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Proceedings of the 22nd Annual Meeting, Southern Soybean Disease Workers (February 20-22, 1995, St. Louis, Missouri)

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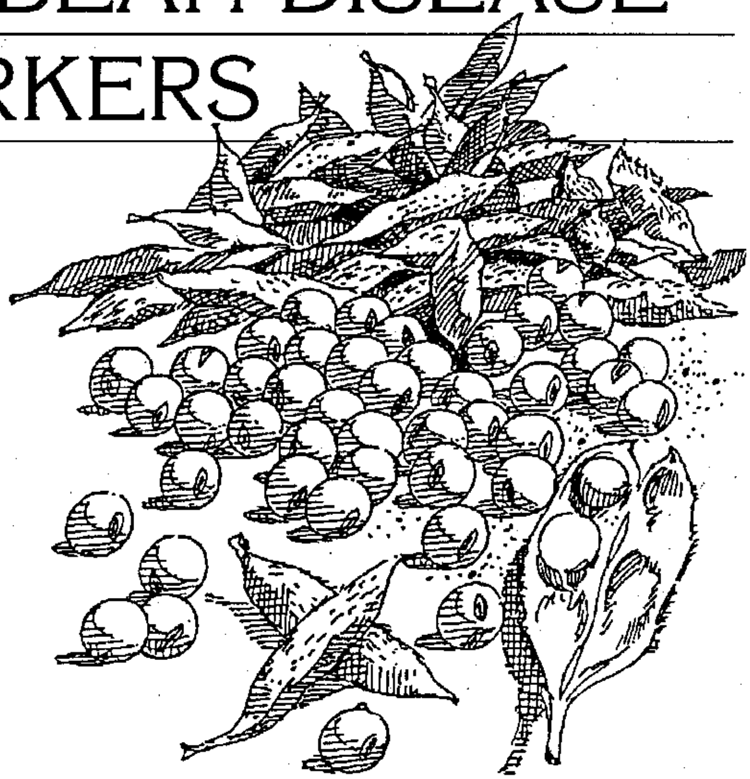
PROCEEDINGS OF THE SOUTHERN SOYBEAN DISEASE WORKERS



TWENTY-SECOND ANNUAL MEETING

FEBRUARY 20-22, 1995 ST. LOUIS, MISSOURI

PROCEEDINGS OF THE SOUTHERN SOYBEAN DISEASE WORKERS TWENTY-SECOND ANNUAL MEETING

FEBRUARY 20-22 1995
ST. LOUIS, MISSOURI

Monday, February 20

Steering Committee Meeting

Tuesday, February 21

National Soybean Breeder/Plant Pathologist Workshop

Business Meeting

Awards Banquet

Wednesday, February 22

Graduate Student Competition

Contributed Paper Session

1996 Program Meeting

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Soybean Disease Loss Estimate For The Southern United States During 1994

J. Allen Wrather, Department of Plant Pathology, University of Missouri-Delta Center, Portageville, MO 63873

Since 1974, soybean disease loss estimates for the Southern United States have been published in the Southern Soybean Disease Workers Proceedings. Compilations of this information has been published elsewhere (2-5).

The loss estimates for 1994 published here were solicited from: Bill Gazaway in Alabama, Gary Cloud in Arkansas, Bob Mulrooney in Delaware, Tom Kucharek in Florida, Guy Padgett in Georgia, Don Hershman in Kentucky, Ken Whitam in Louisiana, James Kantzes 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, Joe Krausz in Texas, and Pat Phipps in Virginia. Various methods were used to estimate disease losses, and most individuals reporting state losses used more than one. The methods used were; field surveys, plant disease diagnostic clinic samples, variety trials, questionnaires to 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. Dollars lost to disease were calculated by multiplying the estimated loss by the average annual price per bushel of $6.00.

In 1994, 594.5 million bushels were harvested from 17.57 million acres in 16 southern states. The total acres harvested, average yield in bushels/acre, and total production in each state are in Table 1.

Percentage loss estimates from each state are specific as to causal organism or the common name of the disease (Table 2). Florida reported the greatest loss at 24.30%, and Delaware reported the least at 4.10%. Soybean cyst nematode caused the greatest percentage loss followed by root-knot nematode, and root & stem rots.

The estimated reductions of soybean yields in 1994 are specific as to the causal organism or the common name of the disease (Table 3). The estimated value of the loss was highest in Missouri at $60.48 million and lowest in Florida at $1.38 million.

It is obvious from these production loss estimates that diseases played a major role in limiting soybean production during 1994 in the south. Soybean diseases have been a problem in the south (2-5) and in the north (1) in the past and will continue to be a problem unless research and extension efforts are expanded to provide more effective preventive and therapeutic disease management strategies and systems to producers.

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Table 1. Soybean production for sixteen southern states in 1994.

State	Acres harvested	Yield/acre (bu)	Total production (bu)
Alabama	300,000	29.0	8,700,000
Arkansas	3,200,000	37.0	118,400,000
Delaware	220,000	36.0	7,920,000
Florida	40,000	24.0	960,000
Georgia	500,000	30.0	15,000,000
Kentucky	1,120,000	37.0	41,440,000
Louisiana	1,100,000	29.0	31,900,000
Maryland	550,000	39.0	21,450,000
Mississippi	2,000,000	29.0	58,000,000
Missouri	4,540,000	37.0	167,980,000
North Carolina	1,350,000	31.0	41,850,000
Oklahoma	264,000	24.0	6,336,000
South Carolina	620,000	25.0	15,500,000
Tennesse	1,050,000	34.0	35,700,000
Texas	200,000	31.0	6,200,000
Virginia	520,000	33.0	17,160,000
Total	17,574,000	505.0	594,496,000

Table 2. Estimated percentage loss of soybean yields in 1994 to disease.

