3-2005

Proceedings of the 32nd Annual Meeting, Southern Soybean Disease Workers (March 2-3, 2005, Scottsdale, Arizona)

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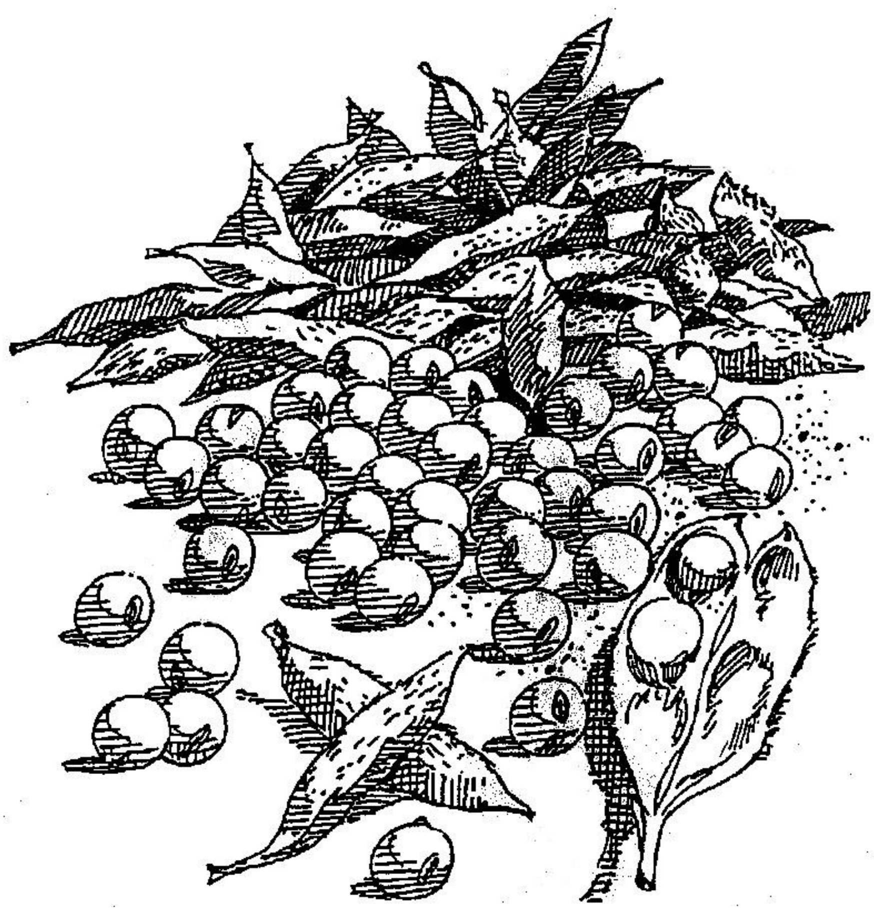
PROCEEDINGS OF THE SOUTHERN

SOYBEAN DISEASE WORKERS



THIRTY-SECOND ANNUAL MEETING

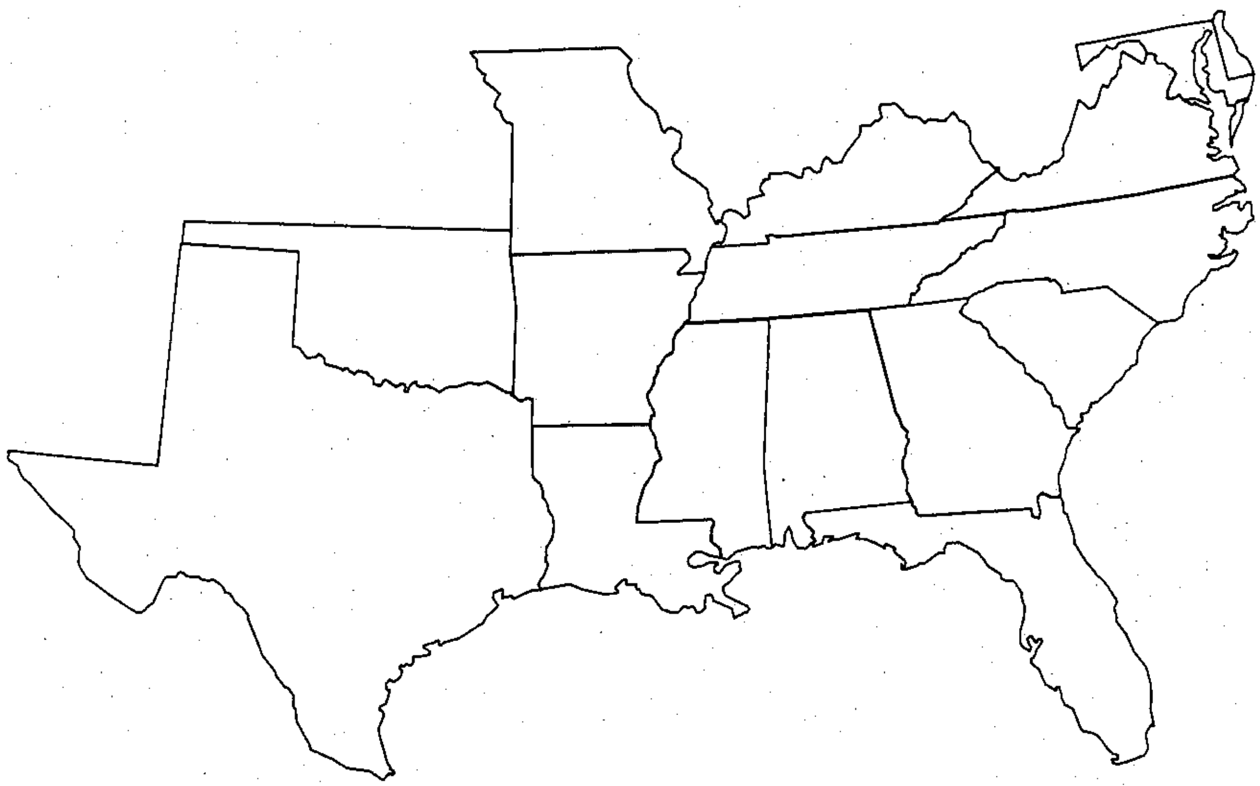
March 2–3, 2005 | Scottsdale, Arizona

PROCEEDINGS OF THE SOUTHERN SOYBEAN DISEASE WORKERS

32ND ANNUAL MEETING

March 2 - 3, 2005

Scottsdale, Arizona



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Program for SSDW/NC-504/NCD-202
Phoenix, Arizona
DoubleTree Hotel
March 2 – 3, 2005

March 2, 2005

7:00	Registration and continental breakfast
8:00	Welcome and overview Dorrance/Schneider
8:05	Discovery of rust in the U.S. Schneider
8:10	Germplasm screening for resistance to *Phakopsora pachyrhizi* Glen Hartman
8:30	Current research on soybean rust, and/or Development of diagnostic procedures Reid Frederick
9:00	Fungicide trials and current recommendations in South America and elsewhere Monte Miles
9:30	Breeding strategies for controlling soybean rust Greg Shaner
10:00	**Break**
10:20	The soybean seed industry perspective towards Soybean Rust Dr. Kelly Whiting, Delta Pine Land Company
10:35	Chemical Industry Perspective
Noon	**Working lunch** **Funding opportunities** **Kitty Cardwell, USDA**
1:00	Section 18s and Chemical control strategies – Fungicide evaluations 2005 Panel Discussion Marty Draper Don Hershman Monte Miles
2:00	Epidemiology, modeling and early warning systems X.B. Yang Roger Magarey Charlie Main
2:30	Sentinel Plots (Comments & Discussion) X.B. Yang Roger Magarey
3:00	**Break**

3:20 The APHIS View
Coanne E. O'Hern
3:30 The Role of Regional Plant Diagnostic Labs
Carrie Harmon
3:45 Soybean Rust Extension Activities/Needs 2005
Anne Dorrance
Marty Draper
Don Hershman
Loren Giesler
4:15 Impact of Quadris/Warrior Tank Mix in Kentucky- Don Hershman
4:40 Impact of Quadris/Warrior Tank Mix in North Central States – Jim Kurle
5:00 Break

