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Proceedings of the 17th Annual Meeting, Southern Soybean Disease Workers (March 20-22, 1990, Biloxi, Mississippi): Soybean Disease Control at a Crossroad

William S. Gazaway
Auburn University

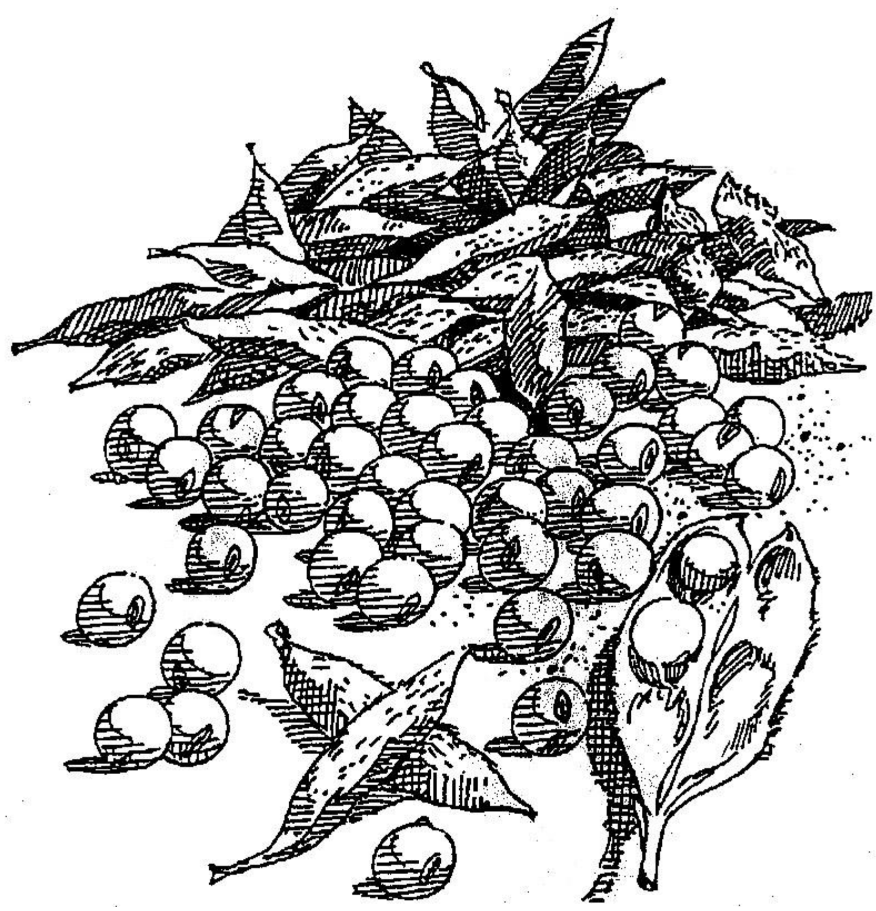
Donald E. Hershman
University of Kentucky

J. Allen Wrather
University of Missouri

Gary W. Lawrence
Mississippi State University

Glenn G. Hammes
DuPont

PROCEEDINGS OF THE SOUTHERN SOYBEAN DISEASE WORKERS



17TH ANNUAL MEETING

March 20–22, 1990 | Biloxi, Mississippi

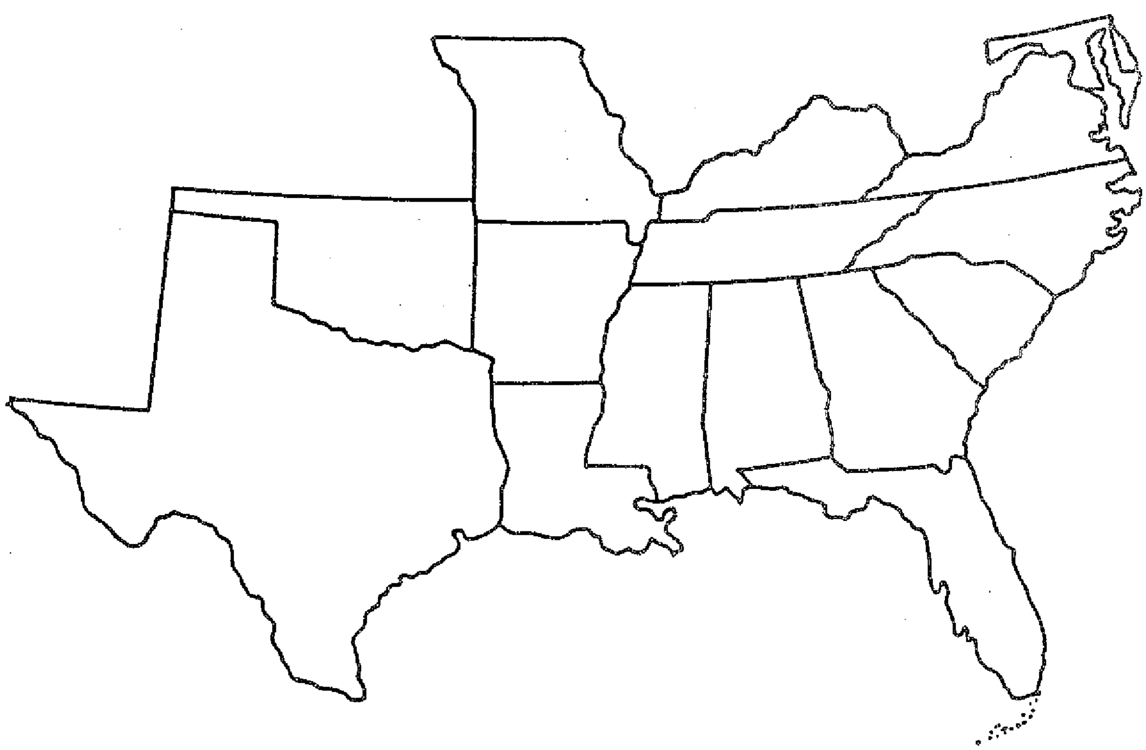
PROCEEDINGS OF THE

Southern Soybean Disease Workers

Seventeenth Annual Meeting

March 20-22, 1990

Biloxi, Mississippi



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J. Allen Wrather
Associate Professor, University of Missouri
1990 SSDW Program Chairman and Proceedings Editor

PROCEEDINGS OF THE

SOUTHERN SOYBEAN DISEASE WORKERS

SEVENTEENTH ANNUAL MEETING

MARCH 20-22, 1990

BILOXI, MISSISSIPPI

THEME: SOYBEAN DISEASE CONTROL - AT A CROSSROAD

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SSDW BUSINESS SESSION

CONTRIBUTED PAPER SESSION

Presidential Address

William S. Gazaway

The Soybean Disease Workers organization (SSDW) has been active in presenting scientific data and exchanging information on soybean diseases and nematodes since its beginning in the mid 1970's. Composed of plant scientists from industry, research, and extension, the organization has been particularly successful in identifying and researching disease problems and formulating successful control programs. Moreover, it has promoted and maintained an interest in soybean disease control throughout the south and in the other soybean production areas of the U.S. as well. A few of S.S.D.W.'s more outstanding achievements include two editions of the soybean disease atlas, financial support for the revision of the APS soybean disease compendium, graduate student competition at its annual meetings and financial support for a graduate student scholarship to work on diseases of soybean. In light of these achievements, the S.S.D.W. is now regarded by many as one of the outstanding organizations of its in the country.

Despite its success, the organization continues to decline in membership and financial support due to a drop in soybean acreage throughout the south in recent years. Industry participation, a major source of financial support in the past, has been sharply curtailed. Seed treatment and foliar fungicide trials, which have traditionally provided most of the financial support, are no longer being conducted and funds from registration fees are smaller than ever as result of decreasing attendance at the annual meeting. So, support funds, once plentiful, are now being slowly depleted.

Yet, the need for an organization like S.S.D.W. is greater today than ever. Nematode and disease problems in the soybean industry still exist and there is a demand for less expensive effective and more effective control practices. The S.S.D.W., therefore, needs to continue its present programs and even develop new ones to meet these new challenges. But to do so, the organization has to survive its present crisis.

