3-1993

# Proceedings of the 20th Annual Meeting, Southern Soybean Disease Workers (March 28-30, 1993, Fort Walton Beach, Florida)

Patrick D. Colyer
*Louisiana Agricultural Experiment Station*

Glenn R. Bowers Jr.
*Texas A & M University*

John C. Rupe
*University of Arkansas*

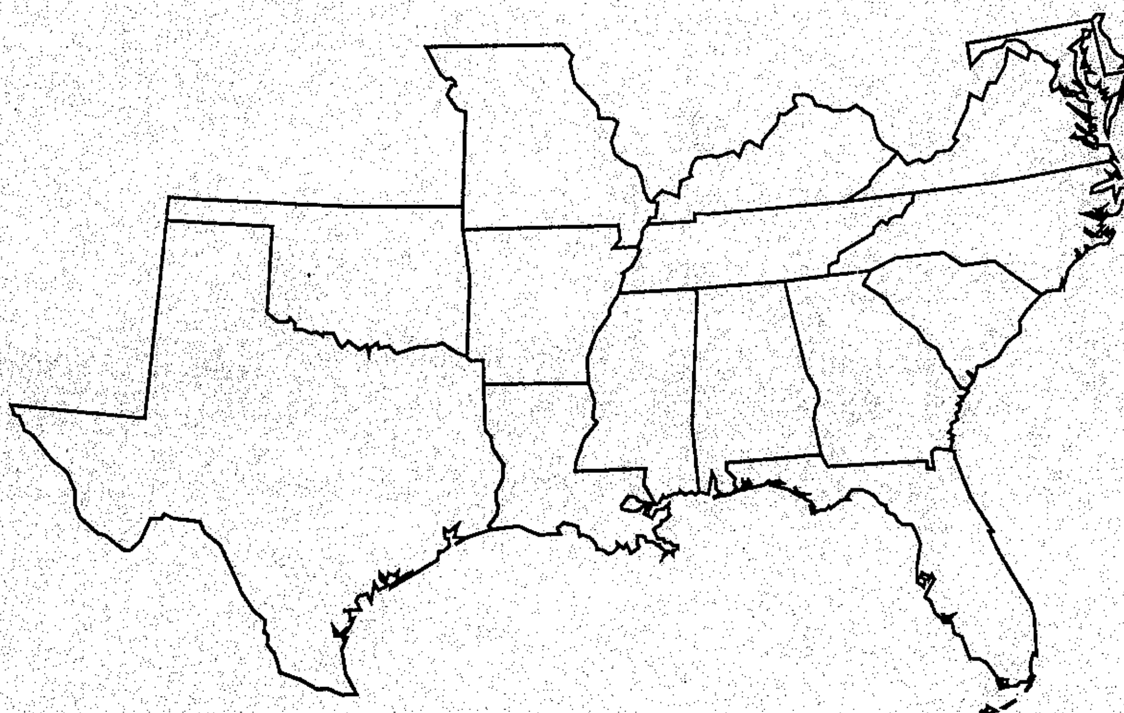
Brian M. Anderson
*Pioneer Hi-Bred*

Glenn G. Hammes
*DuPont*

# PROCEEDINGS

*of the*

# SOUTHERN SOYBEAN DISEASE WORKERS



## Twentieth Annual Meeting
## March 28-30, 1993
## Fort Walton Beach, Florida

# PROCEEDINGS OF THE

# SOUTHERN SOYBEAN DISEASE WORKERS

# TWENTIETH ANNUAL MEETING

## MARCH 28-30, 1993

## FORT WALTON BEACH, FLORIDA

| Sunday<br>March 28 | Monday<br>March 29 | Thursday<br>March 30 |
|---|---|---|
| Workshop-Communicating with Soybean Producers | Symposium-Sustainable Agriculture | Contributed Paper Session |
| Steering Committee Meeting | Graduate Student Competition | |
| | Business Meeting | |
| | Awards Banquet | |

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



John C. Rupe
Associate Professor, University of Arkansas
1993 Proceedings Editor and Program Chairman