5:30 Reception

NCR-137/NC504/NCD202
Scottsdale, Arizona
March 3, 2005

8:00 – Registration and continental breakfast
8:30 -- New Business

- SoyCAP – what is it and current status – Anne Dorrance
- Report on Disease Losses in 2004 – Laura Sweets

9:00- Noon - State Reports
Noon-1: LUNCH
1- 2 – More State Reports
2-2:30 --Business Meeting NCR-137

- Introduction of Participants
- Review and approve agenda
- Review and approve minutes of 2004 meeting
- Discussion of possible meeting dates for 2006
- Election of Secretary for 2005 and Chair for 2006
- Comments from Administrative advisor, Steve Slack-

2:30-3:00 BREAK
3-5 Business Meeting NCD202/NC504

- Introduction of Participants
- Comments from Administrative Advisor, Dr. Steve Slack
- Review and approve agenda
- Review and approve minutes of 2004 meeting
- Review and change rewrite NC504
- Discussion of possible meeting dates for 2006
- Election of Secretary for 2005 and Chair for 2006

32nd Annual Meeting of the Southern Soybean Disease Workers

March 3 2005

8:00	**Registration and Continental Breakfast**
8:45	**Evaluation of Soybean Varieties and Germplasm Lines to Soil Water-logging** J. G. Shannon, G. Stevens and W. J. Wiebold, University of Missouri-Delta Center
9:00	**Replacing Races: Adaptation of the Soybean Cyst Nematode HG Type Test for Practical Applications** T. L. Niblack, G. R. Noel, and J. P. Bond, University of Illinois, USDA-ARS and Southern Illinois University
9:15	**Fungicide Efficacy and Application Timing for Control of Frogeye Leaf Spot of Soybean Caused by *Cercospora sojina*** M. A. Newman, W. Percell and W. Crowder, University of Tennessee Extension
9:30	**Characterization of *Cercospora sojina* Isolates and Germplasm Evaluation** A.K. Gregor, C. M. Vick, J. P. Bond, M. E. Schmidt, J. A. Wrather and J. G. Shannon, Southern Illinois University and University of Missouri-Delta Center
9:45	**Integration of Soybean Rust Control into a Late Season Foliar Fungicide Program** G. L. Sciumbato, D. H. Poston, W. F. Moore, , B. L. Spinks, and M. A. Blaine, Delta Research and Extension Center, and Mississippi State University
10:00 – 10:25	**Break**
10:30	**Simulation of Spore Trajectories to Identify Potential Pathways of Soybean Rust in the Continental US** K. S. Kim, Z. Pan, and X. B. Yang, Iowa State University and St. Louis University
10:45	**Periods from Initial Infection to Detectable Levels of Soybean Rust in Early Stages of Disease Development** X. Li, A. P. Dias, and X. B. Yang, Iowa State University
11:00	**Analysis of Regional Onset of Asian Soybean Rust Outbreaks In South America** E. D. Ponte and X. B. Yang, Iowa State University
11:15	**A Critical Monthly Rainfall Model for Prediction of Asian Soybean Rust Outbreaks** E. D. Ponte, Xun Li and X. B. Yang, Iowa State University
11:30	**A 2-Year Study of Foliar Fungicides in Mississippi Soybeans** B. L. Spinks, D. H. Poston, G. L. Sciumbato, and M. A. Blaine Mississippi State University and Delta Research and Extension Center

12:00 **Lunch**

1:00 **State Reports**
Business Meeting (Treasury Report/Election of Officers/ Meeting Location 2006/Roast of Outgoing President)

SOUTHERN SOYBEAN DISEASE WORKERS
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SOUTHERN SOYBEAN DISEASE WORKERS 2004 TREASURY REPORT
Operational [redacted] Planters First Bank, Hawkinsville, GA

Receipt Summary	
Interest on Operational Account	$ 9.18
2004 Meeting Registration Receipts	$ 1,050.00
2004 Soybean Disease Atlas Sales	$ 0.00
Total Receipts	**$ 1,059.18**

Disbursement Summary	
Printing Fees	$ 0.000
Postage	$ 92.45
2002 Annual Meeting Costs	$ 1,967.31
SSDW Association Awards	$ 90.81
Bank Account Fees	$ 0.00
Total Disbursements	**$ 2,150.57**

SSDW Assets – December 31, 2004	
Beginning Balance – 1/01/04	**$ 2,724.13**
Receipts	**$ 1,059.18**
Disbursements	**$ 2,150.57**
Net Assets – 12/31/04	**$ 1,632.74**
Balance of Operational Account	**$ 1,632.74**

[redacted]

Jason P. Bond
Secretary/Treasurer

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SOUTHERN UNITED STATES SOYBEAN DISEASE LOSS ESTIMATE FOR 2004

Compiled by Stephen R. Koenning Extension Specialist, Department of Plant Pathology, Campus Box 7616, North Carolina State University, Raleigh, NC 27695-7616

Since 1974, soybean disease loss estimates for the Southern United States have been published in the Southern Soybean Disease Workers Proceedings. Summaries of the results from 1977 (6), 1985 and 1986 (2), 1987 (3), 1988 to 1991 (5), 1992 to 1993 (8), 1994 to 1996 (4) have been published. A summary of the results from 1974 to 1994 for the Southern United States was published (7) in 1995, and soybean losses from disease for the top ten producing countries of 1994 was published in 1997(9). An estimate of soybean losses to disease in the US from 1996-1998 was published in 2001, and a summary of losses from 1999-2002 was published on line in 2003 (10, 11).

The loss estimates for 2004 published here were solicited from: Edward Sikora in Alabama, Clifford Coker in Arkansas, Robert Mulrooney in Delaware, Tom Kucarcek in Florida, Bob Kemerait in Georgia, Don Hershman in Kentucky, Boyd Padgett in Louisiana, Arvydas Grybauskas in Maryland, Gabe Sciumbato in Mississippi, Allen Wrather in Missouri, Steve Koenning in North Carolina, John Mueller in South Carolina, Melvin Newman in Tennessee, Joseph Krausz in Texas, and Patrick Phipps in Virginia. Various methods were used to obtain the disease losses, and most individuals used more than one. Allen Wrather provided the estimate for Oklahoma for 2004. The methods used were: field surveys, plant disease diagnostic clinic samples, variety trials, questionnaires to Cooperative Extension staff, research plots, grower demonstrations, private crop consultant reports, foliar fungicide trials, and "pure guess". The production figures for each state were supplied by the state crop reporting services. Production losses were based on estimates o f y ield i n t he a bsence o f d isease. T he f ormula w as: p otential p roduction without disease loss = actual production ÷ 1-percent loss (decimal fraction).

In the southern states, the 2004 average soybean yield and acreage increased from that reported in 2003. In 2004, 683.4 million bushels were harvested from over 17 million acres in 16 southern states. The overall average for the 16 reporting states was 34.3. The overall average reported in 2002 was 31.3 bushels/acre. The Average yield (weighted by production) in 2004 was 39.3 bushels/acre. The 2004 total acres harvested, average yield in bushels per acre, and total production in each state are presented in Table 1. Percentage loss estimates from each state are specific as to causal organism or the common name of the disease (Table 2). The total average percent disease loss for 2004 was 11.58 % or 87.4 million bushels in potential production. In 2004, Tennessee reported the greatest percent loss at 27.8 %, followed by Mississippi at 20.0 %.

The estimated reduction of soybean yields is specific as to the causal organism or the common name of the disease (Table 3). The estimated reduction in soybean yield due to diseases during 2004 was greatest in Tennessee with 18.17 million bushels. The total reduction in soybean yield due to diseases in the 16 southern states was 87.4 million bushels in 2004 up from 79.69 million bushels reported in 2003; largely because of greater production as a result of higher than average yields and increased acreage in most states.

The highest average estimated percent loss was caused by frogeye leafspot 1.56% (11.67 million bushels) followed by soybean cyst nematode 1.51% (14.34 million bushels (Tables 2 & 3).

