APS Soybean Rust Symposium
November 30-December 1, 2006
St. Louis, MO

The following are brief notes taken from the presentations and from the discussion sessions that followed each session.

General Session: Soybean Rust in 2006

Welcome and Overview of Soybean Rust in 2006
Thursday, November 30, 2006
Don Hershman, Moderator
Recorders: Laura Sweets, University of Missouri
Daren Mueller, Iowa State University

Welcome: Gale Buchanan, Under Secretary of Agriculture

Change from welcome address to "thank you" address. Dr. Buchanan recognized many of the individuals that have played key roles in responding to this real threat to American agriculture. Really, truly proud of "our system", important contributions of USDA-ARS prior to rust arrival in US, congratulations to EPA for help in registration of fungicides, impressed with land grant universities, extension, industries, etc. cooperating to such a degree. This response to real threat has established a tremendous program and demonstrated the power of our system when we work together.

Overview of SBR in North America during 2006: Loren Giesler, University of Nebraska, Northern Sentinel Plot Coordinator

Sentinel system during 2006 consisted of

- 62 overwintering plots- all kudzu in 7 states
- 753 in-season plots
    - 650 soybean plots
    - 64 kudzu plots
    - 39 other host plots
- Soybean and kudzu primary hosts scouted
- Entities that established sites or sentinel plots
    - 2005 more consultants
    - 2006 more University Plant Pathologists and Extension agents
- Primarily one planting date per site and early planting was emphasized
- Slight increase in mobile plots in 2006
- 2005 most samples assessed in field: 2006 most examined in lab
- 2005 most samples not incubated; 2006 most samples incubated for 24-48 hours
- Dissecting microscope main tool
- Extension agents, university faculty and students did most of the sample collection
- Number of leaflets collected averaged 100 but ranged from 30 to 200
- Every 2 weeks early in the season and weekly later in season
- SBR always showed up first in earliest MG for any planting and found in lower canopy (late season exceptions)
- Most SBR first detection at very low incidence 1-5% and low severity <0.1%
- More positive kudzu sites
- Non-sentinel plots very productive
- For SBR infection, scouting prior to flowering not as crucial
- Early planting with early and late maturing varieties recommended

- Lab examination still very important

Overview of SBR in South American during 2005-2006: Cláudia Godoy, EMBRAPA

- Brazil-plants October through December and harvest March-January for first crop
    - Plant second crop January through March
- Pirapo May 2006 50% loss in late planted beans
- Paraguay survival on volunteer soybeans along roadsides and other hosts such as kudzu and perennial soybean
- Argentina progression from SBR in one region in 2001; 2 regions in 2002; 2003 National SBR Program initiated; 2003/2004 numerous regions and 2004/2005 numerous regions of country
- First reports each year usually along border of Brazil and Paraguay
- Growth stage at time of SBR detection usually R5-R6
- Brazil- May 2001 first report on volunteer soybean and second crop soybean
- Anti-Rust Consortium was formed - educational effort
- SBR spread very rapidly in Brazil
- Weather conditions and initial inoculum sources very important factors in outbreaks
- 2005/2006 some regions SBR present and other regions SBR present and losses
    - 2.9 million tons of grain estimated lost
- 5% detection in V stages of growth; 95% detection in R stages of growth
- Green bridge- continuous soybeans with rust between 2 crop seasons
- Recommendation (now a law) allow 90 days between harvest and sowing in MT, GO and MS and destroy volunteer soybeans- “sanitary emptiness”
- Early planting were producing inoculum for later plantings
- Increase in number of recommended (available) fungicides
    - 2002- 5 fungicides
    - 2006- 31 fungicides
- Losses due to improper application timing and costs of fungicides preventing their use
- Conclusions:
    - SBR has come to stay
    - Outbreaks related to source of inoculum and weather
    - Continual problem in central west area of Brazil and occasional problem in southern regions of Brazil, Argentina and Paraguay
    - Control- scouting and fungicides at correct time

Overview of SBR in the Caribbean Basin during 2005-2006: Consuelo Jensen, University of Puerto Rico

- 1,000 A of soybeans in Puerto Rico
- Rust was present on soybean, dry beans and other legumes
- 1913 and 1975 Jayuya-SBR but *P. meibomiae*
- 2005- Six seed companies with plots in Puerto Rico- no rust in any of these plots but all plots were treated with Quadris
- 2006 *Lablab purpureus* with *P. meibomiae*
- Puerto Rico- *P. meibomiae* common where shade and rainfall
- 2006 sentinel plots with soybean and dry beans at three locations
    - May and October highest rainfall of season
- No pustules at any location in 2006- some suspected but negative for *P. pachyrhizi*; weather not favorable for disease development

Overview of SBR in Mexico during 2006: Ing. Rigoberto Gomez

- 60,000 hectares of soybean
- May 2005- found SBR
- Phytosanitary Alert System was established
- Government took steps to prevent spread and initiate an educational effort
- 25 leaves per square meter for examination in lab
- 2006 43 sentinel plots established
- More sentinel plots are planned for 2007

Questions and Answers:

Q: There was an increase in detections in 2006. Was this because of a greater level of disease or better detection techniques?

A: Loren Giesler- some of both. Learned value of incubating leaves from 2005 and learned better ways to detect in 2005 and early 2006. Perhaps more movement and spread in 2006

A: Don Hershman- did we miss it in 2005—NO

Q: Ray Schneider- What is cropping system in Mexico and will information from sentinel plots be available on web site?

A: Gomez- plant in July. Hope to report information on web site and Mexican government has its own site too

Q: Don Hershman- Is *P .pachyrhizi* in Cuba?

A: Consuelo Jensen: No PCR was done on samples.

Q: Kitty Cardwell- Is soybean cultivation increasing in Mexico?

A: Ing. Gomez- number of hectares not expected to increase.

Q: How many first finds were in sentinel plots vs. commercial fields?

A: Don Hershman- early planting focus of sentinel plots meant many sentinel plots were gone late in the season so many first detections in 2006 were in commercial fields.

Q: For early planted sentinel plots how much earlier than early planted commercial fields?

A: Loren Giesler- very similar dates. 2007 many states will go with early planted commercial fields.

A: Don Hershman- greater difference in south than north between "early"

Q: In Brazil not obtaining 100% control. 7 applications on winter crop and several applications on summer crop were mentioned. Is there any evidence of fungicide resistance?

A: Claudia Godoy- not 100% control because of differences in efficacy, problems with timing of applications and sensitivity of fungicides.

Q: Some plots positive in 2005 were negative in 2006. Why?

A: Loren Giesler- differences in weather patterns, plots not in exactly the same location each year so general areas similar but specific sites may have been different.

A: Bob Kemerait- more hits in 2006. In 2006 spent more time in GA looking for leading edge of disease development and less time documenting sites in same county or adjacent counties.

Q; Any plans to implement real time PCR on samples in Puerto Rico?

A: Consuelo Jensen- yes, with help from University of Florida.

Q: With overwintering in Brazil is there any evidence of telial stage?

A: Claudia Godoy- yes, find some but don't know how important it is. Usually find at end of crop season as crop is declining.

Q: John Rupe- What are conditions for long distance spread of SBR from Bolivia or your impressions on long distance spread of SBR?

A: Claudia Godoy- In Brazil most sources are local. No firm ideas on long distance spread.

Results from 2006 Soybean Rust Control Studies
Bob Kemerait, University of Georgia, Moderator
Recorder: Doug Jardine, Kansas State University

Results from fungicide efficacy trials, University Data
- Melvin Newman, University of Tennessee

This is a complilation of studies from AL, FL, GA, and LA
Key factors to consider for 2006 and 2007

- dry weather reduced rust
- results cannot always be duplicated in commercial fields
- producer's main question is, "what fungicide do I use?"
- fungicide availability is not an issue, many products are being added to the arsenal
- the bottom line is that they work
- coverage is very important for any fungicide
- producers need to know the growth stages-this is key area for extension
- producers also need to know how to identify the disease at low levels of development
- time to spray is at or before the finding of the first pustule
- brown spot complicates the problem of identification
- modes of action are confusing to the farmers

<u>Alabama</u>

1. compared Absolute vs. Stratego
   - Stratego had best yield
   - severity on the checks averaged 8-9
   - fungicides reduced the severity to 2-3
   - there was a 10-14 bushels/a yield increase with all fungicides

2. compared contacts vs. systemics
   - contacts did not do as well with severity ratings from 5-7 vs. 9 for check
   - while there was a 9-10 bu increase in yield with contacts, there was an 18-26 bu increase with the triazole fungicides

<u>Georgia</u>

The study was part of a regional standardized test, which consisted of two applications one at R2 and again at R3

