

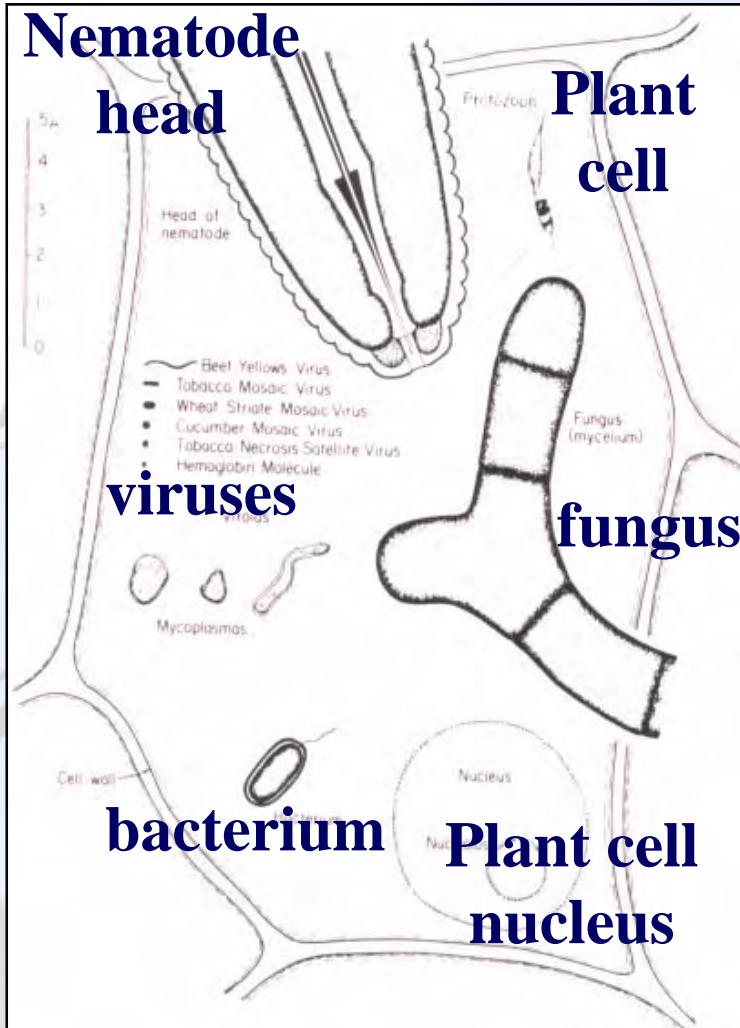


Corn & Soybean Disease Identification and Management

**Tamra A. Jackson
Loren Giesler**

**Extension Plant Pathologists
Department of Plant Pathology**

How big are Plant Pathogens?



Common plant pathogens and their size relative to each other and to a plant cell

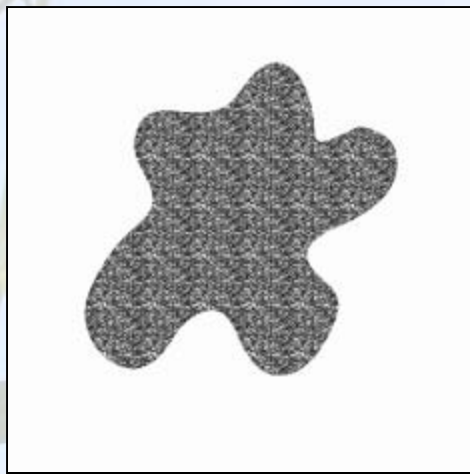
Environment

Many pathogens require moisture for sporulation and infection.

Some pathogens require wounds!

Symptom Distribution

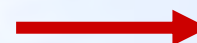
By assessing symptom distribution at three scales, your diagnosis will come much easier.



Field

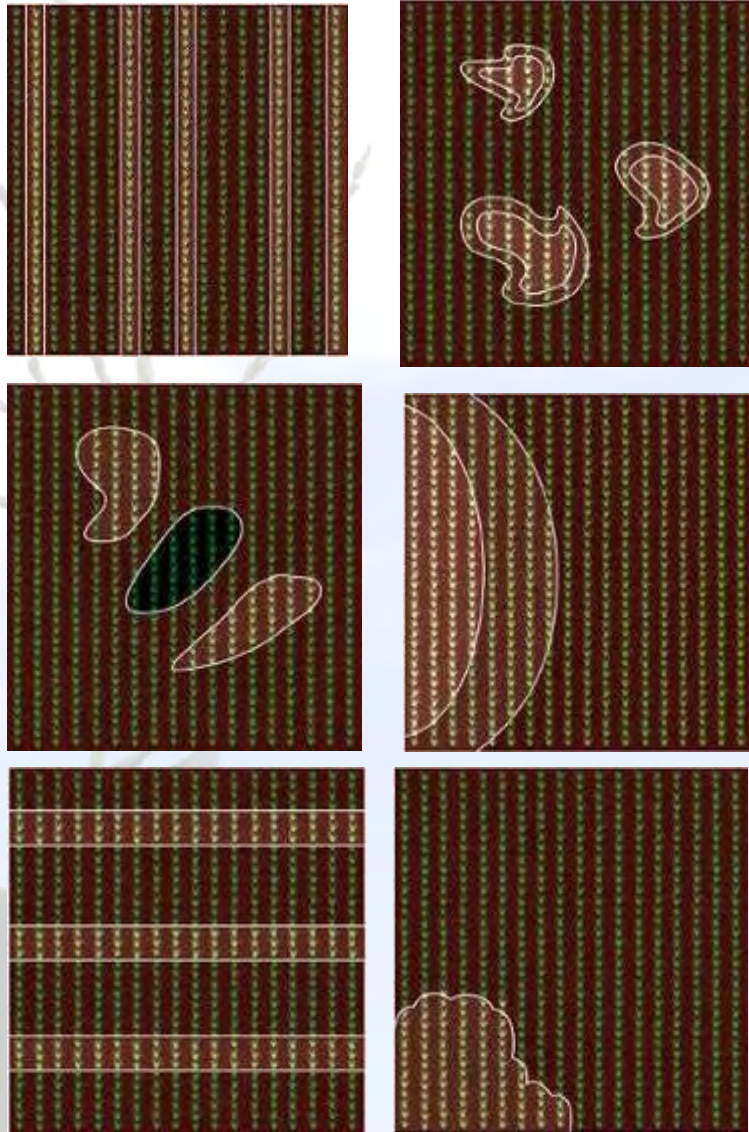


Plant



Plant Parts

Symptom Distribution

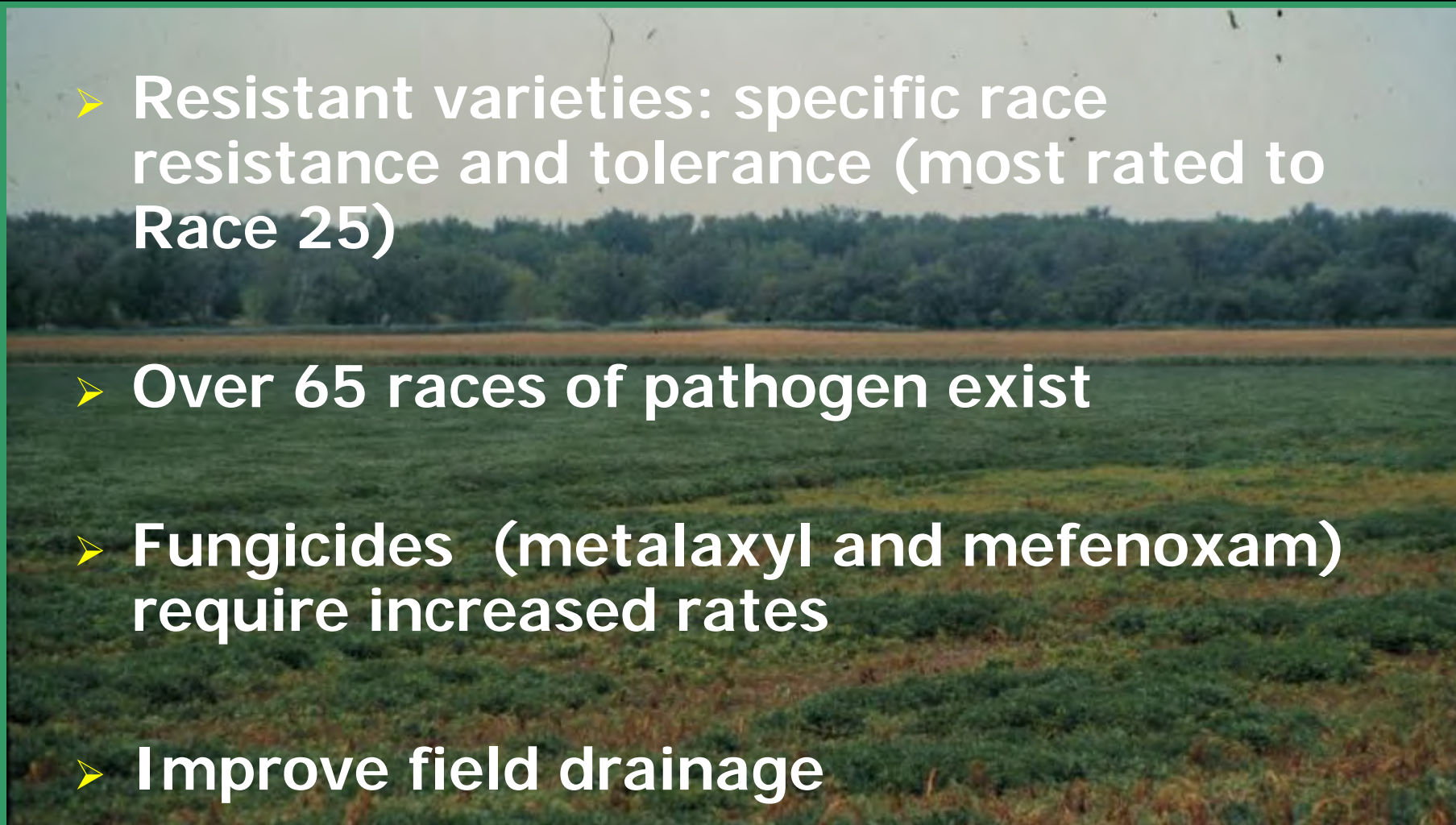


Step 1:
Determine the
distribution in the
field.