Diseases continued to cause significant loss in soybean production throughout the 16 southern that participated in this disease loss estimate states in 2004. It is essential that Extension and University research continue their efforts to discover methods to control these diseases and to educate soybean producers concerning the best methods to prevent yield loss due to soybean diseases.

Table 1. Soybean production for 16 southern states in 2004.

State	Acres harvested	Yield/acre (bu)	Total production (bu)
Alabama	195,000	37	7,200,000
Arkansas	2980000	38	113,240,000
Delaware	207000	42	8,694,000
Florida	17000	34	578,000
Georgia	270000	31	8,370,000
Kentucky	1290000	42	54,200,000
Louisiana	1100000	33	32,700,000
Maryland	490000	42	20,580,000
Mississippi	1600000	39	62,400,000
Missouri	4940000	46	227,200,000
North Carolina	1500000	34	51,000,000
Oklahoma	290000	30	8,700,000
South Carolina	520000	26	13,520,000
Tennessee	1180000	40	47,200,000
Texas	270000	32	8,640,000
Virginia	520000	37	19,240,000
Total	17,367,000	Avg. =34.3 /Wt. Avg. 39.3	683,462,000

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Table 2. Estimated percentage loss of soybean yield due to diseases for 16 southern states during 2004.[a]

Disease	AL	AR	DE	FL	GA	KY	LA	MD	MS	MO	NC	OK	SC	TN	TX	VA	Avg.
Anthracnose	0	0.56	0.5	3	0.2	0.05	1	TR	2	0.1	0.3	0	0.5	4	2	1	0.95
Bacterial diseases	0	0	0	0	0	0.01	0	0	TR	TR	0.3	0	0.25	0	0.5	0.3	0.09
Brown leaf spot	0	0.01	TR	TR	0	0.2	0	TR	1	TR	0.2	0	0.25	2	0.2	0.5	0.27
Charcoal rot	0	1.75	TR	1	0.1	1	0.5	TR	1	0.5	0.05	1	0.01	1	1.5	0.2	0.6
Diaporthe/Phomopsis	1	0.55	0.5	3	0.3	0.75	2	0.25	3	0.1	0.3	0	2	3	1.5	0	1.14
Downy mildew	0	0	0	TR	0.2	0.01	0	TR	TR	TR	0.3	0	0.01	0	0.1	TR	0.04
Frogeye	3	0.8	TR	0.1	2	0.1	0.5	TR	3	0.5	1.5	0	2.5	6	3	2	1.56
Fusarium wilt and rot	0	0	0	0	0	0.01	0	TR	0	TR	0	0	TR	0	0.2	0	0.01
Other diseases[b]	0	0	0	0	0	0	0	0	0	0	4.6	0	0.25	0	0	0.5	0.33
Phytophthora rot	0	0	0	0	0	0.01	0.5	0.01	TR	0.5	0.55	1	TR	0	0.1	TR	0.17
Pod & stem blight	0	0.56	0	0	0.2	0.3	0	0	2	0.1	0.4	0	1	0.1	1.5	1	0.45
Purple seed stain	1	0.05	0	1	0.1	0.01	6	0.75	2	0	0.2	0	0.1	1	2.5	0.1	0.93
Aerial blight	0	0.25	0	0.5	0	0	2	0	TR	0	0	0	0	0	0.2	0	0.18
Sclerotinia	0	0	TR	0	0	0	0	TR	0	TR	0	0	0	0	0.1	TR	0.01
Seedling diseases	1	0.05	TR	2	0.1	0.2	0.5	0.01	2	0.1	0.05	1	0.02	2	0.5	0.5	0.63
Southern blight	0	0.02	0	TR	0.2	0.01	0	0	TR	0	0.2	0	0.5	0	0.1	0.1	0.07
Soybean cyst nematode	0	2	2	TR	0.5	2	0.2	2	TR	1.5	5	1	2	4	0	2	1.51
Root-knot nematode	1	1	0	1	4	0	1.7	0.5	TR	TR	1.2	0.1	4	0.1	0.3	0.8	0.98
Other nematodes[c]	0	0.01	0	0	0.25	0	0.1	0	0	0	0.6	0	4	0.1	0	0.2	0.33
Stem Canker	2	4.25	0	0	0.5	0.01	0.5	0	4	0	0	0	0	2	0.1	0	0.84
Sudden death syndrome	0	1.84	TR	0	0	0.05	0	TR	TR	0.5	0	0	0	2.5	0.1	0	0.31
Virus[d]	1	0.01	0	0	0	0.05	0.2	0	TR	TR	0.2	0	1	0	0.2	TR	0.17
Brown stem rot	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0.03
Soybean rust	0	0	0	TR	0	0	0	0	TR	0	0	0	0.1	0	0	0	0.01
Total disease %	10	13.7	3	11.1	8.45	4.77	15.5	3.54	20	3.9	15.95	4.1	19	27.8	14.7	9.7	11.58

a Rounding errors present. TR indicates trace.

b Other diseases listed were: ozone in NC, red crown rot caused *by Cylindrocladium parasiticum* in NC, GA, SC, and VA.

c Other nematodes listed were: Stubby root, Lesion, Sting and common Lance in VA; Columbia lance in NC,SC, and Georgia; Lance and Stubby root in LA; and Reniform in AL, AR, NC, and SC.

d Viruses were identified as: SMV in AL, AR, GA, KY, MS, NC, MO, and VA; BPMV AR, KY, LA, MO, MS,NC, and VA; TobRSV in AR, NC, and SC; and PMV in NC and VA.

Table 3. Estimated suppression of soybean yield (bushels in millions) as a result of disease for 15 southern states during 2004.[a]

Disease	AL	AR	DE	FL	GA	KY	LA	MD	MS	MO	NC	OK	SC	TN	TX	VA	Total
Anthracnose	0.00	0.73	0.00	0.02	0.02	0.03	0.39	0.00	0.04	0.24	0.18	0.00	0.08	2.61	2.03	0.21	6.58
Bacterial diseases	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.18	0.00	0.04	0.00	0.51	0.06	0.80
Brown leaf spot	0.00	0.01	0.04	0.00	0.00	0.11	0.00	0.00	0.02	0.00	0.12	0.00	0.04	1.31	0.20	0.11	1.97
Charcoal rot	0.00	2.30	0.00	0.01	0.01	0.57	0.19	0.00	0.02	1.18	0.03	0.09	0.00	0.65	1.52	0.04	6.62
Diaporthe/Phomopsis	0.08	0.72	0.00	0.02	0.03	0.43	0.77	0.05	0.06	0.24	0.18	0.00	0.33	1.96	1.52	0.00	6.39
Downy mildew	0.00	0.00	0.00	0.00	0.02	0.01	0.00	0.00	0.00	0.00	0.18	0.00	0.00	0.00	0.10	0.00	0.31
Frogeye	0.24	1.05	0.00	0.00	0.18	0.06	0.19	0.00	0.06	1.18	0.90	0.00	0.42	3.92	3.04	0.43	11.67
Fusarium wilt and rot	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.21
Other diseases [b]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.77	0.00	0.04	0.00	0.00	0.11	2.92
Phytophthora rot	0.00	0.00	0.00	0.00	0.00	0.01	0.19	0.00	0.00	1.18	0.33	0.09	0.00	0.00	0.10	0.00	1.91
Pod & stem blight	0.00	0.73	0.00	0.00	0.02	0.17	0.00	0.00	0.04	0.24	0.24	0.00	0.17	0.07	1.52	0.21	3.41
Purple seed stain	0.08	0.07	0.00	0.01	0.01	0.01	2.32	0.16	0.04	0.00	0.12	0.00	0.02	0.65	2.53	0.02	6.03
Aerial blight	0.00	0.33	0.00	0.00	0.00	0.00	0.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	1.31
Sclerotinia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.10
Seedling diseases	0.08	0.07	0.18	0.01	0.01	0.11	0.19	0.00	0.04	0.24	0.03	0.09	0.00	1.31	0.51	0.11	2.98
Southern blight	0.00	0.03	0.00	0.00	0.02	0.01	0.00	0.00	0.00	0.00	0.12	0.00	0.08	0.00	0.10	0.02	0.38
Soybean cyst nematode	0.00	2.62	0.00	0.00	0.05	1.14	0.08	0.43	0.00	3.55	3.01	0.09	0.33	2.61	0.00	0.43	14.34
Root-knot nematode	0.08	1.31	0.00	0.01	0.37	0.00	0.66	0.11	0.00	0.00	0.72	0.01	0.67	0.07	0.30	0.17	4.47
Other nematodes [c]	0.00	0.01	0.00	0.00	0.02	0.00	0.04	0.00	0.00	0.00	0.36	0.00	0.67	0.07	0.00	0.04	1.21
Stem Canker	0.16	5.58	0.00	0.00	0.05	0.01	0.19	0.00	0.08	0.00	0.00	0.00	0.00	1.31	0.10	0.00	7.47
Sudden death syndrome	0.00	2.41	0.00	0.00	0.00	0.03	0.00	0.00	0.00	1.18	0.00	0.00	0.00	1.63	0.10	0.00	5.36
Virus [d]	0.08	0.01	0.00	0.00	0.00	0.03	0.08	0.00	0.00	0.00	0.12	0.00	0.17	0.00	0.20	0.00	0.69
Brown stem rot	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.11
Soybean rust	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00
Total loss	0.80	17.99	0.22	0.08	0.79	2.71	6.07	0.75	0.40	9.22	9.61	0.37	3.09	18.17	14.89	2.07	87.23

