Soybean Sudden Death Syndrome: Plant Infection and Management

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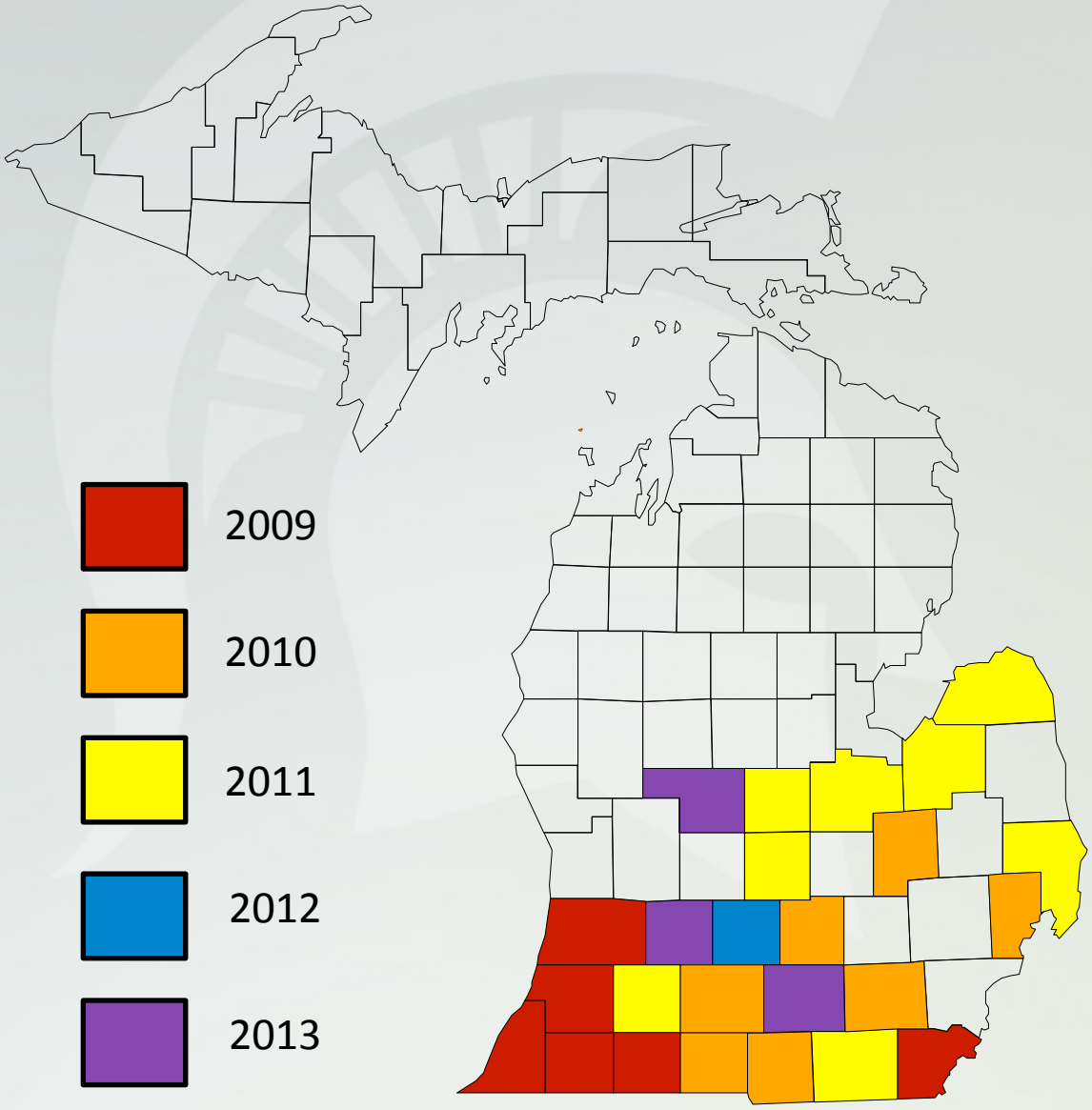
Sudden Death Syndrome (SDS)

SDS has become a significant concern across the Midwest

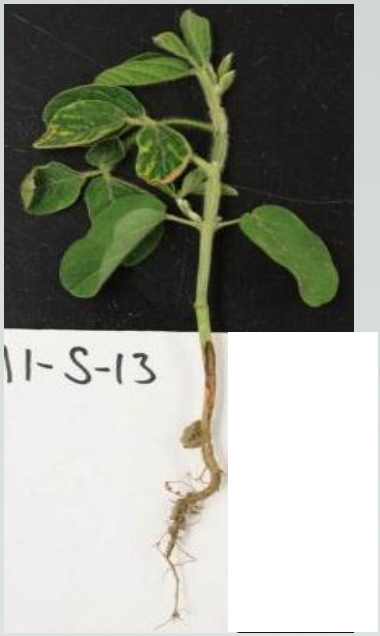
Complex Disease:

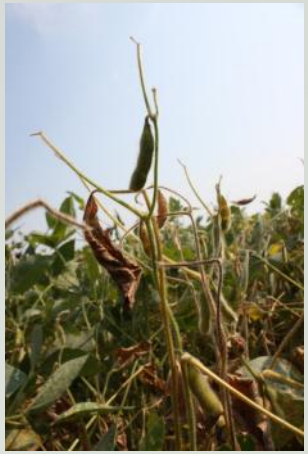
- **Root rot**
- **Foliar symptoms**

Soybean SDS – Michigan



Fusarium virguliforme life cycle





First found Arkansas in 1970

SDS root rot symptoms

Decatur, MI - field trial and screening nursery

Commercial cultivars – differ in resistance

Which is which??

BSR

Dean Malvick, University of M

SDS

BSR: Brown stem rot

Temporal dynamics of *F. virguliforme* root colonization

- Is root colonization by *F. virguliforme* associated with SDS foliar symptoms?
- How do commercial soybean cultivars with varied SDS resistance ratings differ in *F. virguliforme* root colonization?

Experimental Design - 2012

- **2 field experiments**
  - Decatur: **naturally** infested
  - Agronomy Farm: **artificially** inoculated
- **4 soybean cultivars**
  - Two susceptible (S)
  - Two moderate resistant (MR)
  - 5 replicates
- **9 sampling points**
  - **V3 ~ post harvest**
- **Randomized Complete Block Design**

Pathogen quantification

Dry roots

Grind roots

DNA extraction

qPCR quantification

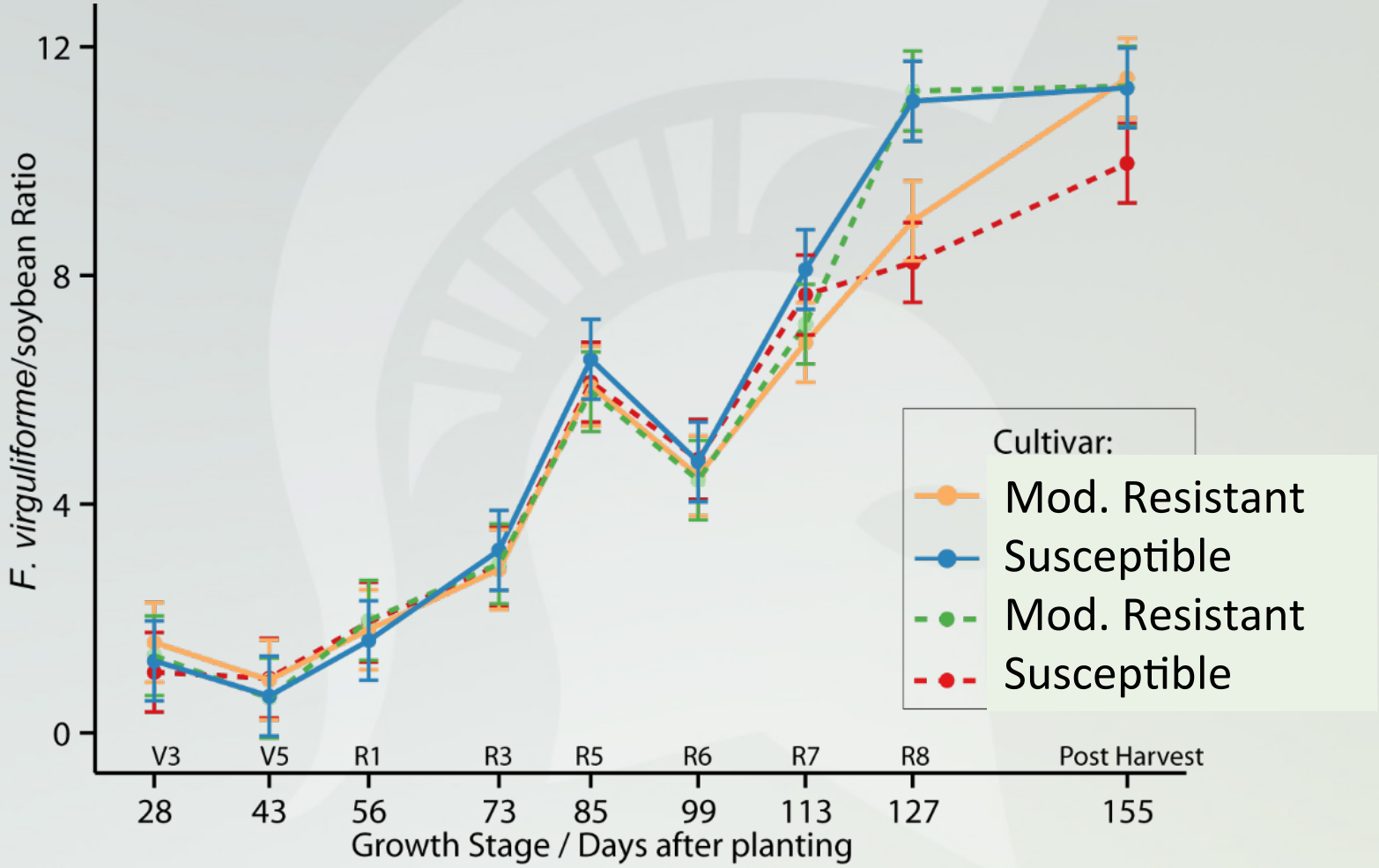
ΔCt method:

$$\Delta Ct = SoyCt - FvCt$$

FvCt: Ct value of qPCR assay quantifies *F. virguliforme* rDNA IGS
SoyCt: Ct value of qPCR assay quantifies soybean beta-tubulin gene

