3-1997

Proceedings of the 24th Annual Meeting, Southern Soybean Disease Workers (March 15-16, 1997, Fort Walton Beach, Florida)

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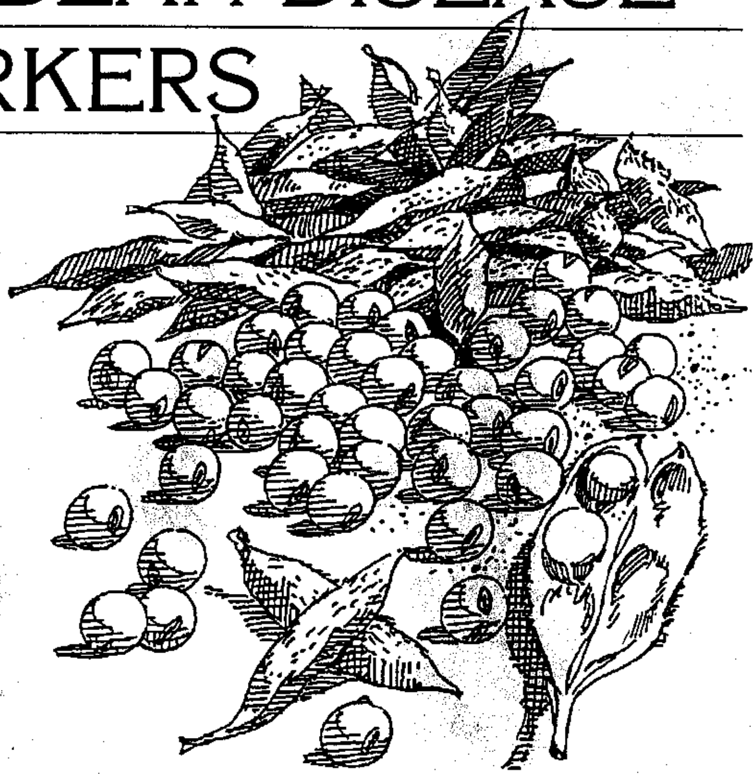
PROCEEDINGS OF THE SOUTHERN SOYBEAN DISEASE WORKERS



TWENTY-FOURTH ANNUAL MEETING

MARCH 15-16, 1997 FORT WALTON BEACH, FL

PROCEEDINGS OF THE

SOUTHERN SOYBEAN DISEASE WORKERS

TWENTY-FOURTH ANNUAL MEETINGS

MARCH 15-17, 1997

FORT WALTON BEACH, FLORIDA

Saturday - March 15

Steering Committee Meeting

Sunday - March 16

Graduate Student Paper Competition

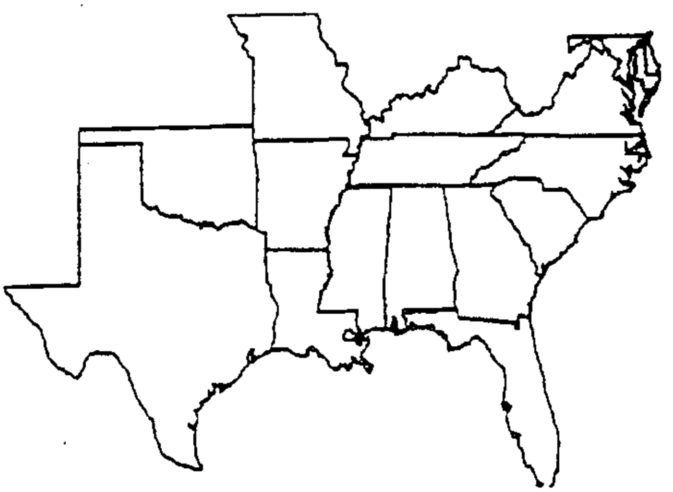
Contributed Paper Session

Panel Discussion

Informal Discussion Soybean Diseases and Pests

Business Session

Steering Committee Exit Meeting



Proceedings of the Southern Disease Workers are published annually by the Southern Soybean Disease Workers.

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1996-1997 Officers

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CONTRIBUTED PAPERS (cont'd)

SOUTHERN UNITED STATES SOYBEAN DISEASE LOSS ESTIMATE FOR 1996

Compiled by Phillip W. Pratt, Area Extension Plant Pathology Specialist, Oklahoma Cooperative Extension Service, Oklahoma State University, Muskogee, OK 74401

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 (5), 1985 and 1986 (2), 1987, (3), 1988 and 1991 (4), 1992 to 1993 (7), 1994 (9) have been published. A summary of the results from 1974 to 1994 has also been published (6).

The loss estimates for 1996 published here were solicited from: Bill Gazaway in Alabama, Clifford Coker in Arkansas, Robert Mulrooney in Delaware, Tom Kucharek in Florida, Boyd Padgett in Georgia, Don Hershman in Kentucky, Ken Whitam in Louisiana, Arvydas Grybauskas in Maryland, Joe Fox in Mississippi, Allen Wrather in Missouri, Steve Koenning in North Carolina, Phil Pratt in Oklahoma, Charles Drye 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. 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, and foliar fungicide trials. The actual production figures for each state were supplied by the state crop reporting service. Production losses were based on estimates of yield in the absence of disease.

In the southern states, the 1996 average soybean yield and the acreage increased over what was reported in 1995 (8). In 1996, 575.8 million bushels were harvested from 17.418 million acres in 16 southern states. The overall average for the 16 reporting states was 30.4 bushels/a. The overall average reported in 1995 was 26.3 bu/a (8). The 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 1996 is 8.66%. This is the lowest total average percent soybean disease loss ever reported by SSDW (Figure 1). The lowest total percent loss reported during the 21-year period between 1974 and 1994 was 9.05% in 1994 (6). In 1995 the total percent loss was reported as 9.14% (8). In 1996 Texas reported the greatest loss at 14.70%, and Virginia reported the least at 1.31%.

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 1996 was greatest in Missouri with 14.673 million bushels and least in Florida with 0.149 million bushels. The total reduction in soybean yield due to diseases in the 16 southern states was 58.217 million bushels in 1996. The estimated value of this loss was $378,410,500 (based on $6.50/bu).

The most destructive soybean disease in 1996 was the soybean cyst nematode that caused 30.1% (17.536 million bushels) of the total yield loss reported by the states participating in this survey. The second most destructive disease was charcoal rot that caused 14.9% of the total yield loss (8.687 million bushels). The least reported diseases were Brown stem rot and Sclerotinia stem rot. Each of these diseases caused and estimated 0.02% of the total yield loss (0.009 million bushels). In 1996 the average percent loss for all recorded diseases was below the 22-year average for each disease except for sudden death syndrome (Figure 1).

In 1996, diseases continued to cause significant loss in soybean production throughout the 16 southern states that participated in this disease loss estimate. 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 1996.