- -incidence of disease on the check was 80 – 100%
- -All fungicides did well after 28 days
- -Many gave out by 37 days after application
- -the check had a severity rating of 6 on a scale where 8 = defoliation
- -yields were not significantly different from the check for any treatment

Attapulgus, GA

Comparision of contact and contact/systemic mixes in the study

- -Microthiol did poorly in this study
- -While most products averaged 19-25 bushel yield increases, Microthiol increased yield only about 9 bu/a

Comparison among triazoles, all the products did well

- -there was a 9-11 bu/a yield increase, but rust infections was light

Florida, Quincy – Late season fungicide study
-two applications were made
-the check had a rating of ~ 4.5
-in early November, all fungicide treatments had ratings of </= 1
-By 27 Nov, all treatments were defoliating heavily, but not as bad as the check

Alabama, Gulf Coast
-compared strobilurins or strobilurins/triazole mixtures followed by triazoles
-check defoliation = 8
-rated 35, 43 and 55 days after application
-most treatments had good control for 43 days
-several still held up after 55 days
-triazoles seemed to be the best, but it didn't matter which one

Louisiana- two locations

- Cercospora blight was a confounding problem
- Rust was light and late in coming
- Fungicides did well on rust, but not on Cercospora
- Yields increased 4-15 bu with a fungicide, but most were not significantly different

CONCLUSIONS

- Triazoles are best for rust
- Mixture may be needed for control of other diseases, use strobilurons when other foliar diseases are present
- early application is essential for good control of rust
- good coverage is very important with any fungicide or combination

Results From Industry Efficacy Trials – Gary Cloud, Ag Research Associates
Materials were Section 3 or 18 registrations for rust and this was all company data

BASF

Trial 1
-Severities were reduced from 65% to <10% for Headline + triazoles @ 21 DALA
-defoliation ranged from 80% for the check to <40% for the treatments
-Yields almost doubled
Trial 2

-Severities were reduced form 35% to <8%
-defoliation was reduced from 70 to ~30%
-Yield increased 10-15 bu

Trial 3
-Check severity 90%
-Range of severities for treatments was from <10% to 50%
-Better control occurred with strobilurons plus triazoles compared to triazoles alone
-10-20 bu/a yield increases occurred
-strobilurins + triazole yields were significantly better than triazoles alone, which in turn were significantly better than the check

-CONCLUSION: Headline + metconazole was effective in all trials
-the level of control was statistically comparable to Headline SBR

Dupont

-Flusilazole and azoxystrobin comparisons were made
-CONCLUSION: flusilazole demonstrated excellent preventive and post-infection control of ASR.
-with post-infection applications however, only flusilazole controlled ASR while azoxystrobin was not active.

Sipcam

-Used a two-tiered rating system, looking at both canopy position and severity
-Examined Echo and Folicur
-Three treatments stood out, Echo plus Muscle and two triazole treatments
-CONCLUSIONS: Echo followed by Muscle produced the highest yields
-Triazoles applied twice gave the highest seed weight

Syngenta – based on studies in Brazil
-tested Alto and Quadris
-All treatments provided significant control
-No differences in efficacy between the two rates of either Quadris Xtra or Alto
-the current recommendation of Quadris + Alto was effective
-Strobilurins generally delay maturation, but can be a negative factor with regard to timely harvest
Adjuvant results, Control was comparable with or without NIS or crop oil
CONCLUSIONS: Even weaker treatments protect some of the yield. We may have to take a look at the economics because it might be cost effective to go with lower rates or cheaper materials.

Valent

-applied at R2, triazole containing materials performed best

-applied at R3, all fungicide treatments were better than the check except Quadris
-applied at R5, all fungicide treatments were better than the check

Is "when" more important than "what": optimizing protection against soybean rust – Bob Kemerait, University of Georgia

-First rust detected on July 3
-Most important spread came from late Aug to Sep (soybeans nearing maturity)

Grower response this past season
-much less anxiety about control than in 2005
-they have confidence in sentinel plots
-less fungicide was applied in 2006
-the first warning for risk of rust infection was issued on 17 Jul
-only localized areas were initially affected
-State decreased from 65 to 45% acres sprayed in 2006

- #1 Question on growers minds is when do I spray?
- #2 Question is what do I spray?
    -Growers are getting mixed messages on when to spray
    -No need to protect once R6 is reached

-Kemerait recommendations:
-Make first application when rust is in the region, but not before R1
-Early applications of chlorothalonil are not needed when rust comes late
-You get little yield bump with later applications

Attapulgus I
-R3 timing was the best
-Yields from R1 sprays were equal to R3 sprays
-Timing more critical for Folicur than Domark and SBR

Attapulgus II
-the fungicide choice was less critical, just spray
-Avoid timing of sprays too late based on infections, R5 was too late, disease was already present
-Folicur applied at R3 did not benefit from a second application
-Strobilurins + triazoles were better than strobilurins alone

Quincy study
-Headline SBR provided the best control, Folicur was also good, Quilt was less effective
-spraying at R1 was too early, but spraying at R3 and R5 were equally effective
-at this location, there was some benefit from two applications

-CONCLUSLIONS:
-Triazoles + strobilurins are better than a triazole alone

-Yield was not typically increased by two applications

RECOMMENDATIONS:
-Timing is important
-R3 worked well each time
-R1 and 5 were variable
-Vegetative stage was too early
-Fungicide choice is important
-A well-timed single application of the best fungicides may be as effective as two applications of combination fungicides
-the importance of R6 applications is still not known
ADVICE: anticipate application between R1 and R3 depending on sentinel plot warnings

DISCUSSION SESSION

Q. How do you deal with latent infections?
A. Bob, err on the side of spraying too early

Comments
-Bob Wolf, Agriculture Engineer, Kansas State University. Noted that the spray rig speeds were very slow in these trials compared to commercial applications
-Need to keep gallonage above 15 gpa
-Control from aerial applications may not match ground trials
-Brazil trials were on 36" row spacings
-Low gallonage sprays in narrow rows will likely not be as effective as at the wider row spacings

Q. Were there any organic product trials?
A. At Quincy, when *Bacillus subtilis* was sprayed weekly, it was as effective as fungicides in reducing disease severity, but yields did not hold up to those of the fungicides.

Q. Were there significant levels of other diseases in Georgia?
A. Frogeye leaf spot is sporadically important. There was a fair amount at Attapulgus, but probably not yield limiting.

Q. Were rust finds from the initial infection or secondary infections?
A. It is not known. The disease may have been asymptomatic in August, causing it not to be detected.

Q. Are there any differences in determinant vs. indeterminate varieties?
A. Indeterminate varieties may be easier to spray because of a more erect plant structure.

Comment: Not all studies adequately report nozzle types and other application information. This may be as important as the fungicide you use.

Concurrent Breakout Sessions – 1:00 to 3:00 pm
Thursday, November 30, 2006

Biology of Soybean Rust – Rusty Smith, USDA-ARS, Moderator
Recorders: Robert Mulrooney, University of Delaare
Wayne Jurick, University of Florida

Life cycle, spore germination, and survival. Dario Narvaez, University of Florida

- Compound interest disease, urediniospores primary and polycyclic
- Teliospores have only been found on kudzu in the US and germination has not been observed.
- 3-6 hours of leaf wetness necessary for spore germination, 12-14 hrs optimum.
- Optimum temperature for infection 18-26 °C
- Symptoms occur in 4-5 days after inoculation, 7-10 sporulating pustules are produced, pustules produce spores for 2-3 weeks.
- Spores are distributed in masses (clumps= 200-300 spores).
- Frequency and amount of rainfall is the driving force behind infection.
- *Phakopsora pachyrhizi* will preferentially form appressoria on polystyrene coated slides and germtubes on PDA and agar plates
- Viability of isolated urediniospores is frequently lost in a few days after being release from the pustule
- Germination of *P. pachyrhizi* urediniospores may occur in clumps.
- Clumps may protect urediniospores against desiccation, UV radiation and other environmental factors.
- Clumped spores are more likely to travel long distances and reach new areas.
- Information about clumping may help to properly design disease management programs.
- Proportion of *P. pachyrhizi* urediniospores decreased with increasing exposure to solar radiation
- Urediniospores are sensitive to exposure to solar radiation, reducing viability
- Rain simulator is an effective tool for examining the vertical distribution of spores in a soybean canopy
- Spores deposited by rainfall are distributed evenly throughout the soybean canopy
    - 20 inches high
    - 36 inch row spacing

Movement of Spores, Paul Mumma, Louisiana State University

- Rhychmic/circadian production of spores
- Bell shaped optimum for spore production
- Spores are released around noon daily from spore trap data in FL
- Spore production is extremely sensitive to temperature
- Maximum spore production occurs between 65 and 75 °F.