Field Results, 2012

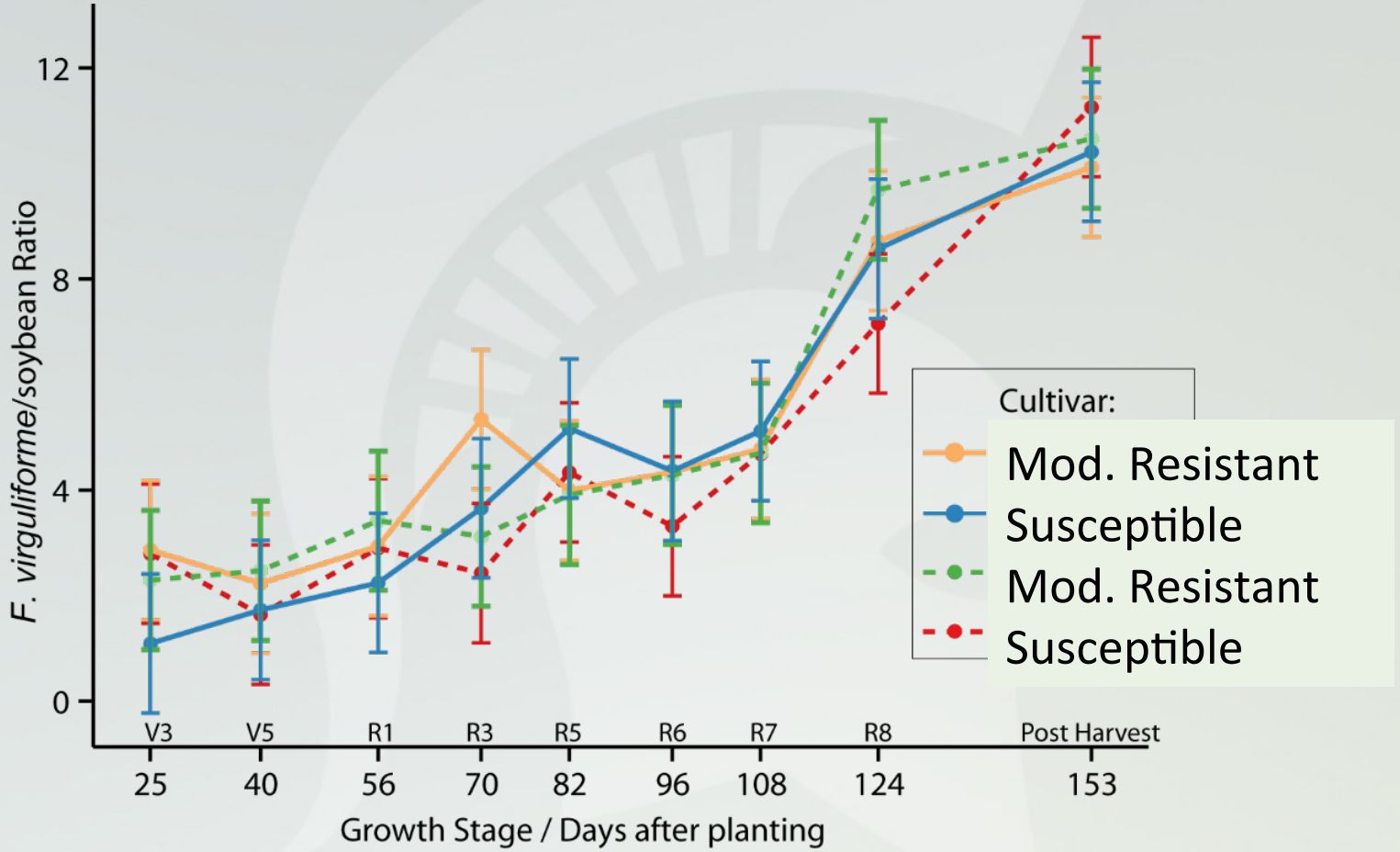
Decatur (Naturally infested)



- Foliar symptoms developed at R1 and peaked at R6
- Most severe SDS foliar symptoms were observed in Susceptible (red line)
- Significant differences were detected at R7 and R8 growth stages

Field Results, 2012

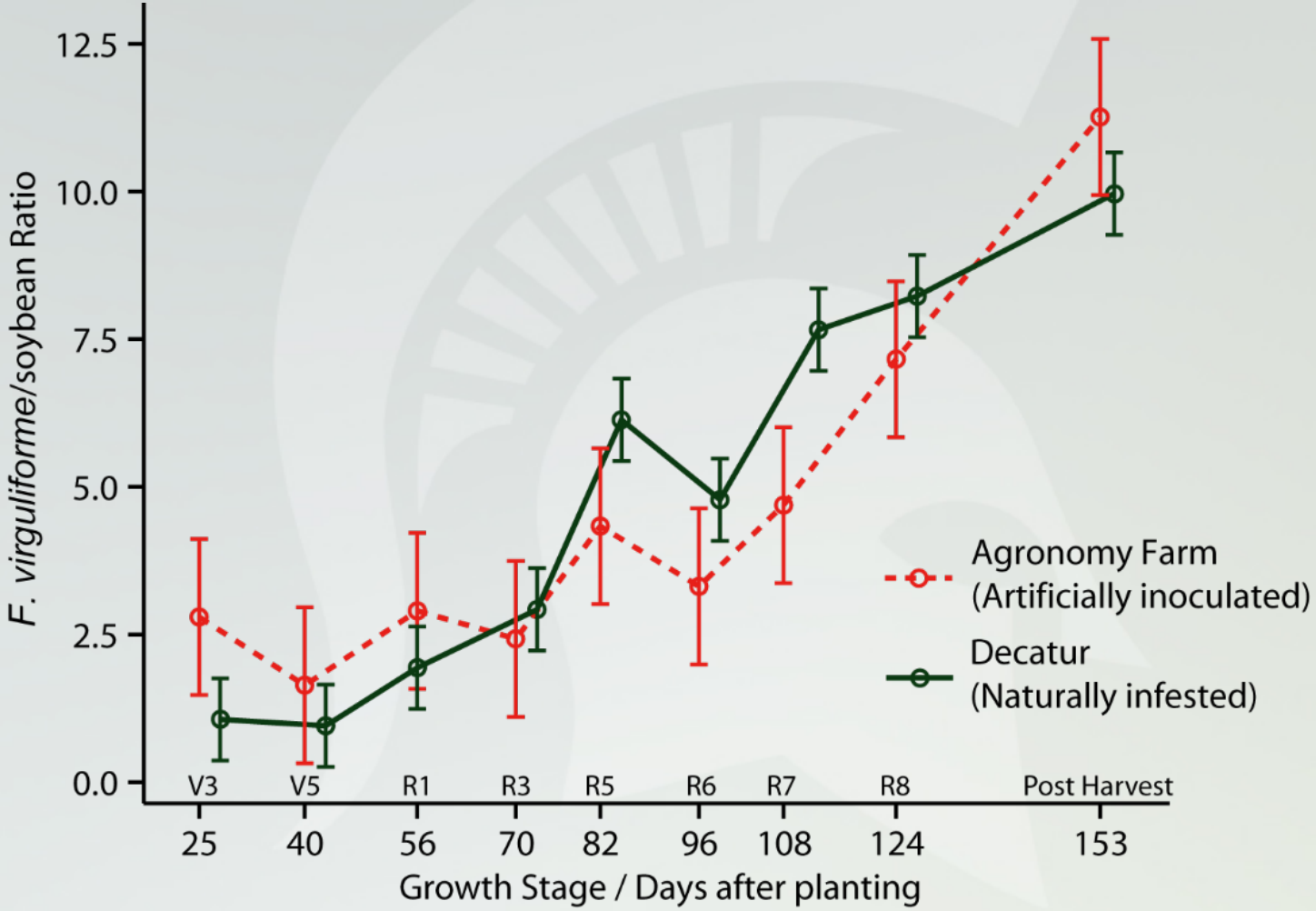
Agronomy Farm (Artificially inoculated)



- No foliar symptoms were observed in this field
- Early time point colonization level was higher than Decatur
- Mid season colonization levels were lower than at Decatur; reached the same level by the end of the season

Comparison between fields, 2012

Susceptible cultivar



- This susceptible soybean variety presented the most severe foliar SDS symptoms
- Colonization was generally higher at Decatur in the middle of the season