State	Acres harvested		Yield/acre (bu)	Total production (bu)
Alabama	315,000		31	9,765,000
Arkansas	3,800,000		32	115,200,000
Delaware	215,000		32	6,880,000
Florida	33,000		30	990,000
Georgia	400,000		27	10,800,000
Kentucky	1,180,000		38	44,840,000
Louisiana	1,020,000		33	33,660,000
Maryland	480,000		34	16,320,000
Mississippi	2,000,000		31	62,000,000
Missouri	4,050,000		39	157,950,000
North Carolina	1,200,000		29	34,800,000
Oklahoma	285,000		24	6,840,000
South Carolina	540,000		26	14,040,000
Tennessee	1,150,000		32	36,800,000
Texas	270,000		30	8,100,000
Virginia	480,000		35	16,800,000
Total	17,418,000	Avg. =	31.4	575,785,000

Table 2. Estimated percentage loss of soybean yields for 16 southern states during 1996[a]

Disease	AL	AR	DE	FL	GA	KY	LA	MD	MS	MO	NC	OK	SC	TN	TX	VA	Avg
Aerial Blight	...	0.06	...	0.10	...	...	4.00	...	0.10	...	...	...	0.01	...	0.30	...	**0.29**
Anthracnose	1.60	0.58	...	2.00	0.20	1.20	0.05	...	0.60	...	0.40	0.40	1.00	0.50	2.50	...	**0.69**
Bacterial diseases	...	0.03	...	...	TR	0.02	TR	...	TR	...	0.05	0.20	0.05	TR	0.10	...	**0.03**
Brown leaf spot	0.60	0.04	0.50	...	...	0.20	0.20	0.10	0.20	...	0.05	TR	0.10	0.50	0.30	...	**0.17**
Brown stem rot	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0.10	...	**0.01**
Cercospora	0.30	0.50	TR	0.20	0.25	0.03	1.00	0.10	1.00	...	0.20	0.40	0.25	...	3.00	TR	**0.45**
Charcoal rot	...	1.95	...	0.50	...	0.10	1.00	...	4.80	1.00	0.05	0.80	0.10	1.00	2.00	...	**0.83**
Diaporthe/Phomopsis	0.30	0.01	TR	3.00	0.25	0.70	1.00	0.05	...	...	0.08	1.50	TR	...	1.00	...	**0.49**
Downy mildew	0.20	0.01	TR	TR	...	0.02	TR	0.05	TR	...	0.08	TR	0.05	0.01	...	...	**0.03**
Frogeye	0.30	0.21	...	0.50	TR	0.05	0.50	...	0.20	...	0.10	0.10	0.10	0.03	1.00	...	**0.19**
Fusarium wilt & rot	0.10	0.03	...	...	0.25	0.01	...	...	...	...	...	...	0.01	...	0.50	...	**0.06**
Other diseases	...	...	...	...	TR	...	...	...	...	...	5.00	...	0.60	0.20	1.30	...	**0.44**
Phytophthora rot	...	0.10	...	...	...	0.02	0.50	...	1.10	2.00	0.40	0.01	0.01	0.01	0.10	...	**0.27**
Pod & stem blight	0.40	1.00	...	3.00	0.75	0.70	2.00	0.10	0.50	...	0.01	1.50	0.95	...	0.30	TR	**0.70**
Root-knot & other nematodes	1.00	0.45	TR	2.50	3.50	...	1.50	0.05	0.20	...	1.50	TR	5.00	0.11	0.30	0.20	**1.02**
Sclerotinia stem rot	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0.10	...	**0.01**
Sclerotium blight	...	TR	...	0.10	0.01	...	...	...	TR	...	0.03	0.01	1.00	...	0.30	...	**0.09**
Seedling diseases	0.10	1.85	...	1.00	0.50	0.20	TR	...	0.50	1.00	0.03	0.10	0.10	1.20	0.50	...	**0.44**
Soybean cyst nematode	1.50	2.55	2.00	0.10	3.00	4.30	1.00	2.00	0.20	4.50	4.00	0.70	3.00	1.50	0.10	1.00	**1.97**
Stem canker	0.10	0.10	...	...	...	0.10	TR	...	0.30	...	...	...	...	0.05	0.50	...	**0.07**
Sudden death syndrome	0.40	0.22	...	...	...	0.10	...	...	0.10	...	...	...	...	0.60	0.10	...	**0.10**
Virus	...	0.20	0.10	...	0.25	0.05	0.50	TR	1.50	...	0.60	0.05	1.50	TR	0.30	0.10	**0.32**
Total	**6.90**	**9.89**	**2.60**	**13.00**	**8.96**	**7.80**	**13.25**	**2.45**	**11.30**	**8.5**	**12.58**	**5.77**	**13.83**	**5.71**	**14.70**	**1.30**	**8.66**

[a] Rounding errors present.
[b] TR = trace
[c] Other diseases include: Ozone and black root rot in NC. Other diseases not identified in SC, TN., and TX.

Table 3. Estimated reduction of soybean yield (bushels x10^6) for 16 southern states during 1996[a]

Disease	AL	AR	DE	FL	GA	KY	LA	MD	MS	MO	NC	OK	SC	TN	TX	VA	TOTAL
Aerial Blight	...	0.077	...	0.001	...	...	1.560	...	0.070	...	...	...	0.002	...	0.028	...	1.738
Anthracnose	0.168	0.741	...	0.023	0.024	0.584	0.020	...	0.419	...	0.159	0.029	0.163	0.195	0.237	...	2.761
Bacterial diseases	...	0.038	...	...	...	0.010	...	...	...	...	0.020	0.015	0.008	...	0.009	...	0.100
Brown leaf spot	0.063	0.051	0.035	...	...	0.097	0.078	0.017	0.140	...	0.020	...	0.016	0.195	0.028	...	0.741
Brown stem rot	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0.009	...	0.009
Cercospora	0.031	0.639	...	0.002	0.030	0.015	0.390	0.017	0.698	...	0.080	0.029	0.041	...	0.285	...	2.256
Charcoal rot	...	2.493	...	0.006	...	0.049	0.390	...	3.349	1.726	0.020	0.058	0.016	0.390	0.190	...	8.687
Diaporthe/Phomopsis	0.031	0.013	...	0.034	0.030	0.340	0.390	0.008	...	...	0.032	0.109	...	...	0.095	...	1.083
Downy mildew	0.021	0.013	...	...	...	0.010	...	0.008	...	...	0.032	...	0.008	0.004	...	...	0.096
Frogeye	0.031	0.268	...	0.006	...	0.024	0.195	...	0.140	...	0.040	0.007	0.016	0.012	0.095	...	0.835
Fusarium wilt & rot	0.010	0.038	...	...	0.030	0.005	...	...	...	...	...	...	0.002	...	0.047	...	0.132
Other diseases	...	...	...	...	...	...	...	...	...	...	1.990	...	0.098	0.078	0.123	...	2.290
Phytophthora rot	...	0.128	...	...	...	0.010	0.195	...	0.767	3.452	0.159	...	0.002	0.004	0.009	...	4.728
Pod & stem blight	0.042	1.278	...	0.034	0.089	0.340	0.780	0.017	0.349	...	0.004	0.109	0.155	...	0.028	...	3.226
Root-knot & other nematodes	0.105	0.575	...	0.028	0.415	...	0.585	0.008	0.140	...	0.597	...	0.815	0.043	0.028	0.034	3.374
Sclerotinia stem rot	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0.009	...	0.009
Sclerotium blight	...	...	...	0.001	0.001	...	...	...	...	...	0.012	.001	0.163	...	0.028	...	0.206
Seedling diseases	0.010	2.365	...	0.011	0.059	0.097	...	...	0.349	1.726	0.012	0.007	0.016	0.468	0.047	...	5.170
Soybean cyst nematode	0.157	3.260	0.141	0.001	0.356	2.091	0.390	0.335	0.140	7.768	1.592	0.051	0.489	0.585	0.009	0.170	17.536
Stem canker	0.010	0.128	...	...	...	0.049	...	...	0.209	...	...	...	...	0.020	0.047	...	0.463
Sudden death syndrome	0.042	0.281	...	...	...	0.049	...	...	0.070	...	...	...	...	0.234	0.009	...	0.685
Virus	...	0.256	0.007	...	0.030	0.024	0.195	...	1.047	...	0.239	0.004	0.244	...	0.028	0.017	2.091
Total	**0.724**	**12.644**	**0.184**	**0.148**	**1.063**	**3.793**	**5.168**	**0.410**	**7.884**	**14.673**	**5.008**	**0.419**	**2.254**	**2.229**	**1.396**	**0.221**	**58.217**

