Use of Fungicides in Hail Damaged Crops

Shawn P. Conley, Paul Esker, and John Gaska

State Soybean and Small Grain Ext. Specialist, State Ext. Field Crops Pathologist, and Senior Outreach Specialist; University of Wisconsin, Madison

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Outline of Today's Discussion Topics

- Rationale behind this research question
- Field corn experiments
  - Simulated hail injury IL. (Bradley and Ames, 2010)
  - Lancaster 2009 – planned fungicide experiment
- Soybean experiment
  - Lancaster 2009 – unplanned hail/fungicide experiment

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Hail Impact on U.S. Soybean and Corn Acres

- Since 2003, the National Crop Insurance Service has paid claims on an average of 2.3 million acres of soybean per year at an average cost of $53.5 million

- Over the same period of time, the NCIS estimates approximately $36 to $59 million in annual claims due to hail damage in corn (Bradley and Ames 2010)

- With increasing global temperatures, more extreme and unpredictable weather patterns have been suggested; therefore; grower risk for severe hail damage may increase (Kajfez Bogataj, 2005)

Why an important question for WI growers

- In 2009, severe hail damage was reported in Southwest WI and across large sections of Iowa; following this hail event, growers, retailers, and agronomists alike were asking if these acres needed to be treated with a fungicide

- Much of this was prompted by BASF's supplemental label for Headline® that states, …..*"the plant health benefits may include improved host plant tolerance to yield-robbing environmental stresses, such as drought, heat, cold temperatures, and ozone damage" and for corn, "improved stalk strength and better harvestability, inducted tolerance to stalk diseases, better tolerance to hail, more uniform seed size."*

Physiological versus Disease Response?

- If we expect a response we must be clear in our understanding of where that response will come?
- Physiological response to stress (Bradley and Ames, 2010)
  - *"…Physiological effects of quinone outside inhibitor (QoI) fungicides on plants in greenhouse and laboratory studies such as delaying senescence, altering amounts of plant hormones, increasing activity of antioxidative enzymes, and increasing activity of nitrate reductase*."
- Disease response to increased wound sites
  - Remember we are applying a fungicide for control of ***FUNGAL*** diseases