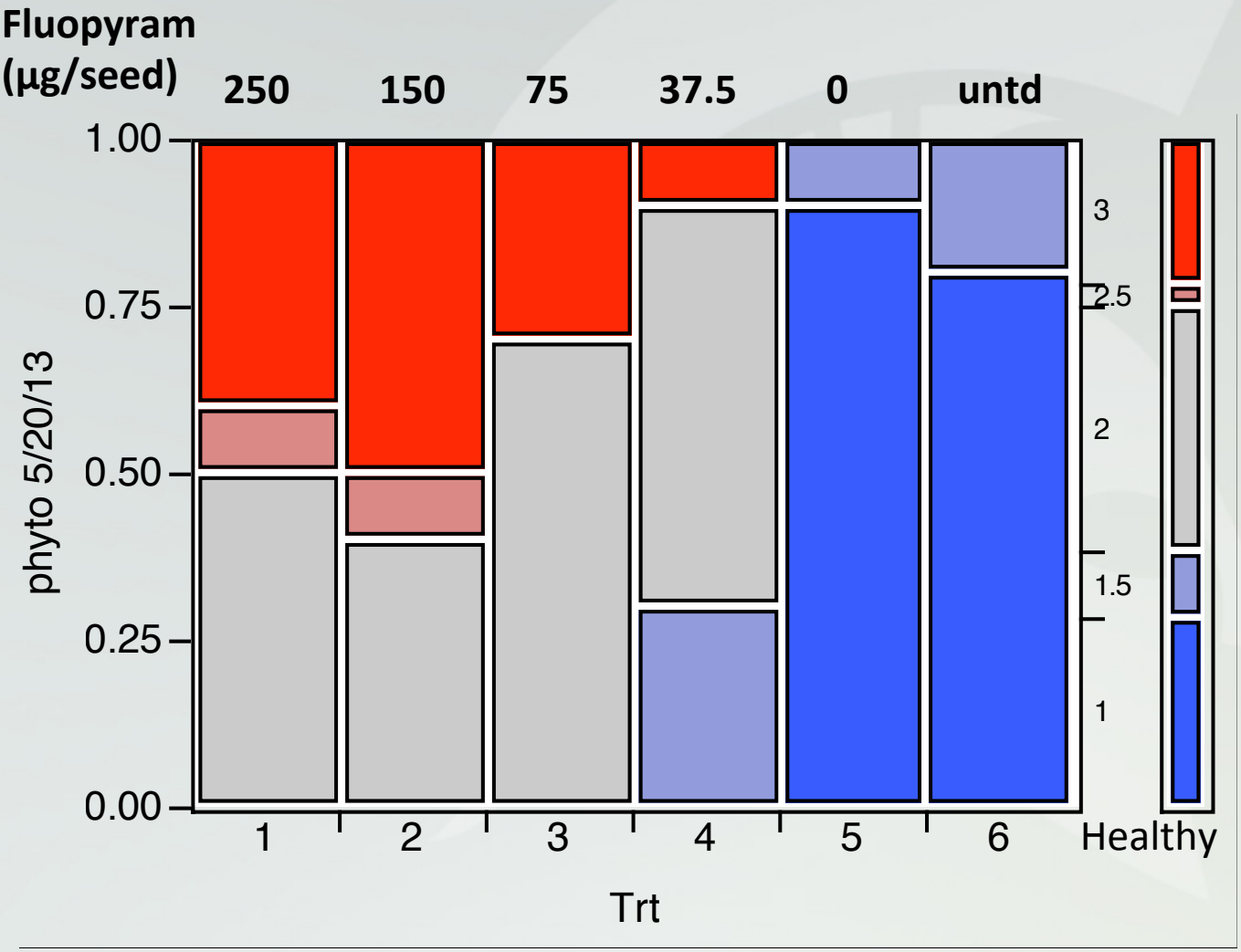
ILeVO (fluopyram) seed treatment rate study

Experimental design - 2013

Treatments:						
Fluopyram (µg/seed)	250	150	75	37.5	0	0
Base seed treatment:	+	+	+	+	+	-

- Design: 6 TRT × 5 REP
- Repeated on cultivars: VarA (susceptible), VarB (mod. resistant)
- Sampling: 5 time points
- Naturally infested field: Decatur, MI