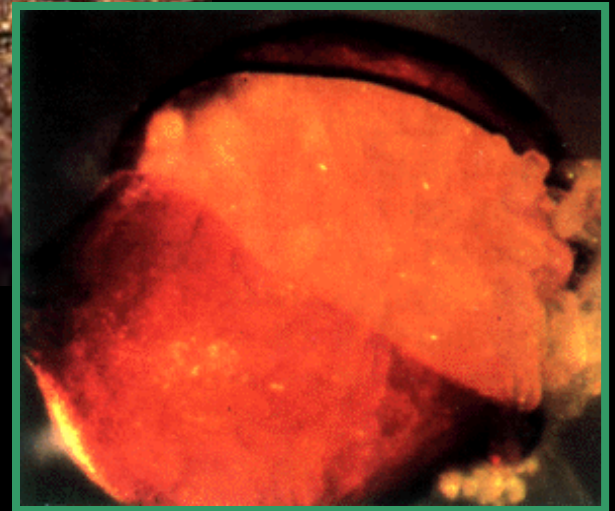
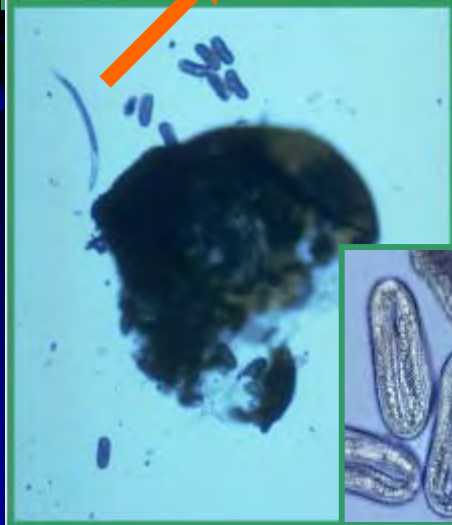
Phytophthora Root & Stem Rot



Phytophthora Management

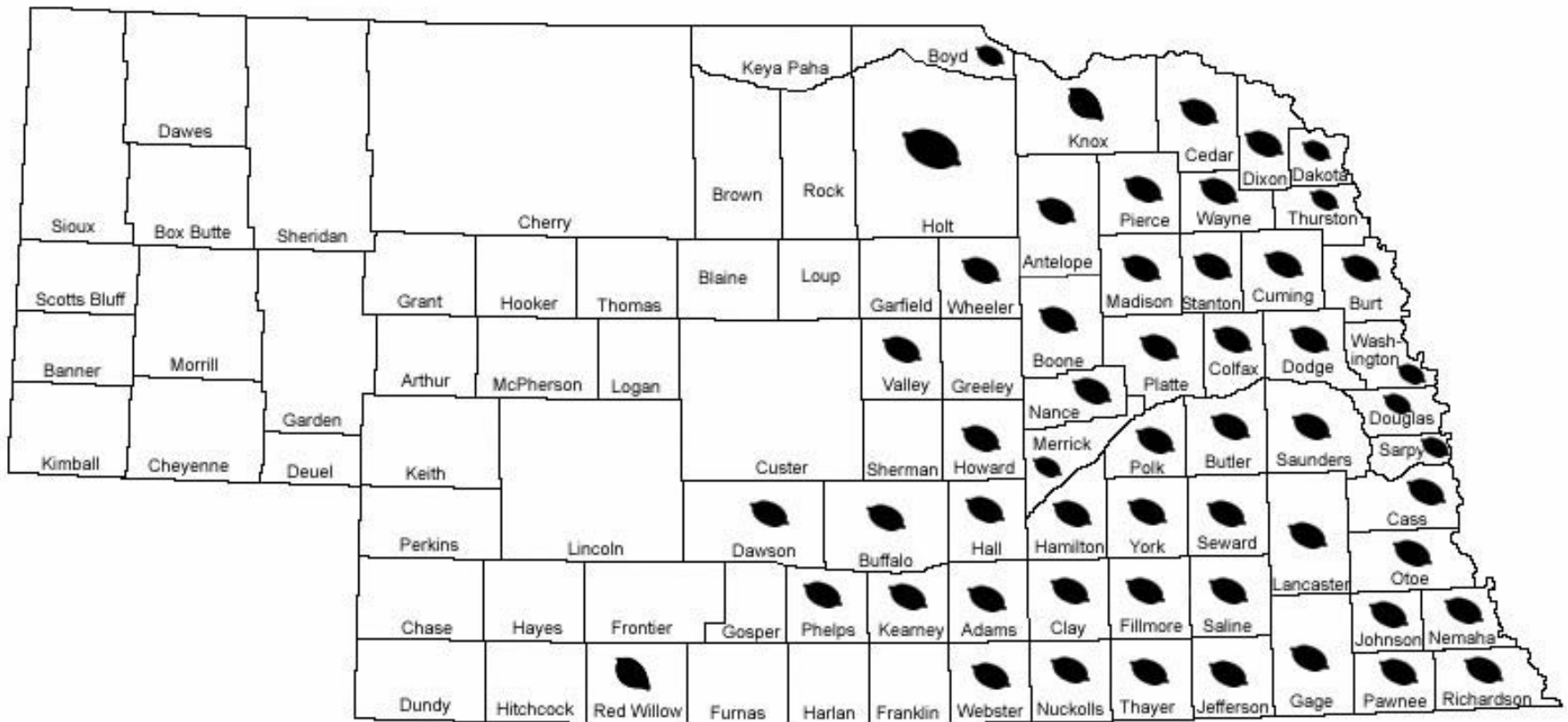
- 
- Resistant varieties: specific race resistance and tolerance (most rated to Race 25)
 - Over 65 races of pathogen exist
 - Fungicides (metalaxyl and mefenoxam) require increased rates
 - Improve field drainage

SCN Life Cycle



Soybean Cyst Nematode

Distribution as of December 2011



Rhizobium

SCN



ROTATION

Year 1 – Non-Host Crop

Year 2 – **Resistant Variety**

Year 3 – Non-Host Crop

Year 4 – **Resistant Variety**

Year 5 – Non-Host Crop

Year 6 – **Resistant Variety**

Know your source of resistance and rotate with other sources.





RESISTANT VARIETIES

- Know your source of resistance
 - **PI 88788** (*most common*)
 - **Peking** (PI 54840)
 - **Hartwig** (PI 437654)
 - **Cyst-X** (*selection from Hartwig*)
 - **Others**
- Rotate Source of Resistance

SCN Demonstration Sites

Variety	Resistance	Yield (Bu./A)		
		Brunswick	Cedar Bluffs	SCAL
Pioneer 93m11	Susceptible	38.8	65.3	73.3
Asgrow 3005	Susceptible	39.6	65.0	77.0
NK-S28-B4	Susceptible	40.7	64.5	75.9
Asgrow 3139	PI88788	53.9	66.2	66.8
Pioneer 93m13	PI88788	52.0	69.1	70.6
NK S27-C4	PI88788	59.2	68.3	70.8
NK S26-P1	Peking	46.2	69.3	74.9
Latham 2620	Cyst-X	50.5	65.7	64.4
LSD (P=0.05)		9.64	2.9	5.03
Spring SCN Pop. Field Avg		502	480	0



SCN Management

- **Sanitation: SCN can be moved with anything which moves soil**
- **Host Resistance**
- **Rotation: control weeds to have full effect of rotation. Infects many weed species (Henbit, Common Mullen, Wild Mustard, Pokeweed, Chickweed)**
 - **Does not affect alfalfa, corn, wheat, or sorghum**

Some Common Nematodes of Corn

- Needle
- Sting
- Dagger
- Spiral
- Stunt
- Stubby-root
- Lance
- Root-lesion

Longidorus spp.

Belonolaimus spp.

Xiphinema spp.

Ectoparasites

Helicotylenchus spp.

Tylenchorrhynchus spp.

Paratrichodorus spp.

Hoplolaimus spp.

Endoparasites

Pratylenchus spp.

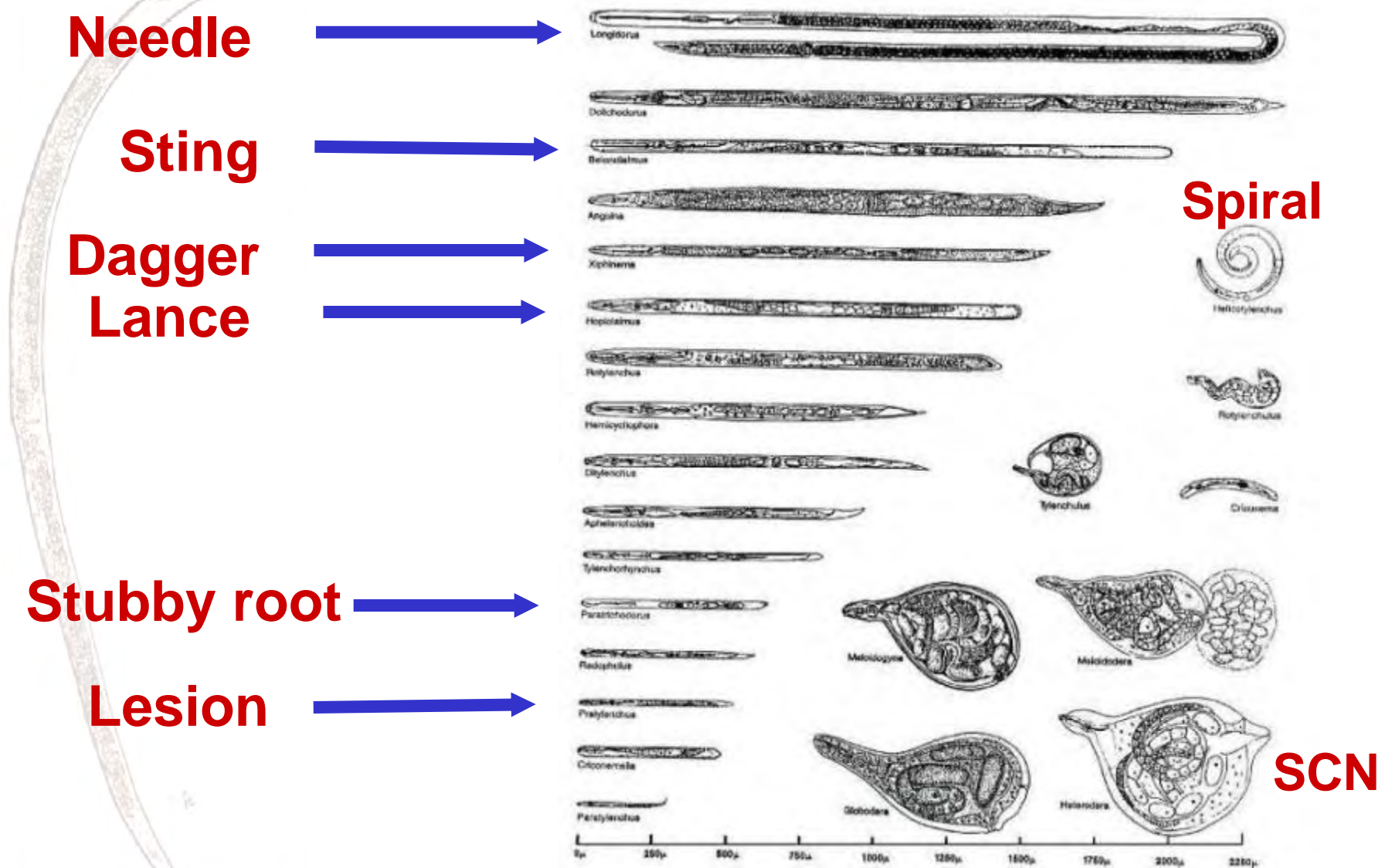


Courtesy S/W Westcott III, APSnet



Courtesy of D. Wixted, APSnet

Relative Sizes of Plant Parasitic Nematodes



(1997. Agrios, Intro. To Plant Pathology)

