2-1992

Proceedings of the 19th Annual Meeting, Southern Soybean Disease Workers (February 19-20, 1992, St. Louis, Missouri)

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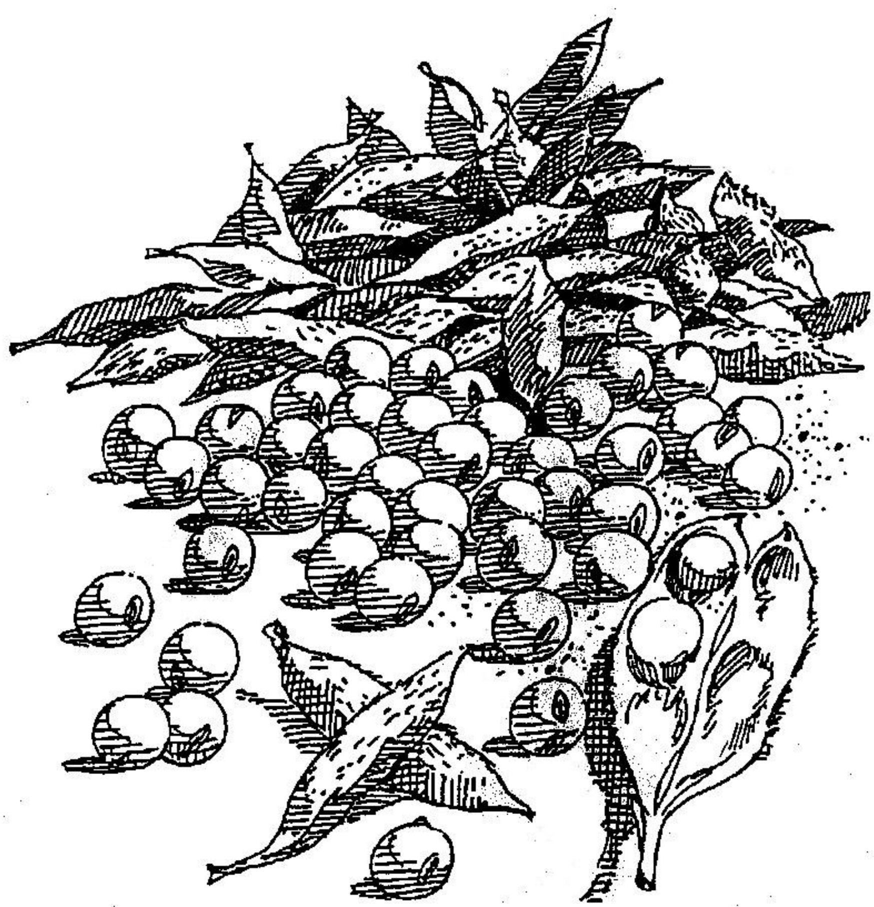
PROCEEDINGS OF THE SOUTHERN SOYBEAN DISEASE WORKERS



19TH ANNUAL MEETING

February 19–20, 1992 | St. Louis, Missouri

PROCEEDINGS OF THE

SOUTHERN SOYBEAN DISEASE WORKERS

NINETEENTH ANNUAL MEETING

FEBRUARY 19-20, 1992

ST. LOUIS, MISSOURI

Tuesday
February 18

- **National Soybean Breeder/ Pathologist Workshop**
- **Steering Committee Meeting**

Wednesday
February 19

- **General Session**
- **Graduate Student Competition**
- **Awards Banquet**

Thursday
February 20

- **Keynote Address**
- **Contributed Paper Session**

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

Glenn R. Bowers, Jr.
Associate Professor, Texas A&M University Agricultural Research & Extension Center
1992 Proceedings Editor and Program Chairman

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S.R. Kendig and J.C. Rupe, Department of Plant Pathology, University of Arkansas, Fayetteville, AR 72701

Charcoal rot of soybeans, caused by *Macrophomina phaseolina* (Tassi) Goid., is the major soilborne disease limiting yields in soybeans stressed by hot, dry weather. The standard control recommendation is to avoid drought stress by proper irrigation. However, it is not known what effect irrigation and irrigation timing have on soybean root colonization by *M. phaseolina*. The effect of irrigation on root colonization was determined on maturity group VI soybean cultivars, Davis and Lloyd, in a field naturally infested with *M. phaseolina* (36 ± 7 microsclerotia/g soil), over three years. Irrigation regimes included; full season irrigation, irrigation until flowering, irrigation initiated at flowering and no irrigation. Plants were removed at several growth stages during the growing season to determine root weight, shoot weight, and numbers of *M. phaseolina* microsclerotia. Irrigation significantly ($P < 0.001$) increased root and shoot weights and yield, and significantly ($P < .0001$) reduced *M. phaseolina* colonization. Root colonization by *M. phaseolina* was significantly greater ($P < 0.05$) in Davis than Lloyd soybeans. Cultivar by irrigation interactions were not observed. Irrigation during vegetative growth significantly reduced root colonization ($P < 0.001$). Termination of irrigation at flowering increased colonization to levels approaching those receiving no irrigation during the study. Prior to reproductive growth, root systems from non-irrigated plots had significantly ($P < 0.01$) greater concentrations of microsclerotia/g in root tissue than those from the irrigated plots. Initiation of irrigation stabilized the concentration of microsclerotia in two years and reduced the concentration in one, due to an increase in root growth. Concentration of microsclerotia in the roots were negatively correlated with shoot weight, root weight and yield. The correlation was greatest in 1990, when precipitation was adequate during reproductive growth. The results of this study reveal that more microsclerotia of *M. phaseolina* are present in drought stressed plants and that preventing drought stress during vegetative growth is just as important in reducing microsclerotia formation as irrigation during reproductive growth.

INFLUENCE OF SOYBEAN PLANTING DATES ON THE INCIDENCE AND SEVERITY OF SUDDEN DEATH SYNDROME

S.S. Alghamdi, P.T. Gibson, and M.A. Shenaut, Southern Illinois University, Carbondale, IL 62901.