Seedling phytotoxicity scores - 2013

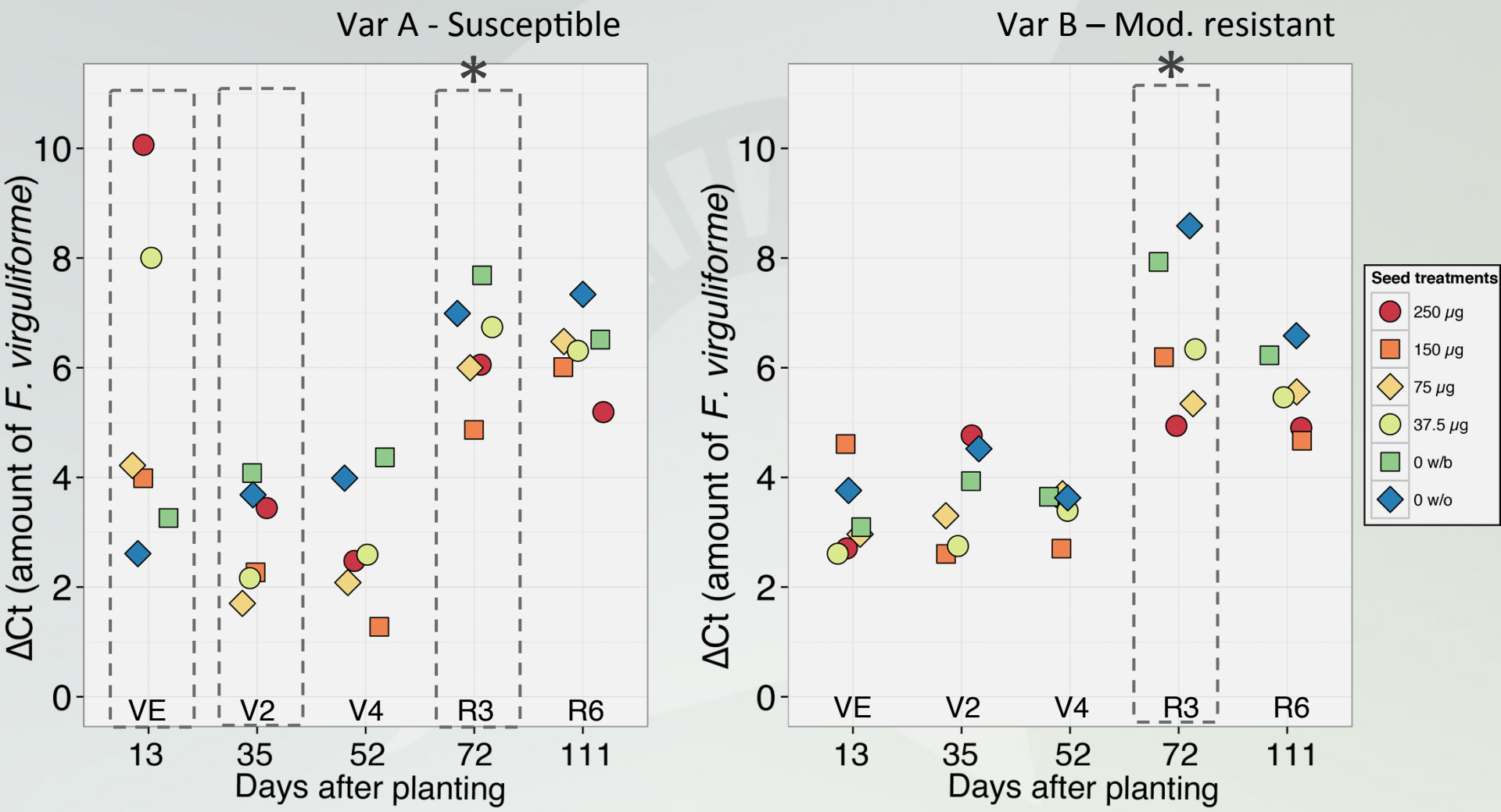


3

2

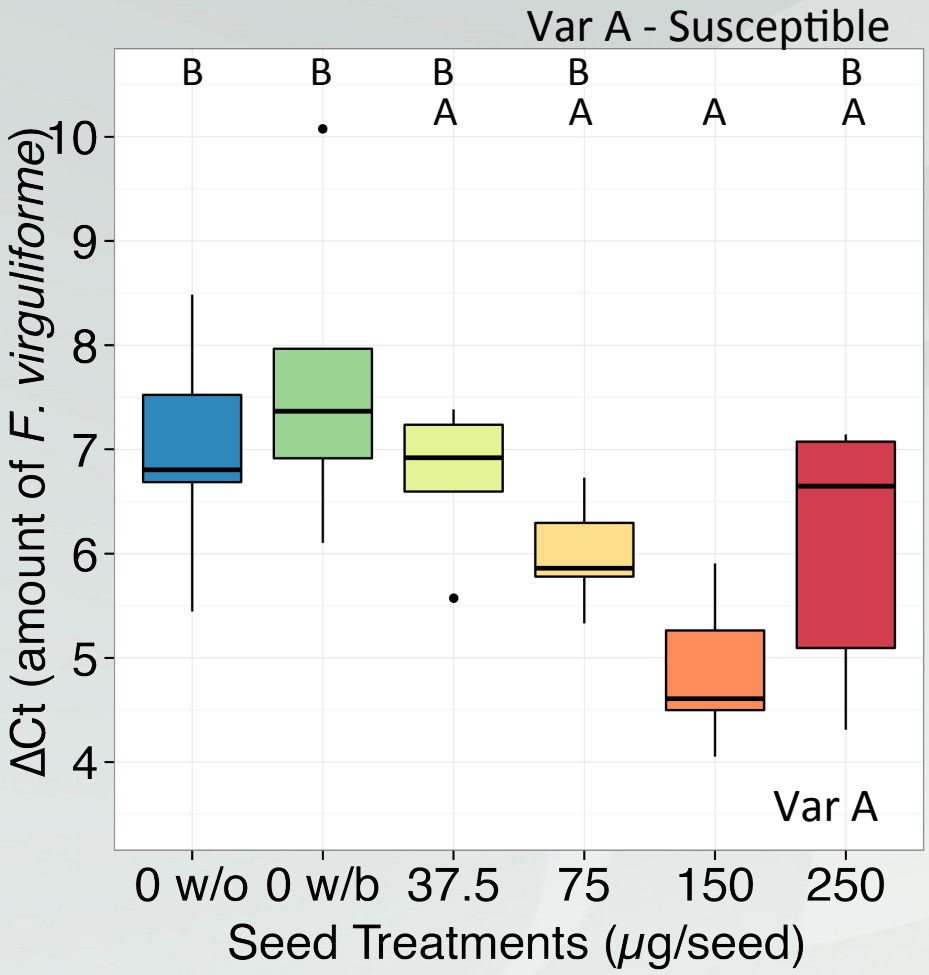
1

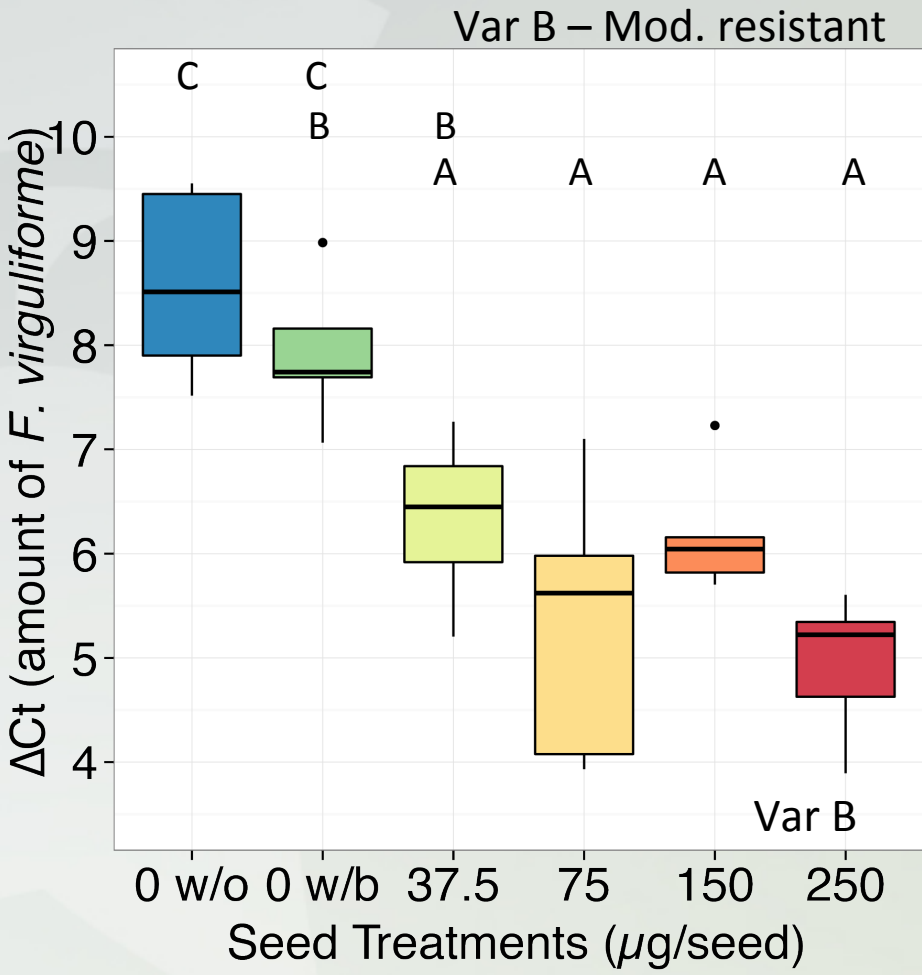
Temporal *F. virguliforme* root colonization - 2013



Sampling point with significant ANOVA results ($p < 0.05$) are highlighted

R3 Growth Stage - 2013

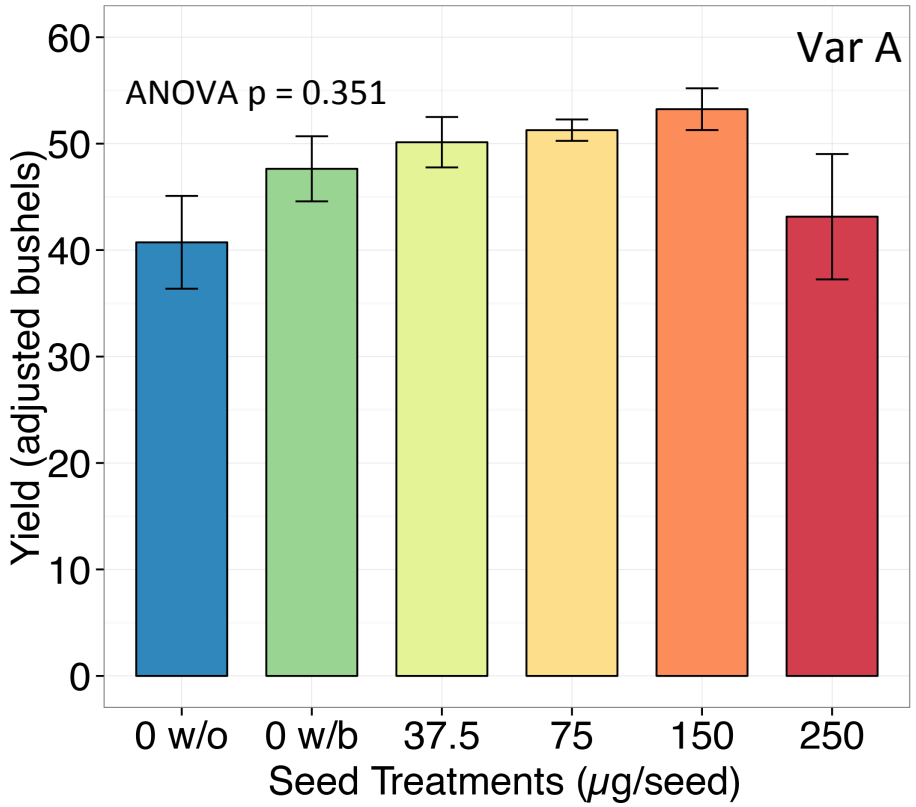


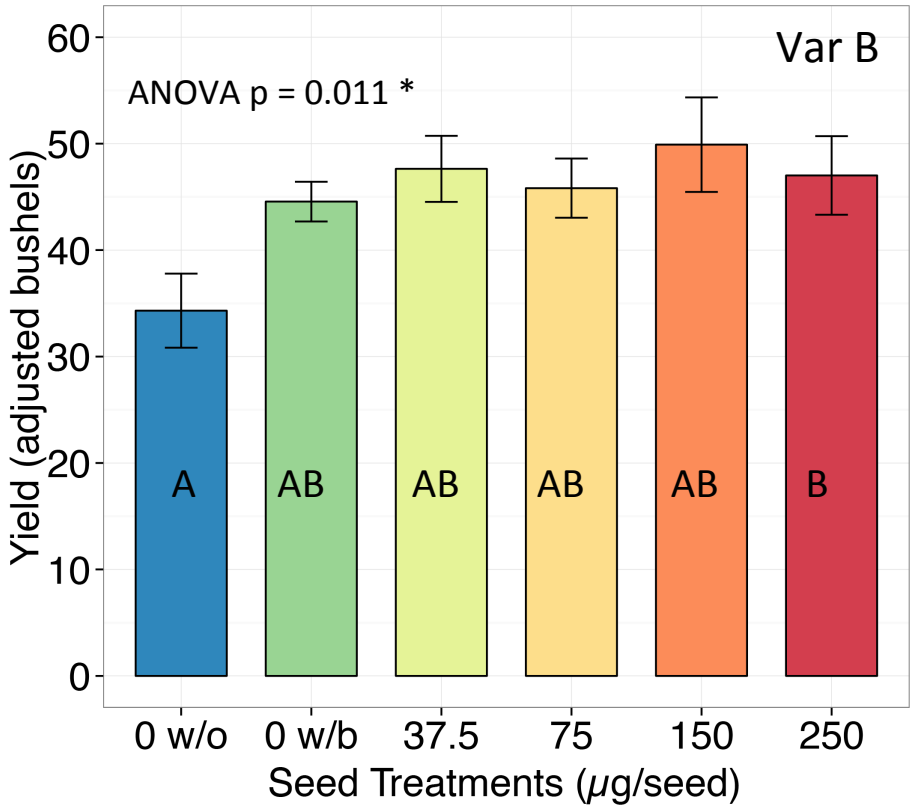


At R3 stage, seed treatment with fluopyram showed significant reduction of *F. virguliforme* root colonization

