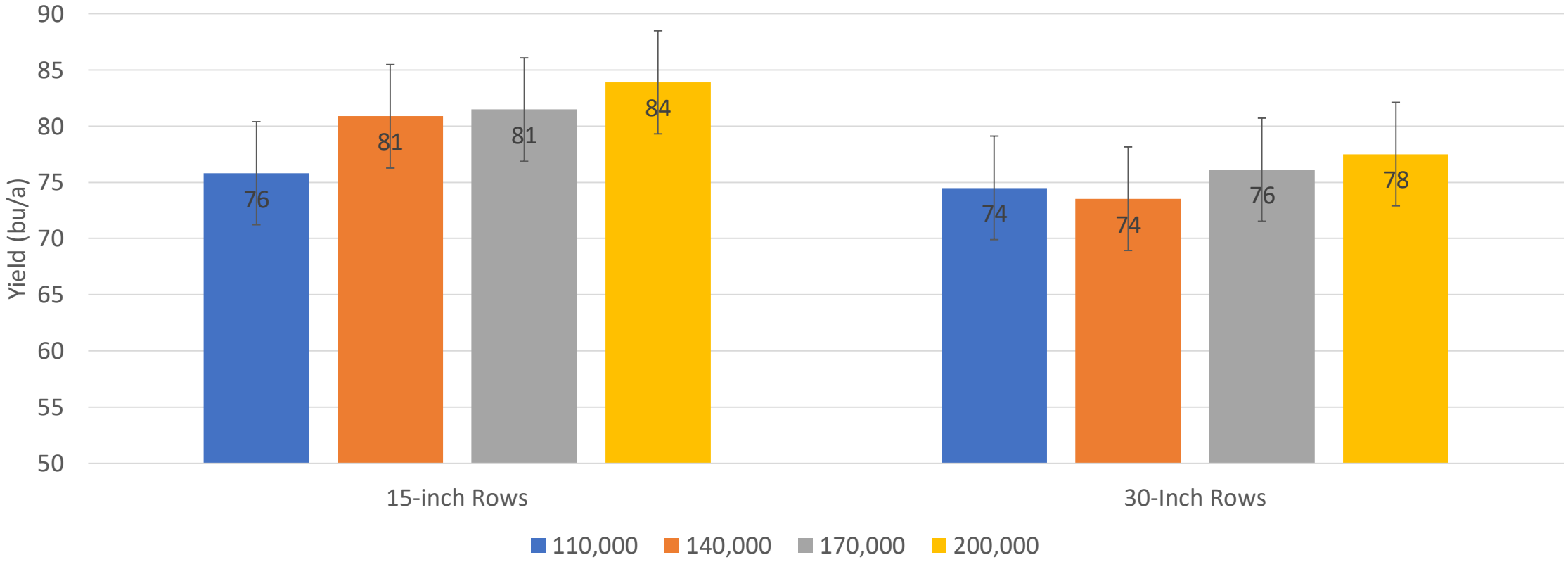


The Next Steps: Revisiting Integrated Management

Integrated Management Trials

- Multiple states (WI, IL, MN, IA, MI) and Years (2017 and 2018)
- Susceptible commercial cultivar
- Row Spacing (15" vs. 30")
- Planting Population (110,000 seeds to 200,000 seeds/a)
- Applying fungicide based on the prediction model (vs. non-treated or growth-stage applications)