Sudden Death Syndrome (SDS) of Soybean is a soilborne disease of recent origin which affects fields with a high yield potential. A study was carried out during the 1987 to 1990 growing season at various locations in Southern Illinois. The objective of the study was to evaluate the incidence and severity of SDS across planting dates on cultivars of four maturity groups. A secondary purpose was to detect a possible interaction of environmental factors on the time of onset and SDS progression. The results at Villa Ridge and Ridgeway, averaged over three years, (five environments) indicated that there was no differences among the four maturity groups for SDS incidence, but specific effects of maturity varied among environments. Further, the means of all maturity groups exhibited reductions in disease incidence (DI) and disease severity (DS) with delayed planting and showed significant differences across planting dates. Generally, plantings after mid-June demonstrated less SDS, but in the Villa Ridge study in 1989, even the July 11 planting resulted in moderate to high incidence of SDS.

In 1990 there was no significant differences detected for the disease rating (DI and DS) across planting dates, with high DI but lower DS than in previous years.

In this study the roles of soil moisture and air and soil temperatures were not clear, but previous observations indicated that wet and cool conditions preceding initial symptoms of SDS seem to promote the disease ontogeny.

THE INTERRELATIONSHIP OF *HETERODERA GLYCINES* AND *FUSARIUM SOLANI* IN SUDDEN DEATH SYNDROME OF SOYBEAN

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Field and greenhouse tests were established to examine the association between the soybean cyst nematode (SCN) and the blue form of *Fusarium solani* (FSA), the causal organism of sudden death syndrome of soybean. Treatments consist of SCN alone, FSA alone, the combination of SCN plus FSA, and an untreated control. Foliar symptoms occurred on more plants per plot, appeared three to five days earlier, and were significantly more severe on plants inoculated with the SCN plus FSA combination compared with FSA alone. An additive relationship was determined between SCN and FSA as measured by yield in the field test and by root-weight reductions in the greenhouse test. In a separate greenhouse test an additional treatment was included in which FSA inoculations were delayed for two weeks after the addition of SCN. Foliar symptom development was not significantly increased when SCN was allowed to develop two weeks prior to the addition of FSA. Foliar symptoms were more severe when both pathogens were added simultaneously. In all tests the SCN life stages of females, males, second stage juveniles, cysts and the number of eggs per cyst were significantly reduced in the presence of FSA.

FROGEYE LEAF SPOT OF SOYBEAN: EVALUATION OF CULTIVARS AND ISOLATES

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One hundred ten public and private cultivars in Maturity Groups (MG) 4, 5, 6, 7, and 8 were evaluated under controlled conditions for reaction to race 5 of *Cercospora sojina*, which causes frogeye leaf spot. Race 5, considered a threat to soybean in the southeastern U.S., was obtained and verified using differentials. Cultivars were divided into three MG classes: 4 and 5, 6 and 7, and 8 for analysis. A completely randomized design with eight replications was used in analyzing the classes, except for the MG 8 cultivars which were replicated four times. The experimental unit was a single pot with three seedlings. Seedlings were inoculated at the V2-V3 growth stage by spraying the adaxial and abaxial leaf surfaces with a conidial suspension (4-6 X 10^4 conidia/ml), using a freon-propelled atomizer. Inoculated plants were placed in a moist chamber for three days, then transferred to a greenhouse bench where they were kept at 25-30 C. Twelve to fourteen days after inoculation, percent area affected was determined on three leaflets per plant. Almost all of the cultivars tested were rated as either resistant (no visible symptoms or small flecks) or susceptible (spreading lesions) based on the observed reaction, which is consistent with the qualitative nature of resistance to frogeye leaf spot in soybean. Differences in disease levels for susceptible cultivars were probably the result of differences in age (developmental stage) of the first or second trifoliate leaf at the time of inoculation. At least 32% of the cultivars were susceptible to race 5; earlier MG classes had a higher proportion of susceptible cultivars. Some entries, such as Centennial and Kirby, showed no disease symptoms, a reaction that is inconsistent with years of field observation. This indicates that there are probably additional races occurring in the Southeast. To identify the races occurring in the Southeast, a set of twenty differentials, utilizing current and ancestral cultivars, was chosen and inoculated with race 5 and single-spore isolates from Alabama, Arkansas, Florida, and Tennessee. Results of these inoculations are being analyzed and will be presented.

SCN RACE SCHEME: A HISTORICAL PERSPECTIVE

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The soybean cyst nematode (SCN) was discovered parasitizing soybeans in the United States in 1954. The first SCN resistant variety in the U.S. was released in 1965. By 1969, resistant varieties were being attacked by SCN in Arkansas, Missouri, North Carolina, Tennessee, and Virginia. In December 1969, a SCN workshop was convened to develop a uniform terminology for the SCN races (previously called physiological strains, biotypes, and variants) attacking the resistant varieties.

The publication "Terminology and identity of infraspecific forms of the soybean cyst nematode (*Heterodera glycines*)" by Golden et al (Plant Disease Reporter 54:544-546) named and characterized four races of SCN on four soybean differential varieties and lines. The numerical designation of the races was based on the chronological order of recognition and the scheme was noted to be "open ended" to permit later expansion as needed. Suggestions were made to deal with variability in the inoculum and testing conditions and the scheme required reproduction on the soybean differentials to be expressed relative to a standard reproductive variety (Lee). Reproduction of less than 10% of that occurring on Lee would be noted as a negative rating and reproduction of more than 10% would be noted as a positive. The 10% breaking point was chosen arbitrarily and was intended to facilitate communication regarding SCN populations differing in their ability to reproduce on a set of soybean differentials.

Race 5 and Race 7 were later characterized and named by nematologists in the Orient. Many SCN populations were characterized by nematologists in the U.S. who chose not to name them. The publication "Complete characterization of the race scheme for *Heterodera glycines*" by Riggs and Schmitt (Journal Nematology 20:392-395) characterized and named the remaining eleven races possible in the SCN race scheme in 1988.