In my opinion, the solution to the organization's present dilemma lies in expanding its area of interest and broadening its support base. This means expanding the organization to include other disciplines such as entomologists, agronomists, weed scientists. Something resembling a small version of the <u>Beltwide Cotton Production Conference</u> appears to be a logical direction to move. This type of organization would attract Industry and soybean farmers as well as plant scientists. It would be especially attractive to University and Industry administrators who are looking to curtail travel expenses and reduce meetings for their personnel.

Whether or not the S.S.D.W. is able to expand in this direction or decides to follow another path in expanding its membership and financial support base remains unanswered; however, it is certain that the organization can not continue to exist as it is today without making some drastic changes in the near future.

To paraphrase Will Rodgers' sage advise , "The train may be on the right track; but if it ain't moving fast enough, it's gonna get run over." Nothing could hold truer for our organization's present situation.

SOYBEAN RESEARCH AT A CROSSROAD

Dr. Keith Smith
Staff Vice President - Research
American Soybean Association

During the 1960s and 1970s soybeans were the "Cinderella Crop." During the 1980s soybeans matured; domestic acreage peaked, South American soybean production increased and the U.S. market share of world trade has declined. Soybean utilization has continued to increase and dominate world feed protein and vegetable oil markets.

What will the 1990s bring? U.S. soybean production will be influenced by international trade policy decisions, domestic farm programs and level of research funding. Soybean research support will be critical to improving U.S. farmer profit opportunities. Continued research funding is needed in developing soybeans with greater stress and disease tolerance, greater yield potential and improved composition. The 1990s will see increased emphasis on production system research, use of biotechnology tools, competitive grant funding, cooperation between disciplines and production of specialty soybean products which meet individual consumer demands.

With aggressive research funding directed at economically important targets, we will be able to assure soybean profits and regenerate the growth that characterized the "Cinderella" years.

FUTURE IMPACTS OF BIOTECHNOLOGY ON SOYBEAN PRODUCTION AND USES

Xavier Delannay
Monsanto Co.

Biotechnology will have a major impact on soybean production and utilization in the future. Techniques have been developed that allow transfer of foreign genes into the soybean germplasm. The possibilities opened by this new technology can be grouped into three main areas:

- Improvement of production practices through tolerance to herbicides, insects, and diseases
- Impact on processing industry through qualitative or quantitative improvements of seed composition (proteins, oil, etc.)
- Longer term, production of novel compounds for new industrial uses

Examples will be given of some of the applications that are currently being developed in soybeans and other crops.

Diseases of Soybeans Associated with International Seed Trade

William F. Moore, Leader
Extension Plant Pathology
Mississippi State University

Soybeans produced in and exported from the United States must meet phytosanitary requirements of the destination country before shipments are allowed entry. Countries may require phytosanitary certificates attesting that fields from which soybean seed were produced were inspected during the growing season and found to be essentially free of certain disease organisms. In some cases, laboratory tests may be required for some seed transmitted organisms.

Diseases of concern in international seed trade are generally those that the causal organism can be carried in or on the seed and could pose a problem by its introduction into a country. Certain countries have placed restrictions on soybean seed that may contain soil peds that could lead to the introduction of certain soil-borne disease organisms. Regulations differ from one country to another and are subject to frequent change.

IMPACT OF REGULATORY CHANGE AND GLP'S ON NEW FUNGICIDE DISCOVERY AND DEVELOPMENT G.G. Hammes, E.I. duPont de Nemours and Company Inc. Opelika, AL.

ABSTRACT

Amendments in FIFRA, enacted on October 25, 1988 established a five phase process for reregistration of pesticides registered by EPA prior to November 1, 1984.

First, EPA will publish a priority list of active ingredients to be reregistered.

Second, registrants are required to notify EPA of intent to seek reregistration.

Third, registrants are required to reformat study data submitted in accordance to EPA guidlines. Registrants must commit to fill outstanding data requirements.

Fourth, EPA will review submissions to determine if data gaps exist. Registrants are required to fill these requirements within four years.

Fifth, EPA will conduct a through examination of all registration data and determine if an active ingredient is eligible for reregistration. Applicants are required to submit necessary product specific data with the EPA to act on a final reregistration decision not later than one year after submission of the complete reregistration package.

In addition to reregistration requirements outlined by the 1988 "FIFRA LITE" amendments, EPA mandated GLP (Good Laboratory Practices) requirements have also become effective since October 19, 1989. GLP reqirements were inacted to insure quality and integrity of data submitted to EPA for registration of new active ingredients as well as reregistration of old products under "FIFRA LITE."

Costs associated with new tests required by EPA under the new FIFRA amendments will affect availablity of fungicides currently registered as well as determine registerability of newly discovered product candidates. Current product labels will in many instances be modified to comply with the current EPA "negligible risk" assessment system. Registration rate of new fungicides will undoubtedly be slowed due to new EPA test requirements and risk assessments.

DOUBLE-STRANDED RNA AND VIRUS-LIKE PARTICLES FROM SOYBEAN STEM CANKER PATHOGEN, *DIAPORTHE PHASEOLORUM* VAR. *CAULIVORA*. Y.H. Lee, J.P. Snow, G.T. Berggren, and R.A. Valverde. Department of Plant Pathology and Crop Physiology, Louisiana Agricultural Experiment Station, Louisiana State University Agricultural Center, Baton Rouge, LA 70803

A total of fifty-two isolates of *Diaporthe phaseolorum* var. *caulivora* (*Dpc*) originating from Louisiana (11), Mississippi (11), Florida (11), Georgia (11), Arkansas (2), Tennessee (1), Iowa (2), and Ohio (3) were collected and grown on potato dextrose broth for 2 - 3 weeks. Double-stranded RNA (dsRNA) was extracted by two cycles of cellulose (CF-11) chromatography and electrophoresed on 6 % polyacrylamide gel. Among them, twenty-nine isolates contained at least one molecule of dsRNA. Molecular weights of dsRNA from *Dpc* ranged from 0.23 to 3.0×10^6 daltons. Eight different band patterns were observed. Southern isolates exhibited all eight band patterns, whereas only one band pattern was observed in northern isolates. Cytoplasmic fractions from two isolates showed the same dsRNA band patterns as those from the total cell extractions within each isolate. This suggested that dsRNA of *Dpc* might be located in the cytoplasm of the cell. One isolate (Stj-2) was transferred from stock culture to PDA successively up to five generations. The band patterns of dsRNA from all generations and the stock culture were similar. These results indicated that dsRNA of *Dpc* is stable in the fungus cell and is transmitted in a stable manner. Isometric virus-like particles were detected from one of the virulent isolates. The diameter of the virus-like particles was 30 nm, which is typical of fungal viruses. Pathogenicity, growth rate, toxin production, and phenol oxidase activity in relation to dsRNA will be discussed.

DEVELOPMENT OF SOYBEAN VARIETIES RESISTANT TO PHOMOPSIS SEED DECAY.

M. S. Zimmerman and H. C. Minor, Dept. of Agronomy, University of Missouri, Columbia 65211.

A source of resistance to Phomopsis seed decay (PSD) was discovered at Columbia, Missouri in 1984. Repeated testing has shown this source (PI 417,479) to have a high level of resistance to PSD. The difference in infection level between PI 417,479 and susceptible genotypes persists for up to six weeks following physiological maturity. Heritability analyses in two studies suggest a high level of genetic control. The first estimate was obtained in 1985 from F_3 family data from the cross PI 417,479 x 'Merschman Dallas', a high yielding cultivar which is susceptible to PSD. The broad-sense heritability estimate was 0.63. A second estimate was obtained from parent-offspring regression in 1987. It was based on F_4 and F_5 derived families from the same cross grown in the field together. The value of this estimate was 0.46. In spite of the apparently high level of genetic control, an exact analysis of the number of genes involved in the resistance has not been successful.

During 1988, seeds from 503 selected F_5 plants from the cross PI 417,479 x Merschman Dallas were grown in individual rows. The basis of selection was low Phomopsis infection in the previous generation, as determined by bioassay. During the season, each row was scored repeatedly for characters which might contribute to its eventual success as a breeding line or variety. A mid-season character of concern was freedom from foliar diseases. Later, standability was the character scored. Following maturity, all lines were scored for shattering. Lines which shattered, demonstrated poor standability, or had an unacceptible level of foliar diseases were discarded. Seventy-eight lines (16%) were retained. The mean level of Phomopsis infection in these lines was 4.5%. A preliminary estimate of yield potential suggests that a major improvement has been made over the original PI, that is, resistance to PSD has been retained, level of shattering has been greatly reduced, and yield level is potentially competitive with that of the widely grown cultivar 'Williams 82'. The Phomopsis infection level of the nine highest yielding lines was 2.4%. The 78 selected lines and three checks were reevaluated in 1989.