Sting Nematode Damage

Holt County, NE - July 2008



T. Jackson, UNL

Dodge County, NE

June 2006

Lesion nematodes

Lance nematodes

Dagger nematodes

Stubby-root nematodes

- * Farm average = 180 bu/A
Yield in small plots was as low as 30 bu/A

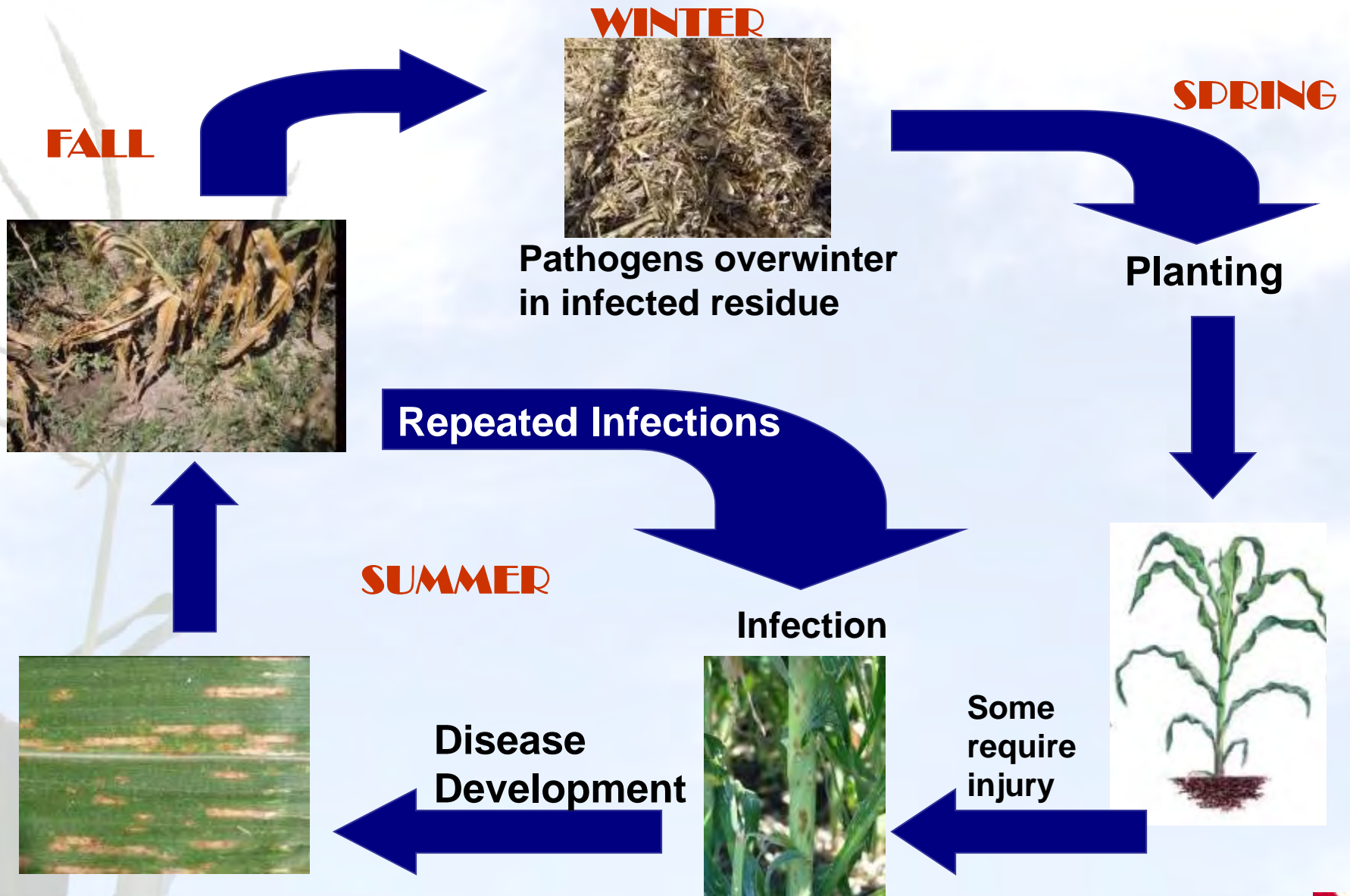
T. Jackson, UNL

New Seed Treatment Nematicides

- **Avicta Complete Corn[®]**
 - Syngenta
 - Abamectin
- **Poncho VOTiVO[®]**
 - Bayer CropScience
 - *Bacillus firmus* I-1582
- **Acceleron[™] HX-209**
 - Monsanto Company
 - Harpin alpha beta protein



Disease Cycle: Residue-borne Pathogens



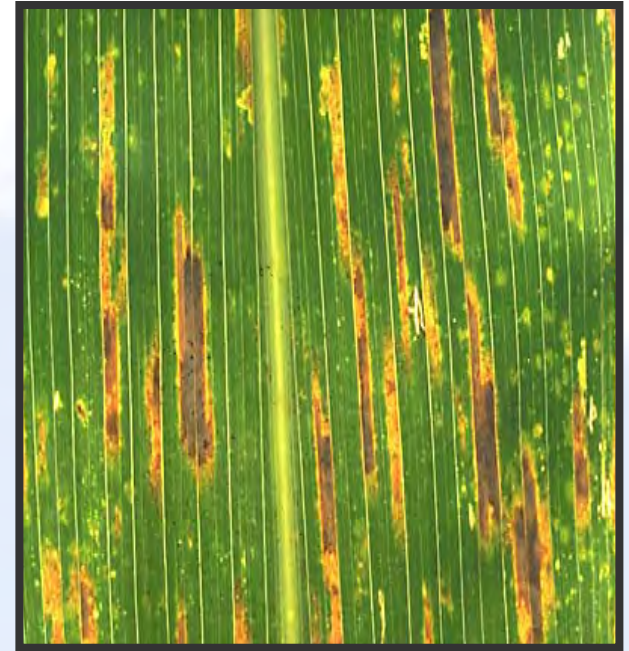
Gray Leaf Spot



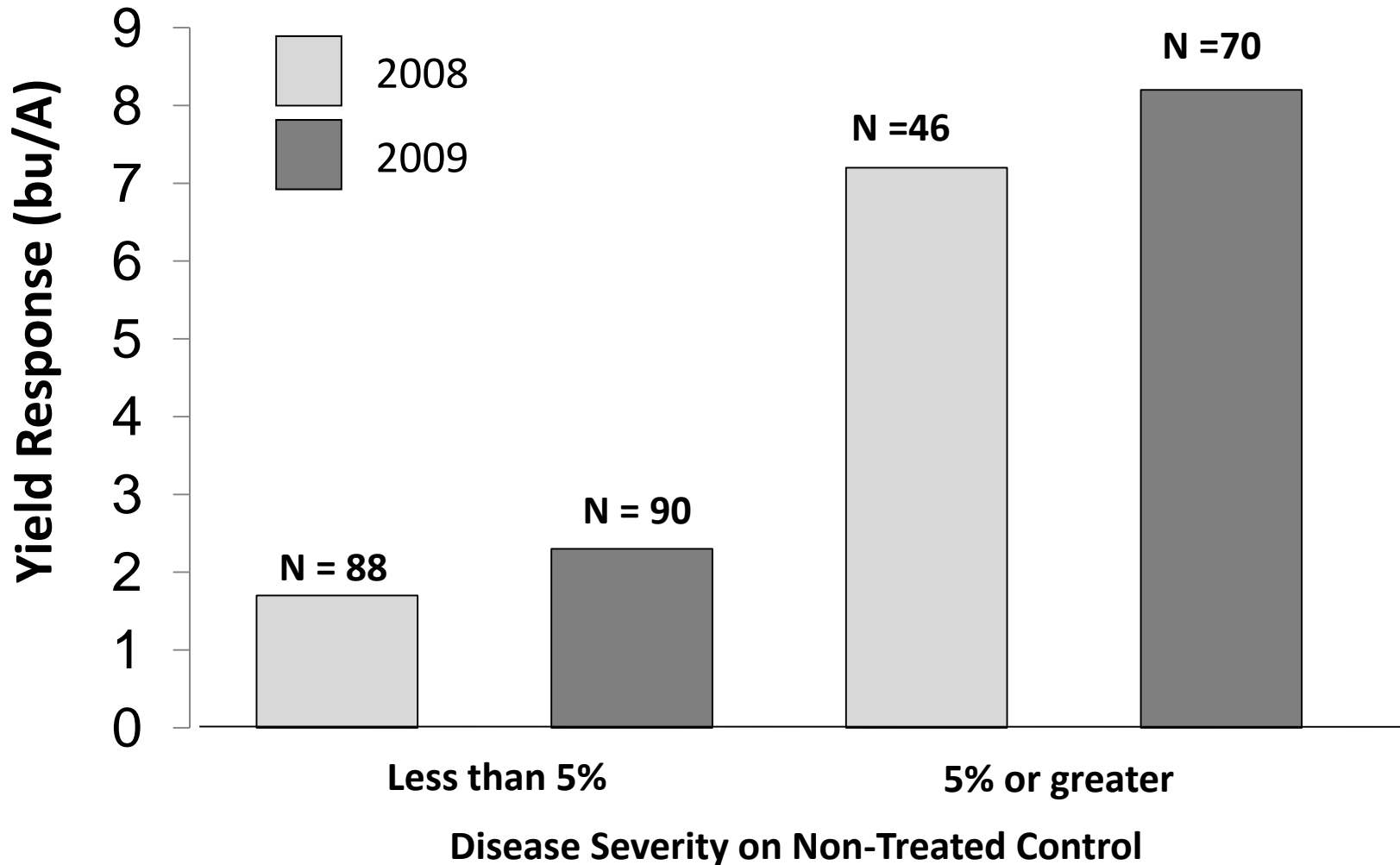
- **Caused by the fungus, *Cercospora zea-maydis***
- **Most common disease in Corn Belt**
- **Overwinters in Nebraska in crop residue**
- **Fungus requires 12+ hours of $\geq 90\%$ RH**
- **2007 early season rain**
- **Early disease development (pre-tassel)**
- **Wider geographic area**
 - **Fungal inoculum already present**

Gray Leaf Spot

- Most common foliar disease
- Up to 50% yield losses if it develops early
- Tolerance available
- Rectangular lesions
- Leaf wetness or $>95\%$ humidity for 11+ hours



2008-09 Regional Corn Foliar Fungicide Trial Results



Regional Publication available today!

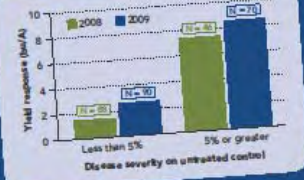


Figure 1 • Summary of University and Extension foliar fungicide research trials on corn conducted in 2008 and 2009 in the United States and Ontario, Canada. Results were summarized by Dr. Greg Shaner, Purdue University and data were provided by University and Extension personnel in Illinois, Indiana, Iowa, Kansas, Kentucky, Maryland, Minnesota, Mississippi, Missouri, Nebraska, North Dakota, Ohio, Ontario, South Dakota, Virginia, and Wisconsin. Bars represent the average yield difference between an untreated control and Headline, Quilt, or Stratego fungicide applied between the VT and R1 or growth stages under different levels of disease pressure.

Which economically-important foliar diseases can be managed with fungicides?

Corn fields in the North Central U.S. and Ontario, Canada are never disease-free, but not all foliar diseases are equal in their potential to reduce yields. In addition, not all foliar diseases can be managed with foliar fungicides. Common rust, for example, often is observed in the North Central U.S. and Ontario; however, its yield-reducing potential generally is low for yellow dent corn hybrids because of their higher levels of resistance. Goss's wilt and Stewart's wilt have the potential to reduce corn yields, but cannot be controlled with a fungicide because they are caused by bacterial pathogens rather than fungal pathogens. A foliar fungicide can be a good tool to help manage gray leaf spot, northern leaf blight, and eyespot. These diseases are considered to be important yield-reducing foliar fungal diseases in the North Central U.S. and Ontario. Southern corn rust, another important foliar disease, can cause yield reductions to corn in the North Central U.S. and Ontario in certain years, but generally is not an annual occurrence.

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ACKNOWLEDGMENTS

Funding for this project was from the United States Department of Agriculture—National Institute of Food and Agriculture (USDA-NIFA; Award no. 2008-34103-19449) for the project entitled, "Development of IPM-based corn fungicide guidelines for the north central states."