- Results from field and incubator studies indicate that short exposure to less than 2 hrs exposure to 90° F severely repressed spore production.
- Higher temperatures, decrease spore production, lower temperatures decrease spore production.
- Field and incubator studies are highly correlated and can be used for model development

Diversity – Typing populations/isolates - Kerry Pedley, USDA-ARS

- Evaluated 30 to 40 different *P. pachyrhizi* different isolates
- Nineteen of the 24 SSR markers were informative for assessing genetic variation among the isolates
- There is much genetic diversity with the FDWSRU collection
- Analysis of the SSR data reveals two distinct clusters (designated Group A and Group B)
- Groups A and B also show distinct reaction phenotypes when tested on different soybean accessions
- The six isolates collected from Louisiana and Alabama in November 2004 are genetically diverse, and show different reaction phenotypes on soybean accessions containing *Rpp1-4*

How do the US isolates compare to isolates collected in other parts of the world? Depends on the isolate
What is the origin of the isolates collected in the US? Can't tell, it's a mixed bag
Are the US isolates genetically similar? Some are similar

Hosts and Host rust interactions, Mo Bonde, USDA-ARS

- Four infection stages – pushing through the cuticle,
- Host anatomy dictates location of urediniospores
- Cow pea – susceptible but does not sporulate well
- Green beans – some fairly susceptible
- Clovers – not very important
- Green peas - very susceptible but leaves fall rapidly
- Lima beans – susceptible but does not sporulate
- Kudzu – susceptible with high sporulation in general
- Two infection reactions- tan susceptible, red-brown resistant reaction and mixed reactions.
- Red-brown reactions produce 1/10 of the spores produced in tan reactions

Questions and Answers

- *P. pachyrhizi* has never been observed to infect through stomates, only direct penetration. Observed appressoria forming over stomata and sent infection peg into guard cell.
- Cell death is rapid once penetration hyphae penetrates epidermis
- Rust penetration hyphae can grow for some time before forming haustoria.
- No teliospore germination in the US.
- Pustules open when leaves are wet.
- *Phaseolus vulgaris* shows great variation to infection among cultivars, get some red-brown reactions but sporulate pretty well (green bean, kidney bean).
- Beans of Andean origin may be more susceptible to soybean rust.
- Clumps of soybean rust spores should not travel as far as single spores.
- Can you use molecular data to develop a phenotype or molecular race test? More molecular markers are needed to determine strains of the fungus.

Economics and Policy Session
Guy B. Padgett (Boyd) – Louisiana State University, Recorder

Robert Wisner, Iowa State University

Dr. Wisner discussed the economic importance of the soybean industry (3.204 billion bushels = 19.86 billion $$ in 2006) to the U.S. and the potential impact of Asian soybean rust on production.

Discussed the regional impact of ASR on soybean production (Central and Northern Great Plains, Western Corn Belt, Eastern Corn Belt, and Mid-South)

The distribution of soybean production was greatest in Eastern (31%) and Northern Corn Belt (32%) and the Northern Great Plains (19%).

Three dimensional impact

1. Producer
2. National
3. International

Talk about where ASR was recorded in 06

1. Southeast and Mid-South hardest hit
2. Recent reports from the Mid-West

Impact greatest if ASR develops in the Corn Belt

Mentioned the potential losses associated with ASR and provided a scenario of about $20000-30000 loss for an 800-1000 acre farm (8% yield loss with a fungicide).

Other losses included livestock feed cost and higher food costs. A provided a USDA ASR report from 2004 projecting losses for a medium and low spread scenario (see PowerPoint)

A 1% decrease in production results in a 2.5% increase in price.

Mentioned the increased interest in Ethanol as an alternative fuel could spawn an increase in corn acreage to replace soybean acres. Existing and planned Ethanol plants would utilize 80% of the current corn crop.

Mentioned rising bean prices could re-start expansion of soybean acreage in Brazil

Kitty Cardwell, National Program Leader, Plant Pathology CSREES

Discussed the CSREES mission and programs for plant systems

1. Research (grant programs)
    a. NRI Plant Biosecurity ($2.25 M)
    b. Critical and Emerging Issues ($370K)
2. NPDN
3. Regional IPM Centers
4. PIPE

NRI Grants directed toward aerial dispersal of spores, GIS and web-based monitoring and forecasting, as well as information delivery. Methods for detection (Mass Spec).

Purpose of IPM Centers mentioned.

1. Response to problem within a region and facilitates collaboration nationwide
2. Regional infrastructure
3. Four regions (North Central, Northeastern, Southern, Western)
4. Funding per region $1M per year

Mentioned the benefits of Regionalization and major hurdles

Development of pest alerts for West Nile, ASR, soybean aphid, etc.

Provided information on the NPDN and Soybean Rust

1. 1st Detector Training
2. Mock exercises (19 exercises involving 22 states)
3. Diagnostic infrastructure and training
    a. PCR identification project
    b. Tracking and documentation

Talked about the sentinel plot program and PIPE and its success and future funding

Emphasized must add more than ASR for PIPE to continue (Steering committee established in 2006)

Summary

1. CSREES continue to support competitive funding
2. USDA NPL will continue to be involved
3. PIPE and NPDN will continue to 'cross talk' to avoid duplication
4. PIPE will need to grow (expand to other pests), but ASR will continue to be the major focus

Dave Bell USDA-RMA

Talked about the role of the USDA in Quality Adjustment and Sampling/Grading for Soybean Rust

PTC (Production to count)
Discussed how PTC is calculated and gave example (see presentation)

Calculated with a reduction in projected yield, but no quality adjustments

Mentioned Quality adjustments and how this is factored into the equation for payment

Unisured cause of loss and examples (Ex. Not spraying for ASR when present, spraying too little or too late). Gave some exceptions (no fungicide available).

Discussed SPOI (special provisions of insurance).

Quality adjustment determined only by

1. Grader licensed by U.S. Grain Standards Act or the U.S. Warehouse Act
2. Grader licensed by State law and employed by a warehouse operator with a storage agreement with commodity Credit Corp.
3. Grader not license under State law, but employed by a warehouse operator with a storage agreement with commodity Credit Corp. and is in compliance with State law regarding warehouses

Gave examples of SPOI (grade, low test weight, excessive kernel damage (not including heat damage), musty odor, sour odor, commercially objectionable foreign order)

Talked about Quality Adjustment Factors (QAF) and how they are determined and listed on a reference chart.

Gave examples of QAF ‘on the chart’ and ‘off the chart’

ASR impact on production

1. Production not quality
2. Field affected by ASR may qualify for quality adjustments (QA)
3. Uninsured causes may also apply if the producer doesn’t follow the advise of Agriculture Expert or use Good Farming Practices

Questions

Dave Bell:

Q. Is purple seed stained covered by insurance?
A. Oil and protein not insured; however, green bean can be insured if green is extensive enough (didn't elaborate). Never answered purple stain, but mentioned if purple beans were damaged, then they were covered.

Q. Is there a safety net for losses?
A. Example: Advised to spray, but producer cannot not. Producer not at fault because sprayers or fungicide not available. Producer must be able to document this.

Q. How to determine production cost on uninsured cause?
A. Example: producer sprayed once, but should have sprayed twice. What are the costs associated with the uninsured cost of not spraying twice. The USDA can use the following: 1. Opinion of an expert (i.e. crop consultant, extension specialist) or 2. Use yields from a neighboring field that received two sprays

Q. How are 'Good Farming Practices' determined?
A. USDA uses 18 independent insurance companies for assessments (adjustors). These practices are hard to determine.

Q. Who is an Ag Expert?
A. Varies (ex. County agent, Extension specialist, Ag consultant)

Q. What is the liability to an Extension specialist for making a wrong recommendation (ex. No spray recommended, but spray was needed)?
A. The specialist incurs no liability

Q. What is the process when conflicting recommendations by two 'Ag Experts'?
A. Arbitration

Robert Wisner:

Q. What is the projected increase in corn acreage and decrease in soybean acreage?
A. 8-9 Million acres in corn (probably 6 to 7 million) or 10% increase. One million acres of increase taken out of soybean. Soybean projected to be 5 to 6 million acres. Corn acreage increase because of increase interest in Ethanol

Q. How many of the projected Ethanol plants will actually be constructed?
A. 1 of 6 (guess)

Q. How far out does the 2.5% price increase in soybean for every 1% reduction continue? For example would a 10% reduction result in a 25% increase in price?
A. Depends on market

Q. What is driving interest in Ethanol?
A. Increased oil prices.

Q. Is there adequate moisture (irrigation) in the west to accommodate expansion of soybean acres?
A. yes

Kitty Cardwell:

Q. There are additional needs for Extension, but decreased funding. How will this be addressed?
A. Push for competitive funding, but not there yet. PIPE has received high visibility to stakeholders (producers). This provides evidence of success for extension

Q. Will PIPE include other pests in future (namely soybean aphid)?
A. Yes. Will continue to use for ASR and soybean aphid. The user community must use site for the added pests. Entomology group will meet in 1.5 weeks for discussion and meet again in 3 months to finalize. The additions PIPE must be tied to IPM

Epidemiology- Glen Hartman, University of Illinois, Moderator
Dean Malvick, University of Minnesota, Recorder

A. Developing a yield loss prediction model for Asian soybean rust: a crop physiology approach. S. Kumudini (U of Kentucky) et al.