a Rounding errors present. TR indicates trace.

b Other diseases listed were: ozone in NC, red crown rot caused *by Cylindrocladium parasiticum* in NC, GA, SC, and VA.

c Other nematodes listed were: Stubby root, Lesion, Sting and common Lance in VA; Columbia lance in NC,SC, and Georgia; Lance and Stubby root in LA; and Reniform in AL, AR, NC, and SC.

d Viruses were identified as: SMV in AL, AR, GA, KY, MS, NC, MO, and VA; BPMV AR, KY, LA, MO, MS,NC, and VA; TobRSV in AR, NC, and SC; and PMV in NC and VA.

INITIAL DISCOVERY OF ASIAN SOYBEAN RUST IN LOUISIANA IN 2004 AND LESSONS FOR 2005

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Asian soybean rust was first discovered near Baton Rouge, LA on November 6, 2004 on a maturity group VII variety. On November 11 four teams surveyed most of the soybean production areas in south and central Louisiana (about 10,000 square miles). In total, 64 sites in 15 parishes (counties) yielded 56 samples, including nine from kudzu, that were examined in the field. Of the nine samples that were submitted for DNA confirmation, six were confirmed as positive.

Symptoms were not found on volunteer soybean plants during the survey of November 11 even though some of the plants were beginning to flower. However, infected young volunteers were found during a subsequent limited survey conducted on December 6. It is possible that the volunteers in the initial survey had not been exposed to the original spore shower, and weather conditions may not have been favorable for infection during subsequent secondary spore showers. There were several rainy days between November 11 and December 6. Of particular concern was the appearance of rust symptoms on unifoliolate leaves of plants still in early vegetative development, but the first trifoliolates were free of symptoms. This was not a result of a lack of inoculum in that these volunteers were growing in the midst of heavily infected mature plants. It is possible that the younger leaves had not been exposed to conducive environmental conditions.

There are several lessons to be learned from these observations. The probability of finding rust would be much higher if surveys are conducted beginning about a week after a rainy period. It is well known that there is a requirement for leaf wetness before infection occurs. Thus, one must examine leaves of different ages on the same plant because each leaf will have a different environmental history. In the case of the infected unifoliolate leaves, these symptoms would have been missed entirely if the second survey had been conducted a few days later because these leaves probably would have abscised by then, and new leaves would be free of symptoms. Frequent and attentive scouting will be required if the disease is to be found at its earliest stages during the next growing season.

Rust symptoms were readily discernable when leaves were free of other diseases. However, it was our experience that when leaf samples were collected after more than about a week of dry weather, only a small fraction of the pustules produced urediniospores even after incubation in a moist chamber. It is possible that uredinia produce a finite number of spores after which they become barren. This is a topic worthy of investigation because of its implications for disease modeling. Cercospora leaf blight, but not frogeye, seemed to affect rust symptom expression. Severe rust symptoms were very similar to brown spot and aerial blight. Photographs will be used to demonstrate these observations.

EFFICACY OF MYCLOBUTANIL FOR CONTROL OF ASIAN SOYBEAN RUST IN BRAZIL (2004)

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Six trials were established in Brazil in 2004 to evaluate the comparative efficacy of myclobutanil and other fungicides against Asian soybean rust, caused by *Phakopsora pachyrhizi*. Soybeans were planted in late 2003 or early 2004. At all locations, fertilizer was applied in furrow at planting and postemergence broadleaf and grass herbicides were applied at the appropriate timing. All plots were 8.3-ft wide by 23-ft long and were separated from adjacent plots with two buffer rows of soybean plants. Two applications between 20- and 31-days apart were applied for each treatment tested. Depending on the trial, the first application was applied at growth stages ranging from V14 to R3. All treatments were applied with a CO_2 backpack sprayer calibrated to deliver between 20 - 24 gal/A. All spray booms were configured with flat fan nozzles. The following treatments (rates per acre) were applied at all six trials: Laredo® EW fungicide (myclobutanil) at 8.5 fl oz, Laredo EC fungicide (myclobutanil) at 7.1 fl oz, Tilt EC (propiconazole) at 6 fl oz, Eminent SC (tetraconazole) at 11 fl oz, Quadris SC (azoxystrobin) at 6 fl oz, Folicur EC (tebuconazole) at 5.5 fl oz, Stratego EC (trifloxystrobin+ propiconazole) at 5.7 fl oz + 0.5% mineral oil and Headline EC (pyraclostrobin) at 9.1 fl oz. Soybean rust was visually rated as the percent foliar infection (severity) throughout the entire canopy. Percent foliar soybean rust was rated weekly with a minimum of three ratings per trial. Data from all evaluation dates were used to calculate the area under the disease progress curve (AUDPC). A 54-ft_2 area in the center of each plot was harvested to determine yield.

In two trials the first applications were applied prior to any observable soybean rust infection at growth stages R1 and R2, therefore the treatments were considered preventative. In both trials the triazole fungicides: Eminent, Folicur, Laredo EC, Laredo EW, and Tilt had the lowest AUDPC values followed by Stratego, Headline, and Quadris. There were no significant differences in yields between the fungicide treatments and the untreated control but all fungicide treatments had numerically higher yields than the untreated control and provided at least 20 days residual efficacy.

In the remaining four trials the first applications were applied after sporulating rust pustules were visible in the lower canopy (at growth stages ranging from V14 to R3) and therefore the treatments were considered curative. In these trials, the triazole fungicides had the lowest AUDPC values followed by Stratego, Headline, and Quadris. In the one curative trial where the first application was applied at V14 and a second application followed 22-days later at growth stage R5, all of the treatments had yields significantly greater than the untreated control while for the remaining three trials all treatments had yields numerically greater than the untreated control.

FLUTRIAFOL – A TRIAZOLE FUNGICIDE GIVING STRONG CURATIVE ACTION AND PERSISTENCE OF EFFECT AGAINST ASIAN SOYBEAN RUST

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Flutriafol is a triazole fungicide from the DMI group, that received first global registrations in the early 1980s. It is not yet registered in the USA. Trials in southern Africa, Brazil, Paraguay and Argentina have demonstrated its strengths against Asian soybean rust (ASBR).

The compound has high instrinsic activity against the disease combined with strong curative action and persistence of protectant action. It is highly systemic, entering the plant rapidly and then translocating within the leaves. These properties result in effective eradication of established infections and the potential for extended spray intervals.