Cover photo by Scott Bratthauer, University of Illinois. Photos of gray leaf spot, northern leaf blight, and southern rust by Carl Bradley, University of Illinois. Photo of eyespot by Alison Robertson, Iowa State University.

FOR MORE INFORMATION CONTACT:

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 Website: <http://pdc.unl.edu/>

UNIVERSITY OF
Nebraska
 Lincoln

October 2010

Foliar Fungicides for Corn: Targeting Disease



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 Extension Plant Pathologist, University of Illinois
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 Extension Plant Pathologist, The Ohio State University
 Alison E. Robertson
 Extension Plant Pathologist, Iowa State University



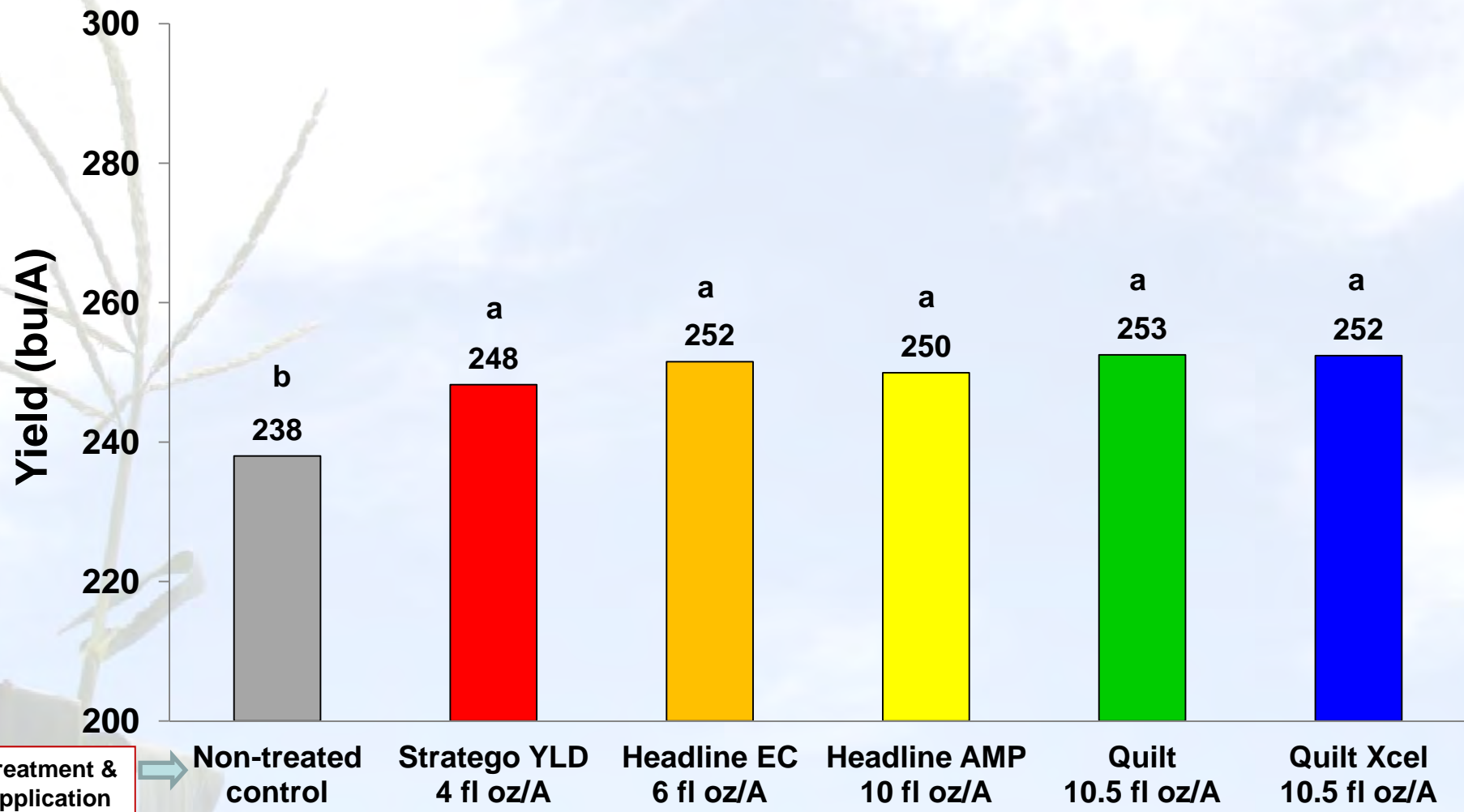
Foliar Fungicides for Disease Control

To spray or not to spray... it's not that simple of a decision. A foliar fungicide application might be a good investment to help boost profits, *but not always*. It is important to target diseases when making a foliar fungicide application decision in corn. Spraying corn fields without considering disease risk factors or scouting observations may be like pouring money down the drain. However, in the right situations, foliar fungicides can be used to help protect against yield reductions due to diseases and boost profits. The key to better and more profitable utilization of foliar fungicides in corn is to *target disease* (Fig. 1).

*** Also available online at PDC – Plant Disease Central under Management Trials**

2011 Fungicide Product Comparison Trial in NE

Yield (bu/A)



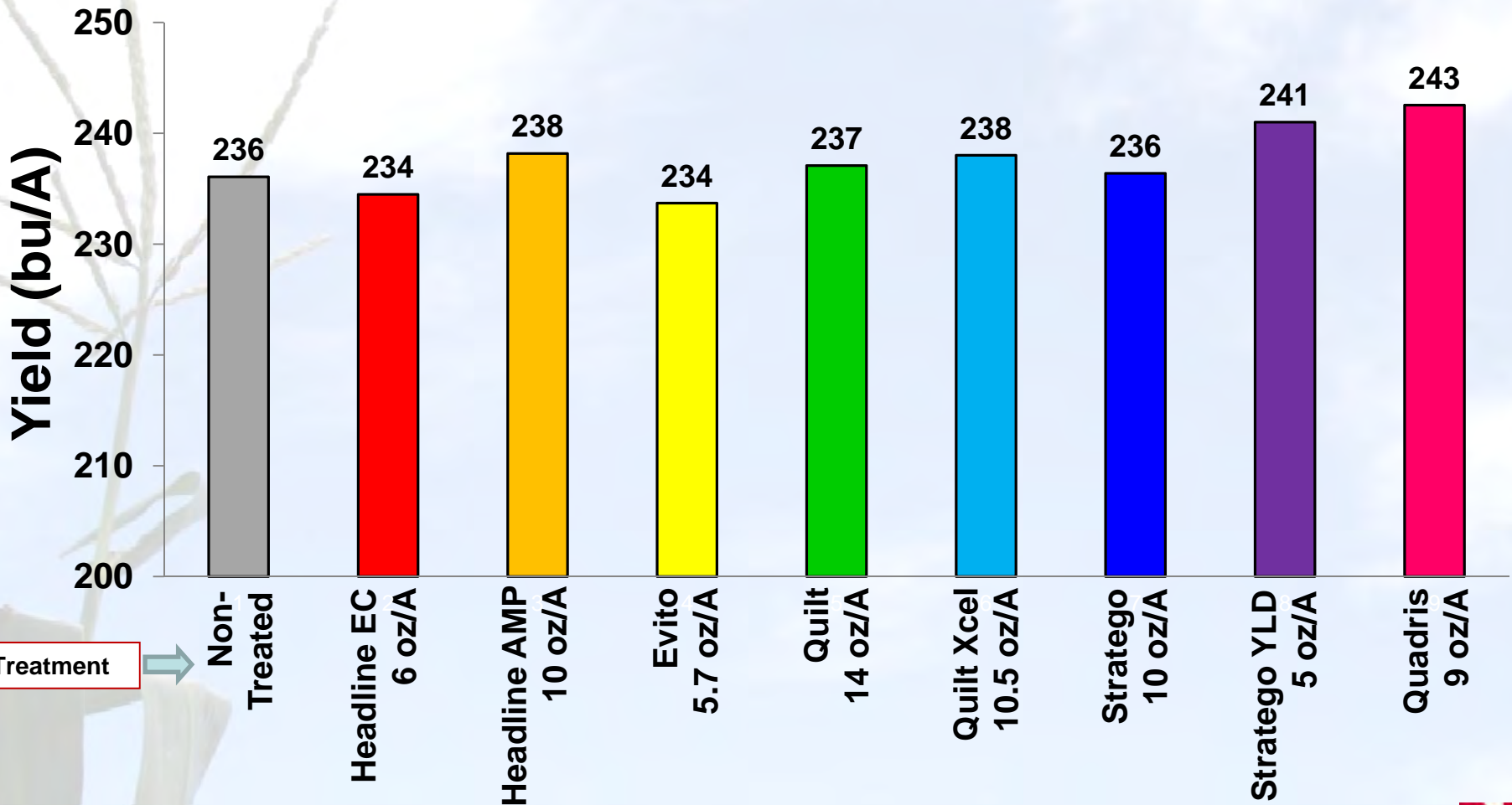
*Foliar fungicide applications made at reproductive stage R1.

*Treatments with different letters are statistically different. Coefficient of variation is 2.9%

2010 Fungicide Comparison Trial in NE

Yield (bu/A)

R1 Application 7/15/10 - DKC 61-69 (GLS rating = 5/good)

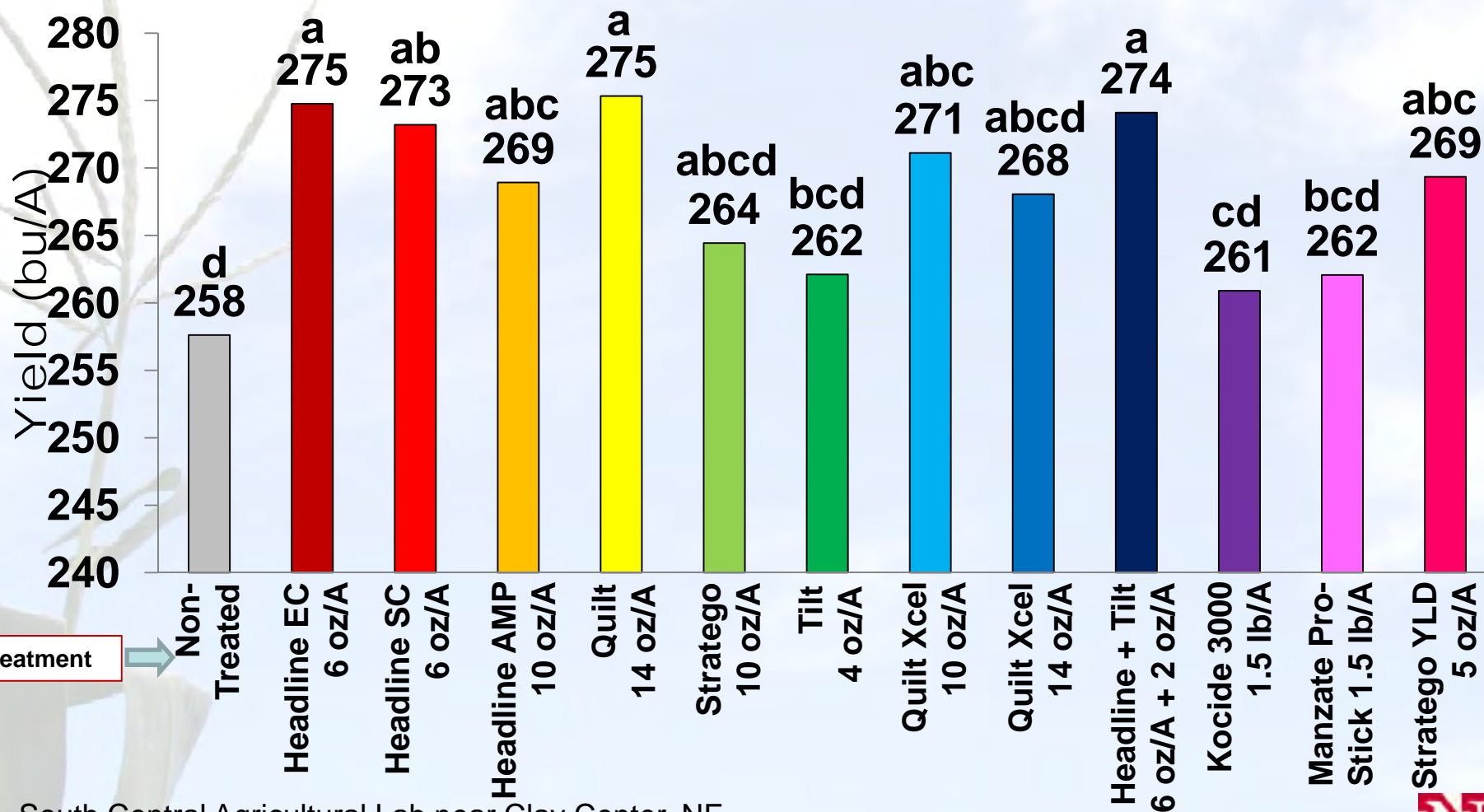


Treatment

2009 Fungicide Comparison Trial in NE

DKC 60-18 (GLS rating = 7/fair)