In hindsight, most of the confusion relating to SCN races derives from three points.

1. The adoption of the 10% breaking point for defining resistance and susceptibility without a body of research to establish its validity.
2. The delay in characterizing and naming all races possible in the SCN race scheme.
3. The use of the race terminology without the testing of nematode populations on the standard differentials.

RACES OF *HETERODERA GLYCINES*: A NEMATOLOGICAL PERSPECTIVE

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Heterodera glycines Ichinohe is a fascinating organism in all respects, zoological and phytopathological. One of the sources of the nematode's appeal to nematologists is its adaptability, which is unfortunately also the source of frustration. Because of the enormous economic impact of *H. glycines* on soybean, and the fact that the nematode's adaptability to resistance has economic implications, we have been forced to deal with genetic variability in a prosaic way in order to make recommendations for *H. glycines* management. The problem is not that the race concept is "bad," for it has clearly aided those for whom it was originally intended. The problem is that the race concept has created confusion by limiting rather than expanding understanding of the host-parasite interaction. The 16-race scheme in *H. glycines* is applicable to populations only; it should not be applied to isolates and cannot be applied to individuals. Race designations are not absolute: they do not accommodate either the within-population variability of the nematode, the within-cultivar variability of the soybean, or the interaction between the two, thus conceptual problems arise when the scheme is used for purposes other than classifying *H. glycines* field populations. The *H. glycines*-soybean interaction is genetically complex and unusual, but our understanding is likely to be improved through population and molecular research. Use of the current *H. glycines* race concept should be confined to population classification for management recommendations.

RACES OF *HETERODERA GLYCINES* AND LEVEL OF RESISTANCE IN SOYBEAN CULTIVARS

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The races of soybean cyst nematode (SCN), *Heterodera glycines* in a field are defined on the bases of their reproduction on a set of four host differentials. A field population may have a high frequency of genes for parasitism which enables it to reproduce on a differential, however, it may have other genes in low frequencies. The gene frequencies in a field population would change when selected on a resistant variety under the influence of selection pressure which would consequently change its race designation. Initially, only four races of *Heterodera glycines* were described using Peking, PI 88788, PI 90763 and Pickett. This scheme was expanded to include all 16 possible combinations although several of these races have not been isolated. Since Pickett was derived from Peking, it is very unlikely to have races 11, 12, 13 and 16 as it would require a positive reaction on Peking and a negative reaction on Pickett. Thus, a 16 race scheme is theoretical, nevertheless, in the absence of a better race classification system, it probably can effectively serve as the communication system.

To describe SCN resistance in a cultivar, one of the suggestions has been to relate it as 'Bedford type' or 'Forrest type' depending on the parentage of a cultivar. However, it will be more appropriate to trace it back to the original source of resistance such as PI 88788 or Peking. Similarly, resistance in 'Cordell' and 'Hartwig' could be described as 'PI 90763 type' or 'PI 437654 type'. In this system, it will be necessary to compare the resistance in the derived cultivar with the donor parent as in some cases the full resistance gene complement may not get transferred (eg. Forrest did not get resistance to race 5 from Peking).

At present, soybean lines or cultivars are considered resistant if they have cyst indices below 10%. Several of the commercial cultivars having a cyst-index slightly above 10% may yield good in an SCN infested field. It is generally felt that a strict '10% rule' be modified to include other levels of resistance. A cultivar may be described as 'Resistant', 'Moderately Resistant', 'Moderately Susceptible' or 'Susceptible' based on the cyst indices of below 10%, 10-30%, 31 to 60%, and above 60% respectively. It may also be appropriate to give actual cyst-index figures in addition to the rating. With this system, cultivars such as Bedford, Avery and Fayette with resistance from PI 88788, would be rated moderately resistant to race 4, in addition to being resistant to race 14.

DIFFERENTIATING SOYBEAN RESPONSES TO SOYBEAN CYST NEMATODE RACES

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Differences of opinion exist amount researchers for classifying physiological variation among populations of *Heterodera glycines* Ichinohe, the soybean cyst nematode (SCN) and its ability to reproduce on soybean [Glycine max (L.) Merrill]. SCN populations have been classified into 16 races, but the existing system leaves ambiguity, especially in the characterization of resistance. Two schemes are proposed 1) for classification of SCN races and 2) for characterization of resistance. The 16 race system by Riggs and Schmitt still serves as a basis for differentiating SCN populations. Peking, Pickett, PI90763 and PI88788 will still serve as differentials with the cultivar Lee as the susceptible standard. PI437654 should be added as an additional response parameter because of its expected use in the development of new SCN resistant cultivars. Pure seed stocks of the above should be obtained from the USDA soybean germplasm collection to insure uniform results among researchers. A practical system using a popular resistant cultivar as "type" of resistance is proposed for advisory purposes. "Centennial type" resistance would indicate resistance derived from Peking or Pickett. "Leflore type" resistance could serve as the indicator of resistance from PI88788. Soybean reaction to paratism by the nematode are denoted by four levels of resistance based on percent reproduction of test plants compared to plants of a susceptible cultivar. The levels are as follows: 0 to 9% = resistant, 10 to 30% = moderately resistant, 31 to 60% = moderately susceptible and > 60% = susceptible. These concepts are presented as a guideline for breeders, nematologists, plant pathologists and extension personnel to differentiate soybean response to SCN. It is important that the system evolve to fit needs and changes as they occur.

STRATEGIES FOR IMPROVED SOYBEAN YIELDS AND PROFITS IN THE SOUTHERN US

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Southern soybean acreage and production efficiency have dropped dramatically since 1980. Poor prices, higher costs, and drought-influenced low yields have been major factors. The decline of soybean as a cash crop has had a negative impact on the agricultural economies of most states in the region, especially the Midsouth and Southeast. In January 1991, a 6-month study leave with the American Soybean Association was initiated to assess the southern soybean situation, including pertinent production efficiency research and extension programs, and recommend strategies for improvement. The following is a short summary of conclusions and recommendations.