CLONING OF THE *vir* REGION OF *AGROBACTERIUM TUMEFACIENS* CHRY5, A STRAIN HIGHLY VIRULENT ON SOYBEAN. L. G. Kovacs, Dept. of Plant Pathology, University of Missouri, Columbia, MO 65211.

The infection process of *Agrobacterium tumefaciens*, that involves the transfer and integration of bacterial DNA into the plant genome, can be exploited to introduce foreign genetic information in plants. Although many dicotyledonous species are routinely engineered by *Agrobacterium* vectors, soybean has proved to be recalcitrant to genetic transformation by this organism. This is largely due to the fact, that most strains of *Agrobacterium* are weakly virulent on soybean. We undertook to isolate the *vir* region of strain Chry5, an *A. tumefaciens* isolate with a very high virulence on soybean. The *vir* region is a 25 to 30 kb long fragment of the tumor-inducing (Ti) plasmid of agrobacteria, that mediates the transfer of the bacterial DNA into plant cells, and has been implicated as the determinant of host-specificity for several strains. In order to isolate this region, a genomic clone bank of strain Chry5 was constructed. The clone bank was screened with radioactive phosphorus-labelled *vir* sequences of *A. tumefaciens* strain C58. Clones that carried Chry5 *vir* sequences were mobilized into different *Agrobacterium* strains, and their effect on the virulence of the recipients was tested on soybean tissue.

ROLE OF OVERWINTERING BEAN LEAF BEETLES IN THE EPIDEMIOLOGY OF BEAN POD MOTTLE VIRUS IN SOYBEAN IN KENTUCKY. J R. dosAnjos[1], S. A. Ghabrial[1], D. E. Hershman[1], and D. W. Johnson[2]. Departments of Plant Pathology[1] and Entomology[2], University of Kentucky, Lexington , Ky 40546.

Bean pod mottle virus (BPMV) is an economically important pathogen of soybeans in Kentucky. Because of the lack of commercial soybean cultivars with resistance to BPMV, it is essential to understand the epidemiology of BPMV. In this study, the significance of overwintering bean leaf beetles, the vectors of BPMV, as a source of primary virus inoculum was examined. Two approaches were used: in the first, viruliferous beetles collected from soybean fields with a very high incidence of BPMV were placed in insect-proof cages for overwintering. In the second, beetles were collected from emergence traps that were placed during the winter in various locations in the state previously known to have high virus incidence. Regurgitant was collected from beetles that emerged in the Spring in the cages and traps , tested for the presence of virus by ELISA, and virus-containing beetles were used for transmission assays. Although relatively high concentration of viral antigen was detected by ELISA in regurgitants from overwintered beetles, only 1% of these beetles transmitted BPMV when allowed to feed on healthy soybean seedlings. Slightly higher transmission rates were obtained with beetles exposed to simulated overwintering conditions. Electron microscopic examination revealed typical BPMV particles in regurgitant from overwintered beetles. Furthermore, RNA and protein analysis of virions from regurgitants collected before and after artificial overwintering indicated no apparent structural changes that could be related to loss or decrease of infectivity.

SOUTHERN UNITED STATES SOYBEAN DISEASE LOSS ESTIMATE FOR 1989

Southern Soybean Disease Workers, Soybean Disease Loss Estimate Committee: Compiled by G. L. Sciumbato, Mississippi Agricultural and Forestry Experiment Station, Delta Branch, Stoneville, Mississippi.

ABSTRACT

Soybean diseases caused major yield losses in 1989. The crop loss estimate from all pathogens in 1989 was 15.81 percent. This resulted in a 87,740,000 bushel loss worth 614,180,000 dollars.

Soybeans and soybean products are a very important southern agricultural commodity. In 1989, 495,645,000 bushels were harvested from 19,260,000 acres. Average yields of each southern state in 1989 were as follows: Alabama 23 bushels/acre; Arkansas 23 bushels/acre; Delaware 29 bushels/acre; Florida 27 bushels/acre; Georgia 26 bushels/acre; Kentucky 26.5 bushels/acre; Louisiana 21 bushels/acre; Maryland 30 bushels/acre; Mississippi 20 bushels/acre; Missouri 31 bushels/acre; North Carolina 27 bushels/acre; Oklahoma 22 bushels/acre; South Carolina 22 bushels/acre; Tennessee 24 bushels/acre; and Texas 28 bushels/acre.

MATERIALS AND METHODS

The purpose of the SSDW Disease Loss Estimate Committee is to compile and record soybean disease loss estimates from southern states as the official disease loss statement on the production year. The disease loss estimates (Table 1) are annually solicited from Cooperative Extension Service and Experiment Station personnel in each southern state. The disease loss estimates reported here were derived from IPM field monitoring programs, field observations, diagnostic clinic records and grower demonstrations.

The bushel loss estimates for each state, disease, and totals are listed in Table 2. Dollar losses are based on what yields would have been had there been no disease present and are calculated on a cost of $7.00 per bushel times the estimated loss.

RESULTS AND DISCUSSION

The losses to some soybean diseases were up in 1989 because of the above normal early season rainfall in parts of the soybean growing areas. Nematodes are estimated to have reduced yields by 26.48 million bushels worth $185.36 million dollars. Soil diseases are estimated to have reduced yields by 11.26 million bushels worth $78.82 million dollars. Foliage, pod, and stem diseases are estimated to have reduced yields by 50.00 million bushels worth $350.00 million dollars. At the established average annual price received by southern soybean growers of $7.00 a bushel, the 87.74 million bushel loss due to diseases cost growers an estimated $614.18 million dollars.

Total percent soybean disease loss in the southern states in 1989 is estimated at 15.81. Florida reported the highest disease loss at 53 percent. States reporting disease loss over 15 percent are Alabama (20.2), Arkansas (26.5), Florida (53.0), Louisiana (16.5), North Carolina (16.6), South Carolina (16.8), and Tennessee (26.82).

Soybean diseases continue to cause significant reductions of possible income to producers (Tables 2 and 3). Therefore, there continues to be a need for expanded research efforts to provide more effective and economical disease control practices.

Table 1. Estimated percent loss of soybean yields in 1989 to disease.

PERCENT LOSS PER STATE

	AL	AR	DE	FL	GA	KY	LA	MD	MS	MO	NC	OK	SC	TN	TX	VA*	AVG.**
Diseases																	
Seedling diseases	TR***	1.0	TR	10.0	TR	1.2	.5	--	.81	1.0	.1	.4	.20	1.0	.08		1.09
Root & Stem rots	TR	.5	--	20.0	TR	.4	1.0	--	.64	.1	.2	.5	2.0	.1	.60		1.74
Diaporthe-pod & stem blight	2.0	.5	1.0	2.0	.1	.2	2.0	.33	1.62	.1	.1	5.5	1.05	.01	.50		1.13
Charcoal rot	.1	.5	.1	2.0	--	--	.5	--	.94	1.0	.1	2.0	.05	.5	.03		.52
Sudden death syndrome	TR	TR	--	--	--	.1	TR	--	TR	.1	--	--	--	.1	--		.02
Stem canker	1.0	7.0	--	--	TR	TR	4.0	TR	3.10	.1	--	--	.05	15.0	.03		2.02
Anthracnose	4.0	1.0	.1	3.0	.1	.3	.5	1.0	1.62	.1	--	2.5	1.75	1.0	3.0		1.33
Downy mildew	.5	TR	--	TR	--	TR	TR	TR	TR	.5	--	TR	.10	TR	--		.07
Cercospora-purple seed stain and blight	.5	TR	TR	2.0	.05	TR	TR	--	1.33	.5	.1	1.0	.30	.01	.30		.41
Brown leaf spot	TR	1.0	--	TR	--	1.4	TR	--	TR	--	.1	--	.20	2.0	.10		.32
Foliar diseases others	4.0	11.0	--	--	--	TR	2.0	--	2.55	--	.2	--	.50	3.0	.30		1.57
Bacterial diseases	.1	TR	--	--	--	TR	TR	--	TR	--	--	.5	.10	TR	--		.05
Virus diseases	TR	TR	TR	--	--	.2	TR	--	TR	.1	.6	--	.50	TR	--		.09
Soybean Cyst nematodes	4.0	3.0	2.0	3.0	1.25	2.8	3.0	3.0	.42	5.0	5.0	.5	4.50	3.0	.01		2.70
Root-knot nematodes and ecto-parasitiac types	3.0	1.0	1.0	11.0	3.40	--	3.0	1.0	.19	--	2.5	--	5.50	.1	.06		2.12
Other diseases	1.0	TR	--	--	--	--	TR	--	TR	--	7.6****	--	--	1.0*****	--		.64
Total Percent loss**	20.2	26.5	4.2	53.0	4.9	6.6	16.5	5.33	13.22	8.60	16.60	12.90	16.80	26.82	5.01		15.81

* No estimates received.
** Rounding errors present.
*** TR = Trace
**** 7% Yield loss due to ozone.
***** Pre-harvest seed deterioration.