PERCENTAGE LOSS PER STATE[a]

	AL	AR	DE	FL	GA	KY	LA	MD	MS	MO	NC	OK	SC	TN	TX	VA	AVG[a]
Diseases																	
Seedling diseases	0.20	1.50	0.00	2.00	0.50	0.20	TR[b]	0.00	0.45	0.00	0.05	0.20	0.10	1.50	0.50	0.20	0.46
Root & stem rots	0.10	0.25	TR	10.00	0.25	0.05	1.00	0.00	1.60	1.00	0.40	0.20	1.10	0.50	0.70	0.10	1.08
Diaporthe-pod & stem blight	0.60	0.10	TR	2.00	0.75	1.20	2.00	0.50	0.90	0.00	0.04	1.00	1.00	0.00	0.50	0.10	0.67
Charcoal rot	0.10	1.00	0.00	0.10	0.00	0.05	1.00	0.00	2.60	2.00	0.05	2.00	0.07	0.50	1.00	0.00	0.65
Sudden death syndrome	0.40	0.75	0.00	0.00	0.00	0.05	TR	0.00	TR	0.00	0.00	0.00	0.00	0.50	0.10	0.00	0.11
Stem canker	0.10	0.75	0.00	0.00	0.00	0.05	0.50	0.00	TR	0.00	0.00	0.00	0.01	0.02	0.50	0.00	0.12
Anthracnose	1.00	0.40	TR	2.00	0.25	0.50	0.50	TR	0.78	0.00	0.40	1.50	1.50	1.00	3.00	0.00	0.80
Downy mildew	0.10	0.10	TR	0.10	0.00	TR	TR	0.00	TR	0.00	0.02	TR	0.10	0.01	TR	0.00	0.03
Cercospora-purple seed stain	0.10	0.20	TR	0.10	0.75	0.02	2.00	TR	0.53	0.00	0.02	0.50	0.70	0.00	1.00	0.10	0.38
Brown leaf spot	0.50	0.00	TR	0.00	0.00	0.50	TR	0.00	0.06	0.00	0.05	TR	0.15	1.00	0.10	TR	0.15
Foliar diseases (other)	0.40	0.50	0.00	0.00	2.00	0.00	1.00	0.00	0.33	0.00	0.30	0.50	0.50	0.01	0.40	0.00	0.37
Bacterial diseases	0.10	0.10	0.00	0.00	0.00	TR	TR	0.00	TR	0.00	0.05	TR	0.05	TR	0.10	0.00	0.03
Virus diseases	0.20	0.60	0.10	0.00	0.50	TR	1.00	0.00	TR	0.00	0.40	TR	1.00	TR	0.30	0.10	0.26
Soybean cyst nematodes	1.50	0.80	3.00	1.00	3.00	2.50	1.00	7.00	0.86	3.00	4.50	0.75	3.00	2.00	0.10	3.40	2.34
Root-Knot nematodes and ecto-parasitic types	1.00	0.20	1.00	7.00	3.50	0.00	2.00	0.50	0.02	0.00	2.50	TR	7.00	0.10	0.40	1.00	1.64
Other diseases[c]	0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.20	0.20
Total Percent Loss[a]	6.40	7.25	4.10	24.30	11.00	5.12	15.00	8.00	8.13	6.00	8.70	6.65	16.28	7.15	8.70	5.20	9.25

[a] Rounding errors present.

[b] TR= Trace

[c] Other diseases include red crown rot (*Cylindrocladium crotalariae*) in Virginia, aerial blight in Louisiana, seed deterioration in Tennessee.

Table 3. Estimated reduction of soybean yields in 1994 to disease.

YIELD LOSS (bushel X 10^6) FOR STATES[a]

	AL	AR	DE	FL	GA	KY	LA	MD	MS	MO	NC	OK	SC	TN	TX	VA	Total[a]	$ Loss x 10^6[b]
Diseases																		
Seedling diseases	0.02	1.77	0.00	0.02	0.08	0.08	0.00	0.00	0.26	0.00	0.02	0.01	0.02	0.54	0.03	0.03	2.88	17.28
Root & stem rots	0.01	0.29	0.00	0.09	0.04	0.02	0.32	0.00	0.93	1.68	0.17	0.01	0.17	0.18	0.04	0.02	3.97	23.82
Diaporthe-pod & stem blight	0.05	0.12	0.00	0.02	0.11	0.50	0.64	0.11	0.52	0.00	0.02	0.06	0.16	0.00	0.03	0.02	2.36	14.16
Charcoal rot	0.01	1.18	0.00	0.00	0.00	0.02	0.32	0.00	1.51	3.36	0.02	0.12	0.01	0.18	0.06	0.00	6.79	40.74
Sudden death syndrome	0.03	0.89	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.01	0.00	1.13	6.78
Stem canker	0.01	0.89	0.00	0.00	0.00	0.02	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.00	1.12	6.72
Anthracnose	0.09	0.47	0.00	0.02	0.04	0.02	0.16	0.03	0.45	0.00	0.17	0.10	0.23	0.36	0.19	0.00	2.33	13.98
Downy mildew	0.01	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.02	0.01	0.00	0.00	0.17	1.02
Cercospora-purple seed stain	0.01	0.24	0.00	0.00	0.11	0.01	0.64	0.03	0.31	0.00	0.01	0.03	0.11	0.00	0.06	0.02	1.58	9.48
Brown leaf spot	0.04	0.00	0.00	0.00	0.00	0.21	0.00	0.00	0.03	0.00	0.02	0.00	0.02	0.36	0.01	0.00	0.69	4.14
Foliar diseases (other)	0.03	0.59	0.00	0.00	0.30	0.00	0.32	0.00	0.19	0.00	0.13	0.03	0.08	0.01	0.03	0.00	1.71	10.26
Bacterial diseases	0.01	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.01	0.00	0.01	0.00	0.17	1.02
Virus diseases	0.02	0.71	0.01	0.00	0.08	0.00	0.32	0.00	0.00	0.00	0.17	0.00	0.16	0.00	0.02	0.02	1.51	9.06
Soybean cyst nematodes	0.13	0.95	0.24	0.01	0.45	1.04	0.32	1.50	0.50	5.04	1.88	0.05	0.47	0.71	0.01	0.58	13.88	83.28
Root-Knot nematodes and ecto-parasitic types	0.09	0.24	0.08	0.07	0.53	0.00	0.64	0.11	0.12	0.00	1.05	0.00	1.09	0.04	0.03	0.17	4.26	25.56
Other diseases	0.00	0.00	0.00	0.00	0.00	0.00	0.96	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.03	1.00	6.00
Total[a]	0.56	8.58	0.33	0.23	1.65	2.12	4.79	1.72	4.72	10.08	3.69	0.50	2.52	2.55	0.54	0.89	45.47	272.82
$ Loss x 10^6[b]	3.36	51.48	1.98	1.38	9.90	12.73	28.71	10.30	28.32	60.48	22.14	3.00	15.14	15.32	3.24	5.35	272.83	1,636.98

[a] The loss is based on the percentage loss of what yield would have been had no disease occurred, rounding errors present.