Based on survey results, the southern soybean producer leader is an older, but well-educated manager of a diversified farm operation. He rents a significant portion of his acreage and spreads management time and capital inputs across many commodities, most of which have a higher per acre value than soybean. He generally doublecrops about half his acreage, and makes yields much higher than the average for his state. New technology, such as drilling and conservation tillage, is incorporated quicker by the producer leader than for average producers.

Southern soybean production efficiency research and extension programs are state-oriented for the most part, even though there are may official regional projects. Duplication of programs has lead to some inefficient use of appropriated and checkoff funds. there is a need for ASA to help forge more interstate cooperative endeavors to address regional or subregional problems. ASA, through SPARC, is encouraged to support long-containment, and environmental issues of the region.

It is recommended that ASA hire a Southern Research Manager to assist ASA Research Director, Dr. Keith Smith, with planning, coordination, and assessment of all southern soybean production efficiency research and extension activities supported with checkoff funds. ASA is strongly encouraged to appoint a Southern Regional Advisory Council, with representation from all segments of the industry, to advise on future directions of production efficiency research and extension programs. In addition, agribusiness should be solicited by ASA to be a contributing partner, with research/extension, in seeking solutions to the problems associated with low profitability of soybeans in the South.

In summary, there is much potential for improved cooperation between state, federal, industry, and producer groups to help solve the problems facing southern soybean production. Within research and extension, more interdisciplinary projects/programs should be initiated with regional or subregional orientation with the objective of improving production efficiency. It is hoped that through these endeavors, yields and profits will increase so that soybean can attain a position of prominence as a cash crop on southern farms.

EVALUATION OF RESISTANCE TO RHIZOCTONIA FOLIAR BLIGHT OF SOYBEAN

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Soybean cultivars were rates for Rhizoctonia Foliar Blight (RFB) caused by natural inoculum over a four-year period (1988-1991). Several resistant and susceptible cultivars were identified. Cultivars in maturity groups VI and VII were more susceptible than cultivars in group V. Variation in levels of resistance to RFB was observed from year to year for several cultivars. Relying on a natural source of inoculum yielded erratic and unreliable results. During 1991, an inoculated plant trial was also conducted. An inoculum suspension of *Rhizoctonia solani* Ag-1 IB, consisting of mycelial fragments and sclerotia, was sprayed with a backpack sprayer onto soybean plants (V8-R3) during the canopy closure period. In general higher levels of RFB were observed on cultivars in the inoculated plant trials than in the uninoculated trials. Cultivars in group V were more susceptible than cultivars in group VI or Vii in the inoculated trial. A significant negative correlation ($p > r = 0.007$) between RFB ratings and plant height was observed in this trial.

A detached leaf inoculation technique was also used to evaluate resistance of soybean cultivars to RFB. Significant correlation ($R^2 = 0.615$, $p > r = 0.0001$) between disease severity on inoculated leaflets in the detached leaf inoculation technique and the RFB ratings in the inoculated plant trial in field were observed. Large scale screening of commercial cultivars could easily be accomplished by inoculating cultivars in the field, and supplementing this information by screening the cultivars using the detached leaf inoculation technique.

FIVE YEARS OF SOYBEAN VARIETY TESTING FOR SDS RESPONSE

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Several hundred soybean (*Glycine max* (L.) Merr.) cultivars, experimental lines, and ancestral parents have been field tested between 1987 and 1991 against soybean sudden death syndrome (SDS, primary causal agent--*Fusarium solani* "Type A") using natural infestation. Test fields were selected based on prior observation of severe and uniform SDS pressure. Entries ranged from MG I to MG VII, with entries grouped by maturity so that all entries in a single trial matured within 10-15 days. SDS disease incidence (DI, 0 to 100% plants in a plot with visible leaf symptoms) and disease severity (DS, 1=mild chlorosis, 5=severe necrosis, 9=plant death) were rated weekly once sufficient leaf symptoms were present until senescence, and combined into a single rating designated as disease index (DX). Developmental stage (R-stage) was also recorded to 0.1 stage at each disease scoring, and DI and DS were standardized to R6 (full pod stage) using linear interpolation. All entries tested have shown some leaf symptoms. All maturity groups contained extremely susceptible genotypes as well as genotypes with minimal symptoms. As a whole, later maturity groups showed more damage than earlier maturity groups, and historical varieties were equal to or slightly worse in SDS response than their modern counterparts. Most genotypes with the least severe SDS symptoms are also resistant to one or more races of soybean cyst nematode (SCN, *Heterodera glycines*), although Ripley, Hamilton, and Asgrow 6785 are notable exceptions. Conversely, Asgrow 5403, resistant to both SCN races 3 & 14, is extremely susceptible, as are the original sources of SCN resistance, Peking, PI 88.788, PI 90.763, and PI 437.654. It appears that SCN resistance is itself generally beneficial, but in some parentages may be linked with negative factors accompanying the SCN resistance. Most genotypes performed consistently, although some seem quite environmentally sensitive, including Fayette and Centennial. Across environment analyses of DX and DI revealed that the genotype x environment (G x E) interaction was highly significant for each maturity group. The G x E variance component was approximately three times the magnitude of the within trial error, and 1/3 to 1 1/3 times the among genotype variance component. Considering all cultivars, DI ranged from near 0 to near 100%, while DX ranged from near 0 to roughly 50. The LSD obtained, assuming 3 environments of testing, was approximately 10-15 for DX, and 15-20 for DI. Of sources which have been widely used for breeding SCN resistance, Bedford and Forrest appear to have transmitted low SDS susceptibility to its progeny most consistently.