BUSHEL LOSS X10^6 FOR STATE*

	AL	AR	DE	FL	GA	KY	LA	MD	MS	MO	NC	OK	SC	TN	TX	VA	Total	Dollar Loss X 10^6**
Diseases																		
Seedling diseases	TR	1.01	TR	.62	TR	.31	.20	--	.37	1.44	.05	.02	.05	.44	.01		4.52	31.64
Root & Stem rots	TR	.51	--	1.24	TR	.10	.39	--	.29	.14	.10	.03	.49	.04	.08		3.41	23.87
Diaporthe-pod & stem blight	.29	.51	.08	.12	.03	.05	.78	.06	.73	.14	.05	.33	.26	.004	.07		3.50	24.50
Charcoal rot	.01	.51	.008	.12	--	--	.20	--	.43	1.44	.05	.12	.01	.22	.004		3.12	21.84
Sudden death syndrome	TR	TR	--	--	--	.03	TR	--	TR	.14	--	--	--	.04	--		.21	1.47
Stem canker	.14	7.08	--	--	TR	TR	1.57	TR	1.40	.14	--	--	.01	6.53	.004		16.87	118.09
Anthracnose	.58	1.01	.008	.19	.03	.08	.20	.17	.73	.14	--	.15	.43	.44	.40		4.56	31.92
Downy mildew	.07	TR	--	TR	--	TR	TR	TR	TR	.72	--	TR	.02	TR	--		.81	5.67
Cercospora-purple seed stain and blight	.07	TR	TR	.12	.02	TR	TR	--	.60	.72	.05	.06	.07	.004	.04		1.75	12.25
Brown leaf spot	TR	1.01	--	TR	--	.36	TR	--	TR	--	.05	--	.05	.87	.01		2.35	16.45
Foliar diseases others	.58	11.13	--	--	--	TR	.78	--	1.15	--	.10	--	.12	1.31	.04		15.21	106.47
Bacterial diseases	.01	TR	--	--	--	TR	TR	--	TR	--	--	.03	.02	TR	--		.06	.42
Virus diseases	TR	TR	TR	--	--	.05	TR	--	TR	.14	.29	--	.12	TR	--		.60	4.20
Soybean Cyst nematodes	.58	3.04	.15	.19	.39	.72	1.17	.52	.19	7.22	2.44	.03	1.11	1.31	.001		19.06	133.42
Root-knot nematodes and ecto-parasitic types	.43	1.01	.08	.68	1.07	--	1.17	.17	.09	--	1.22	--	1.36	.04	.008		7.42	51.94
Other diseases	.14	TR	--	--	--	--	TR	--	TR	--	3.71	--	--	.44	--		4.29	30.03
Total disease loss***	2.90	26.82	.33	3.28	1.54	1.70	6.46	.92	5.98	12.38	8.11	.77	4.12	11.69	.67		87.74	
Dollar loss X10^6**	20.30	187.74	2.31	22.96	10.78	11.90	45.22	6.44	41.86	86.66	56.77	5.39	28.84	81.83	4.69			614.18

* The bushel loss is based on the percent loss of what yield would have been had no disease occurred.

** Dollar loss = estimated loss x 7.00/bushel.

*** Rounding errors present.

Table 3. Southern states soybean disease loss estimate in bushels-dollars - 1989.

DISEASE	BUSHEL LOSS x10^6*	DOLLAR LOSS x 10^6**
Soil		
Seedling	4.52	
Root and lower stem rots	3.41	
Charcoal rot	3.12	
Sudden death syndrome	0.21	
SUBTOTAL	11.26	78.82
Nematodes		
Cyst nematodes	19.06	
Root-knot and other nematodes	7.42	
SUBTOTAL	26.48	185.36
Foliage		
Foliage, Pod and Stem		
Pod and stem blight	3.50	
Stem canker	16.87	
Anthracnose	4.56	
Downy mildew	0.81	
Cercospora	1.75	
Brown leaf spot	2.35	
Bacterial diseases	0.06	
Other foliar fungi	15.21	
Virus	0.60	
Others	4.29	
SUBTOTAL	50.00	350.00
TOTAL	87.74***	614.18***

*The bushel losses are computed from percent loss estimates from each of the States x what total production would have been had no disease occurred.

**The dollar loss is derived by multiplying bushels by $7.00/bushel.

***Rounding errors present.

EFFECTS OF AMINO ACID BIOSYNTHESIS INHIBITING HERBICIDES ON *IN VITRO* GROWTH AND DEVELOPMENT OF *CALONECTRIA CROTALARIAE*

D. K. Berner, G. T. Berggren, and J. P. Snow
Department of Plant Pathology and Crop Physiology, Louisiana Agricultural Experiment Station, Louisiana State University Agricultural Center, Baton Rouge, LA

Commercial herbicide formulations of glyphosate, imazaquin, and chlorimuron ethyl were evaluated for their effects on *Calonectria crotalariae*, the causal pathogen of red crown rot of soybean. Three isolates of the fungus were grown on selective media amended with either water or the herbicide formulations. Herbicide rates were 0.5, 1, 2, and 4X recommended rates for weed control in soybeans. Both surfactant and non-surfactant containing formulations of glyphosate significantly restricted *C. crotalariae* colony area. Repeated applications of 2X rates of both imazaquin and chlorimuron ethyl also significantly reduced colony area below that of the water control. Numbers of microsclerotia produced were reduced by rates of imazaquin as low as 1X. Addition of amino acids to the media failed to reverse the herbicide inhibition of any of these materials. The growth inhibition observed at these low rates may allow commercial formulations of these materials to be used simultaneously as herbicides (pre- and/or post-emerge) and fungicides for the control of *C. crotalariae.*

Infection cushion formation by *Rhizoctonia Solani* Kuhn on soybean leaves

C.S. Kousik, J.P. Snow, and G.T. Berggren
Department of Plant Pathology and Crop Physiology, Louisiana Agricultural Experiment Station, Louisiana State University Agricultural Center, Baton Rouge, LA 70803.

Infection cushion formation by *Rhizoctonia solani* Kuhn (AG-1) on soybean leaves was studied with light and scanning electron microscopy. Infection cushion formation started 18 h after inoculation. An inverted "T" shaped foot formed laterally from the extending mycelium. The tips of the foot extended between the grooves formed by the epidermal cells and 28 h after inoculation additional structures intermingled to form the infection cushion. Mucilagenous material bound these structures allowing the hyphae of the fungus to adhere to the plant surface. Isolates of *R. solani* causing aerial (AG-1 IA) and web blight (AG-1 IB) did not form infection cushions on soybean leaf surface replicas of either resistant or susceptible cultivars. Infection cushions were formed by both aerial and web blight isolates on colloidon membranes over leaves of susceptible and resistant cultivars. This provides preliminary evidence that a chemical stimulus is needed for the cushion formation. More infection cushions formed on resistant or susceptible cultivars when inoculated plants were kept in continous darkness compared to plants kept in continous light. The number of infection cushions formed and the disease severity on ten soybean cultivars were significantly correlated. Fewer infection cushions were formed on resistant cultivars than on susceptible cultivars.