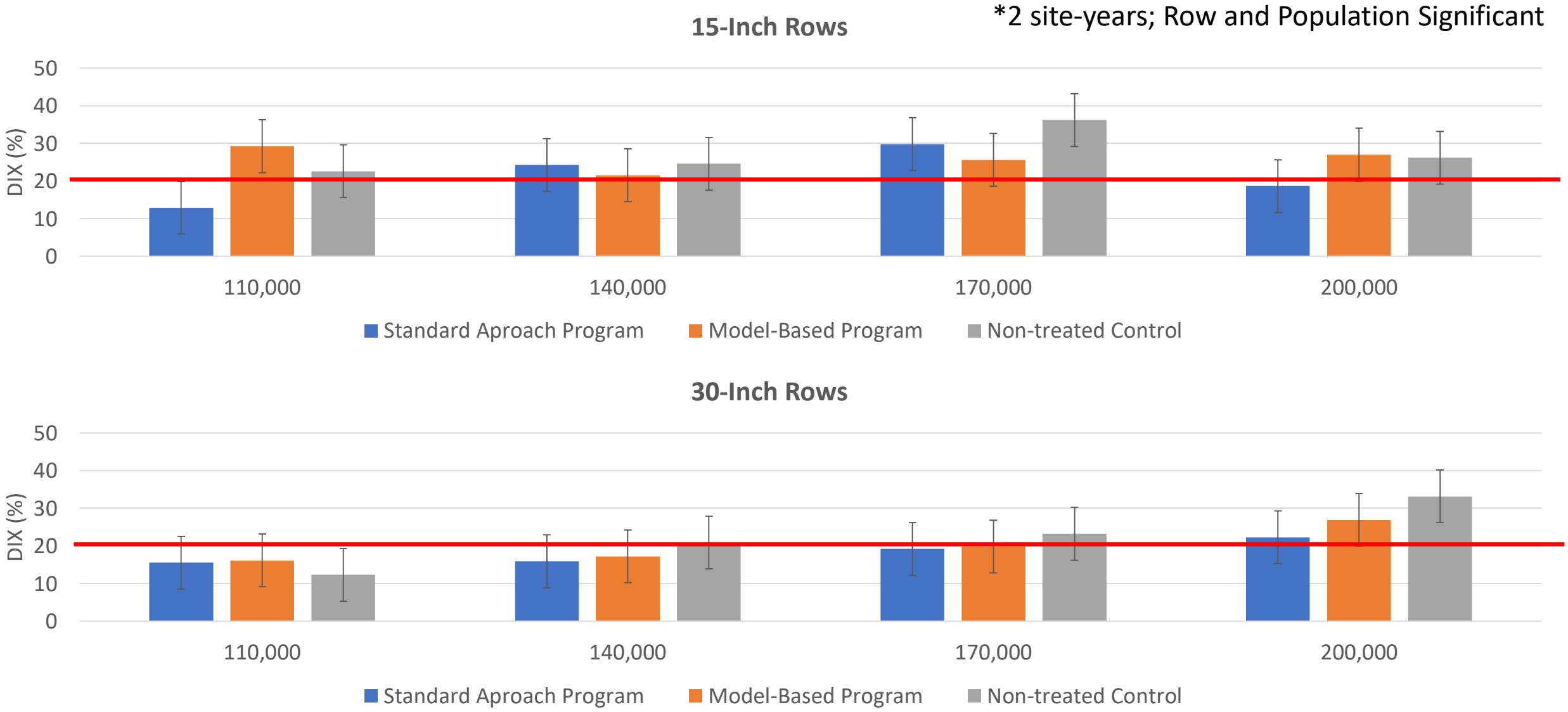
Yield in Low Disease Environments (DIX<2.5)



*5 site-years; Row and Population Significant

DIX in High Disease Environments

*2 site-years; Row and Population Significant



Yield in High Disease Environments

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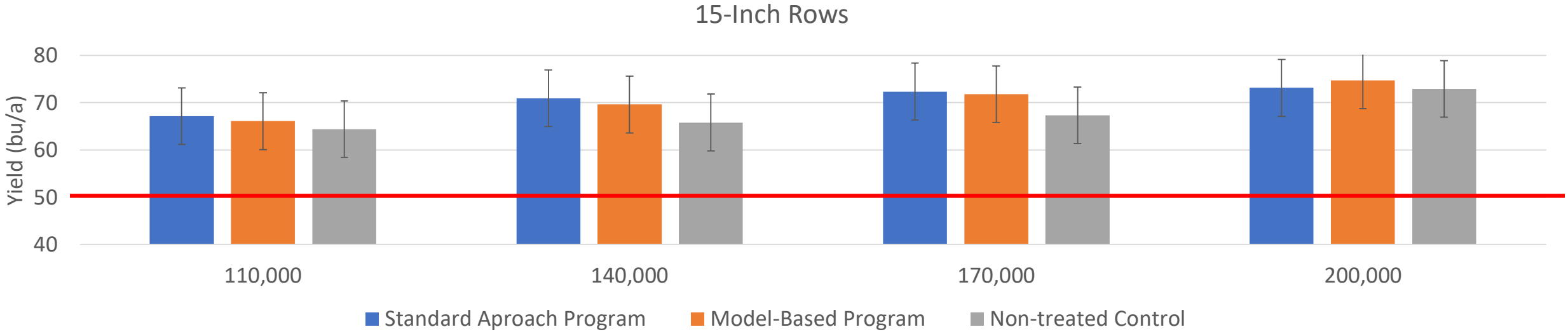