[b] Dollar loss=estimated bushel loss x $6.00/bu

SSDW TREASURY REPORT ENDING 12/31/1994

AT THE BEGINNING OF 1994 THERE WERE TWO OPERATIONAL ACCOUNTS FOR SSDW FUNDS. THE ACCOUNT HELD AT THE 1ST NATIONAL BANK OF OPELIKA WAS CLOSED ON 2/8/1994 AND THE FUNDS TOTALLING $4,724.00 WERE DEPOSITED INTO THE CURRENT PLANTER'S BANK ACCOUNT IN HAWKINSVILLE GA.

AT THE BEGINNING OF THE YEAR, 1/1/1994, THE NET ASSETS OF THE SSDW WERE $7,883.25. DURING 1994 TOTAL SSDW RECEIPTS WERE $ 2,303.99. DISBURSEMENTS WERE $ 4,189.15. ONE CHECK WAS PAID, BUT NOT CASHED DURING 1994 TOTALLING $141.60. THIS AMOUNT WAS CONSIDERED VOID, AND ADDED BACK TO THE OPERATIONAL ACCOUNT ON 1/1/ 1995. BEGINNING THE YEAR 1995, THE NET ASSETS OF THE SSDW TOTALLED $ 6,139.69. THE ACCOUNTING SHEETS AND THE SSDW PLANTER'S BANK ACCOUNT BOTH ENDED IN THIS BALANCE.

SSDW TREASURERS REPORT
12/31/93 TO 12/31/94

OPERATIONAL ACCOUNT 25-163-418 1ST NATL.OF OPELIKA
CLOSED ON 2/8/94 DEPOSTITED IN CURRENT ACCOUNT

PLANTERS BANK HAWKINSVILLE GA. [redacted]

BALANCE ON 12/31/1993 25-163-418	$ 4,724.45
BALANCE ON 12/31/1993 99724	$ 3,158.80
SSDW ACCOUNTS BEGINNING YEAR 1994 BALANCE	$ 7,883.25

RECEIPTS FROM 12/31/93 TO 12/31/94:

INTEREST ON OPERATIONAL ACCOUNTS	$ 183.99
PUBLICATION REVENUE	$ 20.00
1994 MEETING REGISTRATION RECEIPTS	$ 1,500.00
1994 HOSPITALITY CONTRIBUTIONS	$ 600.00
TOTAL RECEIPTS AS OF 12/31/1994	$ 2,303.99

DISBURSEMENTS FROM 12/31/93 TP 12/31/94

POSTAGE FEES	$ 222.74
PRINTING COSTS AND PROCEEDINGS	$ 591.32
SSDW MEETING COSTS	$ 1,731.86
SSDW ASSOCIATION AWARDS	$ 383.23
SSDW STUDENT AWARDS	$ 750.00
CPA TAX PREPARATION FEES	$ 450.00
BANK CHARGES 12/31/93-12/31/94	$ 60.00
TOTAL DISBURSEMENTS AS OF 12/31/1994	$ 4,189.15
CHECKS VOIDED OR UNACCOUNTED AS OF 12/31/1994	$ 141.60

SSDW ASSETS AS OF 12/31/1994

TOTAL 1994 REVENUES	+ $ 2,303.99
BEGINNING BALANCE OF OPERATIONAL ACCOUNTS	+ $ 7,883.25
TOTAL DISBURSEMENTS AS OF 12/31/1994	- $ 4,189.15
CHECKS VOIDED AND RECREDITED TO ACCOUNT	+ $ 141.60
NET ASSETS OF SSDW AS OF 12/31/1994	$ 6,139.69
YEAR END BALANCE OF OPERATIONAL ACCOUNT [redacted]	$ 6,139.69

[redacted]

GLENN G. HAMMES SSDW TREASURER

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1994-95 Committee Chairs

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HOST PREFERENCE OF *ROTYLENCHULUS RENIFORMIS* FOR WEED SPECIES COMMON TO LOUISIANA SOYBEAN

C.H. Carter, E.C. McGawley, and J.S. Russin

Department of Plant Pathology and Crop Physiology,
Louisiana State University Agricultural Center, Baton Rouge, 70803.

Host preference of the reniform nematode, *R. reniformis* was determined for the following 10 weed species alone and in combination with soybean cv 'Davis'; johnsongrass (*Sorghum halpense*), barnyardgrass (*Echinochloa crus-galli*), sicklepod (*Cassia obtusifolia*), hemp sesbania (*Sesbania exaltata*), wild poinsettia (*Euphorbia heterophylla*), pitted morningglory (*Ipomoea lacunosa*), prickly sida (*Sida spinosa*), redweed (*Melochia corchorifolia*), large crabgrass (*Digitaria sanguinalis*), and northern jointvetch (*Aeschynomene virginica*). Weed seeds were pregerminated on moist filter paper then transferred to flats for 8 days. Seedlings were transplanted to 6-inch clay pots containing 1.5 kg of 3:2 methyl-bromide fumigated soil : autoclaved sand mixture. Experimental design was a randomized block with a factorial treatment arrangement and consisted of soybean alone, each weed species alone, and each weed species combined with soybean. Treatments were replicated five times. One half of the pots were infested on 17 June 1994 with a mixed population (juveniles, adult males, and motile females) of 500 *R. reniformis* per pot. All pots were watered as needed and fertilized weekly. After 76 days, *R. reniformis* populations were enumerated as numbers of juveniles, adult males, and motile females per 200 g soil.

Reproduction (R) values were calculated to determine host suitability for each weed species (R = final nematode population /initial nematode population). All weed species were hosts for *R. reniformis*. Large crabgrass (R=3.4), barnyardgrass (R=11.8), johnsongrass (R=11.9), wild poinsettia (R=13.2), prickly sida (R=14.1), hemp sesbania (R=49.5), and sicklepod (R=139.5) were poor hosts. Northern jointvetch (R=391.2) was an intermediate host and redweed (R=670.5) and pitted morningglory (R=799.1) were good hosts. Soybean alone had an R value of 97.6.