Planted 5/6/09, VT Application 7/17/09



South Central Agricultural Lab near Clay Center, NE

Frogeye Leaf Spot



Frogeye Leaf Spot Management

- Soybean varieties vary in their susceptibility and resistant varieties are available.
- Fungus overwinters in residue and will be more severe in continuous soybean and no-till.
- Fungicides can increase yields if applied at growth stage R3- R5. Products containing a strobilurin fungicide are better for this disease.

Special Alert

An Update for Tennessee

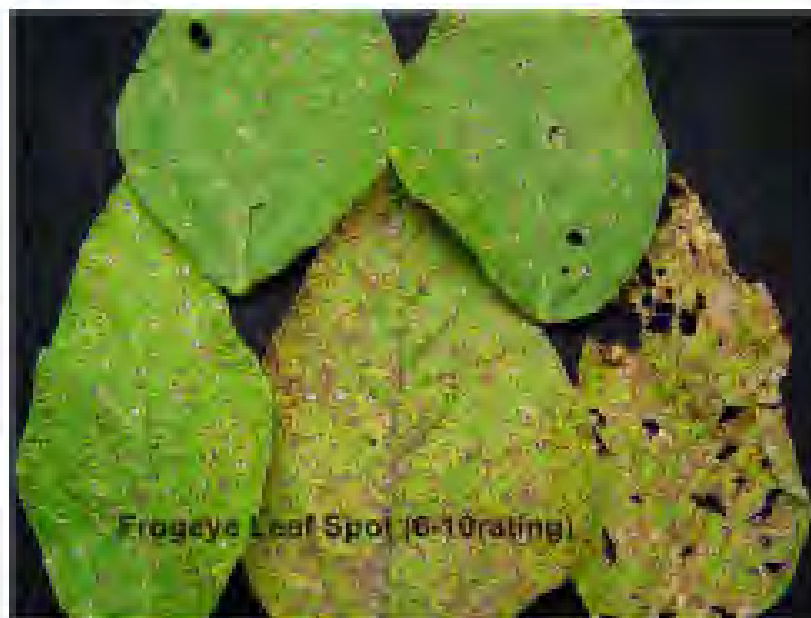
No. 1

October 20, 2010

SOYBEAN PATHOGEN FOUND TO BE RESISTANT TO FUNGICIDES

by Melvin A. Newman and Carl A. Bradley*

Frogeye Leaf Spot (FLS) caused by the fungus *Cercospora sojina* has shown resistance to strobilurin fungicides in a commercial field in Lauderdale County, Tennessee this year. Strobilurin fungicides belong to a group of fungicides known as the quinone outside inhibitors (QoI), which is the most widely-used group of foliar fungicides applied to field crops. In petri dish tests conducted by Plant Pathologists at the University of Illinois, spores from isolates of *C. sojina* were found to germinate in the presence of high concentrations of azoxystrobin, pyraclostrobin, and trifloxystrobin, which are active ingredients found in fungicide products



Results of *Cercospora sojina* fungicide sensitivity testing (conidial germination)

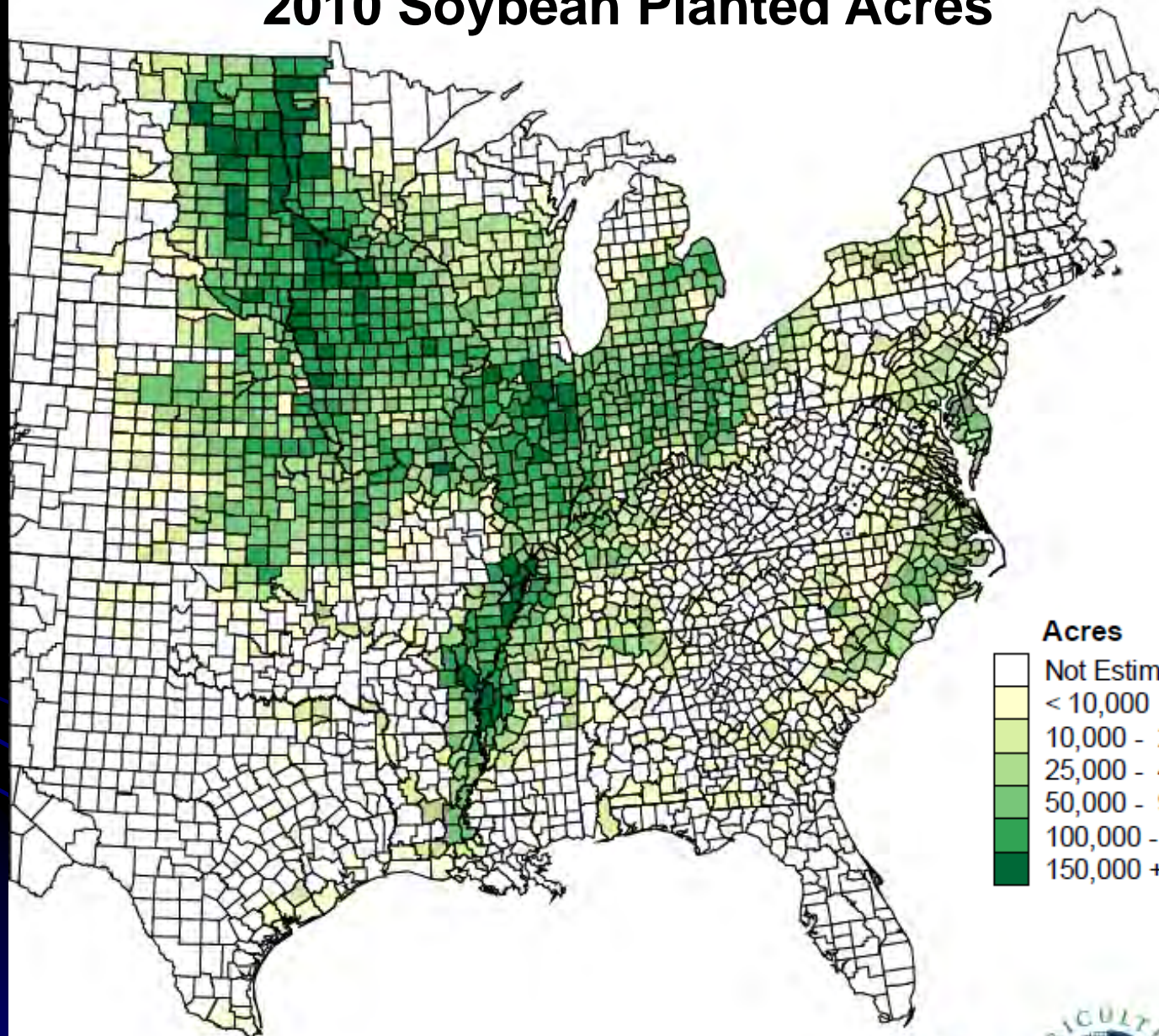
Fungicide	Baseline isolates (n = 58)		2010 TN isolates (n = 15)	
	EC ₅₀ range	EC ₅₀ mean	EC ₅₀ range	EC ₅₀ mean
Azoxystrobin	0.0029 – 0.0323	0.0127	2.7826 – 4.5409	3.1644
Pyraclostrobin	0.00014 – 0.00076	0.00027	0.2818 – 0.6404	0.3297
Trifloxystrobin	0.00018 – 0.00311	0.0012	0.3665 – 2.5119	0.8573

Notes:

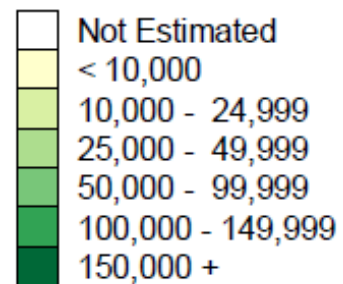
- EC₅₀ = effective concentration that inhibits 50% conidial germination when compared to non-amended (no fungicide) media. Unit is µg/ml.
- Bradley (2010): Research funded by the Illinois Soybean Promotion Board