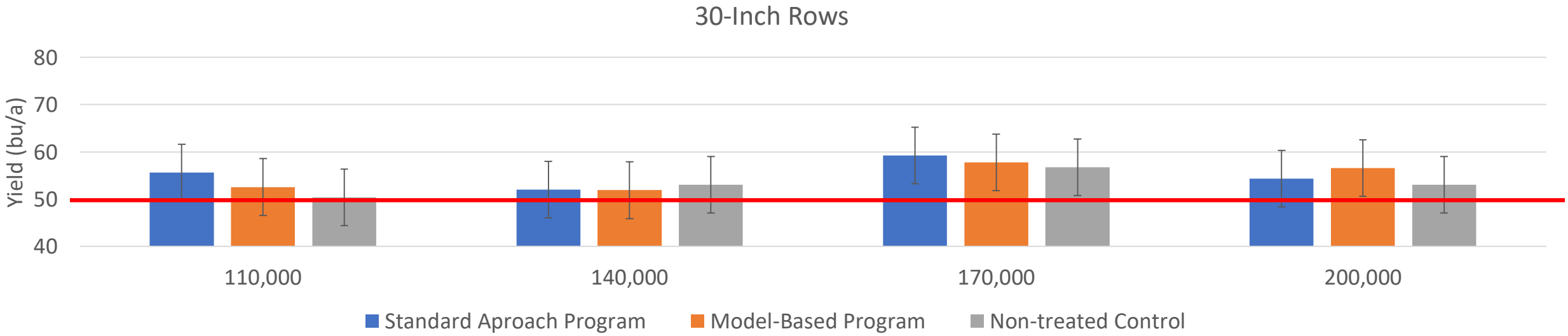

The "Take-Home"- Integrated Management is Key to Success

1. Must have better resistance in commercial varieties – Use the most resistant variety you can
    I. Look at multiple variety trials to find best (most consistent) varieties
    II. Breeding efforts must focus on stable physiological resistance
2. A few fungicides offer some control; choose the right one and resist the "silver bullet" temptation
    I. Reduce the expectation (over-reliance) of fungicide performance
    II. "Fungicide only makes a bad situation, less bad"
    III. Applications should be focused between R1 and R3 growth stages
    IV. <u>Don't Forget Resistant Varieties!!</u>
3. Use predictions models to improve the use and efficiency of fungicide products
    I. Fungicide application timing is critical!
    II. Epidemic initiation and duration isn't the same each season!
    III. <u>White mold Apps.- Download Sporecaster and Sporebuster!</u>
4. Must adjust cultural practices to manage white mold
    I. Wider row spacing ? (more work needed)
    II. Lower planting populations ? (more work needed)
    III. <u>Don't Forget Resistant Varieties!!</u>

Acknowledgements

Lab Personnel
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- Joe Russo
- Jay Schlegel

Wisconsin Soybean Marketing Board

USB United Soybean Board

Iowa Soybean Association

NCSRP North Central Soybean Research Program

Michigan Soybean Promotion Committee
The Soybean Checkoff

NJSB New Jersey Soybean Board
Progress Powered by U.S. Farmers

USDA
United States Department of Agriculture
National Institute of Food and Agriculture

ipmPIPE Pest Information Platform for Extension & Education

USPEST.ORG

Illinois Soybean Association
Checkoff & Membership Programs

SciMed Graduate Research Scholars

College of Agricultural & Life Sciences
University of Wisconsin - Madison

Questions?

Damon Smith, Ph.D.
Associate Professor and Extension Specialist
Field Crops Pathology

University of Wisconsin-Madison
Department of Plant Pathology
1630 Linden Drive
Madison, WI 53706-1598

Phone: 608-286-9706
Twitter: @badgercropdoc
e-mail: damon.smith@wisc.edu
Website: http://badgercropdoc.com