When weeds were combined with soybean, significant differences in R values, compared to weeds alone, varied depending on weed species. Hemp sesbania (R=168.52), large crabgrass (R=159.46), and barnyardgrass (R=94.91), showed increased nematode populations when combined with soybean. Pitted morningglory (R=106.90), northern jointvetch (R=74.90), and redweed (35.50), in combination with soybean showed reduced nematode populations. No differences in nematode populations were detected for johnsongrass (R=72.19), wild poinsettia (R=17.12), prickly sida (R=8.20), and sicklepod (R=106.52) in the presence of soybean. Nematode populations of poor hosts when combined with soybean either increased or remained the same. Nematode populations of intermediate and good hosts all decreased in combination with soybean.

Nematode populations on prickly sida alone were lower than populations on soybean alone. When prickly sida and soybean were combined, nematode population was reduced further. Prickly sida was the only weed to show this response.

DEVELOPMENT OF AN IMMUNOASSAY FOR *HETERODERA GLYCINES* EGGS. Kennedy, M. J., J. E. Schoelz, T. L. Niblack, P. A. Donald. Department of Plant Pathology, 108 Waters Hall, University of Missouri-Columbia, Columbia Mo 65211

New Zealand White rabbits were injected with homogenized or sonicated egg shells of *Heterodera glycines* in Freund's complete adjuvant. Antibody production was boosted by injecting homogenized or sonicated egg shells in Freund's incomplete adjuvant at six week intervals. An indirect enzyme-linked immunosorbent assay (ELISA) was developed using antisera drawn eight weeks after the initial injection. Goat anti-rabbit antibody was conjugated to horseradish peroxidase for color development. Absorbance was measured at 405 nm. Serial dilutions of sonicated egg shells or whole eggs indicated the sensitivity of detection to 1 ng of sonicated egg shells or 1 egg of *H. glycines*; However, the antibodies cross-reacted with sonicated second-stage juveniles (J2) of *H. glycines*, and eggs of *Meloidogyne incognita* and *H. schachtii*. Western blot and Coomassie blue stained SDS-PAGE analysis indicated that most of the proteins in both life stages of *H. glycines* and eggs of *M. incognita* and *H. schachtii* had similar migration and antigenic properties. Preliminary studies in which the antibody was adsorbed with sonicated J2 of *H. glycines* was used in Western blots, indicated that one protein detected is specific to eggs of *H. glycines*. This protein can be used to develop monoclonal antibodies, which will increase the sensitivity of the immunoassay.

EFFECTS OF DELAYED PLANTING AND HOST SUSCEPTIBILITY ON COLONIZATION OF SOYBEAN BY *CALONECTRIA CROTALARIAE* AND DEVELOPMENT OF RED CROWN ROT

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Red crown rot (RCR) caused by the soilborne fungus *Calonectria crotalariae* is an important fungal disease of soybean in Louisiana. The fungus invades the root system during vegetative soybean growth stages; foliar symptoms usually appear shortly after flowering and include interveinal chlorosis and defoliation. Diagnostic red perithecia can be seen at the crown region at that time. Severity of RCR can be reduced by delayed planting or use of less susceptible cultivars. However, the mechanisms responsible for this reduction are not understood. Therefore we established an experiment at the Ben Hur Research Farm, Baton Rouge, LA, in 1994 to examine the effect of host resistance and date of planting on root colonization by the fungus and subsequent development of above ground symptoms and signs. The test was planted in a field that had a history of this disease. Experimental design was a split plot with planting dates (May 25 = optimum, June 16 = 3 wks. late, July 5 = 6 wks late) as main plots and cultivars (Sharkey = more susceptible, Cajun = less susceptible) as sub plots. Treatments were replicated 6 times. Each plot had four, 7.5m long rows planted on 0.76m centers. Four plants were uprooted and root samples were collected on June 15, July 12, Aug. 1 and Aug. 24, from the two outer rows in each plot. Randomly selected root segments 1 cm in length were plated on Phipps medium and percentage root colonization was determined. RCR incidence was determined as the percentage of plants in plots showing symptoms and/or signs of the disease in inner two rows on Aug 24, Sept. 7, Oct. 10, and Oct. 24. Area under disease progress curve (AUDPC) were calculated based on disease incidence.

Root colonization in both cultivars was reduced following planting delays of three or six weeks. Root colonization in Sharkey was greater than that in Cajun following optimal planting, but there were no differences in root colonization following delayed planting. Across both cultivars, root colonization increased over time following optimal planting but did not increase following delayed plantings.

AUDPC for disease incidence on Cajun was lower than that on Sharkey only at optimal planting date but was not at delayed plantings. Delayed planting reduced AUDPC for disease incidence on Sharkey but not on Cajun.

Results suggest that root colonization during first seven weeks after optimal planting date (May 25) was critical for development of RCR on cultivar Sharkey. Delaying planting of this cultivar likely escaped this period, thereby reducing the disease incidence. Low levels of root colonization and disease incidence in less susceptible cultivar Cajun suggests that it is more resistant to colonization during this critical period, which results in low levels of initial root colonization leading to low levels of disease incidence.

EFFECTS OF LONG-TERM CORN/SOYBEAN ROTATION ON PATHOGENICITY OF PYTHIUM POPULATIONS ON SOYBEAN

Ben Q. Zhang and X.B. Yang
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In the North Central Region of the U.S., multiple crops were used in rotation scheme before 1960. In the last twenty years, corn/soybean rotation has become a major rotation scheme. Our previous studies showed that in corn/soybean rotation fields the frequency of *Pythium* isolates highly pathogenic to both corn and soybeans was high. Continued use of this practice could produce selection pressure for soilborne fungi pathogenic to both crops. This study is to evaluate the selection pressure under this production environment by using seedling diseases of *Pythium* as a model system. The pathogenicity of *Pythium* populations from long-term corn/soybean rotation fields was compared with those from long-term continuous soybean or continuous corn fields.

Pythium spp. were isolated in spring from fields in three Iowa State University research farms. The cropping histories for the three research farms, Nashua, Kanawha, and Curtis Research Farms, were 17, 30, and 35 years, respectively. Each farm had continued soybean and continued rotation fields. Thirty to fifty isolates were obtained from each field using soil dilution plating technique and hyphae tip purification technique. Individual isolates were tested for their pathogenicity on soybean. The results showed that the populations of *Pythium* spp. from continuous soybean fields were significantly more pathogenic on soybean than those from continuous corn fields. The populations from 17-year corn/soybean rotation fields were significantly less pathogenic than the populations from 17-year continued soybean fields. Frequency of highly pathogenic isolates was greater in continued soybean fields than that in rotation fields. However, for the fields which had been in the same cropping systems over 30 years, there were no significant differences in the pathogenicity between *Pythium* populations from continued soybean fields and from corn/soybean rotation fields. The results indicated the possibility of build-up of soilborne pathogens which are highly pathogenic to both corn and soybean when we use corn/soybean rotation scheme for long time.