IS STEM CANKER MONOCYCLIC? K.V. Subba Rao, J.P. Snow, and G.T. Berggren. Department of Plant Pathology and Crop Physiology, Louisiana Agricultural Experiment Station, Louisiana State University Agricultural Center, Baton Rouge, LA 70803.

The effects of irrigation and cultivar resistance on the spatio-temporal development of stem canker were studied at Ben Hur and Port Sulphur, Louisiana. Greater stem canker development was observed on all cultivars in irrigated plots. Pycnidia were observed on infected stems about 90 days after seedling emergence. Subsequently, the pycnidia released alpha conidia. Plants infected early, died and produced perithecia releasing ascospores when the crop was at R_4 stage. These observations indicate that the fungus may produce secondary inoculum. The implications of these in the epidemiology of the disease will be discussed.

EARLY-SEASON FUNGICIDE SPRAYS FOR SOYBEAN STEM CANKER CONTROL

Albert Y. Chambers
Department of Entomology and Plant Pathology
University of Tennessee, Jackson, TN 38301

Six foliar fungicide treatments at half normal rates were applied in 1988-89 to highly susceptible 'RA 604' soybeans at V4 growth stage for stem canker control. Half of the four-row, 40-ft plots, planted in mid-May, were sprayed again at half rates two weeks later. Fungicides were applied with three spray nozzles per row (TX-10 tips, 40 psi, 20 gal/A). Penetrator 3 and Triton CS-7 spray adjuvants were used. Treatments were replicated six times in a randomized complete block design. Moderate stem canker injury was present in susceptible soybeans grown in the plot area on a Collins silt loam soil during 1986-87.

Severity of stem canker was low in 1988. However, all of the fungicide treatments - Benlate 50DF, 4 oz/A; Bravo 720, 1 pt; Mertect 340-F, 5 fl oz; Topsin M 4.5F, 5 fl oz; Dithane F-45 4F, 1.5 qt; and Dithane M-45 80W, 1.5 lb - significantly reduced disease injury when compared to no treatment. Plots receiving two applications of Benlate and Topsin M had lowest disease injury ratings. Yields were increased significantly over no treatment in plots sprayed with one and two applications of Benlate and Topsin M and one application of Mertect. Two applications of Benlate resulted in significantly higher yields than one application.

Stem canker injury was severe in the plot area in 1989. Ratings of disease severity made September 12 were significantly lower in plots sprayed once or twice with Benlate 50DF, Topsin M 4.5F, and Penncozeb 80W, 1.5 lb/A, and twice with Bravo 720 and Dithane DF, 1.5 lb, compared to no treatment. Two applications of Benlate had significantly lower disease ratings than other treatments. Stem canker injury greatly increased before a second rating was made October 3. Two applications of Benlate, Bravo, Topsin M, Dithane DF, and Penncozeb resulted in significantly lower disease injury ratings than no treatment. Significantly less disease injury was present in plots receiving two applications of Benlate than in all other plots. Yields were low in all plots but were significantly higher in plots sprayed twice with Benlate, Bravo, Topsin M, Dithane DF, and Penncozeb than in untreated plots. Two applications of Benlate gave highest yields and significantly better yields than all other treatments except Topsin M and Dithane DF applied twice. Treatments of Mertect 340-F did not significantly reduce disease injury or increase yields.

Early-season applications of half rates of fungicides (esp. Benlate, Bravo, Topsin M, Dithane DF, and Penncozeb sprayed twice in 1989) reduced stem canker injury and increased soybean yields but did not give complete disease control in highly susceptible RA 604 soybeans. Plans for 1990 include early sprays of reduced rates in moderately susceptible and moderately resistant cultivars.

SSDW TREASURERS REPORT
12/31/1988 TO 12/31/1989

OPERATIONAL ACCOUNT NO.
1ST NATL. BANK OF OPELIKA

BALANCE ON 12/31/1988	$8275.36

RECEIPTS FROM 12/31/1988 TO 12/31/1989

DEPOSITS FROM STANDARDIZED TESTS 1989	$ 0.00
INTEREST ON OPERATIONAL ACCOUNT	$ 274.64
HOSPITALITY SUITE CONTRIBUTIONS	$ 500.00
REVENUE FROM SOYBEAN DISEASE ATLAS SALES	$13114.55
1989 MEETING RECEIPTS	$3022.30
MISCELLANEOUS 1989 REVENUE	$ 0.00
TOTAL OF 12/31/1988 BALANCE AND REVENUE	$25,186.85

DISBURSEMENTS FROM 12/31/1988 TO 12/31/1989

DISBURSEMENTS FOR STANDARDIZED TESTS 1989	$ 0.00
GRADUATE STUDENT EXPENSES	$1438.79
SSDW PRINTING COSTS 1989	$1273.85
SOYBEAN DISEASE ATLAS PUBLICATION COSTS	$11209.49
POSTAGE AND MAIL ROOM FEES 1989	$1151.83
SECRETARIAL FEES	$ 394.36
1989 MEETING EXPENSES GENERAL SESSION AND BOARD MEETINGS.	$3358.59
1989 AWARDS	$ 580.82
CPA FEES AND PREPARATION OF 1988 TAX REPORT	$ 325.00
AMERICAN PHYTOPATH MEETING EXIBIT COSTS	$ 525.00
OTHER MISCELLANEOUS DISBURSEMENTS	$ 0.00
TOTAL DISBURSEMENTS AS OF 12/31/1989	$20,257.73
REVENUES AND BALANCE IN OPERATIONAL ACCOUNT	$25,186.85
TOTAL DISBURSEMENTS AS OF 12/31/1989	$20,257.73
BALANCE IN OPERATIONAL ACCOUNT ON 12/31/1989 INCLUDING 1989 INTEREST	$ 4,929.12

------------------------------12/31/1989

GLENN G. HAMMES TREASURER SSDW

SSDW TREASURES REPORT

ASSETS AND DEFICITS AS OF 12/31/1989

SCHOLARSHIP ACCOUNT	BALANCE 12/31/1988	$3742.48
INTEREST ON SCHOLARSHIP ACCOUNT		$ 164.36
TOTAL RECEIPTS FROM SCHOLARSHIP ACCOUNT		$3906.84
DISBURSEMENTS FROM SCHOLARSHIP ACCOUNT 1989 3/24/1989 KATHY MCLEAN RECIPIENT		$1000.00
BALANCE ON SCHOLARSHIP ACCOUNT ON 12/31/1989.		$2906.84

TOTAL ASSETS OF SSDW ON 12/31/1989

OPERATIONAL ACCOUNT BALANCE	$4,929.12
SCHOLARSHIP ACCOUNT BALANCE	$2,906.84
NET ASSETS	$7,835.96

--12/31/1989

GLENN G. HAMMES TREASURER SSDW

Effect of Frogeye Leafspot on Soybeans in Florida. F. M. Shokes, C. K. Hiebsch, and D. L. Wright. North Florida Research and Education Center (NFREC), Quincy, Florida, 32351, Dept. of Agron., Univ. of Florida, Gainesville, 32611, and NFREC, Quincy.

Frogeye leafspot of soybean caused by *Cercospora sojina*, has increased in importance in Florida in recent years. Some of the cultivars that are frequently grown because of their nematode resistance and high yield potential are susceptible to frogeye leafspot. Tests were conducted at the North Florida Research and Education Center, Gadsden County, and on a farm in Calhoun County to determine the effect of frogeye leafspot on yields. In the NFREC trial the yield of 'Deltapine 417' was increased by 5.3 bu/A with two applications of benomyl (0.25 lb ai/A) at stages R1 and R3. A 2.4 bu/A increase was noted with applications at R3 and R5. With 'Coker 6738' yield increases of 4.5 to 5.0 bu/A were noted with either two applications at R1 and R3, or R3 and R5 and with one application at R5 (0.5 lb ai/A). One application at R3 was ineffective in both tests. Frogeye leafspot was the predominant disease in these tests. In the Calhoun County trial one application of benomyl increased yields of frogeye-resistant cultivars 2.4 bu/A and yields of a susceptible cultivar by 5.3 bu/A. In areas of Florida where frogeye leafspot is often a problem it may be worthwhile to use fungicidal control when frogeye-susceptible cultivars are grown.