- SBR- yield loss due in part to defoliation
- Web site in development
- Yield loss model based on defoliation injury
- Is defoliation a key part of yield loss due to SBR?
- Recent research done at EMBRAPA in Londrina, Brazil.
- 5 trts 1. SBR inoc at R1; 2. mimic SBR at R1 by mechanical defoliation;
- 3- SBR at R5, based on early fungicide trt allowing rust to develop later; 4. ?
- 5 control – fungicide applied throughout season.
- Low level of disease still developed, to <20% severity, other treatments up to ~80% severity
- Maximum leaf area index (LAI) at R5.
- Did defoliation mimic leaf loss due to disease? – seemed to do a decent job of mimicking stress due to defoliation? But manual defoliation did not result in the same yield loss as disease at similar leaf damage level.
- Next, healthy leaf area index was much more correlated to yield loss than simple LAI.

- Work in Quincy, FL done to look at effect of necrotic lesions on productivity by (in part) measuring photosynthetic capacity, A low number of lesions (% leaf area) resulted in a large increases in losses. Impact of necrotic leaf area on yield was not correlated to loss in photosynthetic area.
- SBR induced yield loss was dependent on plant growth stage.
- Results suggest that yield is a function of healthy leaf area duration
- Yield loss models must consider leaf loss and loss in photosynthesis due to infection, and also must consider other effects of rust on physiology and water relations of plant similar to other rust diseases.

B. Spore deposition, micrometeorological data, and spread of soybean rust. Erick De Wolf et al.

Epidemiology research.

- Aerobiology – spore escape from canopies
- Spore deposition into soybean canopies
- Pathogen biology and epidemiology
- Spore adhesion
- Within field spread of soybean rust
- Question from producers – should crop production practices be changed to address soybean rust?
- Studied row spacing on the temporal and spatial spread of soybean rust in soybean fields. Work done in Quincy. 80x80' plots. 7.5, 15, and 30" rows , with 30' border between plots (fungicide treated borders)
- Plots inoculated at R1-R2 with infected soybean plant from greenhouse placed at point in middle of plot. Disease monitored on 49 pt sampling grid within each plot 20-59 d post- inoculation. Spatial analysis – distance calculated and plotted and analyzed. Power model slight advantage over exponential model in row spacing experiment. The rate of disease spread was different at most assessment dates, and the rate of disease spread did not differ with row spacing at most assessment dates. Similar results for disease severity and incidence. Canopy height deemed to have little effect?
- Temporal analysis - evaluated fit of logistic and exponential models and ANOVA, for comparison of data. Logistic model fit better than exponential model, rate of disease progress did not vary with row spacing considered. Trend was for 30' rows to have greater disease than narrower rows.
- Comparison of disease at discrete time periods - 30" rows had more disease (severity or incidence?), but disease progress was not greater than the narrow rows.
- Duration of wind speed, mean relative humidity at 15" height was measured
- Row spacing did not affect rate of disease spread or disease increase.
- Any difference at a given point of time appeared to be quickly eliminated by a rapid increase of disease. Treatments could possibly reverse order when experiment is repeated.

- DO not change management/row spacing of soybeans for SBR management– rows did not affect rate of disease spread or disease increase over time
- Significant difference of disease at discrete timepoints
- Rapid rate of disease increase will make scouting for soybean rust a challenge.
- If scouting is possible, disease incidence (%) would be a better target than severity.

C. **Soybean rust progress under different environmental conditions. Jim Marois et al,**

- Quincy – 22 acres of small plot SBR research, 1,100 acres at this station
- Pretty good disease pressure in the plots there
- Many native legumes from Midwest are susceptible to SBR in Quincy plots (work continues in progress).
- Jim presented much information on Quincy station and general conditions that are favorable for SBR - including the widespread presence of kudzu and common dew throughout year.
- No lesions below 9C reported in literature, Quincy gets about 67 " of rain a year, humidity usually above 70% .
- Melching published work – no rust at dew periods less than 6 hr., and rain 2X per week seemed optimal for rust development.
- Discrete SBR foci developed in several fields early in the season. Spores common in area and all field plots readily get infected?
- Disease doubled about every week in Quincy.
- Temperatures above 28C for the typical periods of duration in the day at Quincy were not long enough to stop infection. Once disease developed, dry weather did not stop the disease – but dry weather may have the greatest effect on disease development.
- Rust severity measured on a 0-5 scale with 5 being very severe disease.
- Epidemic progressed very quickly and consistently in most plots.
- Severity of rust on 100 leaf samples doubled about every 7 days
- Incidence of rust regularly reached 100% or near it
- The frequency distribution of severity values progress from a right sided tail to a bell curve then to a left sided tail.

Question and Answers

Q. Plant population varies by rows spacing in Indiana, but not done in the work Eric reported. Is this a problem in the work Erick reported- it may not mimic field conditions?
A. Not sure, they were trying to assess row spacing not density- so density was kept constant.

Q. How was it controlled that disease assessors did not spread the disease in the plots when assessing SBR?

A. There was a third rep that nobody walked through and disease progressed at the same rate there.

Q. Photosynthesis measurements? – CO2 measurements may not have been accounting for respiration of fungus, this was acknowledged and more work is in progress that will include respiration measurements. Measuring between two curves may be equivalent to what fungus is doing over and beyond the effect on leaf area. There were problems with measuring respiration. Others in audience noted much previous work on rusts as carbon/metabolic sinks and on increased water loss, and on other effects of insects on overall physiology. Work was noted again that this work reported with SBR is preliminary.

More water loss was noted in rust-infected plants than in the leaves remaining on the mechanically-defoliated plants. Question concerning chlorophyll and other measurements. NDVI values followed disease severity. Leaves must be abscised to do other pigment measurements related to photosynthesis.

Q. Another question on whether the relatively low leaf area index (LAI) reported from experiments in Brazil will result in different effects of reduced LAI on yield reductions. Speaker asked to speculate on whether experiments with a higher LAI will result in different impacts of disease or defoliation on yield.
A. Speculated a greater effect with higher LAI in crop. Also a point was raised that we cannot expect a given response to a given decrease in LAI in general, this effect will vary at different growth stages of the crop. This person said that an increased LAI may have been affected less by the leaf area loss.

Q. On spatial distribution of SBR in data reported by Eric that related to the rate of spread in different row spacings.
A. Data did not explain whether row spacing affected spore production, because in part the graph under consideration explains only one point in time 59 days after inoculation. Opening up canopy with 30” rows may increase the rate of spread.

Q. How much of the worldwide *P. pachyrhizi* genomic /pathogenic diversity do we have in the US at this time.
Discussion and speculation: We may have a very narrow part of the gene pool of Pp in the US – due to a genetic bottleneck during a limited introduction? We don’t know, but work is in progress to address this point.

Q. logit vs DAI plot - how was the extremely low logit value detected and what did it represent.
A. This was probably a very small number of lesions in the whole plot or similar?

Lag period was discussed in detection of spread from the point source in the data Eric presented. Data from point source work showed that disease severity did not increase above about 2% severity until 50 days after placing the infected plant in the plot. Also, disease incidence was not above 5% until after 40 days after 40 days. But the point was

raised that these results are heavily influenced by sampling, and the more sampling that is done the lower level of disease that can be detected.

Suggestion to Eric to also test row spacings at the same plant population next year, in addition to testing row spacing at the different plant pops as was done this year.

Question was raised on how fungicides would affect the epidemics. Some of the triazoles had 4+ weeks of activity when sprayed 4+ weeks prior to rust appearance, thus they can have a major impact on epidemics.

Average soybean yields of about 26 bu/ac were reported for Quincy; - one 'smart' person in the audience suggested that with these low average yields the agronomists may not have been doing their jobs in Quincy for improving soybean production.

Reply - rust can develop very quickly and the window of time for the first application may be only about 5 d – at least in experiments in LA?

Q: Were foci developing late in season in Midwest this year when SBR was detected at multiple locations in US? No clear answer was given, but point was raised in light of observations of early season rust in Quincy.

Q. When during the SBR epidemic would fungicides have the greatest impact on slowing disease spread and development.
Discussion - the effect of growth stage and physiological triggers that influence rapid disease development must be considered and they will have a great impact on disease development and will interact with timing of fungicide applications. SBR latent period is important here too, which is also affected by environment and growth stage.