POSSIBLE SHIFT TO MORE VIRULENT PHYTOPTHORA RACES IN MISSISSIPPI

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Phytophthora root rot (*Phytophthora megasperma*) was the major factor limiting soybean production in the South in the 1950's. Development of *Phytophthora* resistant varieties lead to the widespread cultivation of soybeans in the southern U. S. Some of the varieties now grown in the southern U.S. on the heavier soil types are resistant Phytophthora races 1 and 2. Almost all of the varieties have at least some field tolerance to this disease. Over 27 races of *Phytophthora* have been identified. A number of these races have been isolated from fields which have been in continuous cultivation with soybeans resistant to *Phytophthora* races 1 and 2. These races are usually not as competitive as Races 1 and 2. Stand failures have been observed in producers fields and in state variety trials. In some of these trials, we have isolated from diseased plants, several *Phytophthora* races which attack soybeans having major gene resistance to *Phytophthora* races 1 and 2. The main races isolated have been 10, 14 and some unidentified races. In all of these trials, prolonged periods of wet, cool weather were prevalent after planting. Yield loses have been correlated with stand losses due to *Phytophthora* infection. The entries in the Mississippi Variety Trials have screened and major resistance and/or excellent field tolerance was present in some varieties. While we believe that these races are not as aggressive as races 1 and 2, we believe that under certain conditions, major stand losses can occur from these races.

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THE RELATIONSHIP BETWEEN TREHALOSE CONTENT AND DORMANCY OF SOYBEAN CYST NEMATODE, *Heterodera glycines*.

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Trehalose accumulation occurs during dormancy induction in other nematode species, and its use as a marker for dormancy of *Heterodera glycines* was investigated in a field microplot experiment conducted from March 1993 to December 1994. Changes in the trehalose content of eggs freed from cysts were monitored monthly. Treatments included two near-isogenic lines of soybean cv. Clark differing in date of maturity, and one corn hybrid. The soybean lines were planted in microplots infested with *H. glycines* at a high average initial population density (Pi)(23,810 eggs/100 cm^3 soil), and the corn was planted in microplots infested at high (24,640) and low average (5,485) Pi. Soil temperatures at 15 cm depth were monitored. Trehalose content was measured by gas chromatography. Trehalose content was <3 *ug*/1,000 eggs from April through September 1993, and increased to >6 *ug* in October 1993. After September 1993, the trehalose content from the corn treatments were higher than the content from soybean treatments, but there were no differences between the two soybean isolines. From February to May, 1994, the trehalose content of eggs produced on either soybean decreased as in 1993, but the trehalose content of eggs from the corn treatments remained >5 *ug* trehalose/1,000 eggs. After May, 1994, trehalose content of eggs from both soybean and corn treatments declined, until there were no significant differences between them. Trehalose accumulation was highly correlated with soil temperature (r=-0.7752, p=0.0001) from July through November 1993, in contrast to dormancy induction, measured as hatching rate, which was temperature-independent.

FERTILIZATION EFFECTS ON SUDDEN DEATH SYNDROME (SDS) IN SOYBEANS

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Some diseases have been partially controlled in the past by potassium fertilizer applications. Field experiments were conducted between 1990 and 1994 at The University of Tennessee Milan Experiment Station and in producer fields near Greenfield, TN, evaluating fertilization effects on sudden death syndrome (SDS). Experiments were designed to evaluate the effects of K sources (KCl and K_2SO_4), K_2O rates (0 to 300 lb/A), application timing, and soybean varieties on SDS incidence and severity in soybeans.

Research at Milan in 1990 indicated that SDS symptoms were reduced and yields were increased by applying 80 lb/A K_2O at planting with either 80 or 240 lb/A side-dressed. Results from nine additional trials conducted between 1991 and 1994 showed little yield response to fertilizer application. However, SDS incidence, severity, and root injury were progressively reduced as KCl rates were increased. It appears that Cl^- may be affecting SDS symptoms since K_2SO_4 did not improve foliar incidence and severity of SDS. Some improvement in root injury was noted with K_2SO_4 in 1992 and 1993.

Split application of KCl rates reduced SDS incidence, severity, and root deterioration ratings but did not increase yields. Delayed applications caused a slight increase in disease incidence and severity in 1992 and 1994. In other years, delayed timing did not affect SDS.

In 1992, SDS severity was greater and yields were lower for the cultivar 'FFR 561' than 'FFR 562'. Leaf incidence and severity and root injury were higher for the cultivar 'Hutcheson' compared with 'FFR 561' in 1993 and 1994.

Similar results were found in plots conducted in producer fields near Greenfield during 1992-1994. Fertility rates (lb/A K_2O) of 0, 50, 100, 200, and 300 lb/A as KCl and 200 lb/A as K_2SO_4 were applied on SDS-infested sites. SDS incidence and severity were reduced with no increase in yield of 'Asgrow A5403'.

Except for 1990, SDS symptoms appeared every year later than expected. SDS symptoms were reduced by KCl rates, but yields were unaffected. Additional work is necessary for clarification.

Although yield differences due to applying KCl were not always evident, reduced leaf and root injury may be of substantial value to soybean producers during years of increased SDS pressure.

SCREENING SOUTHERN SOYBEAN CULTIVARS FOR REACTION TO AERIAL BLIGHT

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Aerial blight of soybean, caused by *Rhizoctonia solani* anastomosis group 1 (AG1), arguably is the most important disease of soybean in Louisiana. Aerial blight is a disease complex caused by *R. solani* AG1 IA and IB; these isolates differ in colony morphology and sclerotia type *in vitro* but cause indistinguishable symptoms in the field.