[a] Rounding errors present.

[c] Other diseases include: Ozone and black root rot in NC. Other diseases not identified in SC, TN., and TX.

Figure 1. Estimated Percent Loss of Soybean Yields in 16 Southern States from 1974 to 1996

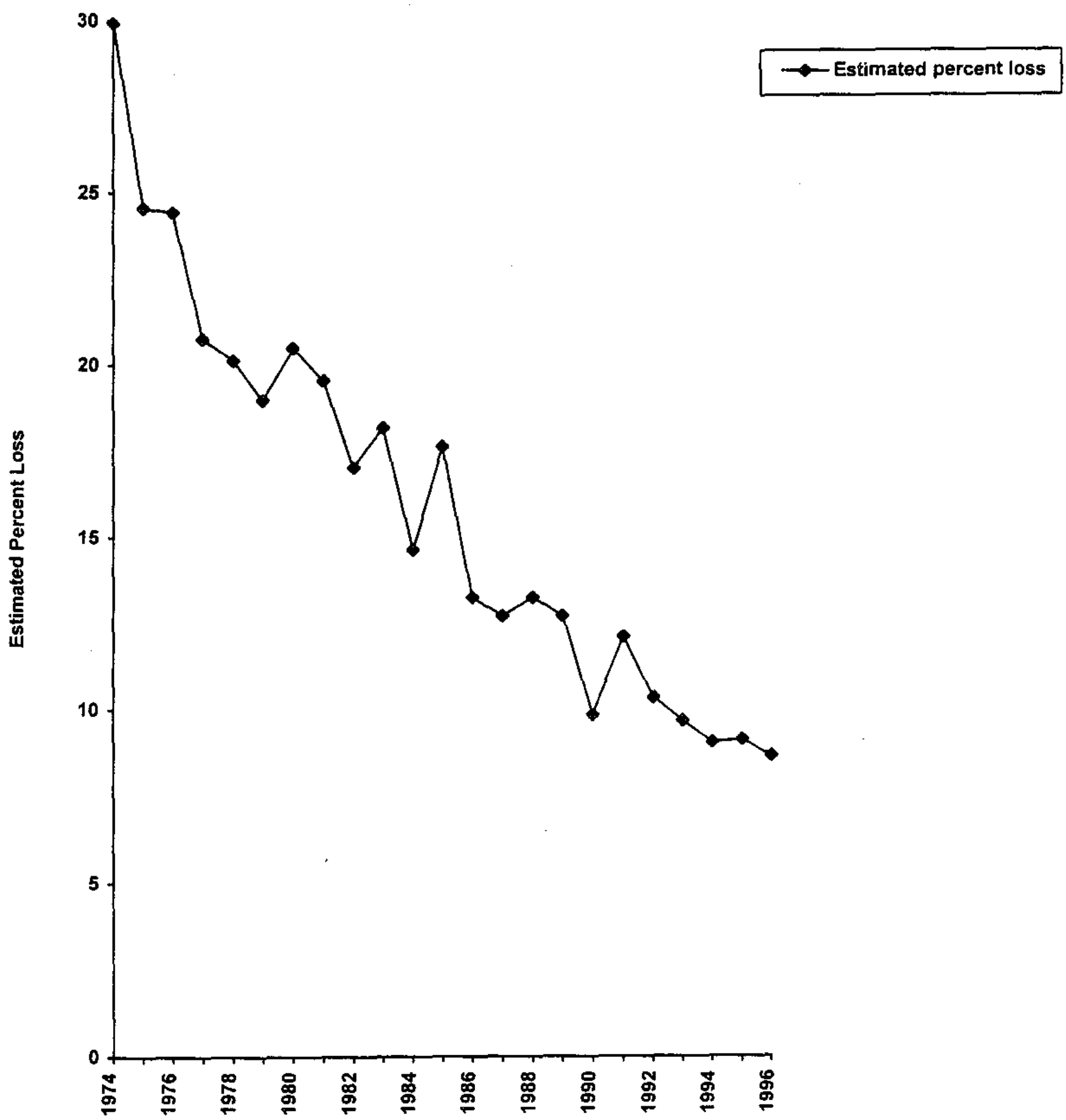
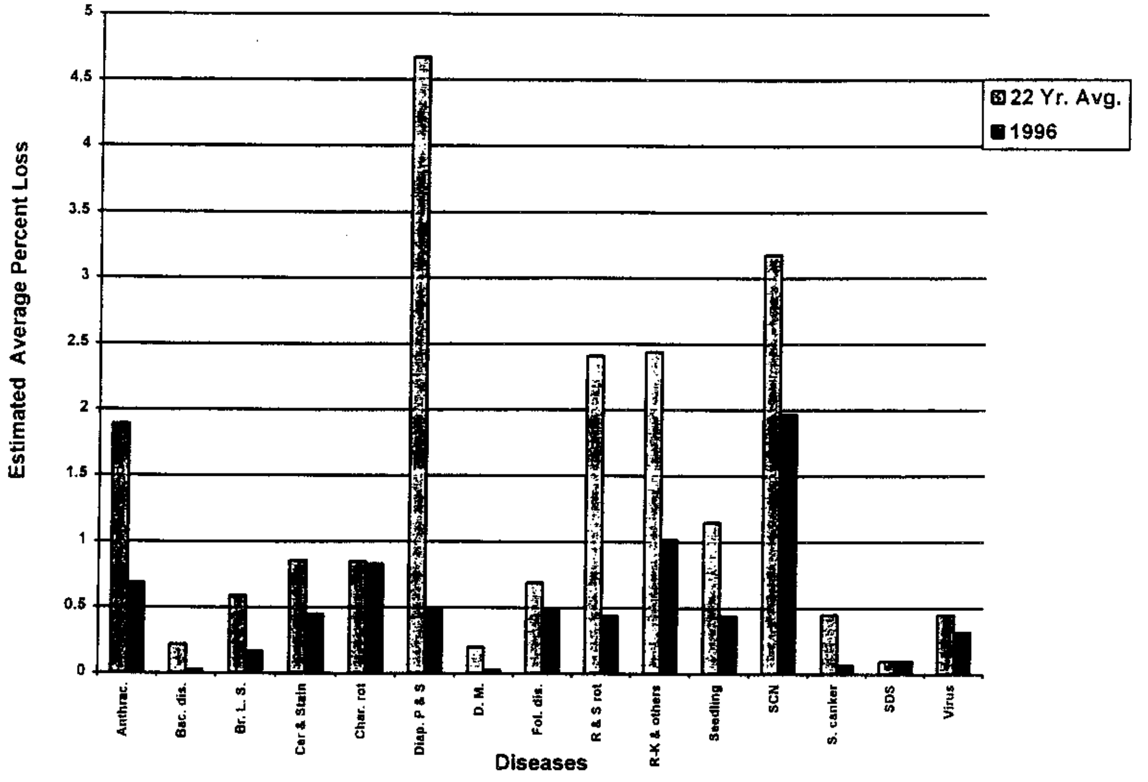