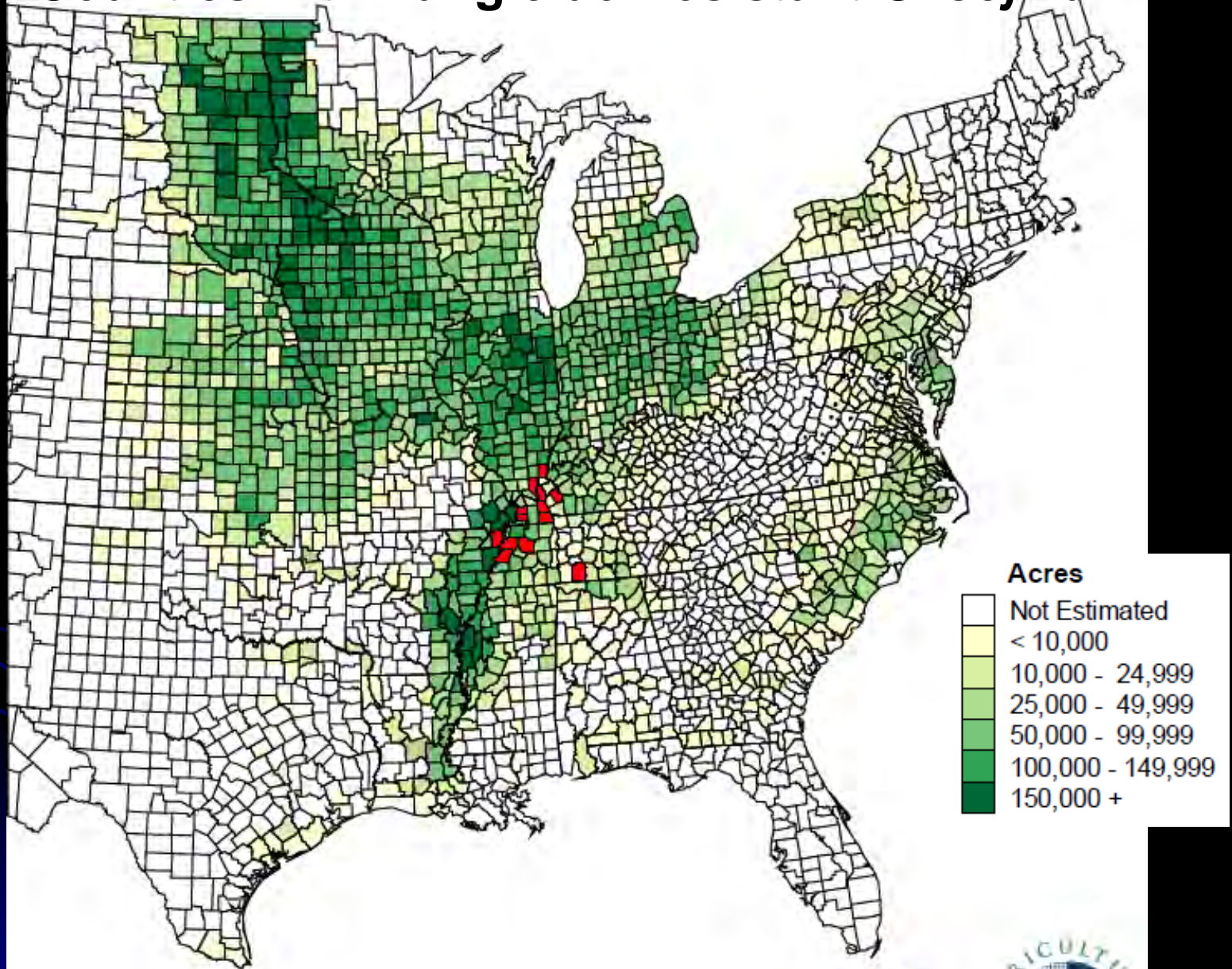
2010 Soybean Planted Acres



Acres



Counties with Fungicide Resistant *C. sojae*



Goss's Bacterial Wilt and Blight

Then and Now

- Common in 1970's-80's
- 2005 – western NE, northeast CO, southeast WY
- 2008 – was widespread in NE, CO, SD, KS, IA, IL, etc.
 - First report IN, TX, ND
- Through 2011 - >60 NE counties
 - 12 states
 - Ontario and Manitoba, Canada



Goss's Bacterial Wilt and Blight

Biology

- **Caused by bacterium**
 - *Clavibacter michiganensis* subsp. *nebraskensis*
 - Gram positive
- **Survives in residue**
- **Wounding**
 - Hail, sandblasting, wind
- **Temperature**
 - Optimum 80 F
 - Range 53 – 104 F



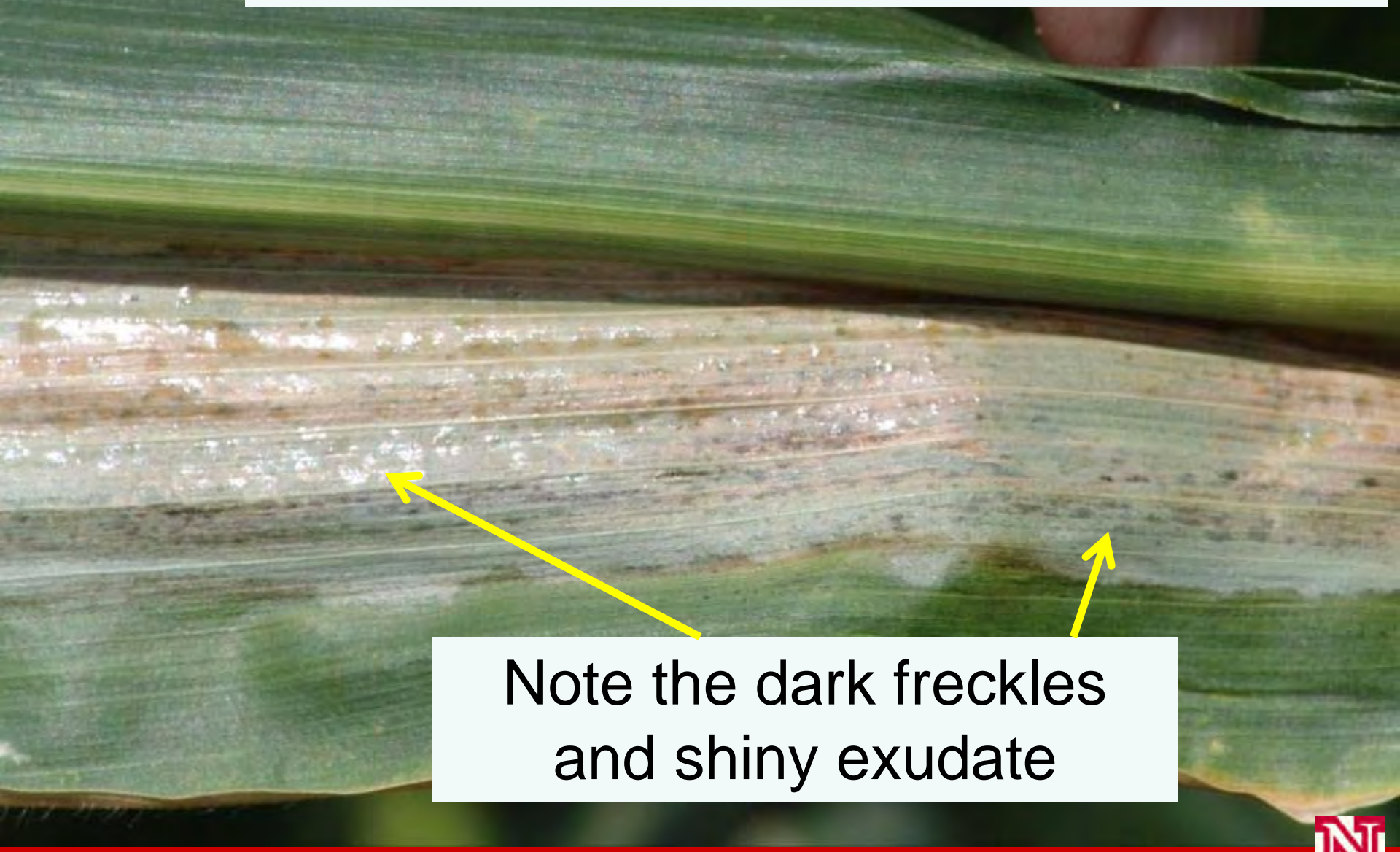
Goss's Bacterial Wilt and Blight

Epidemiology

- **2 Phases of the disease**
 - **Systemic wilt**
 - Esp. injured seedlings
 - Plant mortality
 - **Foliar blight**
 - Most common
 - Diagnostic symptoms:
 - “Freckles”
 - “Ooze” = bacterial exudate



Foliar Goss's Blight



Note the dark freckles
and shiny exudate

Goss's Bacterial Wilt and Blight

Management

- Fungicides not effective
- Hybrid resistance (not immunity) is available
 - 65% companies rate hybrids (2009)
 - 25% in 2006
 - Multigenic (3-5 genes)
 - Additive effect
 - Not for systemic disease, though
 - Popcorn typically susceptible
- Crop rotation
- Tillage
- Weed control may help
 - Alternate hosts
- Bactericides?



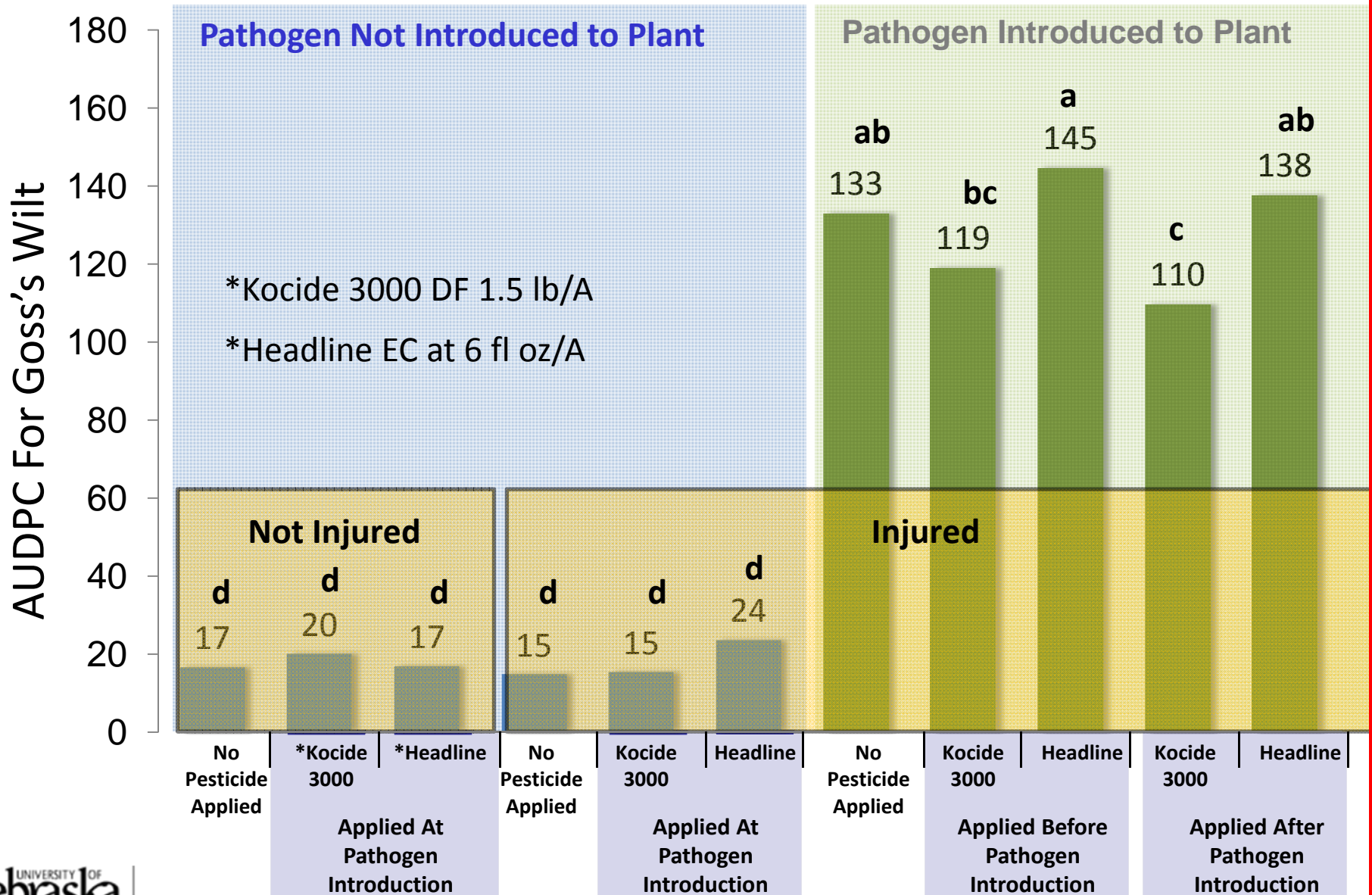
Goss's Wilt Management Trials

- Applications made by CO₂ pressurized backpack sprayer
- 3 application timings
- 6 replications
- 2009
 - 2 hybrids at 105 day RM
 - 2 products
- 2010
 - 4 hybrids – 105 & 110 day RM
 - 5 product/rate combinations
 - Early season flooding = very high variability
 - Results not shown due to poor testing conditions
- Monsanto Water Utilization Center – Gothenburg, NE