In 22 Brazilian trials from 2002 to 2004, Impact (an SC containing 125 g/l flutriafol) was applied at 0.5 l/ha in one or two spray programs against ASBR. The product was compared with a range of leading triazole and strobilurin standards and mixtures at their label rates. The best triazoles consistently gave superior disease control compared to straight strobilurins due to their superior curative and protectant action. Impact was superior to other triazoles and strobilurin/triazole mixtures against ASBR in terms of persistence of effect, reduced defoliation and soybean yield.

Eleven of the 22 trials were conducted independently by officials in 2003/2004. Impact gave the highest average disease control when compared with the most effective other triazoles, strobilurins and their mixtures. In the remaining 11 Cheminova trials, flutriafol gave the highest yields in 10 situations.

A trial conducted by KwaZulu-Natal Dept Agric & Environmental Affairs in South Africa in 2003/2004 compared triazoles, strobilurins and mixtures at their South African label rates (these are often higher than Brazilian rates). The range of compounds tested included triazoles (e.g. tebuconazole, triadimenol, flusilazole and difenoconazole), strobilurins (e.g. azoxystrobin), undisclosed strobilurin/triazole mixtures and mancozeb. Impact at 1.0 l/ha gave 5 weeks protection before the disease started to re-appear in the crop; all other treatments broke down in 2 to 3 weeks. Yield from the Impact program was over 1.0 t/ha greater than from a comparative azoxystrobin program and over 0.5 t/ha greater than that from a similar tebuconazole program.

These results lead us to the conclusion that flutriafol is the superior fungicide for ASBR control. It offers greater flexibility in use and may offer the possibility of extended spray intervals for economic disease management. We are seeking a US registration.

EXPERIENCE IN USE OF SYNGENTA FUNGICIDES FOR CONTROLLING SOYBEAN RUST IN BRAZIL AND EXPECTATIONS FOR THE US

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Prior to *Phakopsora pachyrhizi* infesting Brazilian soybean acres, many growers were applying fungicides to control powdery mildew (*Microsphaera diffusa)* and late season disease complex caused by *Cercospora kikuchii, C. sojina & Septoria glycines*. Applications could be timed as late as R5.3 for control of LSD but was usually at R5.1. Azoxystrobin and difenoconazole were the primary products used. When soybean rust (SBR) became an issue, it was soon discovered that timing and more systemic triazoles resulted in better control. Cyproconazole, which is registered for use in Brazil on coffee, cereals, and some fruits, was found to be excellent for controlling SBR. A premix with azoxystrobin was developed. This premix provided not only excellent activity against SBR, but improved residual activity, broader spectrum activity against powdery mildew, and excellent eradicative activity that provides the grower increased flexibility. With the discovery of SBR this close the South America, efforts have been made to evaluate the currently registered/nearly registered US products on this devastating disease. Propiconazole (Tilt) is not used in Brazil, however, premixes are used in other South American countries. Under the severe Brazilian conditions, the residual control of Tilt alone is less than that of cyproconazole. Research is underway to evaluate higher use rates and premixes with azoxystrobin. The cyproconazole premix is also being supported in the US for Section 18 use.

THE ROLE OF FORECASTING LONG-DISTANCE SPORE MOVEMENT IN MANAGING THE POTENTIAL 2005 SOYBEAN RUST EPIDEMIC

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The **North American Plant Disease Forecast Center** has been operational for nine years. During that period thousands of forecasts have been created and delivered to growers, industry, and others dealing with downy mildew type diseases. Our approach to forecasting involves daily production of meteorological trajectory maps, assessment of threat and risk to crops, and timely distribution to the public via the Internet and toll-free telephone numbers. A new website for continental forecasting of soybean rust (*Phakopsora pachyrhizi*) was established in January 2005 for North Carolina soybean producers. Air parcel trajectories from several Gulf Coast states and three potential source sites in the Caribbean are being monitored. The new SBR Forecasting website can be accessed at www.ces.ncsu.edu/depts/pp/soybeanrust/.

THE ROLE OF THE NATIONAL PLANT DIAGNOSTIC NETWORK LABORATORIES IN ASIAN SOYBEAN RUST DIAGNOSIS

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The National Plant Diagnostic Network was developed after 9-11 in an effort to protect agriculture in the United States. Five regions, based on commodities, climate, and proximity, comprise the Network, and include all 50 states, plus several US Territories. The Network is a collection of land-grant institutions and their plant diagnostic laboratories. The Network labs provide plant diagnostic services according to consistent protocols and can provide surge relief during times of unusually heavy sample submission.

Asian soybean rust (caused by *Phakopsora pachyrhizi*) is one disease the Network lab personnel were trained to diagnose by APHIS. The Network also provides identification training to a cadre of First Detectors, including producers, county agents, and industry. Training scenarios have been participated in by most states, teaching regulatory, Extension, industry, and others the chain of custody and communication of samples and diagnostic results. This training has proven useful during the 2004 positive identifications in several southern states.

In addition to diagnosing plant problems, the clinics also submit data on their diagnoses to a central database. Efforts are currently underway to use some of those data to track the occurrence of Asian soybean rust during the 2005 growing season. Ideally, maps and information generated from the data will be made available in real-time to end-users including Extension personnel and producers, while providing a level of security and privacy to the sample submitters.

IMPACT OF QUADRIS® PLUS WARRIOR® TANK MIX ON SOYBEAN YIELD IN KENTUCKY.

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Almost no foliar fungicides, and very few insecticides, have been applied to Kentucky soybean until recently. In 2003 and 2004, approximately 30,000 and 60,000A of soybean, respectively, were sprayed with a single application of 6.2 fl oz/A Quadris (22% azoxystrobin) + 2.56 fl oz/A Warrior (11.4% lambda cyhalothrin). Applications were made during the R3 to R5 growth stages; there were no specific target pests. In replicated experiments, yields were significantly increased by Quadris + Warrior in two out of two experiments in 2003 and one out of four experiments in 2004. Significant yield increases ranged from a low of 4.2 bu/A in a 2003 test to a high of 8.5bu/A in 2004. In fungicide timing studies where treatments were applied at growth stage R3, R4, or R5, only applications made at the R4 stage in 2003, and the R5 stage in 2004, produced a significant yield response. Results in grower fields were highly variable over the past two years. In large scale replicated plots in 2003, a single application of Quadris + Warrior applied at R3-R4 did not produce a significant yield result in any of three tests conducted. In non-replicated strip tests, yield response over the two years ranged from no observable effect to 18.1 bu/A compared to non-treated soybean. Average yield response in strip tests in 2003 and 2004 was 4.63 bu and 4.19 bu, respectively. In 2003, yield response to the Quadris + Warrior treatment in grower fields tended to be lower in late-maturing cultivars and fields planted after June 20. A planting date by cultivar maturity test conducted in 2004, however, did not confirm this observation. In most replicated small plot and large strip tests, Quadris + Warrior significantly reduced stem anthracnose (*Colleotrichum dematium* var *truncatum*) by about 50%. Pod anthracnose was not similarly impacted. The same stem anthracnose results were seen where Quadris was applied alone, but yields were not increased by that treatment in any of 10 replicated tests in 2003-2004. In all tests Warrior applied alone did not affect anthracnose, or increase yields in nine replicated tests. Yields were only significantly greater than non-treated soybean when Warrior was applied as a tank mix with Quadris, but we have been unable to account for the Warrior effect by insect control (obvious insect levels were low in all studies). At present, we do not know why Quadris + Warrior, but not Quadris alone, is enhancing yield in some, but not all, situations in Kentucky.

EVALUATION OF SOYBEAN VARIETIES AND GERMPLASM LINES TO SOIL WATER-LOGGING

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Excess water or flooding during the growing season adversely affects soybean growth and seed yield in many areas of the U.S. Soil can become flooded or water-logged when it is poorly drained or when rainfall or irrigation is excessive. Flooding injury causes the plant to physiologically shut down resulting in leaf chlorosis, necrosis, defoliation, reduced nitrogen fixation, cessation of growth and reduced yield. Identifying high yielding soybean cultivars and genetically diverse soybean plant introductions that are tolerant to waterlogging can reduce yield losses from over irrigation or in poorly drained fields. Highly tolerant strains can also be used in soybean breeding programs to develop soybeans with greater flooding tolerance.