Figure 2. Comparison of 22 Year (1974-1995) Average to 1996 Average Percent Loss of Soybean Yield by Disease for 16 Southern States



Literature Cited

1. Doupnik, B., Jr. 1993. Soybean production and disease loss estimates for North Central United States from 1989 to 1991. Plant Disease 77:1170-1171

2. Mulrooney, R. P. 1988. Soybean disease loss estimate for Southern United States in 1985 and 1986. Plant Disease 72:364-365.

3. Mulrooney, R. P. 1988. Soybean disease loss estimate for Southern United States in 1987. Plant Disease 72:915.

4. Sciumbato, G. L. 1993. Soybean disease loss estimate for the Southern United States during 1988-1991. Plant Disease 77:954-956.

5. Whitney, G. 1978. Southern states soybean disease loss estimates-1977. Plant Disease Reporter 62:1078-1079.

6. Wrather, J. A., A. Y. Chambers, J. A. Fox, W. F. Moore, and G. L. Sciumbato. 1995. Soybean disease loss estimates for the southern United States, 1974 to 1994. Plant Disease 79:1076-1079.

7. Wrather, J. A., and G. L. Sciumbato. 1995. Soybean disease loss estimates for the Southern Untied States during 1992-1993. Plant Disease 79:84-85.

8. Wrather, J. Allen. 1996. Proceedings of the Southern Soybean Disease Workers. pp 1-7.

9. Wrather, J.A., T.R. Anderson, D.M. Arsyad, J. Gai, L.D. Ploper, A. Porta-Puglia, H.H. Ram, J.T. Yorinori. 1997. Soybean Disease Loss Estimates for the Top 10 Soybean Producing Countries in 1994. Plant Disease 81:107-110

SOUTHERN SOYBEAN DISEASE WORKERS
1996 TREASURY REPORT

OPERATIONAL [redacted] *PLANTER'S BANK HAWKINSVILLE GA.*

BALANCE ON 12/31/1995 : ....$ 5, 661.19

RECEIPTS ON 12/31/1996 : ....$ 989.47
****

RECEIPT SUMMARY:

INTEREST ON OPERATIONAL ACCOUNT ....$ 179.47
1996 MEETING REGISTRATION RECEIPTS ....$ 610.00
1996 HOSPITALITY HOUR CONTRIBUTIONS .... $ 200.00

****

DISBURSEMENTS ON 12/31/1996 ....$ 728.60

DISBURSEMENT SUMMARY

SECRETARIAL FEES ....$ 0.00
POSTAGE FEES ....$ 107.20
1996 ANNUAL MEETING COST ....$ 303.71
SSDW ASSOCIATION AWARDS ....$ 257.69
BANK ACCOUNT FEES 12/31/95-12/31/96 ....$ 60.00

****

SSDW ASSETS AS OF DECEMBER 31, 1996

BEGINNING BALANCE AS OF 12/31/1995 ....$ 5,661.19
REVENUES AS OF 12/ 31/ 1996 .... $ 989.47 +
DISBURSEMENTS AS OF 12/31/ 1995 ....$ 728.60 -
NET ASSETS AS OF 12/31/1996 ....$5,922.06
BALANCE OF OPERATIONAL ACCOUNT ON 12/31/1996 ....$5,922.06

****

[redacted]

GLENN G. HAMMES 12/31/1996
SSDW TREASURER

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CHARACTERIZATION OF RACES OF *PHYTOPHTHORA SOJAE IN ARKANSAS AND THEIR EFFECTS ON COMMONLY GROWN CULTIVARS*

T. A. Jackson, University of Arkansas, Fayetteville, AR
T. L. Kirkpatrick, University of Arkansas, SWREC, Hope, AR
J. C. Rupe, University of Arkansas, Fayetteville, AR

Arkansas is the eighth largest soybean producer in the nation with production worth over $600 million in 1996. *Phytophthora sojae*, causal agent of Phytophthora Root Rot of soybean, was once a severe problem, and is becoming a problem again as a result of what appears to be a race shift. Several cultivars advertised as resistant to Phytophthora Root Rot have experienced severe disease and significant yield losses. A survey was initiated to determine the identity and distribution of races of *P. sojae* within major soybean producing areas of the state. Soil samples from 13 counties were selected. Seedlings of the cultivar Williams were used to bait *P. sojae*. This cultivar lacks *Rps* genes and is therefore susceptible to all races. Isolates were taken from diseased hypocotyls and single zoospore isolates were produced. Races were characterized according to their reaction following hypocotyl injection on a set of differentials. Differentials included 10 seedlings each of Harlon (*Rps*1-a), Harosoy 13XX (*Rps*1-b), Williams 79 (*Rps*1-c), P. I. 103.091 (*Rps*1-d), Williams 82 (*Rps*1-k), L83-570 (*Rps*3), Harosoy 62XX (*Rps*6), and Harosoy (*Rps7*). The frequency of occurrence of each race was determined. *P. sojae* races 10 and 24 were found at the highest frequencies, 37 and 23%, respectively. Other races identified included 2, 14, 15, 26, and 38 (at 3, 3, 10, 10, and 3%, respectively). Of the isolates, 10% were uncharacterized due to inconsistent reactions. Additional studies were also conducted that challenged common commercial cultivars with these races. Hypocotyl injection and inoculum layer methods were used to screen ten cultivars. Riverside 499, Hartz 5545, and Manokin, were consistently resistant to all of the races used in both of the tests.