Tukey HSD Mean separation significant level α = 0.05

Yield responses to seed treatments - 2013





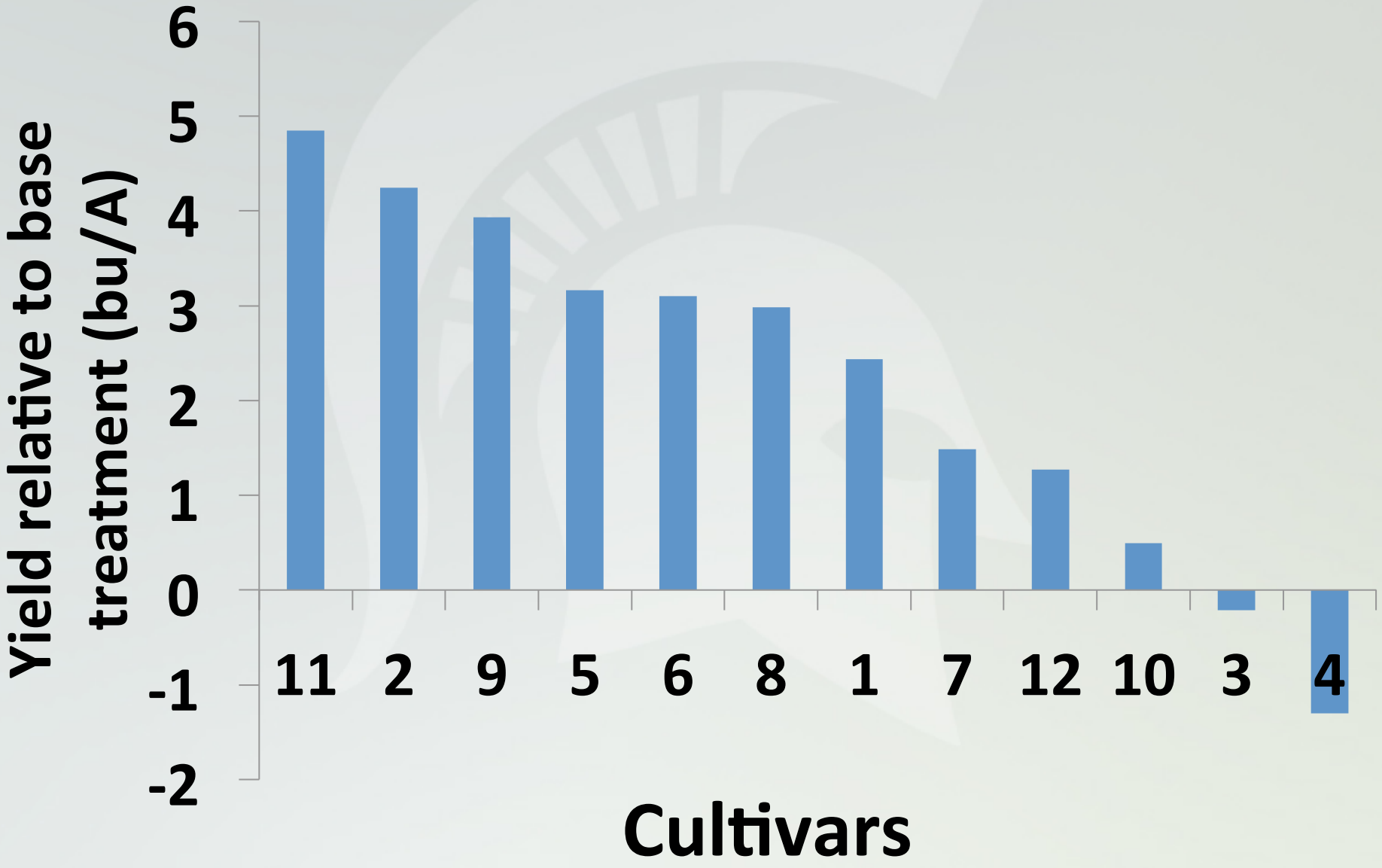
Var A - Susceptible

Var B – Mod. resistant

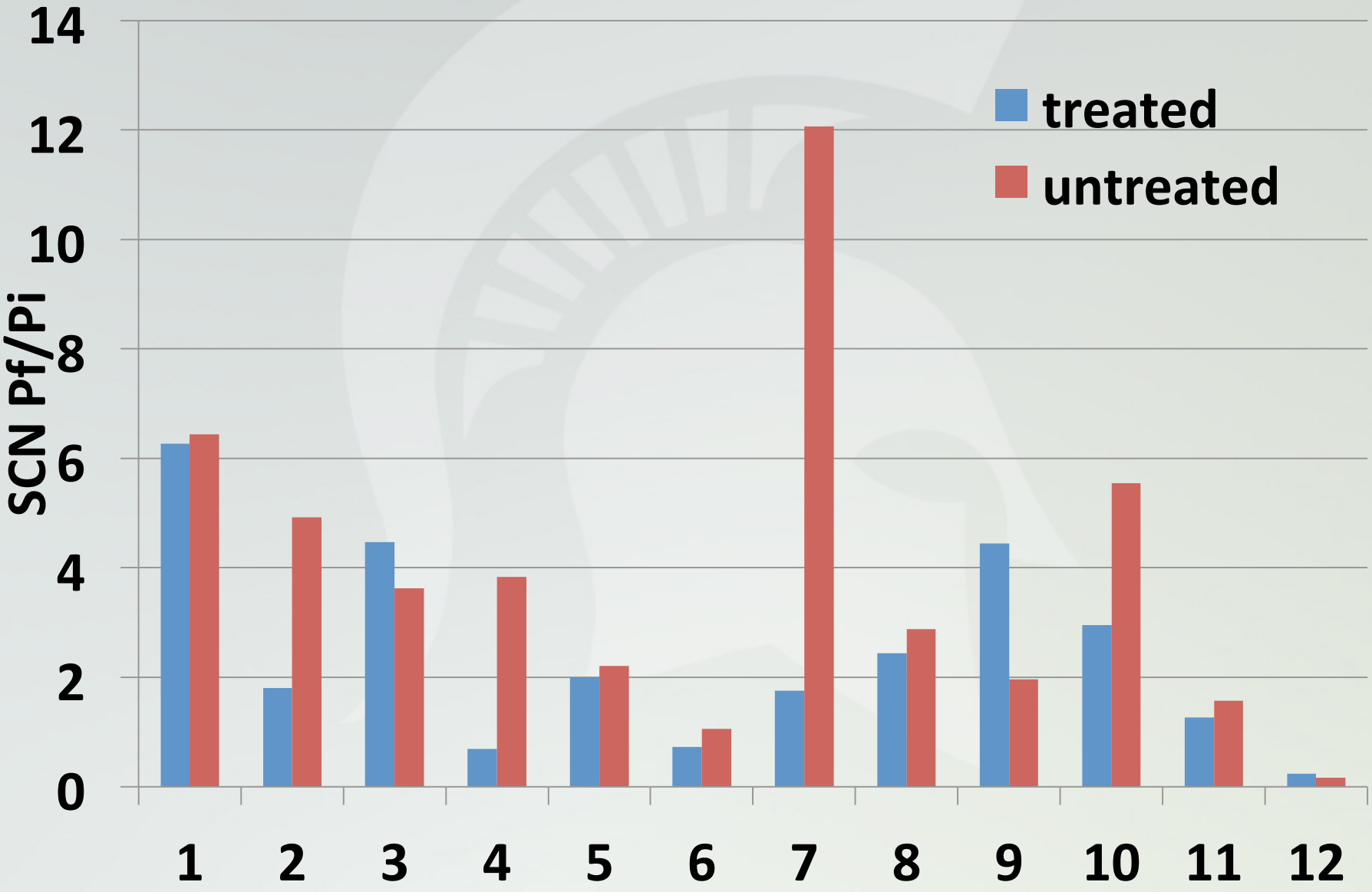
Soybean yield was favored by seed treatment, but it was not significant between fluopyram treatments.

Tukey HSD Mean separation significant level α = 0.05

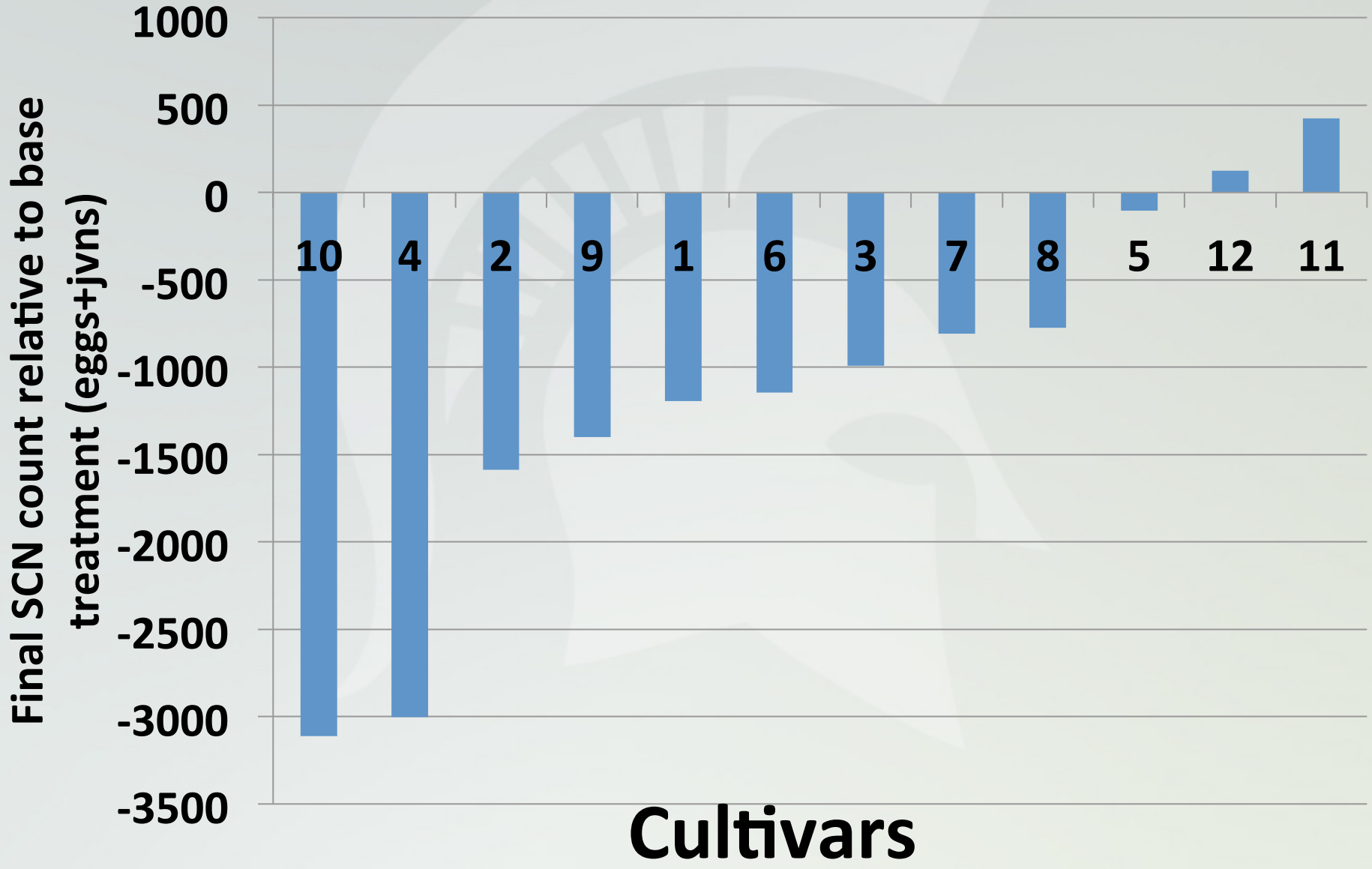
2014, Yield ILeVO vs. base treatment



2014, SCN reproduction ratio (Pf/Pi)