COMPARISON OF APPLICATION TIMING OF TWO FOLIAR FUNGICIDES FOR THE CONTROL OF SOYBEAN DISEASES. John C. Rupe, Mark J. Cochran, and Michael L. Courtney. University of Arkansas, Fayetteville.

Control of foliar diseases of soybean with fungicides can be effective but expensive. Disease control, yield, and economic return from the use of a protectant (mancozeb) and a systemic (benomyl) were compared. These fungicides were applied one to three times at R3, R5, or R6 maturity stages. The test was conducted at two locations in a randomized complete block design with 6 replications. The best strategy for control of the major foliar disease, frogeye leaf spot, was to apply either fungicide at both R3 and R5. The greatest economic returns were obtained when benomyl was applied at R3 or mancozeb was applied at R5.

Performance of Soybean Lines Under Stress Due to Brown Stem Rot, Soybean Cyst Nematode, and Iron-deficiency Chlorosis.

L. M. Mansur, H. Tachibana, and K. Bidne
Iowa State University, Ames, Iowa

Yield potential of soybean in Iowa is primarily reduced due to brown stem rot (BSR), soybean cyst nematode (SCN) and iron-deficiency chlorosis (IDC). The experiment was conducted in 1989 to evaluate the performance of resistant and susceptible soybean lines under increasing levels of stress due to BSR, IDC, and SCN. One environment was low stress (trace BSR only), two had BSR only, one had BSR and IDC, and three environments had BSR, SCN, and IDC.

The following results were obtained: 1) In comparison with the low-stress environment, average yield was reduced 8% in the presence of BSR, 20% in the BSR-IDC environment, and 44% in the BSR-SCN-IDC environments; 2) Phenotypic correlations for yield among BSR-resistant lines grown in the low stress, BSR, and BSR-IDC conditions, were high and positive (r=0.60, 0.90**, 0.93**); 3) Phenotypic correlations for yield among lines having SCN-resistance but grown in the low-stress and BSR-SCN-IDC conditions were positive (r=0.75*, 0.48, 0.58). However, when the lines were grown in BSR and BSR-SCN-IDC environments, the correlations were inconsistent (ranged from 0.13 to -0.67); 4) Regressing yield on resistance to BSR, SCN and IDC, in the three BSR-SCN-IDC environments, indicated that SCN and IDC accounted for a greater portion of the variation in yield than BSR; 5) Line by environment interactions were primarily due to SCN and IDC susceptible lines.

This preliminary data indicated that massive yield losses will occur in SCN-IDC-BSR conditions, unless lines carry at least SCN and IDC resistance. Although BSR losses are usually less dramatic, BSR resistance is important because the disease is widespread over most of Iowa.

PERFORMANCE OF SOYBEAN CULTIVARS IN CYST AND PEANUT ROOT-KNOT NEMATODE INFESTED FIELDS. C. E. Drye, D. J. Barefield, E. R. Shipe, and J. D. Mueller, Departments of Plant Pathology and Agronomy, Clemson University, Blackville 29812.

Thirtyseven maturity group V, VI, VII, and VIII soybean varieties were evaluated for yield and nematode reproduction at two locations. The cultivars were all highly adapted to South Carolina growing conditions and capable of high yields since they comprised the Clemson University recommended variety list and also varieties which had dooe well in preliminary variety tests. Eighteen maturity group V and VI and 19 maturity group VII and VIII varieties were planted on June 15 in a field infested with the peanut root-knot nematode (Meloidogyne arenaria) race 2, and on May 18 in a field infested with the soybean cyst nematode (Heterodera glycines) race 14. Each variety was replicated 4 times in a randomized complete block with each plot consisting of 4 rows 18-ft long on 38 inch centers. The center two rows were harvested on November 28 in the root-knot field and on December 13 in the cyst field. At midseason each of the plots in the cyst field were sampled for cyst females and the root-knot field plots were rated for galling oo a scale of 0-5(0=no galling - 5=roots 100% galled). Mean yield of the group V and VI varieties in the cyst field was 9.9 bu/A and ranged from 21 bu/A for Leflore to 5 bu/A for NK'S Ring Around 606. Recovery of cysts ranged from 2 (Leflore) to 35/100 cm^3 (Deltapine 566). Mean yield of the group VII and VIII varieties in the cyst field was 8.9 bu/A and ranged from 21 bu/A (Deltapine X9085) to 5 bu/A (Cobb). Recovery of cysts ranged from 2 (Kirby) to 28 (Braxton)/100 cm^3 of soil/ Mean yield of the group V and VI varieties in the root-knot field was 11.1 bu/A and ranged from 16 bu/A (Lamar) to 6 bu/A (Deltapine 566). Galling indices ranged from 1.6 (Asgrow A6785) to 4.0 (Hutcheson). Mean yield of the group VII and VIII varieties was 20 bu/A ranging from 30 bu/A (Perrin) to 11 bu/A (Stonewall). Galling indices ranged from 0.38 (Perrin) to 3.63 (Stonewall).

YIELD OF ALDICARB-TREATED NEMATODE RESISTANT AND SUSCEPTIBLE SOYBEAN VARIETIES. C. E. Drye, E. R. Garner, and J. D. Mueller, Departments of Plant Pathology and Agronomy, Clemson University, Blackville 29817.

Four soybean cultivars with varying combinations of resistance and susceptibility to soybean cyst nematode (Heterodera glycines) race 3 and the southern root-knot nematode (Meloidogyne incognita) were planted in a field infested with the two nematodes. The cultivars chosen were: Asgrow A7986 (root-knot-susceptible and cyst susceptible), Braxton (resistant and susceptible), Coker 6738 (resistant and resistant), and Kirby (resistant and resistant). Each cultivar was treated with 0, 3, and 7 lbs of Temik 15G applied in-furrow at planting. Plots were arranged as a split-plot within 4 randomized complete blocks with cultivars as mainplots and Temik 15G treatments as subplots. Plots consisted of 4 rows 40 ft long on 38 inch centers. At midseason cyst nematode reproductioo was estimated by recovery of cysts and females from soil and root-knot reproduction by rating roots for galling on a scale of 1 (no galling) to 5 (roots 100% galled). Treatment with aldicarb significantly (P=0.05) increased yield, but did not significantly affect reproduction of either nematode. Yields for 0, 3, and 7 lbs of Temik 15G for each cultivar respectively were: Asgrow A7986-12.9, 13.5, and 21.2 bu/A; Braxton-6.4, 17.6, and 15.2 bu/A; Coker 6738 20.3, 24.0, and 26.8 bu/A; and Kirby-20.5, 28.4, and 21.8 bu/A. Economically acceptable yields were achieved only in cultivars with cyst resistance.

DISTRIBUTION, RACES, AND EFFECTS OF SOYBEAN CYST NEMATODE IN MISSOURI.

T. L. Niblack and G. S. Smith, Department of Plant Pathology and Integrated Pest Management, respectively, University of Missouri, Columbia, 65211.

In 1988 and 1989 the known distribution of the soybean cyst nematode (SCN), Heterodera glycines Ichinohe, increased to include 70 of the 114 Missouri counties. SCN is now considered to be the most economically important soybean pest in Missouri. The Nematology Lab on the Columbia campus makes recommendations for SCN management based primarily on egg counts. Relative yields at harvest have a higher correlation with egg densities than with cyst counts (log transformed values). The correlations, for susceptible varieties in 1989, were -0.66 and -0.29, respectively. Based on research data and field observations, the framework for specific recommendations is in general categories of egg counts per 250 cm^3 soil: "low" counts are considered to be 1-500 eggs; "moderate," 501-1500 eggs; and "high," over 1500 eggs. These categories are usually academic, however, because in the 679 samples submitted to the Nematology Lab for egg counts between October, 1988, and November, 1989, 71% had densities above 1,500 eggs, and 9% had densities higher than 50,000 eggs. Some of the high densities in samples can be attributed to poor sampling technique. During the same period, 104 samples were submitted for race determinations. Nine of the possible 16 races have been identified. In 1988, 56% were Race 3, and in 1989, 41% were Race 3. Submission of samples for race determination is discouraged except in cases where resistant cultivars have been grown, damage due to SCN has been observed, egg counts are high, and rotation is not possible. Even then, race determination is often not useful to the grower.