Q. How does row spacing influence on epidemics – discussion suggested that larger field scale phenomena in disease spread may mask small effects of row spacing that was seen in the data from Quincy reported by Erick.

Host Response- Brian Diers, University of Illinois, Moderator
Recorder- Anne Dorrance, The Ohio State University

Evaluation of the soybean germplasm collection for resistance to soybean rust – Monte Miles, USDA-ARS

- Two types of lesions on soybean, Tan lesions and Red-Brown (RB) lesion types
- RB lesions– do sporulate
- Focusing on partial resistance or "Slow Rusting" – adult plant
- Counted number of sporulating uredinia –
- Screened 40 soybean accessions with six different isolates – significant genotype x isolate interaction

- Field trials in Fairhope, AL and Quincy, FL, Are identifying resistance under field conditions
- Differential response for all traits evaluated, lesion type, severity AUDPC for sporulating legions
- Soybeans with TAN lesion types with resistance can be identified
- US isolates – three gave different response on each soybean line
- Combined field and greenhouse screens with additional isolates
- Field evaluations are needed to identify and characterize resistance.
- Is no magic bullet.

Evaluation of resistance to soybean rust in field and greenhouse tests in Georgia.
Roger Boerma, University of Georgia

- Hyuuga source of resistance – mapping RB lesion type.
- Mapped to MLG C2, currently designated Rpp? But only accounts for 22% of the variation for disease severity
- Only 15% of lesion number
- In the field, used the following scale to assess resistance

1- no apparent lesions
2- 2 = 1 to 3 leaves with a few lesions
3- 4 or more leaves with a few lesions
4- 1 to 3 leaves with many lesions
5- Tons of lesions

- Dillon – some slow rusting phenotype
- Handout – 45 accessions of the most resistant from the field screening plan to post in two weeks.

Breeding for rust resistance in Brazil. Dr. José Francisco Ferraz de Toledo, EMBRAPA, Brazil

- Major Rpp genes: inheritance, allele testing, molecular markers and stack these genes into the adapted Brazilian germplasm

- Minor genes – heritability is moderate to high F3 progeny means – suggest genetic progress can be made.
- Evaluation of soybean genotypes and selection for Asian Rust resistance does not ensure adult plant resistance
- Quantitative genes expressing additive gene action for resistance to Asian rust are dispersed among soybean cultivars
- Selection for Asian rust resistance based on F3 or later family means is likely to result in genetic progress.
- Measured incubation period, Latent Period, and Severity – severity is the simplist…
- Spore germination – very labor intensive

- All new resistant sources are being studied in allele testing to identify new major loci
- Minor genes – must keep large populations >3,000 individuals!!!
- Even for varieties with resistance – still use two fungicide applications (saving 3rd spray)
- To ensure that resistance doesn't break –
- Maturity plays a key role in expression of disease

Questions and Discussion –

Q. - How long before a rust resistant variety is ready in Iowa –
Boerma. Issue is these current sources of resistance are not anywhere close to being farmer friendly at this point. Require a great deal of breeding and incorporating traits for yield. Some thought that complexity isn't as great as they are learning more. There are races. Already have usable sources of resistance. Cregan has Rpp1 mapped. Dr. Toledo, done some more mapping with Rpp3 and Rpp4. Know location of chromosome.

Q – How many races of soybean rust are there?
A- Monte, number of races, in a field in Thailand – 30 isolates and 18 races. Based on the number of differentials.

Q- If use an isolate that gives an RB phenotype – can you mask the resistance expressed to an isolate with a tan lesion type.
A - Some isolates give both RB and tan…even though from single uredinia
Isolate AL04-3 from kudzu – has the highest number of virulence reactions, more tan lesion types on soybean differentials.

Q - Why is an isolate from kudzu so high in virulence –
A - Monte reminder that this is a legume pathogen, not just soybean.

Q - Is the Rpp? from Hyuuga, one of four Rpp genes or not. Have good information now that it is unique. Rpp1 is on G, top of G and J for 2 and 3; 4 is not on C2 – also looked at haplotypes in this region. One piecing to this… resistance practical point of view.. its ability to prevent yield loss…will this resistance reduce yield loss in the presence of rust.

Discussion - Soybean rust in Taiwan in the early 1970's – 29492 – used to develop resistant cultivars, then both cultivars became susceptible, screened all of 23970, 23971—not like other lesion RB. Bromfield developed the Rpp series, then a year or two later – had totally tan lesions

In Taiwan, resistance evaluations Now focus on disease progress curves – tan lesions… now also look at tolerance, early maturity materials. Selected for resistance types – not fully defoliated, fully seeded with out and with fungicide. This resistance is not mapped nor have the mechanisms identified. Have also used this material in Zimbawbe. Also some in germplasm collection from Vietnam, Indonesia,

Q- soybean lines what is selected in Attupulgus (resistance) will this also work in Alabama-
A. Monte - Not necessarily, especially for RB reaction phenotypes, need more sites for testing
Roger – don't get hung up on these things yet, take notes on lesion development. We are not overly looking at this disease- making it more complex than it really is.

Q - Different traits can score for rust. Is there a trait that really stands out? Type of lesion, sporulation, AUDPC, --
Jose uses severity and yield. Latent period is tied to time that the plant is infected. Using severity can evaluate a large number of plants. Simple for breeding purposes
Monte – collect 5 leaves from mid-canopy in the field – score—
Rpp4 sublines – what is the RB gave us the most resistance to all isolates, Rpp4C is completely susceptible (to all isolates).
Canopy – show that can use middle and upper canopies to calculate AUDPC

Q. How durable are the Rpp genes, how long did they last –
A. Rpp1 and Rpp3 broken first year; Rpp2 and Rpp4; a few tan lesions in Rpp4 material. Stacks are now in progress.

Q. A Non-science question – is there a lot of change in acreage – decrease in acreage
A. Due to soybean rust– more due to devaluation of Brazilian currency on top is rust.

Q. How many races will overwinter in Florida, Louisiana
A. Can't forget Mexico as a location

Q. One breeder expressed desire/wish to breeding to only need the single Rpp genes.
A. There numerous examples of major field crops, wheat and corn where diseases managed effectively using minor genes, gray leaf spot, powdery mildew

Concurrent Breakout Session, November 30, 2006, 3:15 to 5:30

Application Technology: Bob Wolf, Kansas State University, Moderator
Recorder: Carl Bradley, North Dakota State University

General overview of application strategies for applying fungicides in the soybean canopy. Bob Wolf, Kansas State University

-When rust was found in U.S. in 2004, Agriculture engineers listed questions to ask:
- what fungicide or combo of fungicides to use?
- are multiple applications necessary?
- what growth stage of application?
- what application volume is needed?
- what nozzle type, orifice size, and pressure are needed for good coverage?
- what droplet size is needed?
- can fungicides be tank mixed in combination w/herbicides?
- are adjuvants in the tank mix a benefit?
- what application systems can be used……aerial, ground?
- are there spray technologies that are better?
- what environmental considerations are there?

-Strategies
- follow the label
- any spray system should work
- determine appropriate application practices

-Spray droplet management
- depends on knowledge of product being used
- systemic or contact fungicide
- what is target…….penetration into canopy

-Application volume is critical
- label? 10-15-20 GPA
- how is this different from a typical herbicide application gpa?
- herbicide application may not match a fungicide application rate
- increasing gpa will improve canopy penetration
- calibration becomes essential
- speed will be a major issue……research plots are usually applied at slower speeds

-Application speed
- based on field conditions, nozzle type, orifice size, operating pressure requirements
- slower will improve canopy penetration

-Variety of droplet sizes are produced in normal operation
- larger droplet sizes…….good for drift control
- smaller droplet sizes…..better for coverage
- fungicides/insecticides need 200-300 micron (vmd)…..fine to medium
- some labels already specify droplet size

Nozzle type considerations for improved soybean canopy penetration: A Summary of work at Kansas State University. Bob Wolf, Kansas State University

-increase gallonage increased coverage in lower canopy, regardless of nozzle

-electrostatic sprayer
--did not work……majority of droplets go to top of canopy and no advantage for lower canopy
-air assist sprayer
--differences among nozzles

KSU lab studies
-spray track machine
--looked at single and double head nozzles
--single head nozzles appeared to be better
--turbo teejet doublehead may be an exception to above

Nozzle and equipment considerations for improved coverage in the soybean canopy: A summary of the work done in Ohio. **Rich Derksen, USDA-ARS, The Ohio State University, OARDC**

Measures of performance
-spray coverage
-spray deposit
-fungicide spray retention on foliage measured through residue analysis