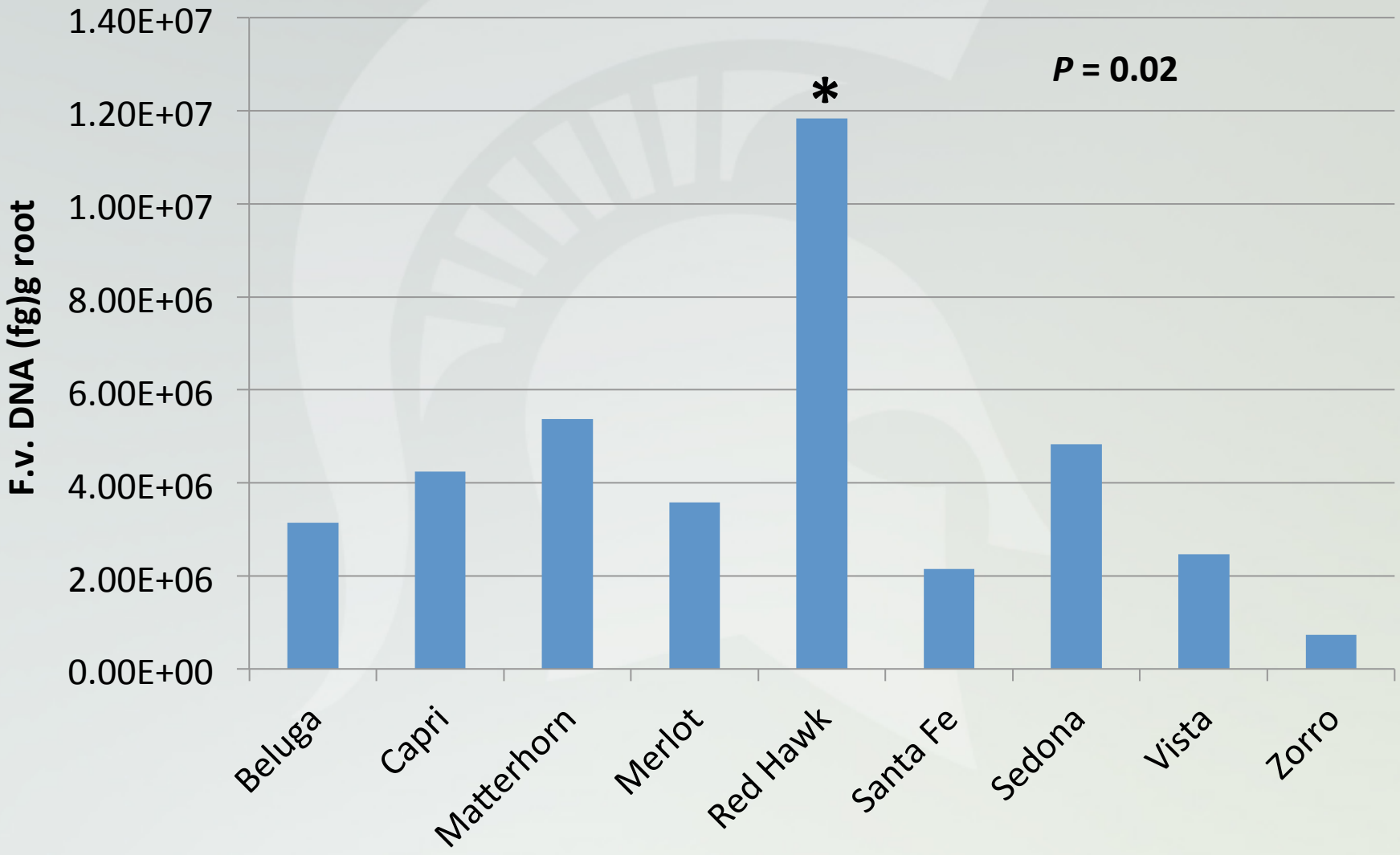


2014, Final SCN ILeVO vs. base treatment



Dry beans – *F. virguliforme*?

F. virguliforme and dry beans



F.v. and root lesion nematodes on dry beans

Effects of crop rotation on SDS

Data from Iowa State

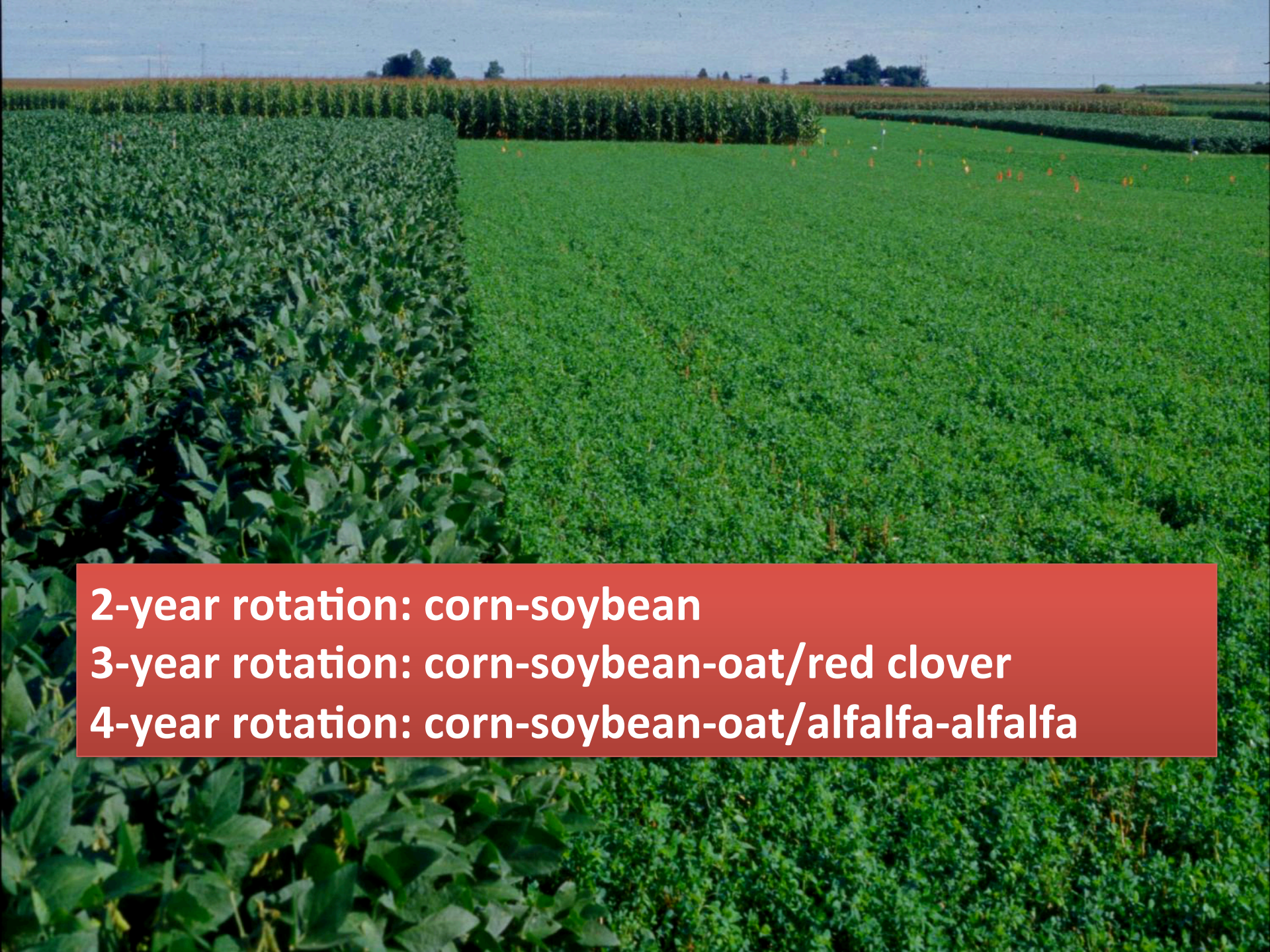
ISU Marsden Farm, Boone Co., Iowa

4 replicate blocks; each phase of each rotation present each year.

Plot dimensions: 60’ x 285’

Liebman, M. et al. 2008. *Agronomy Journal* 100: 600-610.

Cruse, M.J. et al. *Agronomy Journal* 102: 934-941.


2-year rotation: corn-soybean
3-year rotation: corn-soybean-oat/red clover
4-year rotation: corn-soybean-oat/alfalfa-alfalfa

Crop rotation study (ISU, 2010)

SDS management recommendations

- Prevent movement of infested soil
  - power wash equipment if possible
- Confirm it is SDS
- Utilize resistant varieties
- ILeVO seed treatment
- Test and manage for SCN
- Improve drainage
- Extended crop rotation may help

Acknowledgements

- Dr. Carl Druskovich,
- MSU diagnostic lab, Fred and Jan
- John Boyse and Randy Laurenz
- Tim Dietz and Kyle Johnson
- Kerrek Griffes, Steve Gower - Asgrow
- Karen Zuver – Pioneer
- Bill Widdicombe and Lori Williams
- Midwest colleagues

MSPC
MICHIGAN SOYBEAN PROMOTION COMMITTEE

Michigan Corn Growers Association
www.micorn.org

USB
UNITED SOYBEAN BOARD
Making Your Checkoff Pay Off.