Seventeen soybean varieties were planted at each of six locations in north/central Missouri; 5 susceptible and 12 resistant to SCN races 3 and 4 replicated 6 times at each site. Three sites were infested with between 3,000 and 3,900 eggs/250 cm^3 ("low sites") and the other three were infested with between 16,000 and 30,000 eggs ("high sites"). Mean yields of resistant varieties were -3% to +22% compared with yield of susceptible varieties at the low sites. In contrast, resistant varieties yielded 62-90% more than susceptibles at the high sites. Susceptible varieties in aldicarb-treated plots (1.0 lb. AI/acre) did not yield as high as resistant varieties over all locations.

PERFORMANCE OF SELECTED NEMATICIDES IN A FIELD INFESTED WITH ROOT-KNOT AND CYST NEMATODES

R. W. Young, R. Rodríguez-Kábana, D. G. Robertson, and E. L. Carden
Auburn University, Alabama Agricultural Experiment Station, Auburn, Alabama 36849-5409

The relative efficacy of aldicarb (Temik® 15G), and ethoprop (Mocap® 15G) for control of root-knot (*Meloidogyne arenaria*) and cyst nematodes (*Heterodera glycines*, race 4) and to increase Kirby soybean (*Glycines max*) yields was studied in a field infested with both nematodes. The field was in the Gottler farm near Elberta, Baldwin county, Alabama, and had been in soybean for the preceeding ten years with ryegrass (*Lolium* sp.) as a winter cover crop. The nematicides were applied at-plant in a 20-cm-wide band with the seed furrow in the middle of the band. The materials were lightly incorporated 5-8 cm in the soil with the use of spring-activated tines set ahead of the planting equipment. Nematicides were applied at the following rates (gm a.i./100 m row): aldicarb, 17; and ethoprop, 17. Aldicarb was also applied in-furrow at 6.4 and 8.5 g a.i./100 m row. There were also in-furrow treatments with ethoprop and with phenamiphos (Nemacur® 15G) each at 26 g a.i./100 m row. Each treatment and control were represented by 16 plots arranged in a randomized complete block design. A plot was 2-row-wide x 6-m-long and each row was 0.76 m wide. Soil samples for nematode analysis were taken from each plot six weeks before harvest and yields were obtained from the entire plot area at maturity of the crop. Ethoprop increased yields only at the 26 g rate; however, all treatments with aldicarb or phenamiphos resulted in higher yields than the ethoprop treatment. There were no differences in yields between aldicarb and phenamiphos treatments; these treatments improved yields by 22-28%. Nematicide treatments had no effect on juvenile populations of *M. arenaria* or of *H. glycines* in soil.

PERFORMANCE OF SELECTED SOYBEAN CULTIVARS IN A FIELD INFESTED WITH *MELOIDOGYNE ARENARIA* AND *HETERODERA GLYCINES*

D. G. Robertson, R. Rodríguez-Kábana, D. B. Weaver, and E. L. Carden
Auburn University, Alabama Agricultural Experiment Station, Auburn, Alabama 36849-5409

Seven soybean (*Glycine max*) cultivars (Braxton, Centennial, Kirby, Leflore, Ransom, Stonewall, Thomas) were evaluated for yields and their effects on populations of root-knot (*Meloidogyne arenaria*) and cyst (*Heterodera glycines*, race 4) in a field infested with both nematodes. The field had been in soybean for the preceeding two years and was located at the Gottler farm near Elberta, Baldwin county, Alabama. Each cultivar was planted in 16 plots each two-row wide x 6 m long on 0.8 m centers. For each cultivar eight plots were left untreated and the other eight were treated with aldicarb (Temik® 15G) applied at 2.2 kg a.i./ha in a 20-cm-wide band with the seed furrow in the middle of the band. There was no cultivar x nematicide interaction for yield. Aldicarb application resulted in a 26% overall increase in yield. The highest yield was obtained with Kirby and the lowest with Braxton, Stonewall, and Thomas. Soil nematode populations were determined five weeks before harvest. Aldicarb treatment had no effect on juvenile populations of *M. arenaria* in plots with Braxton, Kirby, Leflore, Ransom or Stonewall; the treatment resulted in increased populations for Centennial and Thomas. The highest *M. arenaria* juvenile populations were in plots with Leflore and the lowest in those with Braxton. Soil populations of *H. glycines* juveniles were on the average 17 times lower ($\bar{X}$ = 27/100 cm^3 soil) than those of the root-knot nematode ($\bar{X}$ = 461/100 cm^3 soil). Aldicarb had no effect on numbers of *H. glycines* juveniles. The lowest populations of *H. glycines* juveniles were in plots with Leflore (3/100 cm^3 soil) and the highest in Braxton plots (57/100 cm^3 soil).

SORGHUM-SOYBEAN ROTATION FOR THE MANAGEMENT OF ROOT-KNOT AND CYST NEMATODES: LONG-TERM EFFECTS

C. F. Weaver, R. Rodríguez-Kábana, D. B. Weaver, and E. L. Carden
Auburn University, Alabama Agricultural Experiment Station, Auburn, Alabama 36849-5409

The value of sorghum (*Sorghum bicolor*) in rotation with soybean for the management of nematodes was studied in a field infested with root-knot (*Meloidogyne arenaria*) and cyst (*Heterodera glycines*, race 4) nematodes. The field was in the Gottler farm near Elberta, Baldwin county, Alabama, and had been in soybean with ryegrass (*Lolium* sp.) as a winter cover crop for five years prior to the study. In 1988 and in 1989 cultivars Braxton, Centennial, Kirby, Leflore, Ransom, and Stonewall were planted in plots that had Pioneer 8222 sorghum in 1986 and 1987 and also in plots that had been in continuous soybean production. Yields of all cultivars were higher in the sorghum-soybean plots than in those in monoculture. In 1988 yield increases in response to the sorghum-soybean system when compared with continuous soybean varied from 31% for Kirby to 231% for Stonewall; the average increase in yield for all cultivars was 85%. In 1989, yield responses to the rotation ranged from 30% for Kirby to 173% for Stonewall with an average increase for all cultivars of 81%. The average yield for all cultivars was higher in both the rotation and the monoculture system in 1988 than in 1989. In 1988 the average yield (kg/ha) in the sorghum-soybean plots was 2363 and in the monoculture plots 1163; the corresponding yields for 1989 were 1417 and 782. End-of-season (3-6 weeks before soybean harvest) populations of *H. glycines* juveniles were lowest in plots with Leflore in 1988 and 1989 irrespective of cropping system; however, plots with this cultivar had the highest populations of *M. arenaria* juveniles. *M. arenaria* juvenile soil populations were 8-10 times higher in 1989 than in the previous year; the average number of juveniles per 100 cm^3 in 1989 was 518 and the year before 48. In 1988 the average population of *M. arenaria* juveniles in soil in sorghum-soybean plots was lower than in those with continuous soybean but the reverse was true the following year. For all cultivars juvenile soil populations of *H. glycines* were lower than those of *M. arenaria* in 1988 and 1989. In 1988 the average number of *H. glycines* juveniles in soil from the sorghum-soybean plots was higher than in soil with soybean monoculture but the opposite was true in 1989.