EFFECT OF TILLAGE, PLANTING DATE, AND CULTIVAR ON THE SEVERITY OF SUDDEN DEATH SYNDROME, SEPTORIA BROWN SPOT AND DOWNY MILDEW OF SOYBEAN

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The first year of a four year study on the effect of tillage, planting date, and soybean cultivar on diseases of soybean has been completed. A split plot design with 4 replications comprised 3 tillage regimes (disc only, no-till, ridge-till) as main plots, 3 planting dates (May 22, June 18, July 9) as sub plots, and 4 cultivars (Essex, Forrest, Rhodes, and Hartwig) randomized within subplots. Each 8 row plot (30 in spacing) was 20 feet wide and 25 feet long. Symptoms of Septoria brown spot (SBS), downy mildew(DM), and sudden death syndrome (SDS) were the only ones observed on the above ground plant parts.

The severity of SDS was significantly higher in no-till than the other tillage treatments. The incidence of SDS was also significantly greater in the May 22 planting than July 9 planting, whereas, it was significantly lower in Hartwig than the other cultivars. Septoria brown spot severity was significantly lower in no-till than the other tillage treatments, and it was significantly higher in the May 22 planting than the other two planting dates. There was no difference among the cultivars for SBS. The severity of downy mildew was similar among all tillage treatments, however, it was significantly lower in the May 22 planting than the other two planting dates. The severity of DM was significantly lower on Hartwig than the other cultivars.

EFFECTS OF SOYBEAN PLANTING DATE ON SEVERITY OF STEM CANKER

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Seven field plantings of soybeans susceptible to *Diaporthe phaseolorum* var. *caulivora* were made at about 10-day intervals from early May to late June or early July each year during 1988-91 to evaluate the effects of planting date and associated varying environmental conditions on the severity of stem canker. In 1988, stem canker incidence and severity were low but were highest in May 2 and 12 plantings ('J77-339' line). Disease ratings in later plantings were progressively lower. With August drought, yields were highest in May plantings and declined in later plantings in June and early July.

Stands of J77-339 were poor in 1989, and yields were not recorded. However, disease ratings were highest in the first planting on May 1 and declined almost uniformly in plantings made during the remainder of May and in June. In 1990, disease ratings were highest in the first planting on May 10 ('RA 604' cultivar) and were progressively lower in the other six plantings made during May and June. Yields were lowest in the May 10 planting and increased through the sixth planting on June 15.

During 1991, stem canker ratings were again highest in early planting of RA 604 on May 8 and steadily declined in the other six plantings (May 22-July 1). Yields were lowest in the May 8 planting and increased with each subsequent planting date except for the last planting on July 1 when yields declined from the top yields in the fifth and sixth plantings made June 17 and 26. Results obtained over the four-year period indicate that to delay planting until the latter part of the recommended planting period for soybeans could be expected to reduce incidence and severity of stem canker and possibly increase yields of susceptible cultivars.

COMPARATIVE VIRULENCE OF STEM CANKER ISOLATES FROM SOUTHERN SOYBEAN GROWING AREAS

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Six soybean cultivars were inoculated with toothpicks infested with thirty-five different isolates of the stem canker (*Diaporthe phaseolorum var. caulivora*) fungus collected from Mississippi, Tennessee, Arkansas, Alabama, Georgia, and Florida. Four, fifteen plant replicates of five different soybean cultivars (Tracy M and Hutchinson which are resistant, Asgrow 6785, Pioneer 9642, and Centennial which are intermediate in reaction and J77-339 which is very susceptible to stem canker) were inoculated five weeks after planting with the different isolates. Average lesion length in centimeters was 0 for Hutchinson and Tracy M, 5.51 for Centennial, 9.40 for Asgrow 6785, 9.54 for Pioneer 9641 and 21.99 for J77-399. Average lesion length in centimeters for the different isolates ranged from a low of 2.2 for MS 84-23 to a high of 26.5 of isolate TN-4. None of the isolates were pathogenic on the resistant cultivars Hutchinson or Tracy M. Approximately 15% of the isolates were more virulent than the most virulent isolate from Mississippi in 1988. Observations suggest that there has been a gradual shift toward greater virulence. This may be in response to selection pressure from growing more resistant varieties. Cultivars now considered moderately resistant may become susceptible within a few years. There were large differences in stem canker isolate virulence. However, the near immune reaction of Tracy M and Hutchinson appears not to be affected by the more virulent isolates. The cultivar Centennial was significantly more resistant to the different isolates. Therefore, it appears that there are different levels of resistance to stem canker in cultivars which are rated MR to MS.

EFFECTS OF A LOW RATE OF ALDICARB ON SOYBEAN CANOPY DEVELOPMENT AND YIELD, WEED AND INSECT POPULATIONS IN *HETERODERA GLYCINES*-INFESTED FIELDS

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Field experiments conducted from 1989 to 1991 focused on potential interactions of insects and weeds as influenced by a low rate of aldicarb (5.60 kg ha^{-1} of Temik 15G, in furrow application) in the presence of *Heterodera glycines*. A split-split plot experimental design was used with whole plots as aldicarb treatments, sub-plots designed to manipulate weed population densities and sub sub-plots to manage insects. The sites were planted without pre-emergence herbicides, and post-emergence herbicides were utilized to restrict weed population densities as desired. Plots were cultivated after post-emergence herbicide treatments to encourage weed germination. Effects of aldicarb on early season reproduction of *H. glycines* were determined by counting the white cysts per three plants 28 days after planting. Aldicarb treatment resulted in soybean yield increases of 2.4, 1.5 and 3.0 bu/acre in 1989 through 1991, respectively. Numbers of SCN females per three-root systems were less in aldicarb-treated plots in 1989 and 1991, but not in 1990. Approximately 75% control was achieved in a loamy soil in 1991 with 90 cysts per three plants in treated plots versus 366 for three plants in untreated controls. Numbers of corn earworm larvae were greater ($P = 0.05$) in untreated plots than in aldicarb treated plots in 1989 and 1991. Weed population densities were greatest ($P = 0.05$) in untreated plots in 1991. Aldicarb treatment resulted in increased plant height, canopy width, and number of nodes per soybean plant. The increased canopy growth resulted in lower weed and corn earworm population densities in aldicarb treated plots as compared to the controls. The data indicate that control of soybean cyst nematode can restrict insect- and weed-pest pressure on soybean.