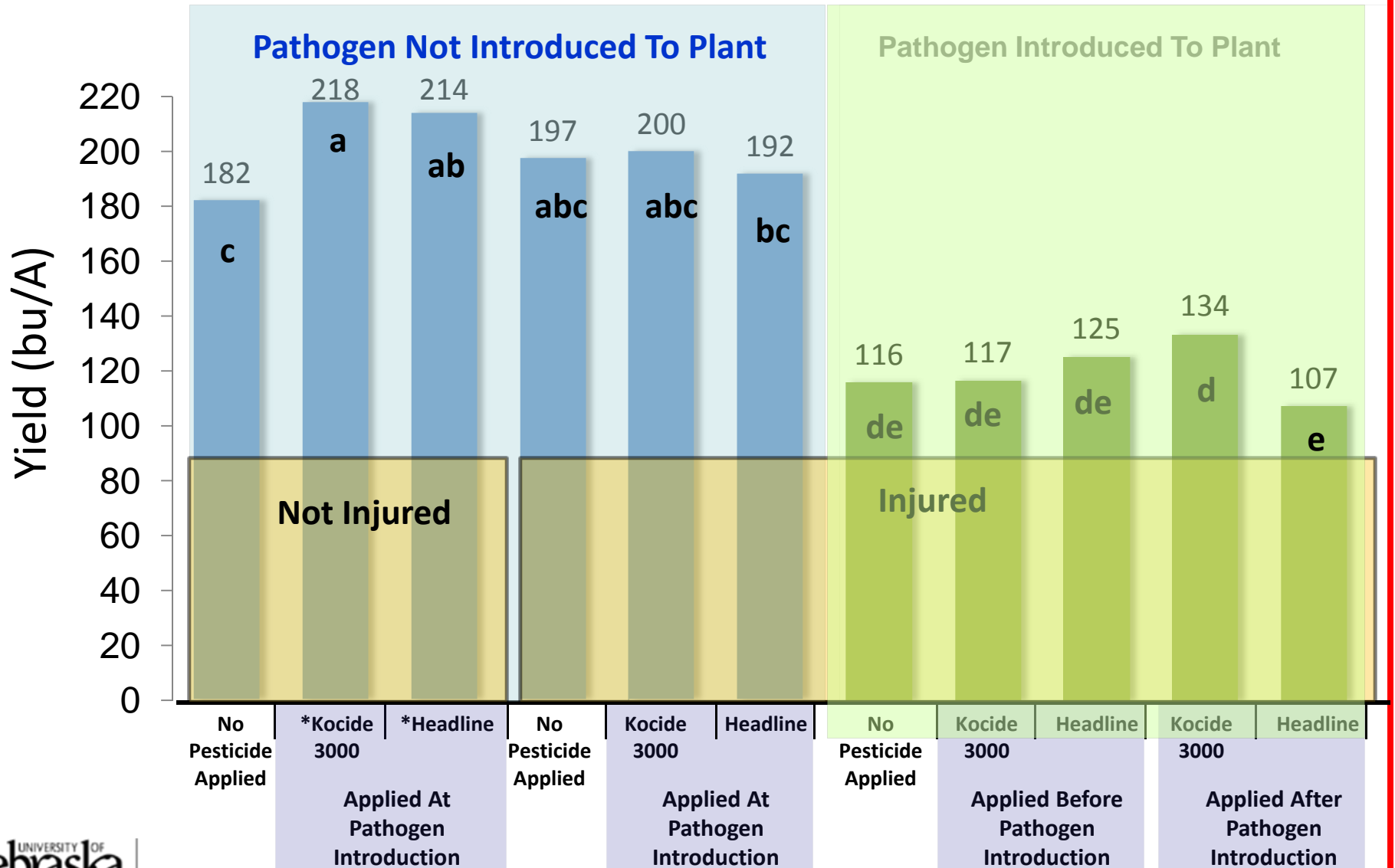
Area Under the Disease Progress Curve (AUDPC)

105RM Susceptible Hybrid (rating = 7/poor)



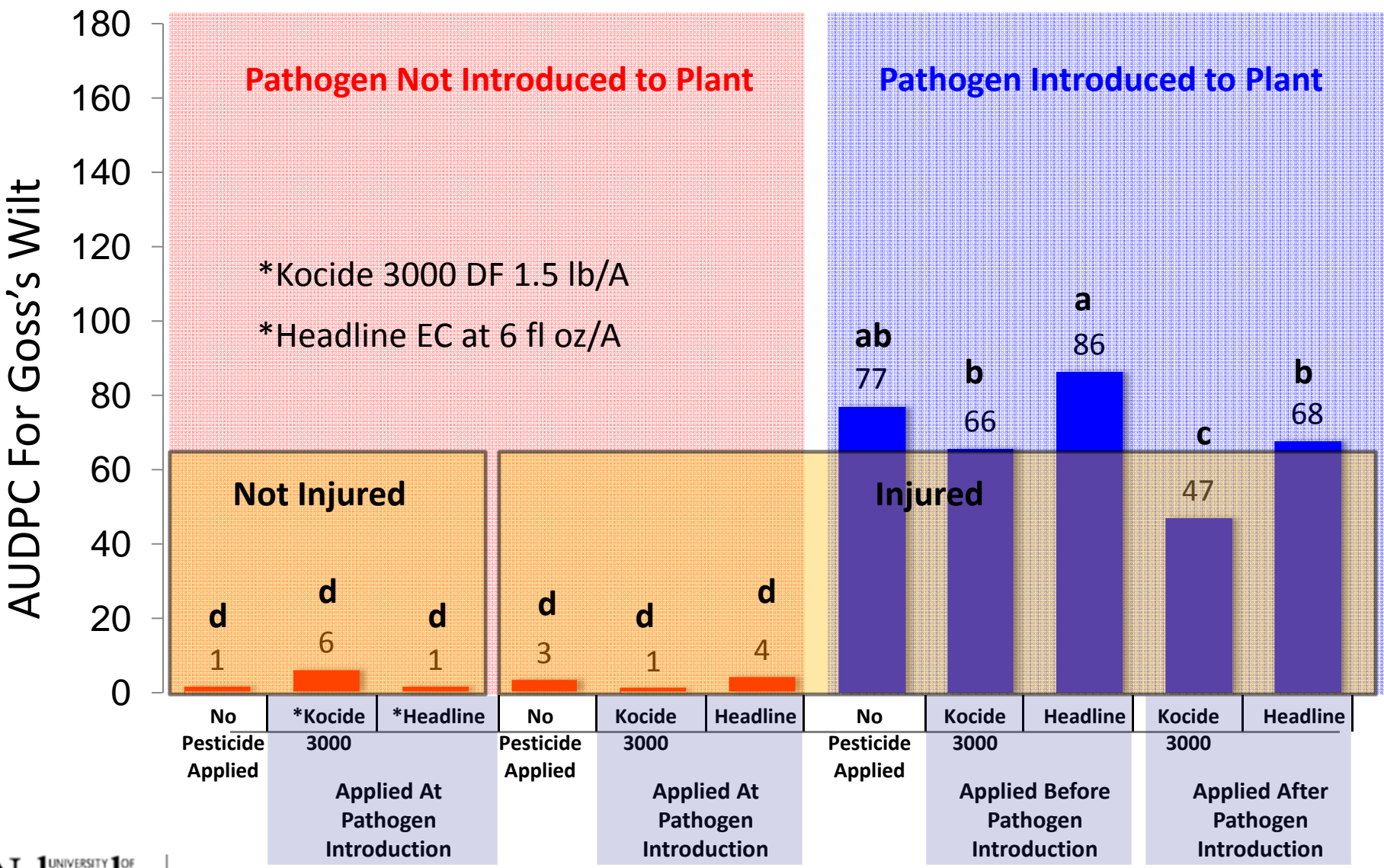
2009 Corn Goss's Bacterial Wilt and Blight Harvest Yield

105RM Susceptible Hybrid (rating = 7/poor)



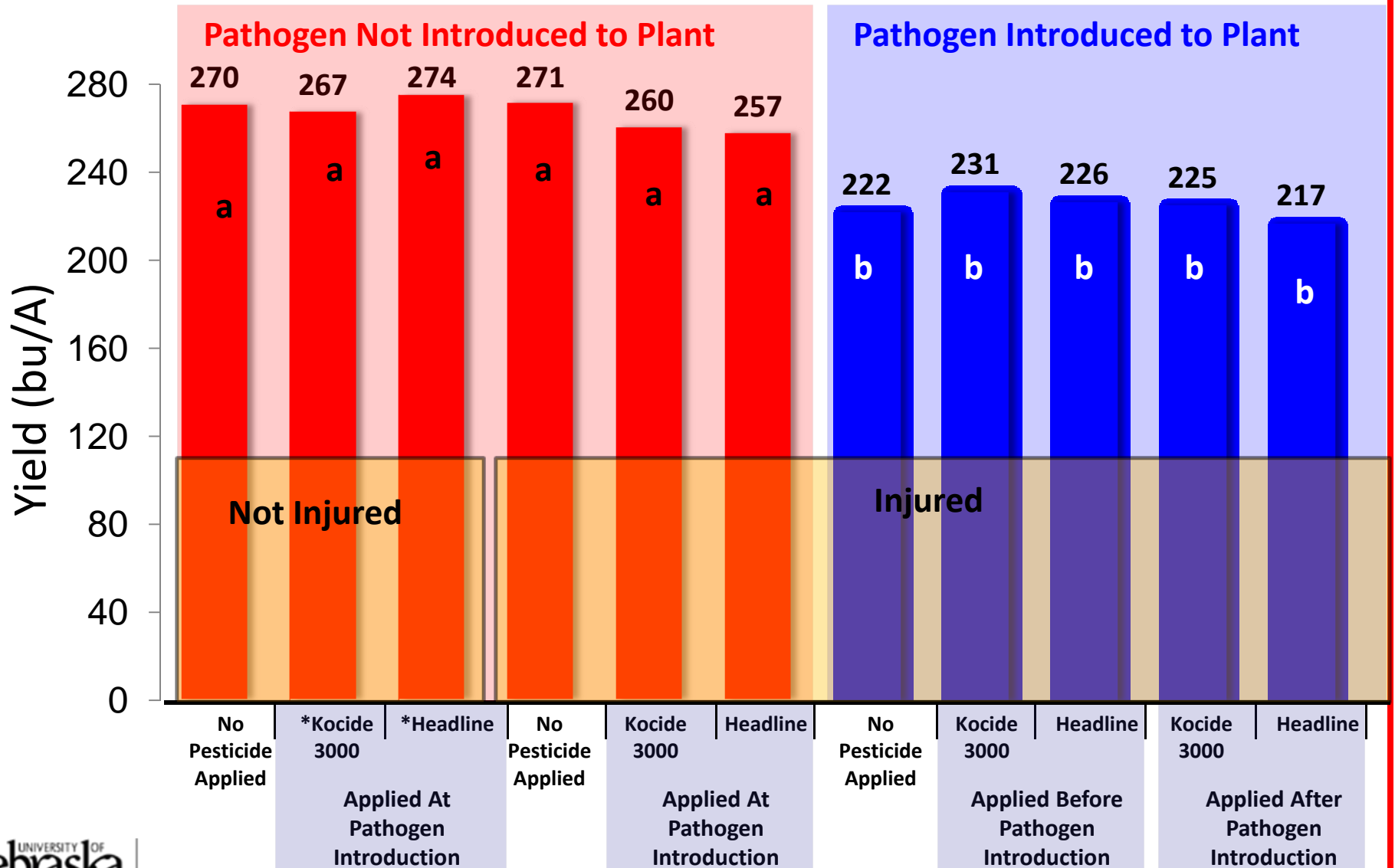
Area Under the Disease Progress Curve (AUDPC)

105RM Resistant Hybrid (rating = 3/very good)