In 1993 and 1994, we screened ca. 137 soybean cultivars in groups IV (n=23), V (n=55), VI (n=42), and VII (n=17) at two locations, Baton Rouge and Crowley, in southern Louisiana. Field trials were planted in a randomized complete block design with four replications. Plots consisted of four 30-inch rows twenty feet in length at Baton Rouge and four 32-inch rows 30 feet in length at Crowley. At both locations in 1993 and at Crowley in 1994, aerial blight developed from natural inoculum. In 1994, all plots in Baton Rouge were inoculated with *R. solani* at or shortly after flowering. Inoculum consisted of an aqueous suspension containing equal proportions of IA and IB mycelium fragments (1-2.5 x 10^5 ml^{-1}). Inoculum was applied using tractor-mounted or backpack sprayers equipped with drop booms to apply inoculum directly on flowers and young pods. Sprayers delivered 120-130 ml inoculum suspension per 100 row-feet through 8002 or 11001 nozzles at 20-30 psi. Aerial blight severity was evaluated during late pod fill or full pod stages according to the following scale: 0 = no disease; 1 = 1-10%, 2 = 11-20%, 3 = 21-40%, 4 = 41-60%, and 5 = 61-100% of pods and foliage diseased. Yields were determined at maturity. Correlation analyses were performed to study the relationship between disease severity and yield across all cultivars in each maturity group.

Aerial blight severity correlated negatively with yield for cultivars in groups V (r = -.48, $P \leq 0.001$), VI (r = -0.47, $P \leq 0.001$), and VII (r = -0.26, $P \leq 0.001$) but not in group IV. This may be due to drier weather conditions that normally are present when group IV cultivars are flowering. Cultivars in order of least susceptibility were:

Group IV

Cultivar	Rating
Vernal	1.0
Pioneer variety 9501	1.5
Pioneer variety 9472	2.0
Hyperformer HY 498	2.0
Deltapine DP 3478	2.5
Eagle LS4L	2.5
Deltapine DP 3499	2.5
Pioneer variety 9442	2.5
Hartz variety H4464	2.8

Group V

Cultivar	Rating
Deltapine DP 3589	2.0
Pioneer variety 9593	2.1
Hartz variety H5088	2.1
Buckshot EK58	2.2
Northrup King S59-60	2.2
Pioneer variety 9592	2.3
Pioneer variety 9584	2.3
Riverside RVS 577	2.4
Hartz variety H5545	2.6
Hyperformer HSC 577	2.6

Group VI

Buckshot 66	1.8
Hornbeck HBK	2.4
Asgrow A6961	2.4
Pioneer variety 9692	2.6
Terra-Vig 6253	2.7
Terra-Vig 616	2.8
Asgrow A6297	2.9

Group VII

Hyperformer HSC 741	2.6
Pioneer variety 9761	2.6
Kunkle KSC 707	2.8
Deltapine DP 3733	2.9
Dyna-Gro 3682	2.9

Comparison of Continuous Soybean, Fallow, and Rotation with Sorghum-Sudan Grass Hybrid for Nematode Control in a Field Infested with Root-knot and Soybean Cyst Nematodes. R. Rodríguez-Kábana, D. B. Weaver, and E. L. Carden, Auburn University and Alabama Agricultural Experiment Station.

Continous soybean (*Glycine max* L.) was compared to fallow and rotation with sorghum-sudan grass hybrid (*Sorghum bicolor* L.X *S. sudanese* Piper) for effects on yield and nematode populations in seven soybean cultivars with and without nematicide treatment. The field was infested with a mixture of *Meloidogyne incognita, M. arenaria,* and *Heterodera glycines* of unknown race. Soybean cultivars were Brim, Braxton, Bryan, Carver, Leflore, Stonewall, and Thomas with or without an at-planting treatment of aldicarb at 1.12 kg a.i./ha. Individual plots were two rows, 8 m long with a 0.8 m row spacing. Treatments were arranged in a 2 X 7 factorial (two nematicides, seven cultivars) with eight replications within 2 split-blocks (fallow, grass rotation, and continuous soybean). Nematode numbers were determined at the R6 soybean development stage by taking a composite soil sample from each plot. On average, soybean following sorghum-sudan grass yielded 3015 kg/ha compared to 2915 kg/ha for fallow and 2425 kg/ha for continuous soybean, but cultivars responded differently to previous crop. All showed a positive yield response to rotation, but Braxton had a yield increase of 200% (891 kg/ha continuous soybean vs. 2626 kg/ha sorghum-sudan) while response of Carver (the cultivar with the most broad-spectrum nematode resistance) averaged only 5% (3591 continuous soybean vs. 3786 kg/ha sorghum-sudan) averaged over nematicide treatment. Numbers of root-knot larvae were higher following grass or fallow (49 and 46 larvae/100 cm^3 soil, respectively) than continuous soybean (23 larvae/cm^3 soil). SCN populations were not affected by previous crop and averaged 16 larvae/cm^3 of soil. Cultivars varied for root-knot numbers, with Carver, the highest-yielding cultivar having the highest numbers. SCN races 3- and 14-resistant Carver and Leflore had almost no detectable soybean cyst larvae, however Braxton (susceptible to SCN) averaged 35 cyst larvae/100 cm^3 of soil.

Recent progress in identifying soybean cultivars field tolerance of Macrophomina phaseolina. G. S. Smith and O.N. Carvil, Plant Sciences Unit, University of Missouri, Columbia, MO 65211.

Twenty four soybean cultivars were screened for field tolerance (non-specific race resistance) of Macrophomina phaseolina (MP) from 1992 to 1994 in a field with a known history of charcoal rot disease. Each cultivar was grown in 4 row by 6 meter plots and each plot was assayed for MP microsclerotia levels at planting. Microsclerotia densities ranged from 29 to 47 colony forming units per gram soil. Twelve of the cultivars were resistant to Heterodera glycines (Hg) and twelve were susceptible to Hg. The cultivars ranged in relative maturity from 3.1 to 4.9 and were grouped into four maturity classes (3.1 - 3.4; 3.5 - 3.8; 3.9 - 4.4; 4.5 - 4.9). One-half of the cultivars in each maturity class were Hg-resistant and the other half Hg-susceptible. The cultivars were planted at two planting dates (early May and early June). Five plants per plot were destructively sampled at growth stages 'R6' and 'R7' from rows 1 and 4. Lower stem/taproots were collected from each plant from the unifoliate node to a maximum 15 cm down the taproot. All primary and feeder roots, and soil were removed from the lower stem/taproot. This tissue was air-dried for one month and ground in an UDE mill. Ground tissue was plated on a semi-selective medium to quantify Mp microsclerotia in host tissue.