Common Diseases of Corn

Fungi

Anthracnose

Eyespot

NCLB

Rust

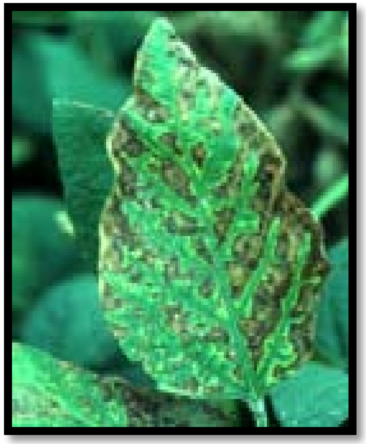
Bacteria

- Stewart’s Wilt and Goss’s Wilt

Common Diseases of Soybean

Fungi

White Mold



Brown Stem Rot

Phytophthora Root Rot

Bacteria

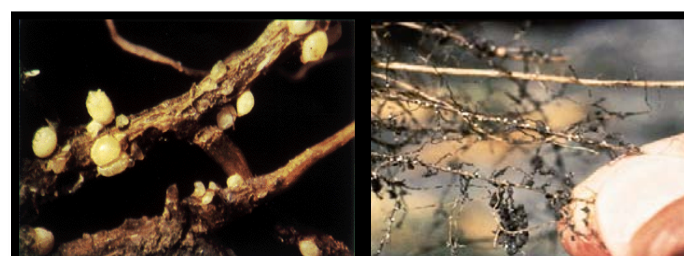
Bacterial Blight

Virus

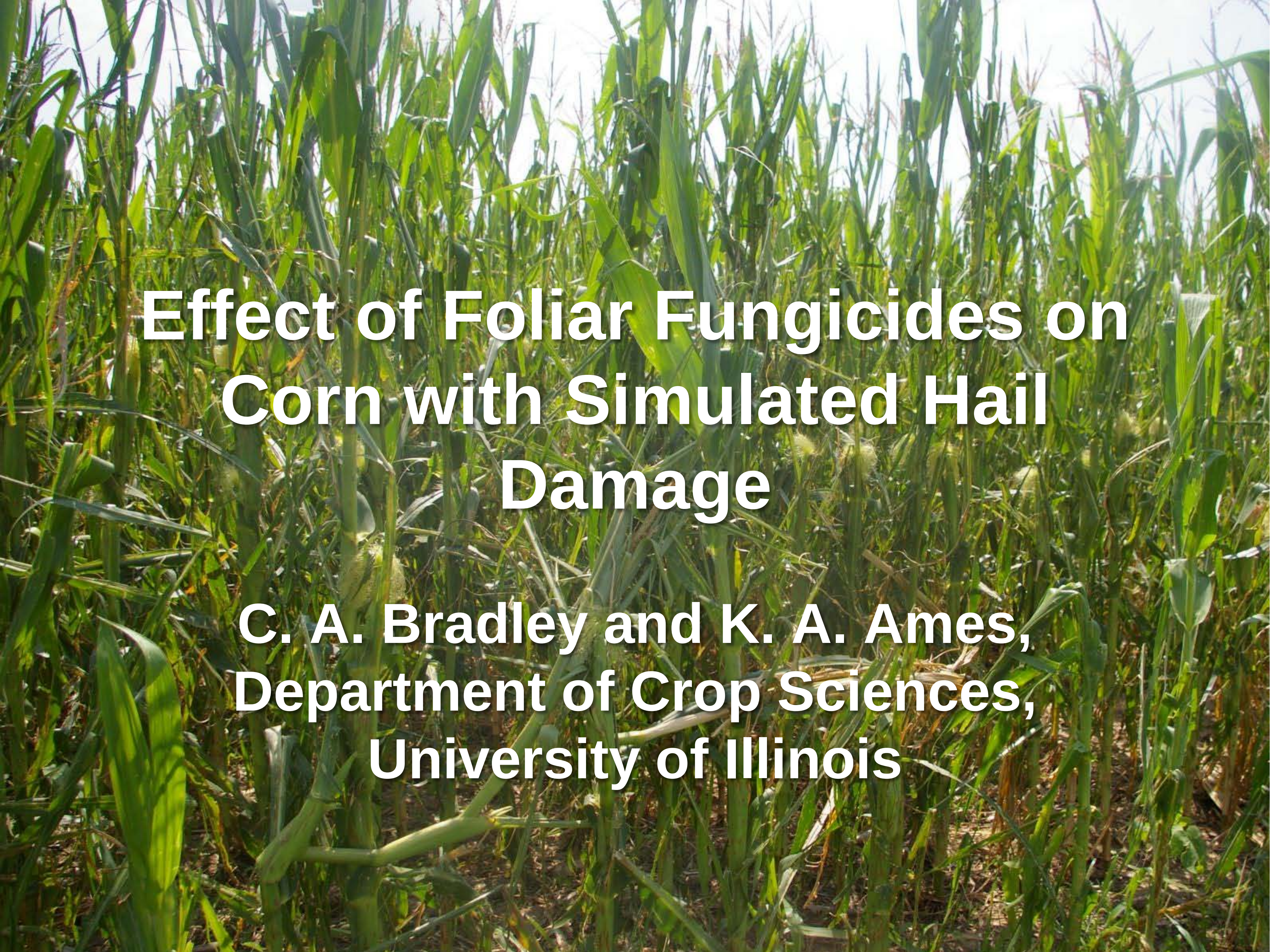
Soybean Mosaic Virus

Bean Pod Mottle Virus

Nematodes



Soybean Cyst Nematode



Effect of Foliar Fungicides on Corn with Simulated Hail Damage

C. A. Bradley and K. A. Ames,
Department of Crop Sciences,
University of Illinois

Materials and Methods

- Prior to EPA's approval of the BASF plant health label, Bradley and Ames (2010) initiated an experiment to quantify the effect of Quinone outside inhibitor (QoI) foliar fungicides on hail damaged corn.
- Simulated hail injury at V12 using a hand-held gas powered string mower
- At the VT growth stage,
  - UTC
  - azoxystrobin (Quadris; Syngenta Crop Protection, Greensboro,NC) at 9 ounces per acre
  - Headline (BASF Corp.) at 6 ounces per acre
- Disease ratings were taken ~3 weeks after fungicide application and grain yield was collected at maturity.