EFFECT OF SOYBEAN CYST NEMATODE ON SOYBEAN ISOLINES DIFFERING FOR MATURITY

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Soybean (*Glycine max*) cv 'Clark' and three isolines differing for maturity were grown in the presence of four levels of soybean cyst nematode (SCN), *Heterodera glycines*, for study of the effect of SCN on soybean growth and yield components. The experiment was conducted in fiberglass field microplots enclosing 1 m^2 surface area and extending 0.6 m below the soil surface. The isolines were: e_2, 10 days earlier than Clark; E_1e_3, 10 days later than Clark; and E_1, 20 days later than Clark. Average initial populations (Pi) for the four SCN treatments were 149 (low, L), 1534 (medium low, ML), 6391 (medium high, MH), and 12,147 (high, H) eggs/100 cm^3 soil. All growth and yield components differed among isolines, but isoline x Pi interactions were not observed. Seed yields over all isolines were 296, 241, 208, and 156 g m^{-2} for the L, ML, MH, and H Pi, respectively. Yield components were calculated on a per plant basis, and included pod number, seed number, and seed size. Of these, only number of pods $plant^{-1}$ was affected by SCN, with the number of pods decreasing with increased Pi. This effect was observed particularly on branches; number of branches and number of seed $branch^{-1}$ were reduced about 50% by the H Pi treatment. Orthogonal contrasts were constructed to extract the regression components of Pi effects calculated over the $\log_{10}$Pi for the L, ML, and H Pi (MH was excluded to obtain equally spaced independent variables). Highly significant linear effects due to Pi were detected over all isolines for number of days flowering, plant height at R1 and R5, change in plant height from R1 to R5, plant growth rate, number of branches, number of barren nodes, seed yield, number of pods, and number of flowers. No quadratic effects were detected. Flower abscission percentage was not affected by SCN treatment and averaged 66% for all Pi, thus the reduced pod number was due to reduced flower production and not to increased abscission.

EFFECT OF REPEATED APPLICATION OF SELECTED HERBICIDES AND NEMATICIDES/INSECTICIDES ON SOYBEAN CYST NEMATODE DENSITY

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Our research was designed to identify microorganisms responsible for accelerated pesticide degradation and microorganisms that may inhibit soybean cyst nematode (*Heterodera glycines* Ichinohe) growth and development. In 1981, Felsot et al. isolated from soil a *Pseudomonas* sp. that was able to degrade carbofuran in culture, and in 1984, Lee isolated and identified several soil fungi and bacteria capable of degrading EPTC. However, little research has been directed toward the isolation and identification of microbial degraders associated with pesticides used in soybean [*Glycine max* (L.) Merr.] production. The initial step in looking for pesticide-induced suppression of soybean cyst nematode is to determine the effects of these pesticides on nematodes under field conditions.

Our research was conducted in field plots at the University of Missouri Delta Center, Portageville, Missouri. Treatments included the soil pesticides tefluthrin (Force), carbofuran (Furadan), thiodicarb (Larvin), alachlor (Lasso), ethoprop (Mocap), imazaquin (Scepter), metribuzin (Sencor), and trifluralin (Treflan). These pesticides were applied to the same plots at the recommended rate for the past three years to condition the soil and enhance biodegradation. The experimental design was a split block, with four replications. Plots were treated early to late June, planted late June to early July to Essex soybean, and harvested early November. Field work was delayed in 1991 because of excessive rain in May and June. Soil samples (2.5 cm x 30 cm, 8 probes per plot) were collected three times during the growing season. Yields were collected with a small plot combine from the two center rows, and yield was adjusted to 13% moisture.

A semi-automatic elutriator was used to extract soybean cyst nematodes. Cysts were crushed to release eggs, and the eggs were stained before enumeration. In 1990, the second year of the trial, soybean cyst nematode egg density at planting ranged from not detected to 1456 eggs/100 cm^3 of soil. In 1991, densities ranged from 23 to 773 eggs/100 cm^3 of soil. At harvest in 1990, densities ranged from not detected to 20,216 eggs/100 cm^3 of soil; and in 1991, densities at harvest ranged from 846 to 4080 eggs/100 cm^3 of soil. In 1990, herbicide treatments (no nematicide/insecticides) resulted in higher soybean cyst nematode reproduction when compared with no pesticide treatment; this pattern was not seen in 1991. As expected, the highest nematode reproduction was observed in plots with the lowest initial soybean cyst nematode density.

The highest yield in 1991 was observed in plots with soybean cyst nematode density of approximately 200 eggs/100 cm^3 of soil, with the exception of the thiodicarb + alachlor treatment. In 1990, yields ranged from 18.3 to 65.5 bu/A and in 1991, yield ranged from 60.1 to 102.6 bu/A.

Felsot et al. 1981. Bull. Environ. Contam. Toxicol. 26:781-783.
Lee, A. 1984. Soil Biol. Biochem. 16: 529-531.
Reed, J.P. 1986. M.S. Thesis. Univ. of MO, Columbia, MO 65211.

SOUTHERN UNITED STATES SOYBEAN DISEASE LOSS ESTIMATE FOR 1991

Southern Soybean Disease Workers, Soybean Disease Loss Estimate Committee: Compiled by G.L. Sciumbato and D.L. Turnage, Delta Research And Extension Center, Mississippi Agricultural and Forestry Experiment Station, Stoneville, Mississippi.

ABSTRACT

In 1991, soybean yield losses due to diseases were about normal. The crop loss estimate from all pathogens in 1991 was 12.6 percent. This resulted in a 66,520,000 bushel loss worth 382,490,000 dollars.