Induction of Defense Related Proteins During Compatible and Incompatible Soybean-*Cercospora sojina* Interactions

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and the Department of Plant Pathology, Auburn University, Al. 36849

Frogeye leaf spot (FLS) of soybean (*Glycine max* (L.) Merr.) is caused by the phytopathogenic fungus *Cercospora sojina*. FLS has a worldwide distribution and is capable of causing significant yield losses especially in favorable environments. We investigated the accumulation patterns of three defense-associated enzymes (peroxidase, chitinase & β-1,3-glucanase) in a pair of soybean lines near-isogenic for FLS resistance infected with *C. sojina*. Plant peroxidases perform many physiological roles including cell wall fortification and oxidative stress metabolism during the early stages of the pathogen development limiting the movement of the invader. Chitinases and β-1,3-glucanases are pathogen-induced hydrolytic enzymes capable of digesting fungal cell wall polysaccharides, especially in those of species such as *Cercospora* spp., which contain chitin and glucan as principal structural components. The actual role of these enzymes *in planta* has not been fully demonstrated, however, many studies with purified chitinase and β-1,3-glucanase isozymes reveled that these enzymes were capable of inhibiting fungal growth in *in vitro* assays.

Soybeans grown in the greenhouse were inoculated with *C. sojina* and leaf samples were collected at 0,1,2,3,5,7,11 and 14 days following inoculation (DFI), flash frozen in liquid nitrogen and stored at -80 °C. Proteins were extracted by grinding frozen leaf tissue samples with a mortar and pestle in the presence of a 0.1 M sodium acetate buffer pH 5.0. Proteins in ground leaf homogenates were isolated from other cellular solutes by centrifugation for 20 min. at 15,000 x g, and the resulting supernatant analyzed by SDS-PAGE, western blot analyses, IEF gel electrophoresis and colorimetric enzyme activity assays.

Results of these studies indicated that total chitinase, β-1,3-glucanase and peroxidase activity levels increased as disease progressed in both resistant (R) and susceptible (S) lines. However, the R line had higher levels of chitinase and β-1,3-glucanase activities than the S line during the early stages of pathogenesis. Western blot analysis revealed two chitinase isozymes (22 & 30 kD) and two β-1,3-glucanase isozymes (32 & 35 kD) were accumulated more rapidly in the R line (3 DFI) and to a higher level than in the S line (7 DFI). No dramatic differences in peroxidase accumulation patterns or activity levels were detected between R and S lines. Our data suggests that higher chitinase and β-1,3-glucanase activities and especially the early accumulation of specific isozymes in the R line are associated with FLS resistance in soybean.

PERFORMANCE AND CYST NEMATODE RESISTANCE OF SELECTED SOYBEAN CULTIVARS IN NORTH CAROLINA PRODUCTION FIELDS

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Most populations the soybean cyst nematode (SCN), *Heterodera glycines*, evaluated in the last 3 years in North Carolina can be classified as host race 2. Only the soybean cultivar Hartwig and some plant introductions are considered to be resistant to SCN race 2. Ten on-farm experiments for evaluation of selected soybean cultivars for resistance to this nematode have been conducted in growers infested fields located in the tidewater and coastal plains regions of North Carolina since 1992.

Cultivars in maturity groups V and VI were planted in May or June of each year, using standard management practices for North Carolina. Plots were twenty-five feet long with five foot alleys and four rows arranged in randomized complete blocks. The race of SCN was determined prior to initiation of experiments. Soil from each plot was assayed at soybean planting and harvest for numbers of cysts and juveniles/500 cm^3 soil. Three plants were removed from each plot 28 days after planting, and the numbers of cysts per three root systems recorded. Soybean yield was determined in November from the center two rows of each plot.

The cultivar Hartwig was highly resistant to all populations in 10 growers fields. A sister line of Hartwig, UMC S92-1603, that was added in 1995 and 1996 was also highly resistant. In spite of the high level of resistance demonstrated by Hartwig, it was the most productive cultivar in only three of the ten experiments. Most cultivars with resistance to nematode races 3, 9 and 14 were susceptible to the field populations, although they frequently performed better than susceptible cultivars. TN 5-92 exhibited some resistance to SCN race 2 populations at most locations and was the highest yielding variety in one experiment located in Pitt County, NC. The cultivar NK S61-89 apparently had a moderate level of resistance to some race 2 populations. Highly productive cultivars with resistance to *H. glycines* races 2 and 4 are needed to enhance soybean production in North Carolina.

Distribution and Diversity of *Heterodera glycines* in Delaware

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Soybean cyst nematode was detected in Delaware in the fall of 1979 in Sussex county. It was subsequently found in many fields in 1980 and has spread throughout the soybean growing areas in Sussex and Kent county. It was detected in New Castle county in 1991. In 1993 a project was initiated to determine the distribution and frequency of races of *Heterodera glycines* in Delaware. Grower samples submitted to the Nematode Assay Program have also provided data on the occurrence and distribution of SCN in Delaware soybean fields.

In 1993, 143 soil samples were submitted for race determinations by county agents and agribusiness personnel. Race determinations were made using an informal system for advisory purposes. Three soybean varieties were used and replicated six times; Essex was the susceptible check, Forrest was the "type" race 1&3 resistant variety and Southern States 516 was the "type" race 3&14 variety. Only 36% of the samples tested were successful. The remainder of the samples either had no cysts, too few cysts, or not enough reproduction on the differentials to permit a determination. Of the successful tests 75% (38) were race 3, 24% (12) were race 1 and one (2%) was determined to be race 14. In 1994 62 samples were submitted for race determinations and the results were similar except that fewer samples with a low number of cysts were submitted. Sixty-five percent of the samples were successful and 62.5% (25) were race 3, 35% (14) were race 1, and one sample (2.5%) could not be determined because it reproduced on all the differentials.

Subsequent testing of some of these populations and others submitted to the Nematode Assay Program, using the complete list of differentials according to Riggs and Schmidt, has revealed the presence of races 1, 3, 5, 6, and 9 in Delaware soybean fields. Race 3 remains the most common (66.6%) followed by race 1 (28.4%). Race 1 populations in Delaware vary widely in their reproductive potential on PI88788.

FOLIAR FUNGICIDES FOR FROGEYE LEAF SPOT CONTROL IN SOYBEANS

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Prior to 1989, frogeye leaf spot, caused by the fungus *Cercospora sojina*, was considered to be a relatively minor soybean disease with only traces of symptoms seen in most seasons. During 1989, yield losses as high as 50 percent were experienced by many Tennessee soybean growers. Growers who applied fungicides for other foliar diseases in 1989 obtained excellent control of frogeye leaf spot and yield increases as high as 20-25 bu/acre. An experiment was initiated in 1990 and continued in 1991-95 at the University of Tennessee Milan Experiment Station, Milan, on an area that had severe frogeye leaf spot injury in 1989. Foliar fungicides applied at R3 and R5 soybean growth stages were evaluated for frogeye leaf spot control. 'FFR 561', a cultivar resistant to stem canker (prevalent in the plot area in 1989) but highly susceptible to frogeye leaf spot, was planted each year. Fungicides were applied in 25 gal of spray mix per acre with a high clearance sprayer with three nozzles per row.