Disease and Yield Response to Simulated Hail and Fungicides

Table 1. Partial analysis of variance table from a foliar fungicide by simulated hail damage field research trial conducted on hybrid corn near Champaign, IL in 2007 and 2008

		$P > F$		
Source of variation	**df**[z]	**Disease severity**	**Yield**	**Seed moisture**
Block (year)	5	0.2254	0.8340	0.1240
Year	1	0.0001	0.0002	0.0001
Hail	1	0.0013	0.0001	0.0290
Fungicide	2	0.0001	0.9977	0.0033
Year × hail	1	0.0023	0.0170	0.6289
Year × fungicide	2	0.0001	0.3949	0.8722
Hail × fungicide	2	0.2250	0.9204	0.8233
Year × hail × fungicide	2	0.1100	0.7229	0.6041

[z] Degrees of freedom.

Table 2. Effect of simulated hail damage on disease severity and corn yield near Champaign, IL in 2007 and 2008 (averaged over fungicide treatments)[y]

Year	**Simulated hail damage**	**Disease severity (%)**[z]	**Yield (kg/ha)**
2007	No	44 b	10,728 a
	Yes	52 a	8,762 b
2008	No	4 c	10,357 a
	Yes	4 c	7,297 c

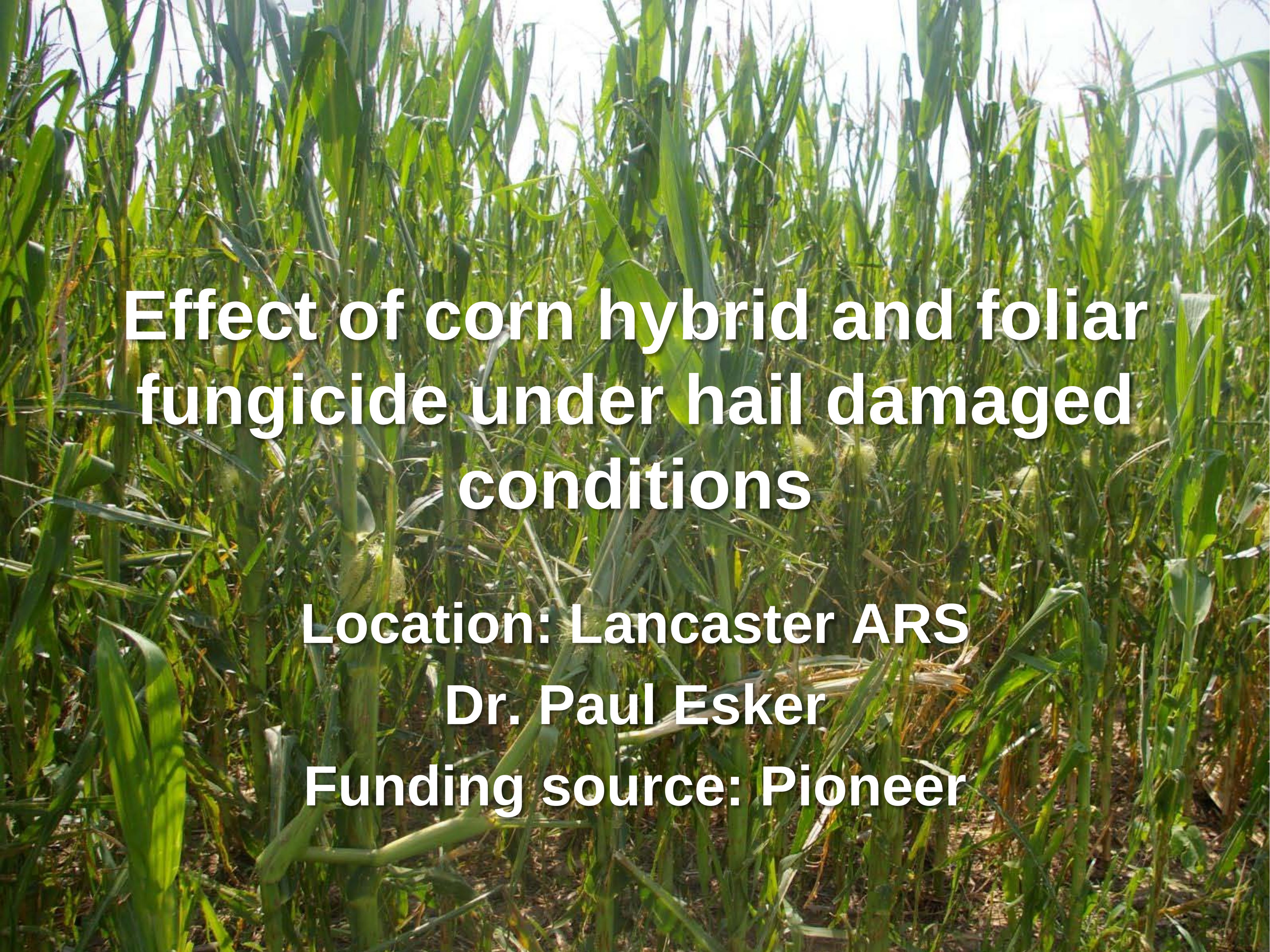
[y] Values followed by the same letter are not significantly different ($P \leq 0.05$).
[z] Percentage of the leaf above the ear covered with fungal foliar disease symptoms. The primary disease present each year was gray leaf spot (caused by *Cercospora zeae-maydis*).