Soybeans and soybean products continue to be a very important southern agricultural commodity. In 1991, 461,152,103 bushels were harvested from 17,055,00 acres. Average yields of each southern state in 1991 were as follows: Alabama 23 bushels/acre, Arkansas 27 bushels/acre, Delaware 31 bushels/acre, Florida 26 bushels/acre, Georgia 26 bushels/acre, Kentucky 30 bushels/acre, Louisiana 25 bushels/acre, Maryland 31 bushels/acre, Mississippi 24 bushels/acre, Missouri 29 bushels/acre, North Carolina 26 bushels/acre, Oklahoma 20 bushels/acre, South Carolina 22 bushels/acre, Tennessee 26 bushels/acre, Texas 28 bushels/acre and Virginia 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 for 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, research plots, 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, total production and production lost to disease are calculated on a cost of $5.75 per bushel times the estimated loss.

RESULTS AND DISCUSSION

Soybean planting in some areas was delayed in 1991 because of excessive rainfall. Nematodes are estimated to have reduced yields by 24.91 million bushels worth $143.23 million dollars. Soil diseases are estimated to have reduced yields by 20.44 million bushels worth $117.54 million dollars. Foliage, pod, and stem diseases are estimated to have reduced yields by 21.17 million bushels worth $121.72 million dollars. At the established average annual price received by southern soybean growers of $5.75 a bushel, the 66.52 million bushel loss due to diseases cost growers an estimated $382.49 million dollars.

Total average percent soybean disease loss in the southern states in 1991 is estimated at 12.6. Florida reported the highest disease loss at 32.5 percent.
States reporting disease losses of 10 percent or over were Arkansas (19.23), Florida (32.5), Georgia (10.0), Louisiana (18.0), Missouri (11.54), North Carolina (16.11), South Carolina (15.71), Tennessee (12.92) and Texas (11.77).

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 1991 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	.2	.5	TR**	5.0	--	.2	1.0	--	.3	1.0	.1	.3	.2	2.5	.3	.2	.73
Root & Stem rots	.3	.6	TR	10.0	--	.2	1.0	--	.18	1.5	.3	.3	1.5	1.0	2.0	.1	1.18
Diaporthe-pod & stem blight	.5	2.0	TR	1.0	.5	1.8	2.0	.16	1.03	--	.2	1.5	1.0	.01	3.0	.4	.94
Charcoal rot	.2	3.7	.5	TR	--	2.0	.5	.1	3.4	2.5	.1	2.6	.05	2.0	.3	TR	1.12
Sudden death syndrome	.1	2.0	--	--	--	TR	--	--	TR	.01	--	--	--	.75	--	--	.17
Stem canker	.1	.3	--	--	--	TR	.5	--	.06	--	--	--	.01	.5	.1	--	.09
Anthracnose	1.2	1.4	TR	2.0	--	.3	1.0	.1	.79	.01	.01	1.5	1.5	1.0	5.0	.1	.99
Downy mildew	.3	.2	--	TR	--	TR	TR	--	TR	TR	TR	TR	.1	.1	--	TR	.04
Cercospora-purple seed stain and blight	.2	2.1	--	1.0	.75	.1	1.0	TR	.55	.01	.1	1.0	.5	.01	.5	.1	.49
Brown leaf spot	.5	.12	--	TR	.75	.5	TR	.03	.06	TR	.2	TR	.2	1.25	.1	.1	.23
Foliar diseases others	.5	2.2	--	--	.25	--	3.0	--	.11	.5	TR	.5	.5	.2	.3	--	.50
Bacterial diseases	.1	.7	--	--	--	TR	TR	--	TR	TR	--	TR	.05	--	--	--	.05
Virus diseases	.1	.01	.5	--	2.5	.1	TR	--	TR	.01	.6	TR	.1	--	.05	.2	.26
Soybean Cyst nematodes	2.0	2.5	4.0	1.5	1.75	2.3	4.0	7.0	.04	6.0	7.0	.7	3.0	3.5	.01	4.0	3.08
Root-knot nematodes ecto-parasitiac types	1.0	.5	2.0	12.0	3.5	--	4.0	1.5	.04	TR	1.5	.5	7.0	.1	.01	1.0	2.16
Other diseases***	1.0	.4	--	--	--	--	TR	--	TR	--	6.0	--	--	--	.1	.6	.50
Total Percent Loss*	8.3	19.23	7.0	32.5	10.0	7.5	18.0	8.89	6.56	11.54	16.11	8.9	15.71	12.92	11.77	6.8	12.60

* Rounding errors present.

** TR = Trace

*** Other diseases or yield loss include southern stem rot (VA), red crown rot (VA) and loss due to ozone damage (NC).

Table 2. Estimated reduction of soybean yields in 1991 to disease.