Only low levels of frogeye leaf spot were seen in the plot area in 1990 and 1991, and none of the fungicides significantly improved yields. Small but significant reductions in disease severity were obtained. Frogeye leaf spot was much more severe in 1992 and 1993. All fungicide treatments - Benlate 50WP, 0.5 lb./acre; Topsin 70WP, 0.5 lb. (85WDG, 0.4 lb. in 1992); Rovral 4F, 1.5 and 2 pt (2 pt only in 1993); and Benlate 50WP, 0.5 lb., applied at R5 stage only - significantly reduced frogeye leaf spot severity compared to the untreated control. Two applications of Benlate and Topsin M at R3 and R5 growth stages were significantly more effective than two applications of Rovral or one application of Benlate for reducing disease severity. Yields from plots treated with Benlate (two applications) and Topsin M were significantly greater than those from untreated plots in 1992 and 1993; Rovral also improved yields in 1993.

Frogeye leaf spot injury was moderate to severe in 1994. The same fungicides applied in 1993 (Benlate, one and two applications; Topsin M; and Rovral at the 1993 rates) significantly reduced disease severity. Yields were again significantly increased by two applications of Benlate, Topsin M, and Rovral. Treatments used in 1994 and Tilt 3.6EC, 6 fl oz/acre, significantly reduced disease injury in 1995. Yields were significantly improved in 1995 by all foliar fungicide treatments including one application of Benlate. Results in 1992-95 indicate that fungicide sprays applied for foliar disease control at R3 and R5 growth stages should be expected to give effective control of frogeye leaf spot. Other foliar diseases were not a problem in the plot area in 1992-95.

Characterization and Control of Soybean Severe Stunt; a New Soilborne Virus Disease of Soybean. Evans, T.A., Mulrooney, R.P., Taylor, R.W., and Carroll, R.B. Department of Plant and Soil Sciences, College of Agricultural Sciences, University of Delaware, Newark, DE 19717-1303

Soybean severe stunt (SSS), caused by soybean severe stunt virus (SSSV), is a new disease affecting Delaware sobyeans. Symptoms occur on the first true leaves, and infected plants have shortened internodes resulting in severe stunting. Infected plants exhibit dark green leaves, superficial stem lesions, and produce a reduced number of flowers, pods and seed. A concomittant reduction in seedling emergence and stand is associated with SSS. The dagger nematode (*Xipinema americanum* Cobb) is the putative vector of SSSV and the disease and its putative vector have been detected in over 50 fields in Sussex County, DE. While fumigation studies using methyl bromide have reduced dagger nematode populations, the use of crop rotation and resistant cultivars remains the only cost effective means of managing SSS. The use of alternate crops to control the vector of SSSV, was evaluated in a 3-year rotation study, and the effect of crop on dagger nematode populations was studied directly in greenhouse trials. Plots planted to corn, sorghum, a double crop of wheat, tolerant soybean or left fallow for 2 yr had significantly reduced numbers of dagger nematodes as well as disease severity when replanted to the susceptible soybean cultivar, Essex. In replicated greenhouse studies, corn, wheat, marigold, castor and fallow treatments had the lowest dagger nematode numbers after 14 wks. In field evaluations in 1995 under natural disease pressure, the varieties with the least SSSV symptoms and not statistically different from the known resistant check 'Sparks' were Delsoy 4710, Southern States SS563, Stressland, and Northrup King Coker 485. Varieties that were as susceptible as the susceptible check variety 'Essex' were Asgrow A4922, A5547, Pioneer brand P9521, TN4-86, TN4-94, TS 504, KS 4694. The remainder of the varieties were intermediate in reaction but enough symptoms were seen in at least one replication to indicate that they do not have a useful level of resistance. Most varieties were selected with soybean cyst nematode (SCN) resistance as well because SSSV occurs in areas that also have SCN problems. In field evaluations in 1996, the cultivars Stine S4650, Defiance, Cisne, Delsoy 4710, and Chesapeake, all Group IV's, were very resistant to SSSV and produced commercially acceptable yields. Stressland and SS563 were also very susceptible in 1996 indicating that they had "escaped" infection in 1995. Yield reductions were documented for the first time in this study. Delsoy 4710 has shown excellent resistance in three tests in two years. Stressland, Hartwig and Hutcheson were stunted early but regrew late in the season, although their yield was significantly reduced. Delsoy 4710 is the only resistant cultivar identified that is also resistant to SCN, which is a common soybean pest in the areas where SSSV has been detected.

Results of a Preliminary Phytophthora sojae Survey in Kentucky

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Phytophthora root rot (PR), caused by Phytophthora sojae, is not a serious problem in Kentucky, but occasionally soybean crops develop economic levels of the disease. Prior to this work, specific information documenting the distribution or races of P. sojae in Kentucky was not available. This information was needed to assess the status of P. sojae as a threat to soybean production and to aid in management of the disease where necessary. Soil was collected from 23 fields representing 10 major soybean-producing counties during the summer of 1994. In fields with plants exhibiting PR, soil adjacent to diseased plants was collected. Other soil samples were collected at random from fields both with and without a history of PR. Isolates of P. sojae were obtained from the soil samples using a soybean seedling bioassay. Race determinations were based on differential virulence following hypocotyl inoculation of soybeans with different Rps genes. Fifty-seven isolates of P. sojae were harvested from 13 of 23 fields and from all counties from which soil was collected. Eight of the 13 fields yielding isolates had no prior history of PR. The predominate race of P. sojae isolates was race 1; this race was present in soil from 11 of 13 fields and nine of the 10 counties yielding P. sojae isolates. Other races found were 2, 13, 15, 24, 26, and an unidentified race. Six of 13 fields yielded multiple races of P. sojae. Results indicate that P. sojae is common in Kentucky agricultural soils and the race composition is more similar to that reported in southern soybean production regions than in the Midwest. Apparently host resistance and/or other unknown factors limit the occurrence of PR in most fields and most years. Also, where PR is a problem, the probability is high that soybean varieties possessing resistance genes Rps1-c or Rps1-K will provide control of the disease since all races detected were incapable of defeating these two common resistance genes.

Reaction of entries in the Mississippi varietal trials to the common races of *Phytophthora sojae* isolated in Mississippi in 1996.

Sciumbato, G. L., B. L. Keeling, J. A. Fox, and J. E. Askew Jr.