NCSRP
NORTH CENTRAL SOYBEAN RESEARCH PROGRAM

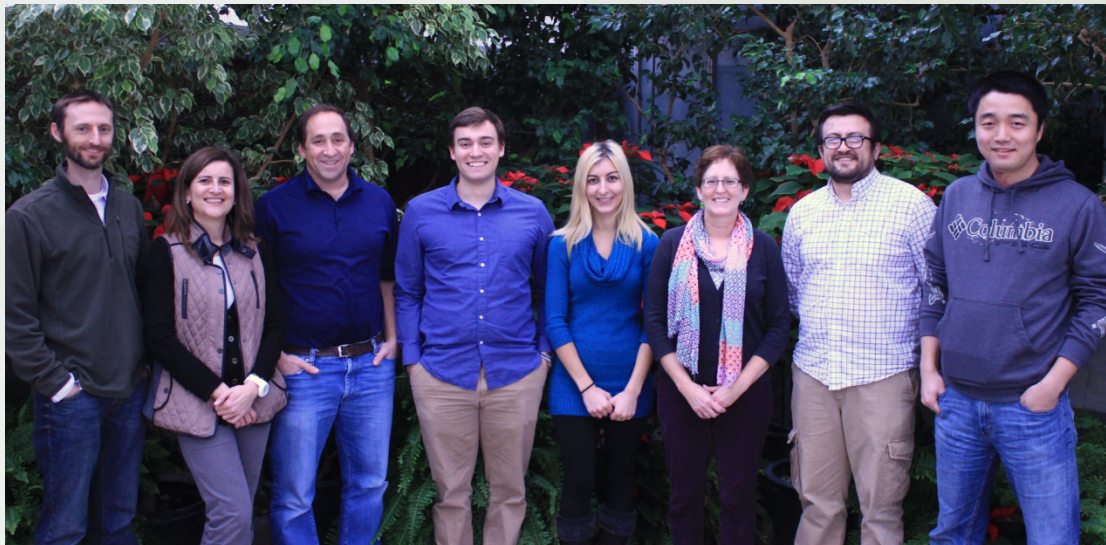
Michigan State University
AgBioResearch

USDA NIFA

Project GREEEN

National Sclerotinia Initiative

BAYER



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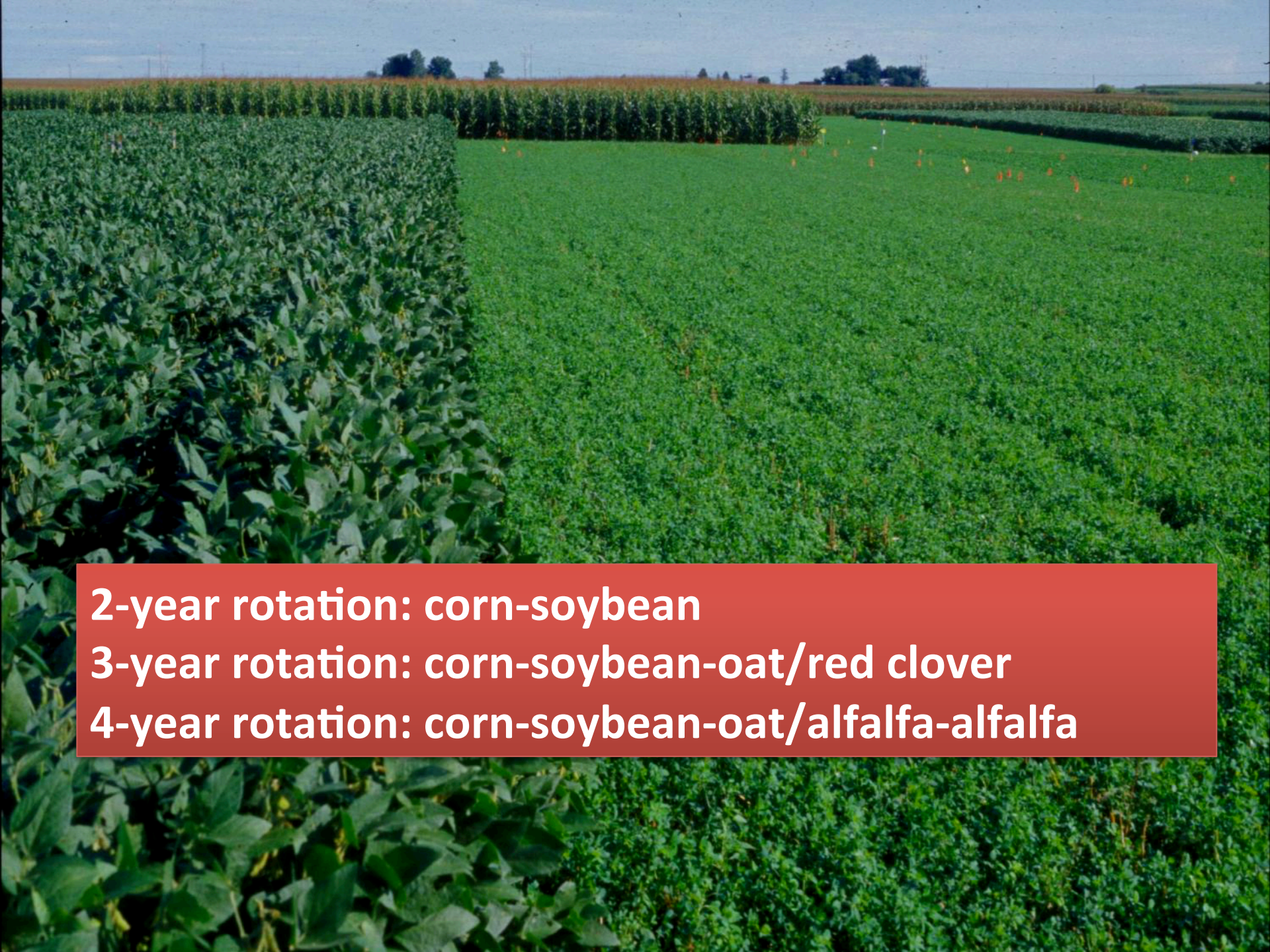
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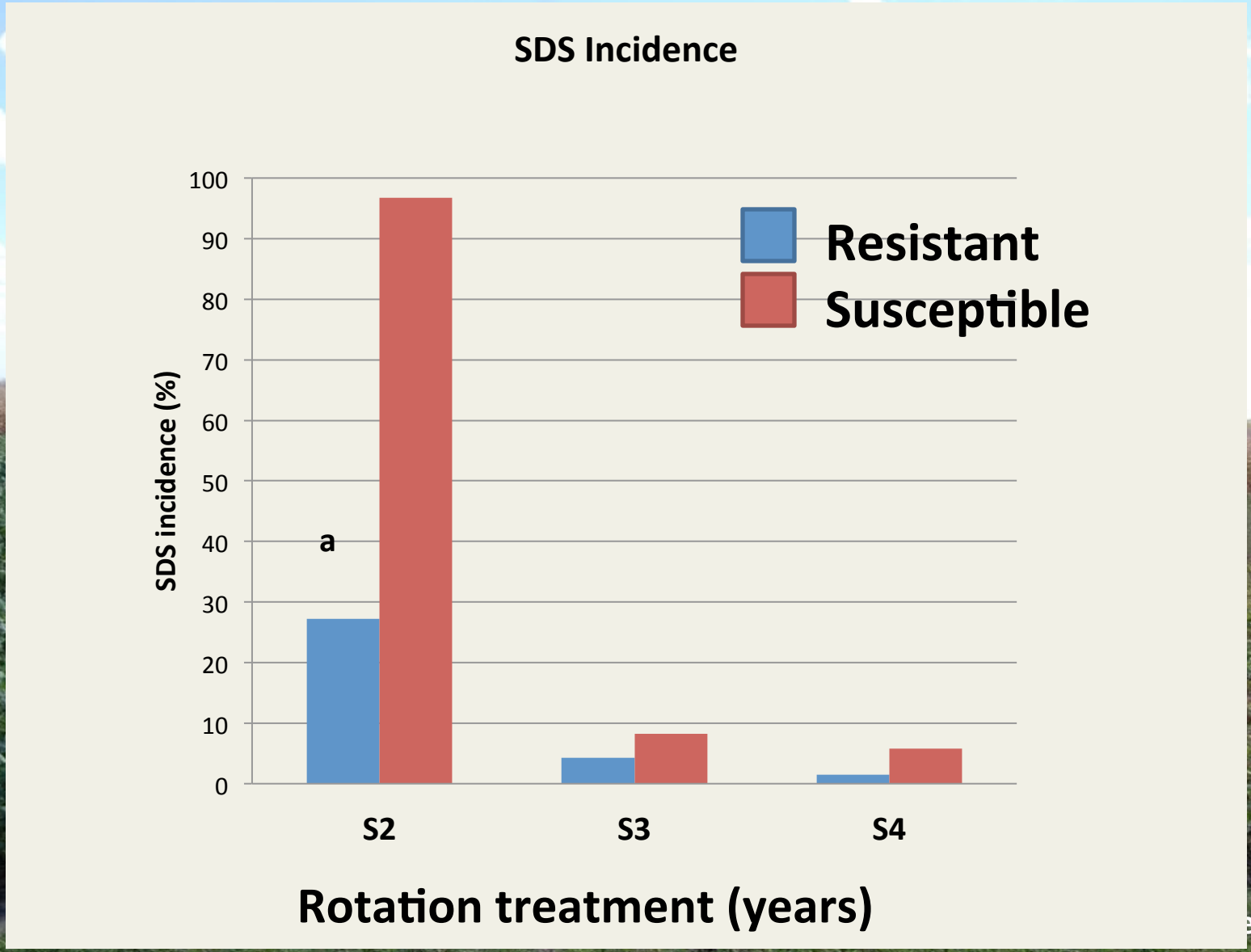


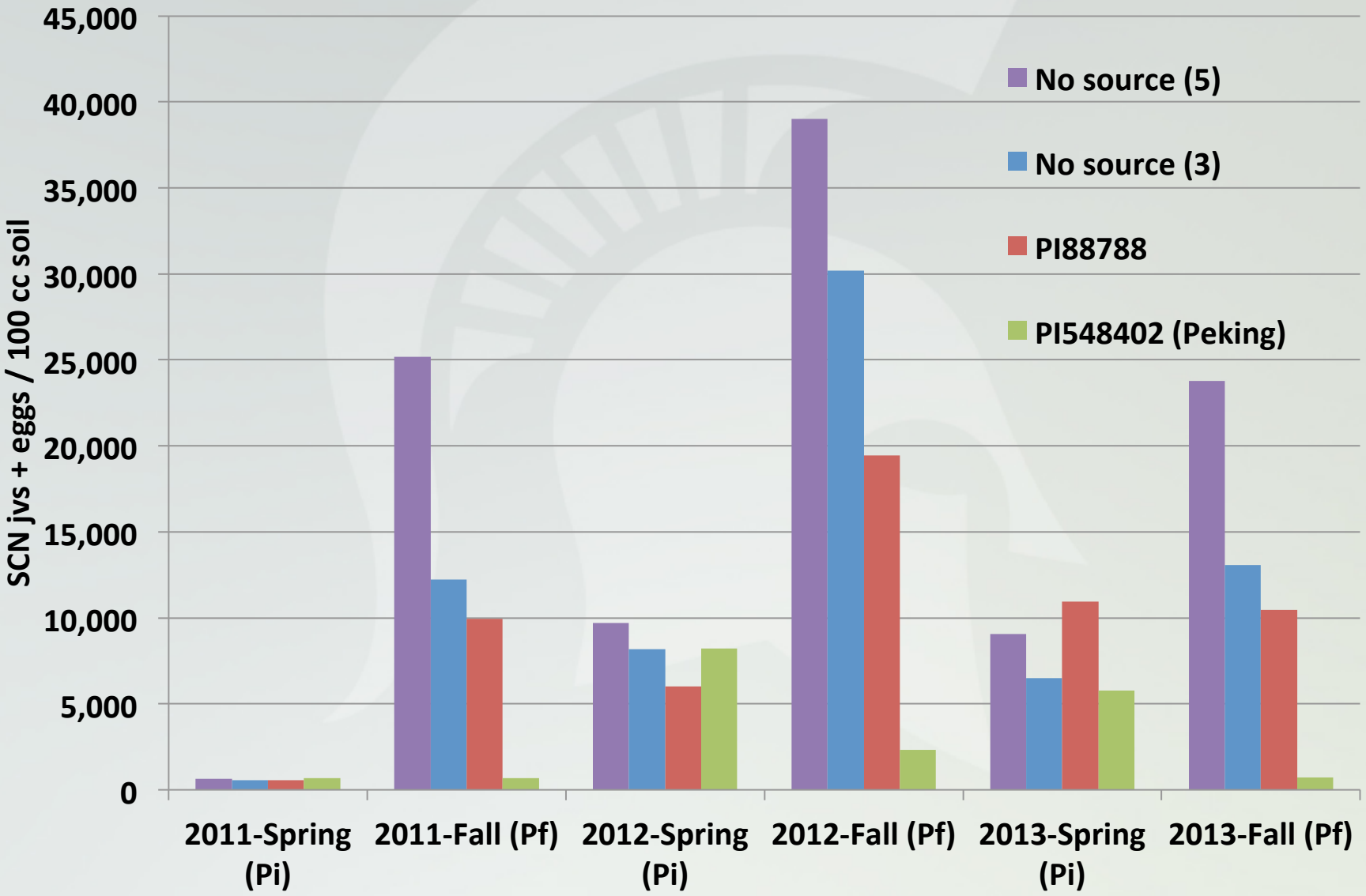
Larger & healthier roots under extended rotation