The objective of this project was to 1) determine if there is tolerance to field waterlogging among group III, IV and V soybean varieties and germplasm lines and 2) identify the most tolerant soybean varieties and germplasm lines and determine levels of tolerance. The evaluation was done by planting all group III, IV and V soybean varieties in the University of Missouri Soybean Variety Tests, plus 400 (200 each in MG IV and V) plant introductions from the soybean germplasm collection in three replicate hill plots spaced 2 feet apart in rows with 30" between rows. When lines reached bloom or R1 to R2, plots were flooded and water allowed to stand until severe plant yellowing occurred. The plot area was allowed to drain and dry and rated for injury. Then, plots were flooded a second time and rated again after a two week recovery period. Strains were rated on a 1 to 5 scale, with 1 being no apparent injury and 5 all plants dead.

A total of 366, 361 and 390 varieties were evaluated in 2002, 2003, and 2004, respectively. Varieties included in 2002 were 116 group III, 161 group IV and 89 group V. In 2003, ratings were made on 131 group III, 140 group IV and 90 group V varieties. In 2005 123 group III, 171 group IV and 96 group V varieties were rated. All varieties showed some injury. Most varieties were severely injured and rated 3.6 or higher on a scale of 1= no injury and 5 all plants dead. Some varieties that were tolerant in one year were intolerant in other years and vice versa. However, some showed ratings of 3.5 or less and were consistent in tolerance across the evaluations in 2002, 2003 and 2004.

To measure waterlogging tolerance of best varieties, ten soybean varieties (five waterlogging tolerant plus five non-tolerant) each selected from within MGs III, IV, and V were compared under severe waterlogged and non-waterlogged conditions. All varieties showed significant yield loss from flooding. The average yield loss of the five most tolerant varieties averaged over all the maturity groups was 39% compared to a yield loss of 77% for the five most sensitive varieties. Three plant introductions which appear to have high tolerance to soil waterlogging are being evaluated further for use in breeding varieties for higher tolerance to excess water.

REPLACING RACES: ADAPTATION OF THE SOYBEAN CYST NEMATODE HG TYPE TEST FOR PRACTICAL APPLICATIONS

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The HG Type classification system for soybean cyst nematode (SCN) populations is based on the female index, a measure of SCN virulence relative to the susceptible soybean cultivar Lee 74, on seven soybean plant introductions (PI): 1) 548402 (Peking); 2) 88788; 3) 90763; 4) 437654; 5) 209332; 6) 89772; and 7) 548316 (Cloud). These seven lines represent the sources of resistance that have been used to develop SCN-resistant cultivars in the United States, according to their publication in the journal *Crop Science*. Although still a bioassay and subject to difficulties associated with testing living organisms, the HG Type test avoids some of the problems inherent in the race classification scheme. One of these problems was the difficulty of adapting the test for different regions or countries, and interpreting the results. Another was the confusion that resulted when cultivars labeled as "resistant to race 3," for example, were found to be susceptible to particular SCN populations identified as race 3. We have been working with the HG Type system to address these problems.

Of the seven indicator lines, only three have been used to develop SCN-resistant soybean cultivars currently available in Illinois: PI 548402, PI 88788, and PI 437654 (indicator lines 1, 2, and 4). An incomplete HG Type test named the Illinois SCN Type test includes only these three indicator lines and Lee 74, and may include one or more additional cultivars for comparison. Conditions of the test are as specified for HG Type tests, except that it may be conducted in a hydroponic system so that labs without greenhouse facilities are able to perform it after training. The results can be used in conjunction with data from yield trials, SCN-resistance screening, and lists of sources of resistance to aid cultivar selection decisions. Similar adaptations can be made for use in other regions and other countries, where different sources of resistance may be used.

Using the HG Type test, we have determined that the most common HG Types in Illinois are 0, 7, and 2.5.7. HG Type 0 populations are not virulent on any of the 7 sources of resistance, and HG Type 7 is virulent only on PI548316. HG Types 0 and 7 would both formerly have been called races 3 or 6 (not respectively). HG Type 2.5.7, virulent on PI88788, 209332, and 548316, would formerly have been called race 1 or 5. Because different SCN populations of the same type can differ widely, we screen cultivars labeled as "SCN resistant" to five different SCN populations, three of which are HG Type 0 or 7, and two HG Type 2.5.7, originating in different parts of Illinois to represent the types we find there. From 2001 to 2004, we screened all of the SCN-resistant cultivars entered in the Illinois State Variety Trials (636 in 2004) to all five SCN populations. Three years' data have verified that SCN virulence on a particular source of resistance predicts virulence on cultivars derived from that source, but the cultivars themselves vary widely in their response to infection. In addition, up to half of the cultivars labeled "SCN resistant" are actually susceptible to our HG Type 0 or 7 populations. Combination of the Illinois SCN Type test and the SCN-resistance screening program has improved our ability to give reliable recommendations to soybean farmers in Illinois.

FUNGICIDE EFFICACY AND APPLICATION TIMING FOR CONTROL OF FROGEYE LEAF SPOT OF SOYBEAN CAUSED BY *CERCOSPORA SOJINA*

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Frogeye leaf spot (FLS) caused by the fungus *Cercospora sojina* has been observed in Tennessee for over thirty years, but until recently has caused only limited yield loss. However, for the last three years (2002-04) this foliar disease has reduced soybean yields state wide by as much as 8 % of the annual crop. It is possible that increased rainfall during the summer months, lack of crop rotation and planting of susceptible varieties have been responsible for the increase in severity of FLS. Increase in the number of reported races of this fungus may also play a role in the increased yield loss.

For the last two years, several experiments have been conducted at the Milan Experiment Station (MES) under heavy FLS conditions to determine efficacy and the best application timing and rates for several foliar fungicides. In 2003, pyraclostrobin (Headline), azoxystrobin (Quadris), and thiophanate-methyl (Topsin M) were compared at various timings of application, number of applications and rates of fungicides to an untreated check. All fungicide applications increased yields, decreased frogeye leaf spot rating and decreased defoliation significantly over the untreated check. There were no significant differences in one or two applications at R3 and R5 growth stages, nor were there any significant differences in the 1X or 2X rate of fungicide application. Headline and Quadris had significantly higher yields and lower disease ratings than Topsin M at either rate. A similar test was conducted on a commercial field where the incidence of FLS was undetectable, and very little yield increase was recorded for any fungicide.

In 2004, a test was conducted at MES in which pyraclstrobin was used to determine the best stage of maturity to make a single application of fungicide. The 6 and 9 fl oz/a rates were used at growth stages V5, R 1, R3 and R5. Yields, disease ratings a nd d efoliation w ere improved significantly over the untreated check for all stages except the V5 stage. The R1 application was better than the V5, and the R3 application was better than the R1 application at either rate of fungicide, but the R5 application was comparable to only the R1 stage. There was no significant difference between the two rates of fungicide. In another test at the same location, 3, 6 and 9 fl oz/a gave no increase in yields at V5, while applications at R1 and R3 were increasingly higher in yields and lower in disease ratings and defoliation. The R3 application always gave the most effective control for FLS in all tests.

In a foliar fungicide test at MES in 2004, ten fungicide treatments applied at the R3 growth stage were compared to an untreated check. The fungicide treatments included: Headline at 6 fl oz/a; Quilt (azoxystrobin + propiconazole) at 10.5, 14, & 20.5 fl oz/a; Quadris at 6.2 fl oz/a; Tilt & PropiMax (propiconazole) at 4 fl oz/a each; Stratego (propiconazole + trifloxystrobin) at 8 & 10 fl oz/a; and Bravo Ultrex (chlorothalonil) at 1.5 lb/a. All treatments increased yields and decreased disease ratings. Fungicides containing a strobilurin fungicide were clearly more effective in controlling FLS than fungicides with just a triazole alone, especially when applied at the R3 growth stage.