Phytophthora root rot was more severe in Mississippi in 1996 than it has been in twenty years. The disease was prevalent in the variety trials at Coahoma county and in many production fields in the Delta. *Phytophthora* rot rot was more severe on heavy clay soil that had been land-formed. In some fields, the disease decimated stands at emergence. In other fields, the disease attacked the soybean plants causing lesions and severe girdling during pod fill and eventually killed ninety percent of the stand. Most of the fields had been under water for an extended period of time after planting due to natural rainfall or irrigation. Diseased plants were collected, returned to the laboratory, and the pathogen was isolated using selective media. Approximately two-hundred isolation attempts were made. Some of the isolates recovered from diseased plants were used to inoculate seedlings of eight *Phytophthora* differential types using the hypocotyl inoculation technique to determine the physiologic race of each isolate. To date, thirty-eight isolates have been classified for race. Seven isolates were Race One, four isolates were Race 2, one isolate was Race 3, thirteen isolates were Race 4, Seven isolates were Race 10, one isolate was Race 17, and twenty-three isolates did not fit any race and may be new races or mixtures. Further testing is needed to identify the unknown races. A large number of isolates have not been run. The reaction of the entries in the Mississippi variety trials was determined by germinating the seed in vermiculite and growing the seedling hydroponically in one-fourth strength Hoagland's solution. The plants were inoculated with the *Phytophthora* isolate to be evaluated and incubated for a week. A total of thirty plants were used per entry. The plants were examined and rated for resistance. Reaction of the entries varied with the different *Phytophthora* races.

THE IMPACT OF PHYTOPHTHORA ROOT ROT, SDS, AND SOYBEAN VIRUS(ES) ON YIELDS IN SOYBEAN VARIETY TRIALS IN MISSISSIPPI IN 1996

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Mississippi soybean variety trials were conducted at 7 locations in 1996. At three of the locations, severe disease symptoms of Phytophthora root rot (PRR), sudden death syndrome (SDS) or soybean mosaic virus (SMV) were observed on Group V soybean varieties (subdivided into tests of 45 early varieties and 31 late varieties) and rated. Regression of the ratings against yields at each respective location indicated the diseases accounted for 31 to 68% of the yield variability.

The Clarksdale location received about 3 inches of rain 5 days after planting. Some varieties had very poor emergence while others had a near perfect stand. Phytophthora was the primary fungus isolated from diseased plants. Ratings of stand density (as a measure of disease severity of PRR) on a scale of 1 to 10 were made of the Group V (early) and the Group V (late) varieties at growth stage V3. Yields were regressed against the disease ratings. Group V (early) had a mean yield of 61.7 bu/A (range of 23.8 to 87.1) with standard deviation (SD) of 15.9 and R2 of 0.68. Group V (late) had a mean yield of 70.4 bu/A (range of 38.3 to 85.9) with SD of 11.6 and R2 of 0.59.

The Olive Branch location received over 8 inches of rain in June and in August, symptoms of SDS were observed in 73% of the plots. Ratings of disease incidence (on a scale of 1 to 10) and disease severity (on a scale of 0 to 4) were made of the Group V (early) and the Group V (late) varieties at growth stage R4. Yields were regressed against the products of disease incidence and disease severity ratings. Group V (early) had a mean yield of 54.7 bu/A (range of 29.9 to 67.2) with SD of 8.04 and R2 of 0.54. Group V (late) had a mean yield of 56.9 bu/A (range of 38.8 to 75.7) with SD of 7.6 and R2 of 0.52.

The Verona location was observed to have a high incidence of viral symptoms at growth stage R4. Ratings of the severity of virus symptoms were made. A commercial lab confirmed presence of SMV in leaf samples of each rating class, however, samples were not tested for bean pod mottle virus. Yields were regressed against the disease ratings. Group V (early) had a mean yield of 38.5 bu/A (range of 21.5 to 52.3) with SD of 8.0 and R2 of 0.31. Group V (late) had a mean yield of 41.3 bu/A (range of 27.8 to 52.3) with SD of 6.5 and R2 of 0.50.

At these three locations, diseases were responsible for at least 50% of the variability between varieties in 5 of the 6 tests reported.

Velvetbean and bahiagrass effects on yield and nematode populations in a field infested with root-knot and soybean cyst nematodes

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Root-knot (*Meloidogyne* spp.) (RKN) and soybean cyst (*Heterodera glycines*) (SCN) are the major plant-parasitic nematodes of soybean (*Glycine max*). We compared continuous soybean with bahiagrass (*Paspalum notatum*) and velvetbean (*Mucuna deeringiana*) as rotational crops for effects on yield and nematode populations with and without aldicarb treatment. The field was located near Elberta, AL and was infested with a mixture of *M. incognita*, *M. arenaria*, and *H. glycines* of unknown race. Seven soybean cultivars (Benning, Brim, Braxton, Bryan, Carver, Stonewall and Thomas) were grown with or without an at-planting treatment of aldicarb at 1.12 kg a.i./ha. Plots were two rows, 8 m long with 0.8 m between rows. Treatments were arranged in a 2 × 7 factorial (+ or - aldicarb, seven cultivars) with eight replications within two split-blocks (continuous soybean, and previous crops of velvetbean and bahiagrass). Soil nematode numbers were determined by taking a composite soil sample at the R6 development stage.

Seed yield following the rotation crops (2335 and 2470 kg/ha following bahiagrass and velvetbean, respectively) was more than double yield following continuous soybean (1035 kg/ha). Aldicarb treatment increased yield by about 15% (1801 kg/ha with no aldicarb and 2092 kg/ha with aldicarb). Among cultivars, Benning and Carver were equal and superior to all others with a yield of 2255 kg/ha. Cultivar performance was dependent upon previous crop but the effect was not large and was mostly caused by differential response to either of the rotation crops among the higher-yielding cultivars. For example, Benning had higher yield following velvetbean (2849 kg/ha) than bahiagrass (2641 kg/ha), while Carver yielded more following bahiagrass (2809 kg/ha) than velvetbean (2500 kg/ha). In general, yield ranking of cultivars was unaffected by previous crop.

RKN populations were higher following bahiagrass (153 J2/100 cm^3 soil) and continuous soybean (136 J2/100 cm^3 soil) than following velvetbean (77 J2/100 cm^3 soil). Velvetbean thus appeared to be more effective in suppressing RKN nematodes in the following crop. Cultivars differed for RKN numbers, ranging from 49 J2/100 cm^3 soil for Brim to 177 J2/100 cm^3 soil for Benning. There was a small cultivar × previous crop interaction for root-knot numbers, but there were no clear trends. Aldicarb had a small suppressive effect on RKN numbers, reducing populations by about 15% from 132 to 113 J2/100 cm^3 soil. Numbers of SCN were generally lower than RKN numbers. Previous crop did not have a significant effect, but cultivars varied widely and followed expected trends based on genetic resistance. Carver (resistant to cyst Races 3 and 14) had lowest SCN numbers (<1 J2/100 cm^3 soil) and Braxton (no cyst resistance) had 29 J2/100 cm^3 soil. We concluded that bahiagrass and velvetbean are equal as rotation crops in yield of the subsequent soybean crop, but velvetbean is superior in nematode suppression, particularly for RKN.