Rotation	Root dry weight (g)	Root Vigor (1-5)	Root rot severity (%)	Fv DNA 0-4" (ng / g soil)	SCN 0-4" (eggs/ 100cc)
2 year	**9.88**	**2.25**	**84.9**	**1.579**	**505**
3 year	**12.06**	**3.65**	**55.6**	**1.054**	**506**
4 year	**12.70**	**4.00**	**51.3**	**1.346**	**456**
St. error	0.88	0.24	8.78	0.264	120

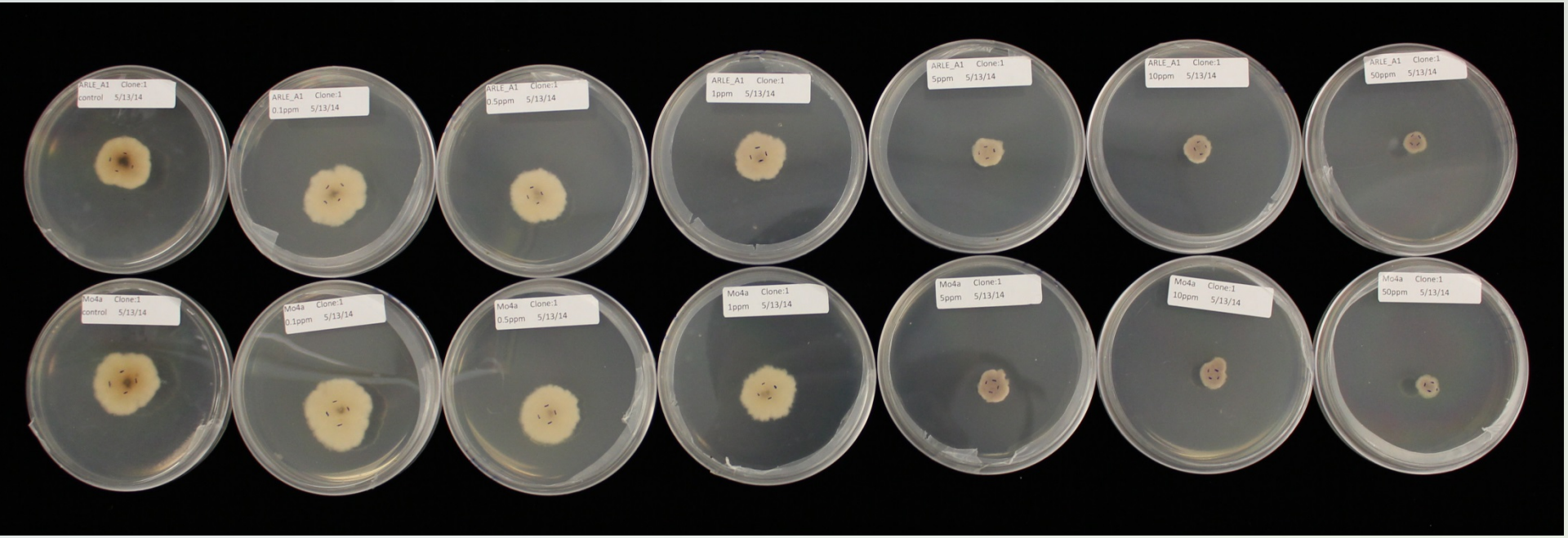
Leonor Leandro, ISU

SCN reproduction Decatur, MI

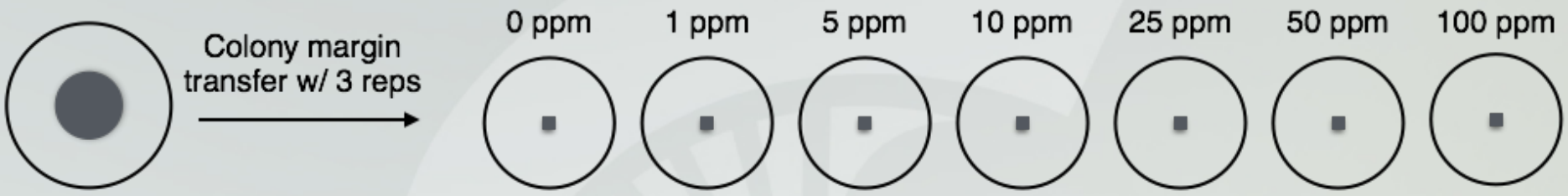
(North field, soy following corn except '12 – soy following soy)



Fluopyram poison plate assay

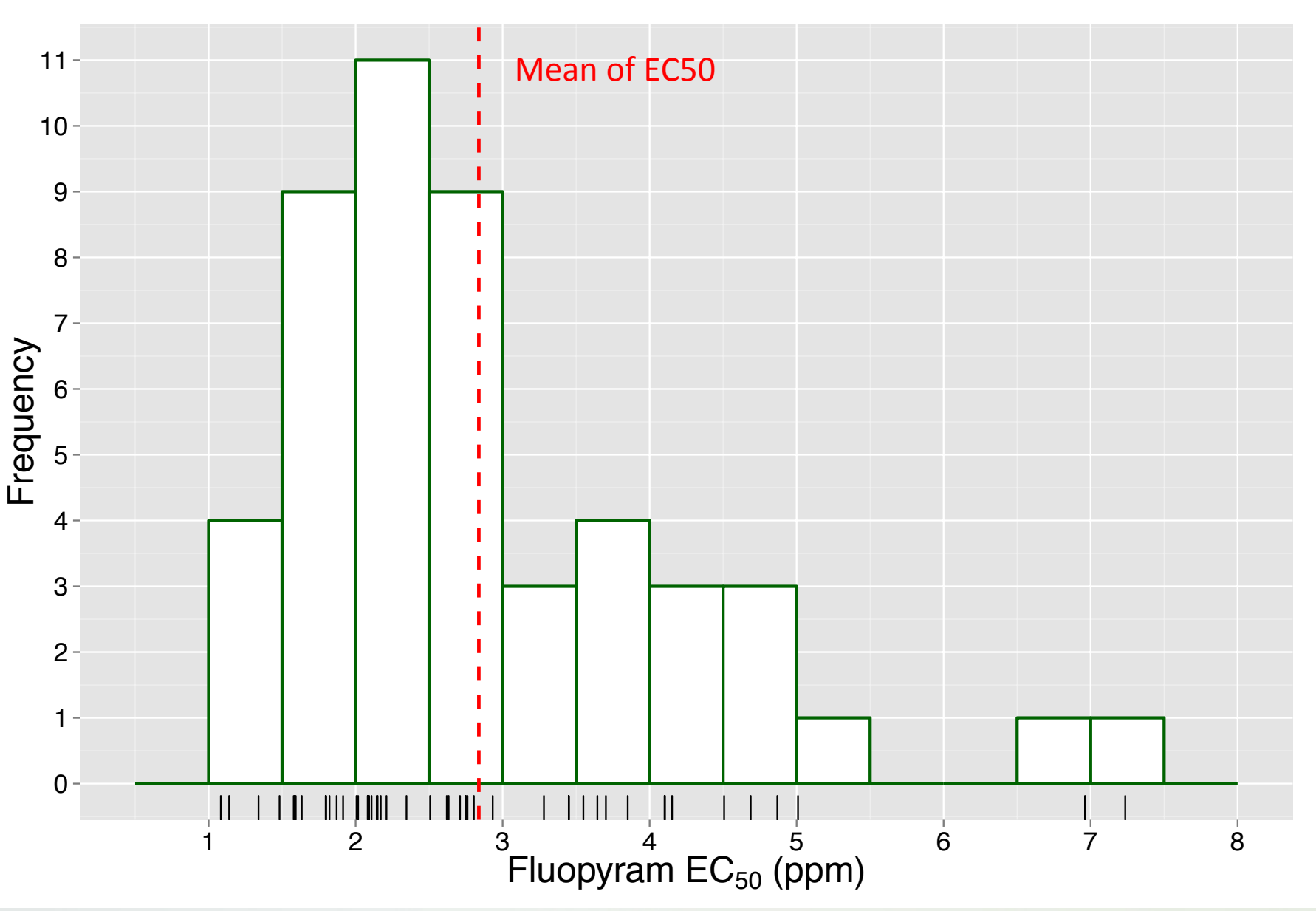


Experimental design



- 7 rates of fluopyram
- 3 reps / rate
- n=130 isolates
- Isolates from multiple states

Fluopyram EC_{50} (n=49)



Sample Collection and Processing

Step 1

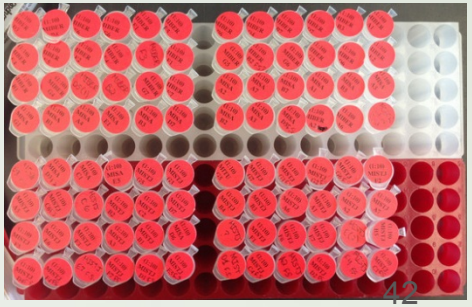
Sample Collection →

Step 2

Sample Processing →

Step 3

DNA Extraction →



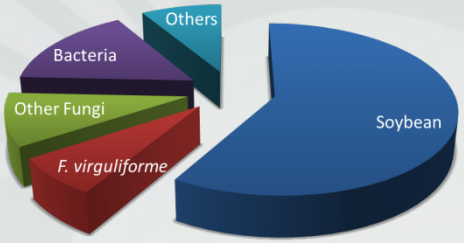
Sample Processing

Step 4

Run qPCR

w/ artificial exogenous control
ABI StepOne Plus System

Quantify
F. virguliforme



Quantify
G. max

Step 5

Data Analyses

$$F.\ virguliforme/Soybean\ Ratio = \ln(10\uparrow 4 * Fv/Soy + 1)$$