Environmental conditions in 1994 were more conducive to disease development than in 1992 and 1993. In 1994, based on host suitability (Mp microsclerotia/gram dried tissue), eighteen of the twenty four cultivars were rated susceptible to Mp (mean 14,078 microsclerotia/gram), and three soybean cultivars, DeltaPineland 3478, Hamilton and Jackson II, were rated as moderately resistant to Mp (2,040 - 2,579 microsclerotia/gram). Three cultivars, Asgrow 4715, Pioneer 9391 and Stine 3240, were intermediate in host suitability to Mp (mean 6,244 microsclerotia/gram). Similar results were obtained in 1992 and 1993. In 1994, the three moderately resistant cultivars yielded from 4.8 to 7.0 bu/A more than the Mp-susceptible cultivars at the May planting and from 5.0 to 10.1 bu/A more than the Mp-susceptible cultivars at the June planting. Resistance in these three cultivars was independent of maturity, Hg-resistance, and the environmental conditions present in the three years of field trials. Our data indicated that the early June planting of the latest adapted cultivars resulted in significantly lower Mp levels in host tissue during growth periods 'R6' and 'R7', probably due to decreasing soil temperatures in September. Therefore, field screenings should be planted so that growth stages 'R6' and 'R7' coincide with highest soil temperatures and lowest soil moisture.

MAJOR SOYBEAN DISEASES IN BRAZIL

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In 1993/94 crop season soybean production in Brazil reached 11 million hectares and 24 million metric tons. For 1994/95, acreage and production should remain about the same. More than 40 diseases caused by bacteria, fungi, nematodes and viruses have been identified in Brazil. Annual yield and input losses due to diseases are estimated at $2.0 billion. The major disease problems and the states where they predominate are: a) stem canker (SSC) (*Diaporthe phaseolorum* f. sp. *meridionalis*) (BA, GO, MG, MS, RS, and SC); b) anthracnose (ANT) (*Colletotrichum dematium* var. *truncata*) (North-Central Region: N-CR); c) brown spot (BRS) (*Septoria glycines*) (N-CR); d) Cercospora leaf blight (CLB) (*C. kikuchii*) (N-CR); e) Frogeye leaf spot (FLS) (*Cercospora sojina*) (GO, MA, MT); f) pod and stem blight (PSB) (*Phomopsis spp.*) (N-CR); g) Sclerotinia white mold (SWM) (*S. sclerotiorum*) (MG, PR, RS, SC); h) sudden death syndrome (SDS) (*Fusarium solani*) (GO, MG, MS, PR, RS, SC); i) brown stem rot (BSR) (*Phialophora gregata*) (RS, SC); j) Rhizoctonia damping-off (RDO) (*R. solani*) (PR, RS, SC); k) Sclerotium damping-off (SDO) (*S. rolfsii*) (PR, RS, SC); l) Corynespora root rot (CRR) (*C. cassiicola*) (GO, MG, PR, RS, SC, especially under no-till); m) charcoal rot (CHR) (*Macrophomina phaseolina*) (GO, MS, PR, RS, SC, SP); n) root-knot nematodes (RKN) (*Meloidogyne incognita, M. javanica*) (GO, MG, MS, RS, SP); and soybean cyst nematode (SCN) (*Heterodera glycines*) (GO, MG, MS, MT, SP). During 1993/94 crop season the diseases most responsible for yield losses were: SSC ($300 million in losses); BSR (up to 80% loss - total loss not estimated - t.l.n.e.); BRS and CLS (up to 33% loss - $1 billion); SDS (up to 50% loss - t.l.n.e.); CHR (up to 60% loss - t.l.n.e.); RKN (up to 50% loss - t.l.n.e.); SCN (up to 100% loss - ca. 1 million ha infested; losses of more than $100 million). Control of FLS, SSC, BSR and SDS has been effective through resistant cultivars. For diseases for which resistant cvs. are not available or are limited (SBS, CLB, SWM, RKN, and SCN), crop rotation/succession, soil and population management are emphasized. Chemical control is restricted to seed treatment and about 25% of all seed is treated. Fungicide sprays are seldom used but there is a great potential for increase in the North-Central Region, mainly for late season foliar diseases (brown spot and Cercospora leaf blight).

PRE- AND POST-INFECTION EFFICACY OF BENOMYL FOR THE CONTROL OF STEM CANKER OF SOYBEAN.

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Stem canker is one of the most devastating diseases of soybean in the south. Yield losses of 80% or more are not uncommon when stem canker is severe. Infection of soybeans by the stem canker pathogen, *Diaporthe phaseolorum* var. *caulivora* (Dpc), occurs early in the growing season during extended periods of wet, rainy weather. Symptoms, however, do not appear until reproductive development.

Currently, control of stem canker is through the use of resistant cultivars. While this form of control is very effective, it limits cultivar selection. An alternative control strategy is the use of fungicides. Studies have shown that fungicides can control stem canker, but the results were erratic. These erratic results may be the result of improper application timing.

To determine how long after infection the systemic fungicide benomyl can be applied to soybeans and still control stem canker, a test was established in microplots at the University of Arkansas Experiment Farm in Fayetteville, AR. Each microplot consisted of a 55 gal plastic barrel filled with steamed soil. The stem canker susceptible cultivar 'Walters' was planted in each microplot and thinned to ten plants per plot. Except for the uninoculated control, all plots were inoculated with a 10^6 ascospore/ml suspension of Dpc to runoff at the V4 growth stage. A large plastic bag was placed over each plot to maintain leaf wetness. After three days, the bags were removed. A 0.56 g-ai/L suspension of benomyl was applied to runoff. Treatments were two controls (uninoculated, untreated control and an inoculated, untreated control) and five benomyl treatments (1 day before inoculation, 1 day after the bags were removed, and 1, 2, and 3 weeks after inoculation). The number of diseased plants in each microplot was determined weekly from July through September. Yields were taken.

All fungicide treatments significantly reduced stem canker compared to the inoculated control. The fungicide treatments fell into two groups based on control: 1-3 wk delay in application and the pre- and post-infection applications. Delaying application by a week or more after infection delayed but did not prevent disease development. Disease levels of 50% were reached 12 to 16 days later in these delayed applications than the inoculated control with final disease levels ranging from 75 to 83% compared to 98% for the inoculated control. Applications just before and just after infection both delayed and reduced disease reaching a disease incidence of only 10 and 20% at the end of the season for the pre- and post-infection treatments, respectively. The relationship of control to yield will be discussed.

Comparison of Continuous Soybean and Rotation with Cotton for Nematode Control in a Field Infested with Root-knot and Soybean Cyst Nematodes. D. B. Weaver, R. Rodríguez-Kábana, and E. L. Carden, Auburn University and Alabama Agricultural Experiment Station.