BAHIAGRASS-SOYBEAN ROTATION FOR THE MANAGEMENT OF ROOT-KNOT AND CYST NEMATODES: LONG-TERM EFFECTS

P. S. King, R. Rodríguez-Kábana, D. B. Weaver, and E. L. Carden
Auburn University, Alabama Agricultural Experiment Station, Auburn, Alabama 36849-5409

The effect of rotation with bahiagrass (Paspalum notatum) on soybean (Glycine max) yields and end-of-season (2-4 weeks before soybean harvest) soil populations of root-knot (Meloidogyne arenaria) and cyst (Heterodera glycines, race 4) nematodes was studied for 4 years (1986-1989) in a field at the Kaiser farm, near Elberta, Baldwin county, Alabama. Soybean cvs. Braxton, Centennial, Kirby, Leflore, Ransom, and Stonewall were planted for two years (1988, 1989) in plots that had been with 'Pensacola' bahiagrass for the previous two years and in others that had been in monoculture with soybean. Yields of all cultivars were higher in the bahiagrass-soybean plots than in those in the soybean monoculture. The average percent increase in yield for all cultivars was 110% in 1988 and 158% the following year. Yield response to the bahiagrass-soybean rotation varied according to the soybean cultivar and year. In 1988 the response ranged from 33% for Leflore to 233% for Braxton and in 1989 from 100% for Ransom to 238% for Braxton. Yields of all cultivars in 1989 were lower than in 1988. The average yield (kg/ha) for all cultivars in the rotation in 1988 was 2323 and in the monoculture 1105; the corresponding values for 1989 were: 744 and 288. In 1988 juvenile populations of M. arenaria in soil were either not affected by the cropping system or were lower in the bahiagrass-soybean plots than in the corresponding monoculture plots. In 1989 juvenile populations of M. arenaria were 5-10 times larger than in the previous year and there were more juveniles in soil from plots in the rotation than in those with monoculture. Numbers of H. glycines juveniles in soil were lowest in plots of Leflore in 1988 and in 1989 irrespective of cropping system. H. glycines juvenile populations in soil were lower than those of M. arenaria and this was more so in 1989 than in the previous year.

PEANUT-SOYBEAN ROTATION FOR THE MANAGEMENT OF *MELOIDOGYNE ARENARIA*

R. Rodríguez-Kábana, D. G. Robertson, and L. Wells
Auburn University, Alabama Agricultural Experiment Station,
Auburn, Alabama 36849-5409

The effects of monoculture Florunner peanut (P), monoculture Braxton soybean (S), and a peanut-soybean rotation (P-S) on populations of *Meloidogyne arenaria* (race 1) and crop yields were studied for seven years (1983-1989) in a field at the Wiregrass substation, near Headland, Alabama. Each cropping system was represented by eight plots in a randomized complete block design. Each plot was eight-rows wide x 10 m long on 0.9 m centers. Each year yields were obtained at maturity of the crops by harvesting the 2 center rows and soil samples for nematode analysis were taken from each plot 2-3 weeks before peanut harvest. The relation between peanut yield (Yp) in kg/ha and years elapsed under monoculture (T) was adequately described ($R^2 = 0.55^{**}$) by:

$$Yp = [16943.688(0.194^{(1/x)}]/[x^{0.960}].$$

Numbers of *M. arenaria* J2 in soil were significant (>50/100 cm^3 soil) only in plots with peanut irrespective of whether the plots were in P or in P-S. Peanut yields in P-S plots were either no different or were only slightly (3-5%) higher than those from P plots. Soybean yields (Ys) in S plots declined in relation to T according ($R^2 = 0.62^{**}$) to:

$$Ys = 3923.07 - 308.18T$$

where Ys is in kg/ha. Soybean yields in P-S plots were 6-7% higher than in S plots.

Field Evaluation of Polyspecific Nematode Resistance in Soybean

D. B. Weaver, R. Rodríguez-Kábana, and E. L. Carden

Alabama Agricultural Experiment Station
Auburn University, AL

Resistance or tolerance to many different species of plant-parasitic nematodes (polyspecific resistance), particularly *Meloidogyne incognita*, *M. arenaria*, and *Heterodera glycines* is a desirable objective in soybean breeding programs. Often, this requires tests in several locations or separate greenhouse screenings. Field evaluations of advanced experimental breeding lines of soybean were conducted near Elberta, AL during 1987 and 1989 in a field naturally infested with *M. arenaria*, *M. incognita*, and *H. glycines*. Thirty-seven lines in two experiments each year were evaluated along with resistant and susceptible check cultivars for visual appearance (1 = best and 5 = worst) and yield in two-row plots. In 1987, yield ranged from 10.3 to 43.6 bu/A in the late maturity test, with visual ratings from 1.0 to 3.5. Resistant check cultivars all ranked in the upper 50% in yield. In the early maturity test, yield ranged from 9.9 to 33.8 bu/A, with ratings from 1.0 to 4.0. Resistant check cultivars ranked in the upper 25% in yield. Correlations between yield and rating was -0.77** in both experiments. Nematode resistance evaluations in the USDA Preliminary Group Tests in 1988 showed good agreement with previous field performance for the late maturity test, but not for the early maturity test. In 1989, yield ranged from 1.6 to 31.4 and from 1.5 to 30.7 bu/A in the early and late maturity tests, respectively.

LONG-TERM EFFECTS OF SELECTED ROTATIONS WITH SOYBEANS AND CORN ON POPULATIONS OF MELOIDOGYNE ARENARIA

R. Rodríguez-Kábana, C. F. Weaver, D. G. Robertson, and E. L. Carden
Auburn University, Alabama Agricultural Experiment Station, Auburn, Alabama 36849-5409

The value of rotations with corn and soybean cultivars for the management of *Meloidogyne arenaria* was studied for seven years (1983-1989) in a field at the Gulf Coast substation near Fairhope, Baldwin county, Alabama. Rotations of cv. Davis (D) with cv. Braxton (B) or with cv. Foster (F) were compared with rotations of D with one (D-C) or two (D-C-C) years of corn, and with D in monoculture without D(-) and with D(+) nematicide treatment. The nematicide treatment consisted of at-plant application of EDB-90 (1983-1985) or aldicarb (1986-1989). EDB-90 was applied in the row at 19 l/ha using two injectors per row set 20 cm apart to deliver the fumigant to a depth of 20 cm. Aldicarb (Temik 15G) application was in a 20-cm-wide band with the seed furrow in the middle and at a rate of 17 gm a.i./100 m row. The seven-year average yield of D(-) plots (2380 kg/ha; 35.4 bu/A) was 17.5% lower than that of D(+) plots. The D-C rotation had no effect on yield but D-C-C resulted in an average 10% yield increment compared with D(-). The seven-year average yield for the D-B rotation was not different from that for D(-) but plots with D-F yielded 4.5% more than those with D(-). Analysis of soil samples collected 3-6 weeks before soybean harvest indicated that *M. arenaria* juvenile populations were lower in D(+) plots than in those with D(-). The seven-year average number of *M. arenaria* juveniles (100 cm^3 soil) for D(-) was 221 and that for D(+) 93. All rotations but one (D-F) resulted in lower average numbers of *M. arenaria* juveniles than D(-); plots with D-F rotation had higher numbers of juveniles than those with D(-). Juveniles of *Heterodera glycines* (race 3) were detected in low numbers (<15/100 cm^3 soil) first in 1985 and their populations remained low through 1988; however, significant numbers (>100/100 cm^3 soil) were observed in 1989. The highest number of *H. glycines* juveniles in 1989 was in plots with D(+) and the lowest in those with D-F. Soil samples from D-B plots had almost double the number of *H. glycines* juveniles than the D-F plots.

Histopathology of soybean roots inoculated with Fusarium solani and Heterodera glycines. K. S. McLean, K. W. Roy and G. W. Lawrence. Department of Plant Pathology and Weed Science, Mississippi State University.

Scanning electron and light microscopy were used to examine pathogenesis of root tissue and response to the following inoculation treatments: Fusarium solani form A (FSA), Heterodera glycines race 3 (SCN), FSA + SCN, or a nontreated control. Following each treatment tissue was collected from tap roots at 24-hour intervals for 3 weeks, and was prepared for scanning by fixation in 2.5% glutaraldehyde followed by post fixation in osmium tetroxide and dehydration in ethanol. Tissue for light microscopy was fixated in FAA, dehydrated in TBA and embedded in paraplast. Sections 10 µm thick were stained with Johansen's quadruple stain. In the FSA treatment, germinated spores with short germ tubes were found to occur on root surfaces within 24 hours. Hyphae entered roots by direct penetration without forming appressoria. After 48 hours, hyphae were observed growing intercellularly within cortical tissues. Epidermal and cortical cells of the infected area appeared macerated and collapsed. When roots become symptomatic, intracellular hyphae were found within the cortex. Hyphae did not appear to penetrate the endodermis. No reproductive structures were found within infected tissue, although chlamydospores were observed on the surface of infected tissue. In the FSA + SCN treatment, hyphae were found associated with the SCN. Cysts appeared flat and immature. In the SCN treatment, mature SCN cysts appeared healthy and had assumed the typical cyst shape. Control tissue contained no hyphae.