-2005 evaluated nozzle types (droplet sizes) and sprayers (boom and air-assist)
--canopy opener
--jacto air –assist sprayer
--conventional broadcast
-2005 Spray coverage
--air assist had the highest spray deposit (%)
--air assist had highest spray coverage (%)
-2005 fungicide spray retention (foliar deposits)
--canopy opener had highest concentration of Headline in upper leaves
--air assist had highest in lower leaves

-2006 Compared three nozzles
--turbo teejet conventional
--air assist flat fan
--air assist hollow cone
-2006 foliar deposits
--turbo twin and air assist looked good as well as xr8004 w/ 20 gpa (rest 15 gpa) for upper leaves
--no diff in lower leaves

Important that leaf area index (LAI) be reported in fungicide coverage (measure of canopy density)

Conclusions:
-canopy differences affect deposition
--higher deposits in less dense canopy
--coverage higher in less dense canopy
--in taller more dense canopies….single flat fan delivery treats lower canopy better than dual-fan or cone nozzles
--medium quality sprays are recommended for conventional, broadcast applications
-based on all measures of performance, air assist provides better canopy penetration
-cone and flat fan nozzles performed similarly in air-assisted applications (not reported…but differences in air-assist sprayers exist)
-bending over the top of the canopy (canopy opener) helps improve spray penetration
-unable to detect Headline on stems

Aerial Application strategies for improved coverage in the soybean canopy: A summary of work done in recent years. Dennis Gardisser, University of Arkansas (from speaker phone)
-all applications must be made uniformly over the entire crop
--make sure aircraft is utilizing optimum swath width
--avoid misses around obstructions
--dress headlands to get those areas around trees and power line
--do not plant areas that cannot be effectively treated by aircraft……work w/ applicator

Utilize optimum application height
-most turbine aircraft need to be operated w/ boom 10-12 ft above crop canopy and large aircraft even higher
-both, lower and higher, release heights may reduce pattern uniformity and increase drift potential

Tips
-don't spray during heat of day due to strong micro-inversion layer that forms at top of the crop
-utilize nozzles that control droplet spectrums well. Choose nozzles that make as few droplets as possible below 200 microns
-285-385 is target vmd
-droplet spectrum may be most important aspect of air applications and should be adjusted w/ nozzle selection, pressure, and mounting configuration
-small changes in droplet diameter make big changes in droplet volume
-there are excellent aerial models available to help determine expected droplet spectrum aircraft speed vs droplet spectrum
-optimum droplet spectrum can be developed by selecting appropriate setup configuration
-turbine powered, faster aircraft generally have more uniform patterns
-difficulty for faster aircraft to work around obstructions

-typical volume is 5-7 gpa; canopy penetration have not indicated a strong need for more diluent volume
-use of adjuvants and surfactants may be beneficial, ……care should be taken to avoid major droplet spectrum changes when products are utilized
-if multiple applications, utilize different travel lanes or go in opposite direction to move droplets into different angles

Weather
-winds are an aid to canopy penetration (3-8 mph)
-avoid spraying under calm conditions
-early in day may be best time to apply
-direct sunlight builds strong inversion layer over dense canopies

Droplet size is important……..small differences are bigger than it looks
-290/250 vmd = 1.16
-250 vs 290
-change in size?
-change in volume or weight?
-volume or weight
--cube root relationship
--2*2*2 = 8 times heavier

Operation S.A.F.E.
-verify aircraft set up
-attend an operation S.A.F.E. fly-in

Other areas
-electrostatics…….don't see advantages
-low and slow v. optimum and normal……not necessarily uniform and optimum
-smaller droplets are better?.....more uniform would be more important

Summary
-top of canopy will have highest coverage
-canopy reduced coverage by 3x
-3 gpa had more canopy coverage than 1 gpa

Arkansas soybean deposition summary:
-more volume/coverage with higher rate but not more ai.
-droplet size is very important……. 285-295 vmd more efficient
-better canopy penetration with some wind……3-7 mph
-always better coverage in the top on the canopy
-dense canopies are difficult to penetrate……especially with calm conditions and direct sunlight

Discussion/questions

Q. Boom heights……..what was used in studies?
A. Wolf – 17 to 19 inches from top of canopy recommended, studies done in 15 inch range
A. Derksen – 12 to 14 inches in the studies
True height level is not well defined……..old data is based on height from ground

Q. Did Ohio State studies use opener on air-assist?
A. Derksen - No, and did not use at all in 2006. This would be hard to adapt to commercial boom (due to large lengths of boom).

Q. Any differences in effectiveness of fixed wing aircraft vs. helicopter (rotary wing)?
A. Gardisser- no differences, except that each should be configured differently.

Q. What about aerial applications at night to avoid inversion?
A. Gardisser - used in dry climate areas mostly……could help but safety problems are too big of an issue.

Q. Soybeans have a closed canopy at application time and is dark in the canopy…..how much penetration is needed due to most photosynthesis coming from the top?
A. –Unsure, -top 4 layers of leaves are where photosynthesis takes place

Q. If you summarized the work…….what are the recommendations?
A. -Wolf – apply 15-20 gpa; 10-15 mph or less, calibrate sprayer;
A. -Derksen – read the label, 10-15 gpa, 7 mph, med size droplet, fan nozzle if you don't have air-assist sprayer

Q. If you can apply 3 gpa aerial can you do same with ground?
A. -Gardisser- probably……..be aware that increase in speed is a problem…..behind wheels coverage is not as good……dust could be a problem as well

Q. Is there a single nozzle at 30 in spacing that gives med droplet at 15 gpa?
A. -Derksen - not aware
A. -Wolf…..hard to do…….easier to do with dual, but coverage issues are not as good

Q. Any work on bi-fluid nozzles, ie. Airjet nozzles?
A. -Wolf – worked on several years ago……..problems with calibration
A. -Derksen- problems with calibration, numbers looked good for 2005, but inconclusive

Disease Assessment- Larry Madden and Anne Dorrance, The Ohio State University moderators
Recorder: Howard Schwartz, Colorado State University

Pros and cons of different disease assessment ratings

- Larry Madden, The Ohio State University
- Cláudia Godoy, EMBRAPA
- Gary Cloud, Ag Research Associates
-

Question/Answer – Discussion Session

- Sampling protocol (extent of rating, number of plants or leaves, size of plot, number of samples, average or individual rating per estimate) is determined by the level of resources available to the rater. You gain less and less with improving precision, adjust rating for disease aggregates in the plot/canopy/field. If estimating disease on a field basis, use random sampling or transects across the field basis. A lower disease level will require more sampling to improve precision; it's exponential.
- We need to establish the relationship between disease incidence, disease severity and defoliation with yield loss components.
- Soybeans (and other legumes) can sustain 35-40% defoliation with no effect on yield; and this needs to be related to disease incidence/severity ratings. But for now we need to measure disease as accurately as possible. Leaf area affected may not be the best predictor of yield loss, but lesions do affect leaf area and other plant responses (i.e., respiration).
- Removal of leaves for disease measurement may reduce inoculum in small plots; but is not viewed as a concern for larger plot work or field monitoring.
- Walking through plots or fields could spread inoculum , so use alleyways or border areas to move between plots
- Define sample for consistency, ie: a trifoliate or one of 3 leaflets per trifoliate taken from the upper, middle and or lower portion of the canopy.
- Rating of plots with defoliation should be explained in reports so the reader know what valued (75 or 100% infection) was assigned to the a plant or plot where defoliation occurred. Later evaluations of the same plot may exhibit a skewed (lower) rating on remnant leaves, so this anomaly should be pointed out in the report as well.
- The remote sensing approach in Brazil, is fast, requires assessment of disease(s) pests, abiotic stress and needs additional testing for repeatability over time and in plots with variable plant stands.
- Management of other diseases and insects in trials can be useful to improve precision of soybean rust measurement, but reduces utility of breeding nurseries to evaluate response to multiple variables.
- What is the value and cost of tagging individual leaves or plants for disease evaluation over time?

Forecasting: Scott Isard and Erik DeWolf, The Pennsylvania State University, Moderators
Recorders: Ray Schneider, Louisiana State University
Layla Sconyers, University of Georgia

Discussion/Questions

Q. Updrafts develop as wind speed increases, and it is these updrafts that carry spores to higher altitudes for long distance dispersal. Are there also downdrafts that would result in stratification of spores, or do they simply settle out of the atmoshphere?
A. Zaito. There are downdrafts after the front passes, and these downdrafts would be expected to forcibly deposit spores.

Q. There is heavy dew in Iowa until 2PM. Would you expect spores to be released after leaves dry?
A. Spores are not released from dew-covered leaves. Model currently uses 6-hr release period centered around noon.

Q. What effect does the dew have on spore production?
A. Scott: Does not seem to have an effect, but they need to somehow work that into the model. Right now they don't take that into consideration. They need to have better data validation.

Q. Is there a wetness model being used?
A. Joe: It (Dew) is used in the local disease development model, but is not included in the movement model. We need to have this info—this would be a good tool.