CHARACTERIZATION OF *CERCOSPORA SOJINA* ISOLATES AND GERMPLASM EVALUATION

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Cercospora sojina Hara, the causal agent of frogeye leaf spot (FLS), is becoming a persistent threat to soybean producers in the North Central region. The incidence and severity of the disease has increased o ver the p ast 5 years. T he d isease c an b e m anaged m ost effectively with the use of resistant varieties; however, very few commercial varieties are evaluated for resistance in the north central region. Compounding this problem are the many pathotypes that are known to exist. The objectives of this project were 1) to characterize the virulence of isolates collected in the region and 2) to evaluate commercial and public for resistance to *C. sojina.*

Host tissue with FLS symptoms was collected throughout southern Missouri and southern Illinois in 2002 - 2003. Cultures of *C. sojina* were obtained from this tissue and subsequently purified by scrapping spores from lesions and initiating isolates from single spores. Each isolate was tested for virulence on a set of soybean differentials provided by Dr. Dan Phillips. The differentials were selected based on known resistance genes and prior reactions to isolates collected throughout the United States. The *C. sojina* isolates were grown on soybean, lima bean medium for 10 days to produce spores for inoculum. When the differentials reached the V2 growth stage, each plant was sprayed with ~100,000 spores/ml. Plants were maintained in the greenhouse under clear plastic, shrouds that trapped moisture from fog machines. Lesion production occurred on the leaflets after 10 days, and leaf ratings were collected at 14 and 21 days after inoculation. A 0-9 rating scale was used, representing percent leaf area covered by lesions, a zero having no lesions and 9 having 90% of the leaf area covered in lesions. The isolates tested can be assigned to distinct groups based on their reaction on the differentials.

Over 700 commercial and public varieties were evaluated for resistance to a single isolate of *C. sojina* in 2003 and 2004. Soybean varieties were planted in single rows (152 cm long) and in hill plots in Illinois and Missouri, respectively. Each variety was replicated three times at each location. Prior to infesting the plots, the foliage was kept moist for five hours with overhead irrigation at the rate of 2.54 cm of water per hour. At the V6 growth stage, spores were applied using a CO_2 back pack sprayer at a rate of 22ml per 152 cm row or ~33,000 spores per plant. Symptoms were expressed after 11 days and the plants were rated after 14 days using the 0-9 scale. Frequent rainfall, use of overhead irrigation and adequate cloud cover following inoculation provided excellent conditions for the development of the disease. Out of the 570 commercial varieties evaluated, 95 of these did not have symptoms of FLS. In the public germplasm, 140 lines were evaluated, and 25 did not have symptoms. These v arieties w ithout s ymptoms w ill b e s creened i n t he g reenhouse a gainst a dditional isolates to confirm resistance.

INTEGRATION OF SOYBEAN RUST CONTROL INTO A LATE SEASON FOLIAR FUNGICIDE PROGRAM

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The adaption of the Early Soybean Production System (ESPS) in Mississippi has caused a s hift f rom t he g rowing o f M aturity G roup V I a nd V II t o M aturity G roup I V a nd V . Soybeans are now planted in April and early May and mature in August and September versus October and November. Also, the number of soybean varieties available to the producer has increased dramatically (Over 200 in 2004). Soybeans are now maturing when weather conditions are often favorable to disease development and the disease resistance present in the individual varieties varies tremendously.

We have been doing research on the response of late season foliar fungicide applications on soybean yields and seed quality of the ESPS soybeans for several years. Research has shown that fungicide applications at the R1 stage result in little or no yield or seed quality increase. Applications at the R3 stage have given the greatest return on investment averaging 5 bu/A and applications at the R5 stage have averaged 4.1 bu/A with the most effective fungicides (strobulurins and thiophanate methyl). Later applications have in some cases resulted in increased seed quality but not yield increases. Applications at the R3 stage and R5 stage have sometimes resulted in increases in seed quality.

We have developed a suggested spray sequence to control soybean rust and to take advantage of the yield returns obtained from controlling other diseases. This will help offset the costs of the fungicides used to control rust. This system involves the use of a triazole fungicide applied at the R1 stage followed by a strobulurin fungicide applied at the R3 stage.

SIMULATION OF SPORE TRAJECTORIES TO IDENTIFY POTENTIAL PATHWAYS OF SOYBEAN RUST IN THE CONTINENTAL US

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Long distance dispersal (LDD) has been considered to the cause of successful transmissions of rust, powdery mildew, and blue mold diseases between distant regions. Soybean rust is caused by obligate fungi that are capable of LDD. In this study, a method to quantify spore movement was developed by incorporating spore viability into the atmospheric dispersal model, and LDD of soybean rust spores was simulated to identify potential pathways from an over-winter site to major soybean production region.

The 80 km output data of the ETA Data Analysis System (EDAS) were used to simulate LDD of soybean rust spores using an atmospheric model of particle deposition. In this study, the HYSPLIT 4 (Hybrid Single-Particle Lagrangian Integrated Trajectory) model was used to predict movement of soybean rust spores, computing air-mass trajectories, dispersion, and deposition with the mean wind fields and their turbulent components. A step-wise simulation was implemented to combine a set of multiple simulations of an atmospheric transport model during half of a month in 1997-2003. To quantify difference in spore availability between areas, viability of spores deposited on an area was estimated using a statistical distribution function. Estimates of spore viability obtained from simulations in a year were combined into a single value for the period of 1997-2003, which was referred to as Combined Availability Index (CAI).

Overall, step-wise simulations suggested that potential deposit areas of soybean rust spores were extensive, including midwestern states at the beginning of a season. For example, potential deposit area from a site in southeastern Texas covered IA, IL, KS, MN, WI, MI, and IN during early May. However, a potential infection area, which was defined as a potential deposit area with CAI >3, tended to locate within specific zones in southern states. Using step-wise simulations, it was possible to deduce the likely pathway from a suspected over-winter site of soybean rust or a bridging source area to the major soybean production region. For example, when soybean rust survives in central Florida during a winter, soybean rust could spread to southeastern Mississippi during early April, establish here as a bridging source a rea. D uring e arly M ay, t he s tep-wise simulation s uggested t hat s pores c ould b e transported from southeastern Mississippi to northeastern Arkansas (second bridging source area) or western Kentucky relatively frequently in 1997-2003. However, for later periods until late June, spores were rarely dispersed to the outside of MS and AB, suggesting presence of dispersal window. When spores moved into northeastern Arkansas and western Kentucky, it was likely that IL, IN, OH, and IA were within the potential infection area. Our simulation results also suggested that spores could be transported to OK, KS, NE, SD, and ND along the "Puccinia pathway," when soybean was infected by soybean rust in a southeastern part of Texas during the early season.

PERIODS FROM INITIAL INFECTION TO DETECTABLE LEVELS OF SOYBEAN RUST IN EARLY STAGES OF DISEASE DEVELOPMENT

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Epidemics of soybean rust (SBR) caused by *Phakopsora pachyrhizi* would be dependent on amount of initial inoculum in the form of airborne spores. Early detection of the disease is important for timely fungicide spray decision. If initial disease incidence is relative high at a very low severity level, disease could be detected early due to high incidence. If level of initial infection and incidence after a few infection cycles are both very low, the disease could still l ikely be d etected b ecause a few l eaves w ould h ave h igh s everity d ue t o localized secondary infections. In the later case, detection would require more samples.

Initial disease should fit a random distribution due to random airborne inocula; then as localized secondary infections occur, aggregated distribution appears that could fit negative binomial distribution. The relationship between incidence and severity could be mathematically described based on disease distribution. When disease process fits logistical model, time for disease development from an initial infection level to a detectable level could be estimated. Based on the results of previous experiments in Taiwan, we analyzed the time needed to reach a detectable level under different scenarios. Here, incidence was defined as percentage of infected leaves; severity as lesion number per leaf and then divided by 2700 (maximum number of lesions per leaf). Total severity was the averaged severity for all leaves in a sample.