Continous soybean (*Glycine max* L.) was compared to rotation with upland cotton (*Gossypium hirsutum* L.) for effects on yield and nematode populations in seven soybean cultivars with and without nematicide treatment. The field was infested with a mixture of *Meloidogyne incognita, M. arenaria,* and *Heterodera glycines* of unknown race. Soybean cultivars were Brim, Braxton, Bryan, Carver, Leflore, Stonewall, and Thomas with or without an at-planting treatment of aldicarb at 1.12 kg a.i./ha. Individual plots were two rows, 8 m long with a 0.8 m row spacing. Treatments were arranged in a 2 X 7 factorial (two nematicides, seven cultivars) with eight replications within 2 split-blocks (cotton rotation vs. continuous soybean). Nematode numbers were determined at the R6 soybean development stage by taking a composite soil sample from each plot. On average, soybean following cotton yielded 1990 kg/ha compared to 1112 kg/ha for continuous soybean, but cultivars responded differently to previous crop. All showed a positive yield response to cotton rotation, but Brim had a yield increase of almost 300% (345 kg/ha vs. 1503 kg/ha) while response of Carver (the cultivar with the most broad-spectrum nematode resistance) was 42% (1816 vs. 2573 kg/ha) averaged over nematicide treatment. Previous crop did not affect numbers of root-knot or soybean cyst larvae. Nematode populations were generally low, averaging 30 root-knot larvae and 22 soybean cyst larvae/100 cm^3 of soil for the experiment. Cultivars varied for root-knot numbers, with high-yielding cultivars having the highest numbers. SCN races 3- and 14-resistant Carver and Leflore had almost no detectable soybean cyst larvae, however Bryan (resistant to SCN race 3, but susceptible to race 14) averaged 45 cyst larvae/100 cm^3 of soil. We concluded that cotton as a rotation crop could be effective in increasing soybean yield, but effects on nematode numbers is difficult to determine in this environment because of the overall low numbers.

A Rapid Screening Method for Resistance to Nematodes and Soilborne Pathogens using Alginate Films. *Nancy Kokalis-Burelle* [1], *Natalia Martínez-Ochoa* [1], *David B. Weaver* [2], *and Rodrigo Rodríguez-Kábana* [1]. [1] Department of Plant Pathology, [2] Department of Agronomy and Soils, Auburn University, AL, 36849.

A simple method for assessing resistance to phytopathogenic nematodes and other soilborne pathogens using alginate films was developed. Eggs of *Meloidogyne incognita* were harvested from galled roots, surface disinfested, suspended in 2% (w/v) aqueous sodium alginate, and applied to 1 x 2.5 cm polyvinyl chloride coated fiberglass screens (1.5 mm^2 mesh size) at a thickness of 0.5 mm. The alginate solution was gelled by dipping in 0.25 M $CaCl_2$. Each screen contained approximately 867 eggs. Greenhouse experiments were conducted to determine the effects of increasing inoculum levels on disease incidence in soybean (*Glycine max* L.) cultivars Brim, Bryan, Carver, Leflore, and Thomas. One-L pots containing sterile sand were planted with two soybean seeds. Alginate films containing inoculum were buried to a depth of 2-3 cm and arranged in a circle around the seeds. Treatments in the experiment were 0, 2, 4, and 6 films/pot with six replications, arranged in randomized complete blocks in the greenhouse. After 10 weeks plant roots were washed and the fresh root weight, number of galls, and root knot index values were determined. The number of galls g^{-1} root was correlated with the number of alginate films placed in each pot at planting for each cultivar tested. Bryan had lowest disease incidence according to all rating systems while Brim consistently had highest levels of disease incidence. Carver, Leflore, and Thomas exhibited intermediate levels of resistance. Alginate films provide many advantages for delivery of inoculum, including uniform distribution of galls through the root system. Other methods often result in downward movement of the inoculum with watering, and loss of a major portion of the inoculum, or gall formation only in the lower portion of the root system. Nematode eggs will remain viable for long periods (6 months) in alginate films stored in sterile water at 8-12°C. This method is currently being adapted for use with many other soilborne pathogens including species of *Sclerotium*, *Rhizoctonia*, *Fusarium*, *Phytophthora*, *Pythium*, as well as bacterial pathogens.

PROGRESS OF A PROJECT TO IDENTIFY DIFFERENTIAL CULTIVARS AND RACES OF *CERCOSPORA SOJINA*

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The potential success of efforts to breed soybean cultivars for frogeye leaf spot resistance depends on knowledge of the potential for variation in the fungus, *Cercospora sojina*. The goals of a project at the University of Georgia are to develop a set of differential cultivars to identify races of this fungus and classify a collection of *C. sojina* cultures. Accurate race identification is essential to select the proper soybean genotypes to use in breeding for resistance.

The ideal set of differentials could be selected only if all potential variants of the fungus were known. While this cannot be achieved, using the largest possible number of diverse isolates will approximate the ideal situation. The present collection includes 105 isolates from the USA, China, South America, and eastern Africa. This diverse set of cultures should provide an excellent measure of the potential for variation in this fungus and help insure that the set of differential cultivars identified at the end of this project should be useful for many years. To prevent ambiguous reactions resulting from cultures that contain mixtures of genes for pathogenicity, we are using a four-step purification process before they are extensively tested.

We have determined the reaction of over 150 cultivars to one or more of the *C. sojina* isolates in our collection. About 45 of these appear to have promise as differential cultivars for race identification. Because we were able to collect nearly twice the number of *C. sojina* cultures that we originally planned, we are attempting to reduce the number of tentative differential cultivars to a "base set" of about 15. This will allow us to more efficiently screen the cultures and place them in preliminary "race groups".

The final "best possible" set of differentials, of course, cannot be selected until this project is nearly completed. However, as we identify cultivars that have an excellent chance of being in the final set we are making single seed selections to provide a seed source homogeneous for frogeye reaction. These selections are being crossed with Blackhawk to determine the number of resistance genes present in each. This process will continue with promising differentials and the number of resistance genes in each cultivar of final set of differentials will be known. If possible, differentials with only one resistance gene will be selected.

Seed of each differential cultivar in the final set and cultures of each identified race of *C. sojina* will be deposited in established collections, so they will be preserved and will be readily available to all interested researchers.