Q. Are there other variables that are drying the canopy to influence the dew period.
A. Joe: they are working on changes to the model to answer this.

Q. Was the Mississippi valley movement from Arkansas to Illinois a jump? It appears to be.
A. Zaitao, Scott: it does seem to be a jump. It is considered one event, but a jump. Scott said that spores were probably in the area in the Carolinas, but Ernesto moved the spores, causing spread. It is an imperfect science. We need to give better disease data, quicker. There needs to be fine tuning. Spores were washed out from LA to IN in one swath.

Q. HYSPLIT model: is there a downward movement of air and spores as well as an upward movement?
A. Yes, it can move in different directions.

Q. What are the user's perceptions of the ensemble forecasts? Should the ensemble forecasts and related maps be made public?
Yes. Would be helpful for local interpretations, but extensive training would be required.

Maybe. Meteorology forecasts need to be adjusted for crop development and disease. Growers do not need long-range disease forecasts; they need accurate forecasts with sufficient time (2 days) to prepare to spray.

Models should not be made available to the public until they are accurate. Otherwise public will learn to ignore forecasts. Models must be near-perfect in order to gain public confidence.

Q. How can models gain confidence?

Experience and verification.

We cannot change sentinel plot protocols from year to year. Long term sentinel plot protocols must be adhered to. The dilemma is that modelers need verification from sentinel plots that are maintained after the first find, but producers may insist that sentinel plots be destroyed. These plots serve two purposes: first occurrence in a region and data sets for model verification.

Russo. Mobile scouting is valuable, but modelers need repeated observations in order to generate useful data sets. This is critical.

Growers understand that it may be necessary to tolerate a short-term risk for a long-term benefit, i.e. a useful model that will serve practical needs such as spray advisories, imminent disease, directed scouting, etc.

Isard. Suggest partitioning sentinel plots into those used for early detection only and a subset that would be monitored routinely and used for model development and verification.

Monitoring sentinel plots on a weekly basis may not be practical if long distances are involved. Suggest having plot caretakers send 100-leaf samples to the expert on a weekly basis rather than having the expert drive across the state every week.

Growers and others have come to interpret “green” counties on the website as being disease-free. “Green” counties should be interpreted as “disease not found,” which is very different from “disease-free.” Even so, this designation may be misleading because counties are probably not surveyed intensively. However, there was a comment that counties are surveyed intensively because there are numerous crop consultants, chemical sales people, and county agents, all of whom have a personal stake in finding rust in their areas.

Q. How much of the model output should we display on the restricted website?
A. Continue to show what’s been on the website.

We need to continue to visit sites over and over, get consistent data.

Jim VanKirk says we need to transfer some funding to more mobile scouting.
Glen says mobile scouting may be very helpful to the model. Joe Russo agrees.
Scott suggested we could follow progression of disease in two locations.

Q. What is the level of certainty of the red and green on the maps?
A. Green just means we can't find it. It does not mean it is not there.

There are a lot of issues still to be discussed concerning the modeling and scouting.

MONITORING

Carrie Harmon Session Coordinator
Edward Sikora - Recorder

Sentinel and Mobile Plots - Jim Marois, University of Florida

Objective of Sentinel plots:

1. Serve as early warning system
2. Collect data for epidemiological research
3. Quantify time and amount of spore production in over-wintering and growing season source area.

Rust should always overwinter south of Tampa.

Experience so far searching for rust:

- Trained scouts work best
- 30X hand lens needed
- Look low in soybean crop canopy and in shaded area
- Kudzu – protected area with afternoon shade from west sun

Early season foci - just a few plants are infected then inoculum develops and spreads out slowly through plot; late season spread is more uniform and rapid through a sentinel plot

They have observed more infected kudzu sites in Florida in 2006, disease appears to be spreading out within kudzu in Florida. More positive kudzu sites in Panhandle.

11% kudzu sites positive in 2005
40% kudzu sites positive in 2006

We do not know full inoculum potential in the SE.

Spore Trapping, John Rupe, University of Arkansas

Multiple projects evaluating dry and rain deposition collection traps available

Purpose of spore trapping:

1. Where are spores and when are they being distributed.
2. Possible inoculum source.
3. Efficacy of spore trapping in predicting disease development.

August and September were the peak periods for collecting SBR-like spores in Syngenta spore traps in 2005 and 2006.

There appeared to be an overlap of positive SBR-like spore findings in Syngenta spore traps and disease spread within U.S.

*Detection of SBR with PCR in rain water traps peaked in late July and August.

Summary:

- Wide distribution of rust spore deposition early in season.
- Highest concentration of spores in August and September.
- Spores in Midwest may have low viability.

USDA Web site, PIPE, Julie Golod, Penn State University

Developed for use in 2005

Added soybean aphid and "Good Farming Management Practices" in 2006

Web based real-time information system

Purpose:

1. Monitoring of SBR, soybean aphid.
2. Data modeling, mapping validation.
3. Education and extension, for pest and risk management.

In future we will try to improve and expand the functionality of system

Spore Identification, Sally Miller, Ohio State University (Anne Dorrance)

An Immunofluorescence Assay

Purpose:

- Need for an effective Early warning system
- Spores can be trapped in many ways (wet and dry traps)
- Must be able to identify SBR amongst rust-like spores
- Immunoflourescens is rapid, simple and well defined

Double-stick tape versus vaseline for dry spore traps. Don't lose as many spores when washing.

- Antisera will be available
- Develop ELISA formats
- Develop and assess field sampling protocols

QUESTIONS:

What about *P. meibomiae*? Adapt fluorescent assay to see if dilutions may separate *P. meibomiae* from *P. pachyrhizi*. Next generation is more specific.

Is *P. meibomiae* in U.S.? It has not been detected.

How many active kudzu patches will you have come 1/1/2007: Many, unless there is a significant freeze event.

When will ELISA test in plate or strip form be available? Strips are already available. ELISA plates with higher levels of specificity may be available in a couple years.

General Session: The Present Soybean Rust Situation
December 1, 2006
John Rupe – University of Arkansas – Moderator
Recorder: Diane Brown-Rytlewski-Michigan State University
Albert Tenuta – Ontario Ministry of Agriculutre

Summary of soybean rust communication activities in North America
Gregory Shaner, Purdue University

Communication-

- Who is audience, what proportion of growers can we reach/ how quickly, how to counter misinformation
- How do we respond to epidemics

Websites - State soybean rust websites- University/State Dept. of Agriculture
Web issues

- Goal of website, Ease of discovery-Google, Ease of navigation, How current is information
- Recommendations for improving websites - Date of latest revision, Keep news current, Archive older items, Display phone line prominently, Link to PIPE
- How many growers use the internet - Probably not more than 60% may be considerably less, modem- slow connections, tend to be younger, more educated farmers, large farms more likely to use internet, more diverse farm operations, full time farmers, more use in corn belt
- Visits/Hits to PIPE-Peak number of visits 15,632 in October- only a fraction of US soybean growers- 25,000 in Indiana alone-Suggests that many farmers don't use it.

Phone lines

- 4/10 states surveyed-toll- free for most
- Frequency of updates varies; may be active only during growing season
- Direct contact with specialists- some phone numbers for specialists listed

Publications

- Print or online, Rust background, Spray technology, Newsletter- weekly

Are we reaching everyone we should?

- Websites- only a fraction
- No real test of system- no epidemic
- Phone line to reach farmers in field
- Direct access to farmers through extension-
- Radio and TV

Section 18 recap and future perspectives, Martin Draper, USDA-CSREES

Situation - Ultimate need: Fungicide to cover 74 million acres
Why so many products

- Production demands, no one company can fill the need
- Distributes risk across the companies for finanacial aspects of production costes

- Provides more options for growers
- Price stabilization for products

Quarantine Sec 18 labels are good for 3 years, the first will be expiring after the 2007 or 2008 season, seven products were part of the initial submission filed in November 2003

The activation date was revised by EPA following first find in US of soybean rust, November 2004. Second amendment to original request – November 2004; Third amendment - March 2005; Fourth amendment- June 12, 2006
Another factor was to address the export concerns, establish temporary tolerances for products with Section 18 labels.
The initial submissions, Section 18 products are set to Expire November 2007
2008- need to move these products to section 3 labels, this is in process for many of these products.