2009 Corn Goss's Bacterial Wilt and Blight Harvest Yield

105RM Resistant Hybrid (rating = 3/very good)



Help is available at:

Plant & Pest Diagnostic Clinic

448 Plant Sciences Hall

University of Nebraska

Lincoln, NE 68583-0722

(402) 472-2559

UNL P&PDC Sample Submission form



UNIVERSITY OF Nebraska LINCOLN EXTENSION

Plant & Pest Diagnostic Clinic
Specimen Identification Form
448 Plant Science Hall
Lincoln, NE 68583-0912

Author: _____
Created: _____
Revised: _____
Printed: _____
Date: _____
Time: _____
User: _____

SUBMITTER		CLIENT	
Name: _____	Name: _____	Name: _____	Name: _____
Business Name: _____	Business Name: _____	Business Name: _____	Business Name: _____
Address: _____	Address: _____	Address: _____	Address: _____
City/State/Zip: _____	City/State/Zip: _____	City/State/Zip: _____	City/State/Zip: _____
Phone: _____	Phone: _____	Phone: _____	Phone: _____
Fax: _____	Fax: _____	Fax: _____	Fax: _____

Mail type to: Bulk Clear Flat Soft Class First Second Third Surface Registered Return Receipt Return Receipt for Merchandise

Seeking Response: Plant ID Plant Disease Insect Chemical Injury Weed ID Other Unknown

Sample Fee: Routine only basic diagnosis (\$10.00) Please notify if additional analysis is needed (over \$10.00) Routine advance testing needed (up to \$70.00)

Make checks payable to "University of Nebraska"

Crop or Plant: _____ Variety/Cultivar: _____
Date collected: _____ County of Origin: _____ Symptoms developed in: _____
Days _____ Weeks _____ Months _____
Days _____ Weeks _____ Months _____
Dormant in previous year: _____

Fieldgrown: Year established: _____ Soil Seed Plug

Tree/shrub/vine/strawberry: Age: _____ Height: _____ Number of years at site: _____

Lesions	Incidence	Symptoms	Parts Affected	Distribution	Field History
<input type="checkbox"/> Leaf	_____	<input type="checkbox"/> Abnormal growth	<input type="checkbox"/> Branch _____ %	<input type="checkbox"/> Center canopy	Soil pH: _____
<input type="checkbox"/> Petiole	_____	<input type="checkbox"/> Dead areas	<input type="checkbox"/> Entire plant	<input type="checkbox"/> Edge of plantings	<input type="checkbox"/> Soil Drainage: _____
<input type="checkbox"/> Throat/Node	_____	<input type="checkbox"/> Dieback	<input type="checkbox"/> Flowers	<input type="checkbox"/> General	<input type="checkbox"/> Good _____
<input type="checkbox"/> Gold Course	_____	<input type="checkbox"/> Leaf drop	<input type="checkbox"/> Fruit/seed	<input type="checkbox"/> High areas	<input type="checkbox"/> Poor _____
<input type="checkbox"/> Lower Turgor	_____ % of area	<input type="checkbox"/> Leaf spot	<input type="checkbox"/> Lenticel _____ %	<input type="checkbox"/> Low areas	<input type="checkbox"/> Plant _____
<input type="checkbox"/> Lenticel	_____	<input type="checkbox"/> Gum	<input type="checkbox"/> Bark	<input type="checkbox"/> Southern	<input type="checkbox"/> Previous Crop: _____
<input type="checkbox"/> Growth	_____	<input type="checkbox"/> Wilted	<input type="checkbox"/> Stem	<input type="checkbox"/> Tolerant areas	Yr 1: _____
<input type="checkbox"/> Necrotic/Stripped	_____ % of plant	<input type="checkbox"/> Wilted	<input type="checkbox"/> Trunk	<input type="checkbox"/> Soggy areas	Yr 2: _____
<input type="checkbox"/> Chlorotic	_____ % of plant	<input type="checkbox"/> Yellowed	<input type="checkbox"/> Crown	<input type="checkbox"/> Sandy areas	Yr 3: _____
		<input type="checkbox"/> Other: _____		<input type="checkbox"/> Other: _____	

Planting date: _____
Chemical history: Please provide chemical name, application date, and rate:
Fertilizer: _____
Soil treatment: _____
Herbicide: _____
Fungicide: _____
Insecticide: _____
Tillage: _____ Irrigated: Yes No

Please describe problem. Include any details not covered above. Attach photos if possible. (Please see reverse side for more space)

Available on-line at:

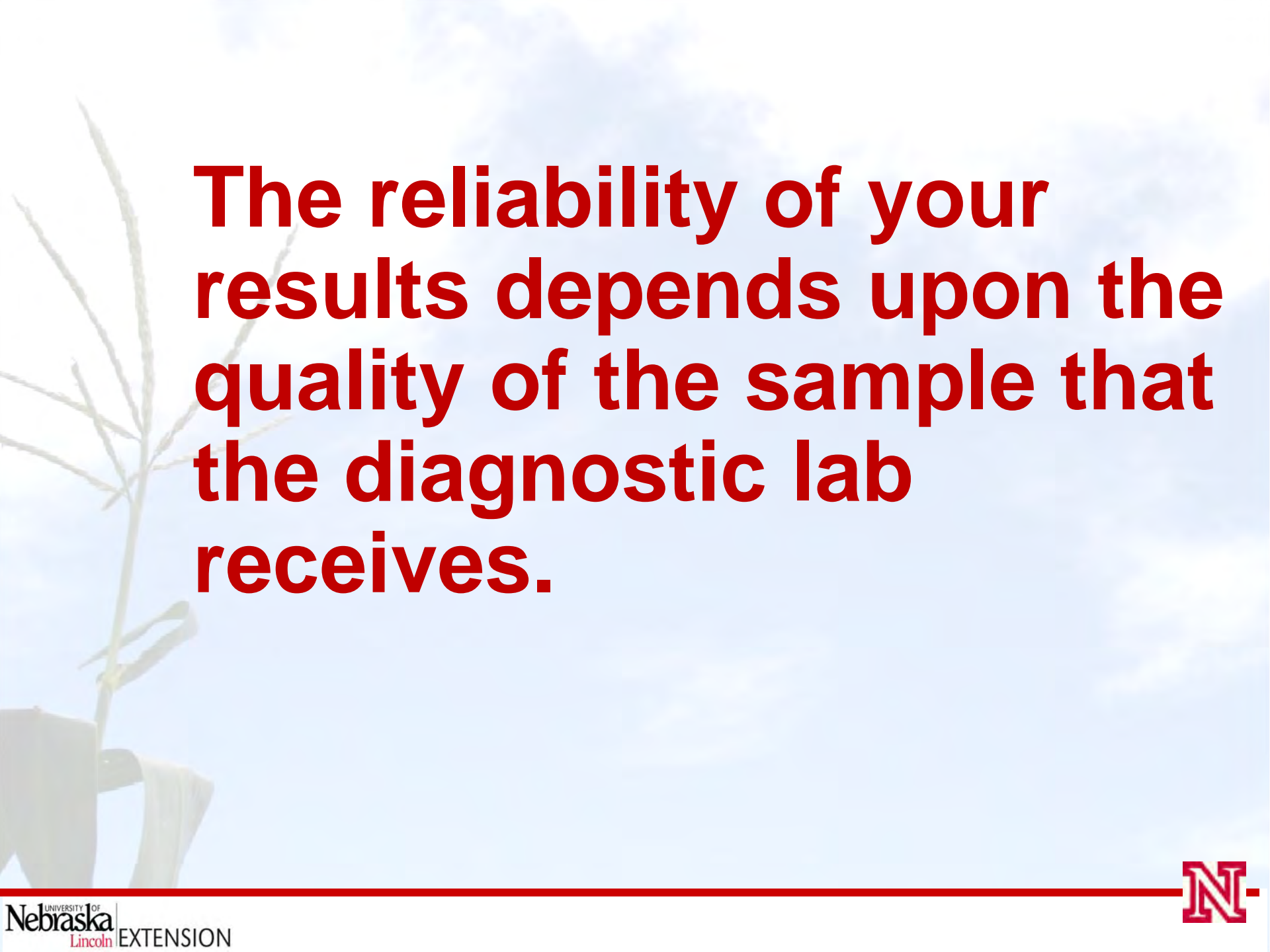
<http://pdc.unl.edu/diagnosticclinics/plantandpest/submissionforms>

Tips for Submitting Samples for Diagnosis

- Send several whole plants, roots and all that represent all stages of the symptoms
- Include “normal” plants
- Enclose the root ball in a plastic bag separate from the leaf material
- Place entire sample into a plastic bag
- Provide as much information as possible
 - Crop Growth Stage
 - Symptoms Distribution
 - Description of the symptom
 - How many plants in area affected?
- Mail sample Monday through Wednesday

When Submitting Samples DO NOT:

- DO NOT Add water
 - If there is excess water with the sample add *dry* paper towels to absorb the moisture
- DO NOT Let samples get too hot/cold
 - Keep samples cool. Store in a refrigerator overnight/weekend if possible
- DO NOT Place samples in paper bags
- DO NOT Mail Thursday or Friday



The reliability of your results depends upon the quality of the sample that the diagnostic lab receives.

> Navigation

Home

Plant Disease Basics

Agriculture Crops

Corn , Soybeans , Wheat ,
Sorghum , Alfalfa

Specialty Crops

Sugar Beet , Dry Bean ,
Sunflower , Citrus

Urban & Landscape Plants

Turf , Ornamentals , Trees

Fruits and Vegetables

Backyard Fruits , Backyard
Vegetables

PDC Specialists

Loren Gaylor , Tamra Jackson ,
Stephan Wiegand , Amy Davis ,
Robert Harrison

Disease Forecasts

Sugar Beet-Cercospora Alert ,
Wheat , Corn , Soybeans

Diagnostics Clinics

Plant & Pest Diagnostic Clinic -
Lincoln , Panhandle Plant
Disease Diagnostic Lab , Middle
Plant Diagnostic Lab

Management Trials

Efficacy , Cultural

Page Content - Look and Feel - Configuration - Close



Page Content - Look and Feel - Configuration - Close

Plant Disease Central

Mission: To be the plant disease information and management resource for the state of Nebraska.

Plant Disease Central (PDC) was developed by the Extension Plant Pathology Team of the University of Nebraska-Lincoln for extension educators, home owners, urban landscape managers, agricultural consultants, crop producers, and other agricultural professionals in Nebraska. This site will be updated and expanded as information becomes available, as additional and better images are acquired, and as resources allow.

The resources found on PDC were assembled to help users diagnose and manage plant diseases in Nebraska. The most critical issue for profitable management of plant diseases is obtaining a correct diagnosis. In any given year, the question is not whether or not diseases will occur in Nebraska but rather which diseases will occur and at what incidence and severity. Diagnosis of plant diseases can be difficult in the early stages of disease development. Users will find links to the University of Nebraska-Lincoln Plant and Pest Diagnostic Clinic, and the Panhandle Plant Disease Diagnostic Lab on this page for confirmation and assistance with diagnosis. For many diseases, symptoms become diagnostic and a reasonable level of confidence can be placed in diagnoses based on symptoms.

Approval for use of any materials on this Web site should be obtained from the primary author on the page the information appears.



Navigation - Look and Feel -
Configuration - Close

Home

- Plant Disease Basics

- Agriculture Crops

- Specialty Crops

- Urban & Landscape
Plants

- Fruits and Vegetables

- PDC Specialists

- Disease Forecasts

- Diagnostics Clinics

- Management Trials

<http://pdc.unl.edu/>