Bradley, C. A., and Ames, K. A. 2010. Effect of foliar fungicides on corn with simulated hail damage. Plant Dis. 94:83-86.

Summary

- Both Headline and Quadris decreased disease incidence in 2007, however no differences in disease control were noted in 2008

- No yield benefit was shown in either year



Effect of corn hybrid and foliar fungicide under hail damaged conditions

Location: Lancaster ARS

Dr. Paul Esker

Funding source: Pioneer

Study objective and design

- **Objective**: *evaluate performance of corn hybrids to anthracnose stalk rot under inoculated and non-inoculated conditions, and with and without the use of foliar fungicides*
- Experimental design: Split-split plot
- Main plot: foliar fungicide
  - Headline®, 6 oz/A, R1 application
  - No fungicide
- Subplot: corn hybrid (next slide)
- Split-subplot: *Colletotrichum graminicola* (inoculation at planting)
  - Previous crop = corn
  - History of corn anthracnose

Corn hybrids

- P37K11 (CRM 99)
- P0377XR (103)
- P0461XR (104)
- P0916XR (109)
- P9990XR (99)
- P37Y14 (99)
  - Anthracnose ratings range from 3 to 5

Trial information

- Hail damage
  - July 24
  - Pea to marble size
- Fungicide application:
  - 29 July
  - 40 PSI; 20 GPA
- Hail damage notes
  - 3 August
  - 10 plants per plot
  - Leaf defoliation (% per plant)
  - Necrosis (% per plant)
  - Stalk bruising (% per plant)

Late season disease notes

- 8 September
- Incidence estimated on 10 plants per plot for:
  - Evidence of ear rot
  - Top dieback
  - Stalk lodging based on push test
  - Common smut

Anthracnose stalk rot

- Ratings made on 12 October (black layer)
- Five plants per plot (destructive sampling)
- Ratings (0-5) using the Hinds et al. scale (U. Illinois)

Yield and quality

- Hand harvest (3 November)
- Grain yield (adjusted to 15.5% moisture)
- Grain moisture
- Test weight
- Ear length and ear width (cm) measured for 3 randomly selected ears per plot

Results

- Hail damage:
  - Fungicide x variety x inoculation interaction for defoliation (*P* =0.0792) and stalk bruising (*P* = 0.0963) although no clear trend
- Diseases (September assessments):
  - Ear rot (*P* = 0.0011) and lodging (*P* = 0.0014) affected by hybrid
    - Highest ear rot observed in P37K11 and P9990XR
    - Lodging highest in P37K11 and P37Y14
  - Top dieback: fungicide x hybrid interaction (*P* = 0.0078)
    - P37K11 and P37K14 had highest incidence of top dieback, which was observed in plots with fungicide application

Results (Cont.)