At infection rates of 0.25, 0.2, 0.15, and 0.1 with a latent period of 7 days, from initial incidence of 0.1–1%, it would take 14–23, 15–27, 18–33, or 23–46 days respectively to reach the detectable level (5% incidence) for a random distribution. If the disease distribution is aggregated (negative binomial distribution) with degree of aggregation at 0.5, it would take 15–23, 17–28, 20–34, or 27–48 days respectively to reach 5% incidence. If disease incidence is always low, severity (number of lesions a leaf) affects the detectable level. When initial disease on a leaf is 1 lesion (0.037% severity), this would take 16, 19, 22, or 30 days respectively to reach a detectable level of 10 lesions a leaf on infected leaves. However, detection level based on leaf severity would highly depend on the sample size.

Experimental data from Taiwan showed that average infection rate is about 0.11 with maximum around 0.3. From the data, we estimated value of infection rates in a range of 0.1–0.15 in vegetative stages under suitable environment conditions. Thus in most cases, calculated periods for the disease to reach the two detectable levels mentioned above are 18–48 days. However, if there is continuous external inocula deposition over a few days with favorable environment conditions, the disease could build up in fewer days.

ANALYSIS OF REGIONAL ONSET OF ASIAN SOYBEAN RUST OUTBREAKS IN SOUTH AMERICA

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Once soybean rust is established in a region, it may spread to new areas and show up every following season at different times and aggressiveness. Although it is well known that the fungus encounters suitable conditions to infect the crop in all soybean areas, the factors triggering regional epidemics are not well understood. Among them, inoculum presence and initial concentration, along with suitable environment for infection process and inoculum build-up are supposed to be of great importance. Hence, understanding of the mechanisms underlying those processes is critical in a disease forecast framework. Laboratory studies have demonstrated the effect of leaf wetness duration and temperature in the disease cycle's components, considering high inoculum. Previous modeling efforts using those variables have led to successful calibration and validation of disease models using a dataset from Taiwan. Those models have not been validated in other locations for further improvement. Some other efforts include the use of daily infection index based on leaf wetness duration and temperature as input v ariables, in o rder t o predict d isease o utbreaks. Monthly c umulative risk maps developed in Brazil using a similar approach did not m atch well with o bserved disease occurrence.

An analysis of a dataset originated from intense monitoring of spatial and temporal disease onset in Brazil and Argentina in the 2003/2004 and 2004/2005 season has been carried in relation to rainfall data. In both countries, timing of disease onset and spread in a single region seemed to be well correlated to rainfall in the preceding months. In Argentina, last year, first detections occurred in January and early February, in two northern provinces bordering Brazil. No other detections were recorded along February and March, being the disease recorded again in April and May. Amount of rainfall in November and December bypassed 350mm whereas total precipitation in January and February was below 125 mm. The increase in average rainfall in March (>80 mm) and April (>180 mm) apparently was associated with the spread of the disease to southern locations. In the 2004/2005 season, less than 10 detections were recorded in December and early January (1 case). Total rainfall in October and November was around 400 mm. Rainfall in December was below 150 mm and January was drier (<90 mm) and one detection was reported at late January.

In Brazil, the clearest picture is from 2004-05 season. Disease onset started in early December and continued mainly in regions where rainfall was plenty in October and November (>500 mm), for instance of Parana State. On the other hand, disease showed up at late January in the states of Bahia and Rio Grande do Sul. In those regions, total amount of rainfall for November and December was around 180mm. In January alone rainfall was over 150 mm, and first sequential detections occurred further on. These results demonstrate a potential role of rainfall in triggering regional epidemics.

A CRITICAL MONTHLY RAINFALL MODEL FOR PREDICTION OF ASIAN SOYBEAN RUST OUTBREAKS

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It has been well documented that Soybean rust epidemics are severe in locations where inoculum is available early and environment is most suitable for epidemic development. Extended dew periods and cool temperature has been considered important for rust development. Studies in China, using historical disease data, have demonstrated the association of rainfall (amount and number of events) on final severity levels. In Brazil, severe epidemics have been observed where rainfall was high and frequent at reproductive stages - flowering throughout beginning seed stage. Although inoculum is available early in Brazil, epidemics were considered light in some regions, apparently influenced by extended dry periods along the window of vulnerability. In Argentina, disease largely spread to major soybean areas later in a season, and affected the crop at maturing stages without losses. In sequential planting experiments conducted in Taiwan, disease could be noticed within 3 weeks after planting in some cases due to high density of spores, whereas in Brazil it shows up mostly after flowering. Using historical disease severity data (8 years) for a location in Hubei, China, a rainfall-based model was modified by us after using the month around flowering as a critical month to predict the disease development.

In our work, the data from China and Brazil are used. Historical data were from three locations Hubei, Lishui and Datian in southeastern China. Data from Brazil were from past seasons. The model well predicted the historical Chinese epidemic data. Our regression model using number of rain days and amount of rainfall for a given month was evaluated for Brazil situation. Monitoring of soybean rust onset in the last and current season in Brazil showed that December and January, especially the latter, is the time disease onset most increase, concurrent to the time when fields have already reached flowering. Then, January and February were used as the critical month to define severity of outbreaks in Brazil, and can be interpreted considering differences in planting dates and varieties.

Results presented in a regional basis indicate that the model was able to explain differences in epidemic levels of soybean rust among distinct growing areas in Brazil. Maps of predictions were consistent with estimated regional severity in the last season, excepting some northern locations. The model run for current season in Brazil, using rainfall data for January 2005 indicates that fields that already reached flowering being the disease noticed in December and early January at Central and Southern regions in Brazil may present high severity levels, whereas epidemics in southern areas may be light, considering that no control measure has been taken. The results suggest that rainfall during 30 days, when soybean is most susceptible to the rust, may be critical to several components of the entire epidemic process, including spore deposition, sporulation, dispersal and infection, which defines the final disease severity. Since the model is developed with data where rust is endemic, further medications to adjust to the US situation are needed.

A 2-YEAR STUDY OF FOLIAR FUNGICIDES IN MISSISSIPPI SOYBEANS

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Twelve foliar fungicide treatments were evaluated at R3-4 and R5-6 growth stages in Mississippi in 2003 (5 locations) and 2004 (4 locations). Treatments were: 1) 6.2 oz/A Quadris, 2) 0.75 lb/A Topsin M, 3) 1.5 pt/A Bravo Weatherstik, 4) 2 oz/A Dimilin, 5) 6.2 oz/A Quadris + 0.5 lb/A Topsin M), 6) 6.2 oz/A Quadris + 1.0 pt/A Bravo Weatherstik, 7) 6.2 oz/A Quadris + 2 oz/A Dimilin, 8) 1.25 lb/A Solubor + 2 oz/A Dimilin, 9) 3.1 oz/A Quadris + 2 oz/A Dimilin, 10) 3.1 oz/A Quadris + 0.5 lb/A Topsin M, 11) 5 oz/A Tilt, 12) 3.9 oz/A Tilt + 4.1 oz/A Quadris, and a 13) Nontreated control. Application timings were R3-R4 and R5-R6. Applications were made with a tractor-mounted compressed-air sprayer calibrated to deliver a spray volume of 20 GPA at 39 PSI or a CO2-pressurized backpack sprayer that was calibrated to deliver a spray volume of 15 GPA at 22 PSI. Soybean varieties included maturity groups IV and V and planting dates ranged from the first of April to the end of April. Visual ratings for Frogeye leaf spot (FLS), caused by *Cercospora sojina* Hara, were taken at all locations approximately 2 weeks after R5-R6 applications. Soybean yield and net returns above fungicide and application costs were determined. Net returns were calculated using a $6.09/bushel price for soybean.

Averaged across all locations and timings, Quadris at 6.2 oz/A applied alone or in combination with other products increased soybean yield 4.4 to 5.5 bu/A. Similar yield increases occurred with 3.1 oz/A Quadris + 0.5 lb/A Topsin M. Soybean yields with these treatments averaged 2.4 bu/A higher with R3-4 applications than with R5-6 applications. Quadris at 6.2 oz/A and Quadris at 6.2 oz/A + 2 oz/A Dimilin were the most profitable treatments and increased net returns $11.55 and $14.54/A, respectively compared to the untreated control.