Velvetbean and bahiagrass effects on yield and nematode populations in a field infested with root-knot and other plant-parasitic nematodes

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The efficacies of velvetbean (*Mucuna deeringiana*) and bahiagrass (*Paspalum notatum*) as rotation crops for the management of nematode problems in soybean were compared in a field experiment in south Alabama. The field was severely infested with root-knot nematodes (*Meloidogyne arenaria* and *M. incognita*) and the cyst nematode, *Heterodera glycines*. Other nematode species present were: spiral (*Helicotylenchus dihystera*), lesion (*Pratylenchus brachyurus*) and stubby root (*Paratrichodorus minor*). Yields of all 7 soybean cultivars (Braxton, Brim, Stonewall, Thomas, Benning, Bryan, Carver) increased when planted after two years of either bahiagrass or velvetbean. Overall percent yield increases (relative to soybean monoculture) in response to velvetbean and bahiagrass were 138 and 124, respectively. Degree of yield response was cultivar dependent with some cultivars (Stonewall, Thomas, Braxton, Brim) benefiting more than the others. Application of nematicide (aldicarb) in continuous soybean resulted in an average 33% increase in yield but only 11% in the velvetbean system and 14% in the bahiagrass system. Populations of lesion and juveniles of root-knot and cyst nematodes in soil at soybean harvest time were lowest in the velvetbean system. The bahiagrass system was ineffective in reducing populations of root-knot and cyst nematodes. Highest populations of spiral nematodes were in soybean following velvetbean but numbers in soybean after bahiagrass were similar to those in the continuous soybean system. Numbers of microbivorous nematodes and dorylaimida were lowest in the velvetbean system and highest in either the monoculture (microbivorous) or the bahiagrass system (dorylaimida).

Susceptibility of selected soybean cultivars to lesion nematode

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A greenhouse study was conducted to assess the adequacy of eight soybean cultivars as hosts for the lesion nematodes *Pratylenchus brachyurus* and *P. scribneri*. Cultivars selected for the study were Brim, Carver, Dillon, Haskell, Hutcheson, Maxcy, Stonewall and Young. Each nematode species was studied in separate experiments of identical design. In each experiment five seed of each cultivar were planted in 1-L, 10-cm-diam, cylindrical pots filled with washed siliceous fine river sand. Each pot was inoculated with 1,000 adults and juveniles of each nematode species and there were eight pots per cultivar. Pots in each experiment were arranged in a randomized complete block design. Soybeans were watered and fertilized as needed to maintain good growth. After eight weeks, soybean plants were removed and sand and root populations of the nematodes were determined using the salad bowl incubation (72 hr) method. No cultivar supported development of *P. scribneri* and all cultivars served as hosts for *P. brachyurus*. Cultivars Brim and Hutcheson had the highest numbers of *P. brachyurus*/g of fresh root and the lowest numbers were with Haskell and Young. Numbers of *P. brachyurus* in sand were very low (<10/100 cm^3 sand) in all pots. Our results indicate that there are important genetically controlled differences among soybean cultivars in their susceptibility to *P. brachyurus*.

Estimating Soybean Yield Loss Caused by Rhizoctonia Foliar Blight

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Rhizoctonia foliar blight (RFB), caused by *Rhizoctonia solani* AG-1, was first reported on soybean in Louisiana in 1954. Since then, two intraspecific groups of *R. solani* AG-1 have been identified: AG-1 IA and IB, which cause aerial blight and web blight, respectively. RFB is the most destructive disease of soybean in Louisiana, and is present on up to half the acreage yearly. The disease can be very devastating and can result in complete loss of pods and foliage in extreme cases. Although it has long been known that RFB can cause yield loss in soybean, experiments to estimate yield loss across a range of RFB severities have been lacking. Our objective was to study soybean yield loss in small plots that had varying degrees of RFB damage, and to compare pod severity versus foliage severity for accuracy in estimating yield loss.

Soybean variety NK S57-11 (MG V) was planted at Crowley, Louisiana in a field with a history of RFB. A large block of this variety was planted June 6, 1996 on a 0.76 m row spacing. When plants reached the late R5 growth stage, sections of row 0.5 m in length were selected based on severity of RFB. A total of 31 plots was selected to represent the entire range of observed disease severity. Estimates of both foliage and pod loss were made for all plots. After plant senescence, yield components were measured. These included pod filling (%), pod number, seed number, weights of 100 seeds (g), and total plot yield (g).

Pod filling was not influenced by either pod or foliage disease, which indicates that losses to RFB occurred through death of entire pods. Weight of 100 seeds also was not influenced by RFB severity. This suggests that surviving seeds did not compensate for lost seeds by increasing their weight, as has been documented for plants damaged by stink bugs. Numbers of pods and consequently numbers of seeds were reduced by RFB. Regression analyses showed that the relationships between total plot yield and pod or foliage disease were described by the equations:

Pod disease:	$\text{Yield} = 95.22 - 7.26\,x$
Foliage disease:	$\text{Yield} = 87.27 - 6.73\,x$

where x = pod or foliage disease severity. This means that, for every 10% increase in pod or foliage disease severity, yield was reduced 7.6% or 7.7%, respectively. These results suggest that relative measures of yield loss in plots should be similar regardless of which plant portion is considered. However, regression coefficients were greater for yield loss and pod disease than for yield loss and foliage disease. This suggests that RFB ratings based on pod disease account for more variability in plot yields than do ratings based on foliage disease.

A relationship between RFB severity and soybean senescence was detected. Plots with the highest levels of pod or foliage disease remained green and had foliage attached for a period of time after the surrounding, less-diseased plants had senesced.

identity, the Assistant Secretary may issue such orders or impose such additional limitations or conditions upon the disclosure of the requested chemical information as may be appropriate to assure that the occupational health services are provided without an undue risk of harm to the chemical manufacturer, importer, or employer.

(11) If a citation for a failure to release specific chemical identity information is contested by the chemical manufacturer, importer, or employer, the matter will be adjudicated before the Occupational Safety and Health Review Commission in accordance with the Act's enforcement scheme and the applicable Commission rules of procedure. In accordance with the Commission rules, when a chemical manufacturer, importer, or employer continues to withhold the information during the contest, the Administrative Law Judge may review the citation and supporting documentation "in camera" or issue appropriate orders to protect the confidentiality of such matters.

(12) Notwithstanding the existence of a trade secret claim, a chemical manufacturer, importer, or employer shall, upon request, disclose to the Assistant Secretary any information which this section requires the chemical manufacturer, importer, or employer to make available. Where there is a trade secret claim, such claim shall be made no later than at the time the information is provided to the Assistant Secretary so that suitable determinations of trade secret status can be made and the necessary protections can be implemented.

(13) Nothing in this paragraph shall be construed as requiring the disclosure under any circumstances of process or percentage of mixture information which is a trade secret.

(j) "Effective dates." Chemical manufacturers, importers, distributors, and employers shall be in compliance with all provisions of this section by March 11, 1994.

Note: The effective date of the clarification that the exemption of wood and wood products from the Hazard Communication standard in paragraph (b)(6)(iv) only applies to wood and wood products including lumber which will not be processed, where the manufacturer or importer can establish that the only hazard they pose to employees is the potential for flammability or combustibility, and that the exemption does not apply to wood or wood products which have been treated with a hazardous chemical covered by this standard, and wood which may be subsequently sawed or cut generating dust has been stayed from March 11, 1994 to August 11, 1994.

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