BUSHEL LOSS X 10^6 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	.02	.5	TR	.07	--	.07	.27	--	.14	1.44	.04	.01	.03	.77	.02	.03	3.41	19.61
Root & Stem rots	.03	.6	TR	.14	--	.07	.27	--	.08	2.16	.12	.01	.24	.31	.11	.02	4.16	23.92
Diaporthe-pod & stem blight	.05	2.0	TR	.01	.09	.66	.53	.03	.47	--	.08	.07	.16	.003	.17	.07	4.39	25.24
Charcoal rot	.02	3.7	.04	TR	--	.73	.13	.02	1.57	3.60	.04	.12	.01	.62	.02	TR	10.62	61.07
Sudden death syndrome	.01	2.0	--	--	--	TR	--	--	TR	.01	--	--	--	.23	--	--	2.25	12.94
Stem canker	.01	.3	--	--	--	TR	.13	--	.03	--	--	--	.002	.15	.006	--	.63	3.62
Anthracnose	.11	1.4	TR	.03	--	.11	.27	.02	.36	.01	.004	.07	.24	.31	.28	.02	3.23	18.57
Downy mildew	.03	.2	--	TR	--	TR	TR	--	TR	TR	TR	TR	.02	.03	--	TR	.28	1.61
Cercospora-purple seed stain and blight	.02	2.1	--	.01	.13	.04	.27	TR	.25	.01	.04	.05	.08	.003	.03	.02	3.05	17.54
Brown leaf spot	.05	.12	--	TR	.13	.18	TR	.01	.02	TR	.08	TR	.03	.39	.006	.02	1.04	5.98
Foliar diseases others	.05	2.2	--	--	.04	--	.80	--	.05	.72	TR	.02	.08	.06	.02	--	4.04	23.23
Bacterial diseases	.01	.7	--	--	--	TR	TR	--	TR	TR	--	TR	.01	--	--	--	.72	4.14
Virus diseases	.01	.01	.04	--	.44	.04	TR	--	TR	.01	.24	TR	.02	--	.003	.03	.84	4.83
Soybean Cyst nematodes	.18	2.49	.33	.02	.31	.84	1.06	1.18	.02	8.64	2.75	.03	.49	1.08	.001	.66	20.08	115.46
Root-knot nematodes ecto-parasitiac types	.09	.5	.17	.17	.62	--	1.06	.25	.02	TR	.59	.02	1.14	.03	.001	.17	4.83	27.77
Other diseases	.09	.4	--	--	--	--	TR	--	TR	--	2.35	--	--	--	.006	.10	2.95	16.96
Total Disease Loss***	.76	19.19	.58	.45	1.77	2.73	4.78	1.50	3.02	16.61	6.32	.41	2.56	3.98	.66	1.12	66.52	
Dollar loss x 10^6**	4.37	110.34	3.34	2.59	10.18	15.70	27.49	8.63	17.37	95.51	36.34	2.36	14.72	22.89	3.80	6.44		382.49

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

** Dollar loss = estimated loss x 5.75/bushel.

*** Rounding errors present.

Table 3. Southern states soybean disease loss estimate in bushels-dollars - 1991.

DISEASE	BUSHEL LOSS x 10^6*	DOLLAR LOSS x 10^6**
Soil		
Seedling	3.41	19.61
Root and lower stem rots	4.16	23.92
Charcoal rot	10.62	61.07
Sudden death syndrome	2.25	12.94
SUBTOTAL	20.44	117.54
Nematodes		
Cyst nematodes	20.08	115.46
Root-knot and other nematodes	4.83	27.77
SUBTOTAL	24.91	143.23
Foliage		
Diaporthe Pod and stem blight	4.39	25.24
Stem canker	.63	3.62
Anthracnose	3.23	18.57
Downy mildew	.28	1.61
Cercospora	3.05	17.54
Brown leaf spot	1.04	5.98
Bacterial diseases	.72	4.14
Other foliar fungi	4.04	23.23
Virus	.84	4.83
Others	2.95	16.96
SUBTOTAL	21.17	121.72
TOTAL	66.52***	382.49***

* 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 $5.75/bushel.

*** Rounding errors present.

SSDW TREASURERS REPORT
12/31/1990 TO 12/31/1991

OPERATIONAL ACCOUNT
1ST NATL. BANK OF OPELIKA

BALANCE ON 12/31/1990..............................$ 7,313.60

RECEIPTS FROM 12/31/1990 TO 12/31/91

INTEREST ON OPERATIONAL ACCOUNT ....$	444.97
PUBLICATION REVENUES ....$	189.00
1990 MEETING RECEIPTS ....$	4798.00
AND HOSPITALITY CONTRIBUTIONS......................$	450.00
STANDARDIZED SEED TREATMENT RECEIPTS...............$	16000.00
TOTAL RECEIPTS AS OF 12/31/1991 ....$	21881.97

DISBURSEMENTS FROM 12/31/90 TO 12/31/91

SSDW PRINTING COSTS ....$	595.28
POSTAGE AND MAIL ROOM FEES ....$	436.25
SECRETARIAL FEES ....$	56.00
SSDW MEETING EXPENSES ....$	4695.89
STUDENT AWARDS ....$	400.00
MEETING AWARDS ....$	208.40
CPA FEES ....$	325.00
BANKING CHARGES ....$	1.00
TOTAL DISBURSEMENTS AS OF 12/31/1991 ....$	6717.82

SSDW ASSEST AS OF 12/31/1991

TOTAL 1991 REVENUES ....$	21,881.97
BALANCE OF OPERATIONAL ACCOUNT ON 12/31/1990 .....$	7,313.60
TOTAL DISBURSEMENTS FOR 1990 OPERATING YEAR ....- $	6,717.82
NET ASSESTS OF SSDW AS OF 12/31/1991 $	22,477.75
BANK BALANCE AS OF 12/31/1991 $	22,477.75

-- 12/31/1991

GLENN G. HAMMES TREASURER SSDW

SOUTHERN SOYBEAN DISEASE WORKERS

1990-1991 COMMITTEE CHAIRMEN

Audit:	Phillip Pratt Oklahoma State University
Awards:	Patrick D. Colyer Louisiana State University
Disease Loss:	Gabe Sciumbato Mississippi State University
Disease Resistance:	John Rupe University of Arkansas
Educational Resources:	Patrick D. Colyer Louisiana State University
Foliar Disease:	***
Graduate Student Papers:	Johnny Snow Louisiana State University
Hospitality:	Chip Graham Gustafson
Local Arrangements:	J. Allen Wrather University of Missouri
Nematology:	Terry Niblack University of Missouri
Nominations:	Donald E. Hershmann University of Kentucky
Program:	Glenn R. Bowers, Jr. Texas A&M University
Public Relations:	Melvin Newman University of Tennessee
Seed Pathology:	William S. Gazaway Auburn University
Site Selection:	Phillip Pratt Oklahoma State University
Steering:	J. Allen Wrather University of Missouri

SOUTHERN SOYBEAN DISEASE WORKERS

1991 AWARD RECIPIENTS

Past President Award	Donald E. Hershmann University of Kentucky
Distinguished Service Award	
Junior Award	Terry L. Niblack University of Missouri
Senior Award	Gabe Sciumbato Mississippi State University
Graduate Student Awards	
1st Place	W.J. Matthews Southern Illinois University
2nd Place	F.G. Baker