Initially, Section 18 issuance provided products with potential to producers
Performance has been variable; market will sort out which products will be available.
Challenge - Products in storage w/sec 18 labels-Sec 3 labels may not match may need supplemental labels- will need to get them into hands of growers
More information can be found at EPA website for updated info
www.epa.gov/oppfead1/cb/csb_page/updates/soybean_rust.html

Economic aspects of Asian Soybean Rust - Robert Wisner, Iowa State University

U.S. losses kept at minimum in 05 and 06 through highly successful work of researchers, extension, government, industry and weather.
How to evaluate the economic impact of your work

- Opportunities for interdisciplinary collaboration with agricultural economists
- Micro or farm level-factors to consider: Yield losses, chemical costs, application costs, insurance, and government payments
- Macro level effects to consider: national production, National control costs and price impact
- International effects - Supply shortage in US is tempered by signals to expand in SA

Record production in US 2006-3.2 billion bu at an average of $6.20; Almost $20 Billion value soybean crop 2nd most valuable after corn, Rust very late in 2006- 2005 and had very little economic impact

Change in soybeans acres planted due to rust- little impact so far
Southeast drop in soybean acres, Increase in other regions ethanol- Eastern and Western corn belt

The Value of Public Information- A Case Study of the Soybean Rust Coordinated Framework
Uptal Vasavada, USDA-RRED-ERS

Is there a value for the soybean rust coordinated framework?
Will people use it?
What is value of information provided?
Where does value come from?

- Cost of providing information is negligible- social benefit to farmers-public good
- Private firm would charge a price- some persons would be excluded

By providing information \information>decisions>profits
Value of information= profits with information- profits/without information
Simple model: No information vs. perfect information
e.g. apply preventative fungicide
field infected or not
infected-apply- good decision
not infected bad decision
or
don't apply
field affected or not
affected – bad decision\
not infected- good decision

Information provided to make right decision to ensure profits, no information can't make informed decision, profits affected
In reality much more complicated than model

To people who can't decide on the fence-value of information extremely high- $3 A
Quality of information- poor med high
Poor-20% of uncertainty-value 11 -29 million
Med-50% of uncertainty 81-124 million
High-80% of uncertainty 210-299 million dollars

Questions/Answers/Comments
Comment - Visit the PMN portal site for all info rust related with 3 mouse clicks
Comment - if planting continuous corn watch out for gray leaf spot
Need to consider impacts of continuous corn on other factors such as water quality.

Q. Information presented indicated that not very many growers use website- is there a way to determine how many growers benefited who didn't use website directly- got information indirectly from others?
A. There is a multiplier effect through extension agents, crop consultants who do use the web.

The survey to be conducted will only be sent to producers only not crop consultants or others will not capture other user information- need to learn more about it.

Comment: Soybeans have good future in US- cheaper to plant soybeans; than corn can get yield bump in corn following soybeans. South America has decreasing acres due to rust- unlikely we will need to spray more than 1-2 apps for rust unlike SA with up to 7 applications–advantage to US. US growers are prepared for rust-the value of rust information was that it allowed for advance preparation and registrations of fungicides so that producers could spray if needed; soybean acreage was not lost.

Q. In the 2-3 round of Section 18 products-Alto not granted yet doesn't appear to be moving forward- any information?
A. Assumption, may be pending on other states, likely in process.

Comment about Website- also soybean aphids on site; good to have it on one site- convenient for producers will get more visits to site with both.
Q. Are records kept of growth stage of soy when rust is found, if so where can information be found?
A. Not aware of this information

Q. Can producers be certain of corn/soybean prices for next year?
A. Can't ever be certain. Corn prices almost doubled- in comparison, soybean prices are far from it, in the range of $ 6.70/bushel. Initial reports are that soybeans acreage is lagging for 2007based on information for seed company sales, nitrogen application in fall (for 2007 corn). Corn acreage may be increasing-up to 15% -need 10-12 % increase for next year (ethanol) A Billion bushel gap between use and supply plants will be bidding for corn- don't know where it will end up.

Q. Different people make decisions at farm operations. Some farmers make all decisions, some turn over some decisions to crop consultants or chemical companies. Farmers still make ultimate decision to spend $ or not. Is there way to assess who makes decision- crop consult- number of acres affected take into account impact of others influencing decision to spray.
How do you determine how multipliers (Ext. agents, crop consult. etc.) assess risk- they may understand more about the risk than producers how to capture this in survey-
A. Survey questions will provide benchmarking for U.S.-How to use information – refine analysis, understand who is making the decisions, effect of value of information we will need to look at more closely.

General Session: Lon-term Perspectives on Soybean Rust
Jim Marois, University of Florida – Session Coordinator/Moderator
Clayton Hollier, Louisiana State University Agricultural Center – Scribe

What will PIPE look like in five years? *Joe Russo, ZedX, Inc.*

- PIPE is expected to go through several changes during the next five years especially in the planning through management phases.
- Currently the technical infrastructure is based on an epidemiological model for data collection that inputs a model that deals with data management.
- Data management inputs modeling, that is integrated, has individual interpretation and grows through general dissemination.
- In the future the model will be modified and will include more automated data collection through technological advances.
- Model modification will include an interpretation team that is represented by education, Extension, government and industry.

Long term impact of soybean rust on chemical industry. *Jim Barrentine, Cheminova, Inc.*

- Impact began with the discovery of ASR in Louisiana in 2004.
- ASR has the potential to become a market that could sustain a product.
- Industry's allocation of resources is generally from within current budgets and without new resources.
- Several resource draining activities for industry include: mapping, spore trapping, epidemiological research, chemical and efficacy research, learning about other diseases and registration efforts.
- Even without ASR, the agricultural industry invests substantial resources.
- Challenges for the industry: supply and demand, and research and development.
- Supply and demand challenges include no guarantee of a market and industry's investment in products and a desire to meet producer needs.
- R&D challenges: new modes of action, integration of ASR into fungicide screening, new products, rust resistance, cultivar resistance, improvement in application technology, development of prediction models, increased awareness of other soybean diseases.
- Market dynamics: alternate crops reduce market potential, ASR establishment increases market potential.
- What will impact the soybean chemical market in the US? The speed and frequency of ASR development.

Long term impact of soybean rust on Midwest corn/soybean rotation system (also considering cost of N and soydiesel). *Gary Munkvold, Iowa State University.*

- Factors affecting corn-soybean production ratios: corn price, soybean price, corn production costs, soybean production costs and yield.

- Corn-corn issues: yield reduction when corn follows corn (average of 9%), corn rootworm populations increase, increased number of diseases, possibility of fungicide usage, harvest season lengthened, increased lodging, increased amount of ear rots, increased mycotoxin risks, fewer herbicide options, high crop residue issues, hastening of glyphosate resistance, stand establishment issues, tillage practices change, fertilization practices change.
- Needed tools for corn-corn rotation: range of hybrid choices with insect resistance genes, alternatives for herbicide resistance, early season stress tolerance traits, improved disease resistance, effective seed treatment packages, creative tillage options, dry-down trait.
- ASR may be a factor in deciding to plant corn vs. soybeans.

What can we learn after five years of sentinel plots and should we keep going?
Layla Sconyers, University of Georgia.

- Sentinel plots as a technique for scouting for ASR were begun in Africa.
- Sentinel plots are indicators for deciding to make fungicide applications, provide data collection for forecasters, provide data and about the disease, provide data for PIPE, better understanding of ASR epidemiology.
- In the US in 2004 there were 39 counties where ASR was detected; in 2005, 132 and in 2006, 236.
- Learned so far: we need to record both positive and negative sites, conditions favorable for development, effect of weather on spread, overwintering sites, progression of disease development, there is an increase in the knowledge of insects and other diseases and here is a need for consistent data.
- Value of the sentinel plot system: according to ERS, “important even in a low rust year”; valued at $11 – 299 million dollars; exceeded budgetary costs of $2.6 – 5 million.
- In five years: will not know all the answers, will have more reliable forecast models, will have improved detection techniques, will have better understanding of disease epidemiology and timing of fungicide applications.
- Continue? Yes! Soybean acreage may increase and sentinel plots will become even more critical.
- Points to ponder: information in the system is only as good as the data collected, consistent data needed, follow protocol closely, communication is improved among ASR scientists, plant a range of maturity groups or use a range of planting dates, sometimes ASR is found in commercial soybean fields and not in sentinel plots.
- Summary: ASR can be detrimental if undetected, sentinel plots can be an early warning system, sentinel plots can reduce unnecessary applications of fungicides, plots can help to improve yields if used as a detection method.
- We are still in a learning mode.

What will happen if soybean rust doesn't happen? *David Wright, North Central Research Program.*

- If ASR doesn't happen, research program leadership will remain.
- NCRP sponsored the first soybean rust symposium in 1994.
- NCRP sponsored soybean cultivar and plant introduction screening in 2001 in both the US and internationally.
- Much research co-founded by soybean checkoff and USDA funding.
- $7.5 million has been devoted to ASR.
- Producer funding of ASR sentinel plots is not sustainable because it is not fully funded forever.
- Future needs: need for less dependence on grower sources of funding, better prediction systems, further development of aerobiological systems and stable funding.
- Added resources are needed from CSREES for development of prediction models.