- Stalk rot @ black layer
  - Affected by hybrid ($P < 0.0001$)
    - P37Y14 had average rating of 3.6 (all other hybrids were between 1.1 and 1.5
- Yield and quality
  - Ear length ($P < 0.0001$) and width ($P = 0.0081$) affected by hybrid
    - Longest ears in P9990XR (17.4 cm)
    - Largest ear width in P0377XR (4.6 cm), P0461XR (4.6 cm), P9990XR (4.5 cm)
  - Yield ranged from 113 to 159 bu/A (CV = 16%) (NSD among treatments)
  - Grain moisture: fungicide x hybrid interaction ($P = 0.0905$)
    - Highest (26%) in P0916XR with fungicide

Results (Cont.)

- Test weight
  - Fungicide x hybrid interaction (*P* = 0.068)
    - Driven by differences between P9990XR (lower in plots that received fungicide) and P37Y14 (lower in plots that did not receive a fungicide)
  - Fungicide x inoculation (*P* = 0.0073)
    - Inoculated plots had test weight higher when no fungicide, which was opposite in non-inoculated
  - Hybrid x inoculation (*P* = 0.0216)
    - Driven mostly by P37Y14 – higher test weight in inoculated plots (no other clear trends)

Summary

- Overall, results suggest that the primary factor that should be considered for corn anthracnose is hybrid selection
  - Hail did impact trial (i.e., reduced yield)
  - Application of foliar fungicide did not improve plant health

Soybean Yield Response to Fungicides and Hail

- Crop Injury
  - July 24th hail event
  - From 15 to 12 nodes
  - 80% defoliation
- Application
  - 8/5/09 – R3 soybean
  - 15 GPA
  - 4 reps – 10 by 25’

Soybean Hail Fungicide Trial; Lancaster, WI			
			Grain
Treatment	Product	Rate	Yield (bu/a)
1	UTC		55.6
2	Quilt	14 fl oz/a	51.0
3	Headline	6 fl oz/a	53.1
4	Stratego	10 fl oz/a	50.7
Means			52.6
Probability %			33.6
LSD 10%			NS
CV%			8

Summary of Hail Fungicide Trials

- These results are limited to fungicide applications following a hail event
- Results from the two WI studies coupled with Bradley and Ames (2010) suggest variable disease response and no yield response to fungicide following severe hail damage in corn or soybean
- Given the significant yield loss that can occur from hail events, we have not seen any benefit from foliar fungicide applications to severely hail damaged corn or soybean

The Soy Report

MONDAY, NOVEMBER 30, 2009

Biological Control and White Mold of Soybean

With the wide-spread reports of White mold (or Sclerotinia stem rot, SSR) this year in Wisconsin and across the region, we have been fielding many questions about control options. In particular, many of these questions have been about Contans WG. In this blog, Angie Peltier (Postdoctoral Research Associate in Plant Pathology) and I try to provide information that will help you understand more what biological control for white mold entails.

What is Contans WG?

Contans WG (SipcamAdvan; Durham, NC) is a commercial biocontrol agent and is a proprietary powder formulation that contains the fungus *Coniothyrium minitans*. Contans WG has been labeled for use in both conventional and organic soybean.

C. minitans was first described in California in 1947, and it is now known to have a world-wide distribution. The host range of *C. minitans* includes important plant pathogens such as *Sclerotinia sclerotiorum*, *S. trifoliorum*, *S. minor*, and some strains of *Botrytis cinerea*, *B. fabae*, and *Sclerotium cepivorum* (Turner and Tribe, 1976).

How does it work?

The fungus that causes white mold (*Sclerotinia sclerotiorum*) produces long-lived survival structures called sclerotia that many say resemble rat droppings. Sclerotia are important in the life cycle of *Sclerotinia*, allowing the fungus to survive in the soil until conditions are favorable for the disease cycle to begin: Upon canopy closure and during periods of cool and wet weather, sclerotia germinate to produce mushroom-like fruiting structures called apothecia. Apothecia produce ascospores that are wind-disseminated. If during a period of leaf wetness ascospores land on dying soybean flower tissue, they can use this food source to gain entry into susceptible soybean plants and cause disease. Many apothecia can emerge from one sclerotium, making each sclerotium an important inoculum source.

The Soy Report Mission

To provide Wisconsin growers and agricultural clientèle with timely crop management recommendations, diagnostics, and crop updates.

WI State Soybean and Wheat Extension Specialist

Shawn Conley

WI State Extension Field Crops Plant Pathologist

Paul Esker

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