## SOUTHERN SOYBEAN DISEASE WORKERS 1992-1993 OFFICERS

Patrick D. Colyer, President

Glenn R. Bowers, Jr., President Elect

John C. Rupe, Vice President

[redacted] Brian M. Anderson, Secretary

Glenn Hammes, Treasurer

## 1992-1993 PROGRAM COMMITTEE:

John C. Rupe,-Chair, University of Arkansas; Patrick D. Colyer, Louisiana Agricultural Experiment Station; Glenn R. Bowers, Jr., Texas A&M University; Brain M. Anderson, Pioneer Hi-Bred; Glenn Hammes, DuPont, Phillip Pratt, Oklahoma State University; Gabe Sciumbato, Mississippi State University; Johnny Snow, Louisiana State University; Chip Graham, Gustafson; Terry Niblack, University of Missouri; Donald E. Hershman, University of Kentucky; Melvin Newman, University of Tennessee; William S. Gazaway, Auburn University; Joe Fox, Mississippi State University.

## TABLE OF CONTENTS

### SUSTAINABLE AGRICULTURE SYMPOSIUM



### GRADUATE STUDENT COMPETITION



### CONTRIBUTED PAPERS

# Sustainable Agriculture and the Soybean Industry: Building a Winning Strategy

Dixon D. Hubbard and Michael S. Fitzner[1]

Even in today's "post-industrial economy" more than 16 percent of America's Gross National Product (GNP) comes from the soil. The fact remains that U.S. agriculture is still an economic powerhouse that is larger than the U.S. defense or health care industries. By virtue of both technology and global markets, agriculture has the opportunity to become one of the fastest-growing value-added segments of the American economy—exceeding the growth of the health care, manufacturing, or financial services industries. While it is naive to think of the nation's economic future as "neo-agrarian", it would be just as foolish to think of agriculture as a shrinking relic of our past.

U.S. agriculture has attained impressive gains in productivity through highly specialized capital and chemical intensive production systems. The agricultural industry has provided the United States with an abundant and economical supply of food, has contributed to its international balance of payments, and has produced enough surplus to contribute food aid throughout the world. U.S. agriculture has been extremely effective in exploiting technologies that maximize the productivity of the land. However, it has not been as successful in protecting our environment and adding market value to agricultural products.

## New Organizing Principles

Two new organizing principles are currently struggling for the soul of U.S. agriculture. However, it is still unclear whether these two principles can be successfully merged in a way that will lead to an even more successful agricultural industry, or whether they will become opposing forces. It is likely that debates over agricultural policy in the United States will be dominated by attempts to balance these two forces over the next one or two decades.

Principle One: **Exploitation of innovation opportunities.** New and emerging technologies, particularly genetic engineering and other biotechnologies, will result in tremendous increases in agricultural productivity and global marketing opportunities. History has demonstrated that many agricultural innovations enjoy tremendous economies of scale. For this reason, it is likely that the real costs of developing new technological innovations for agriculture will consistently drop as these new technologies are implemented on a large scale.

Principle Two: **Establishment of sustainable agricultural systems.** Sustainable agricultural practices will permit U.S. agriculture to maintain its status as an economic powerhouse over an extended period of time. Strong proponents of this principle argue that the importance of exploiting economic opportunities created by new and emerging technologies must be carefully balanced against their environmental costs. Agricultural production, like virtually all of man's activities, has a negative impact on our environment. The challenge facing the

[1]Manager, Competitiveness of American Agriculture Initiative and National Program Leader, Integrated Pest Management, respectively, Extension Service, U.S. Department of Agriculture, Washington, D.C.

agricultural industry is to balance productivity and profitability with environmental impacts maintained at socially acceptable levels. Agriculture, along with every other industry, must continue to search for sustainable methods of doing business.

The impact of these two organizing principles on U.S agriculture should become more apparent over the next decade. The question is whether profitable new agri-niches can be established in isolation from environmental and social acceptability concerns or whether these concerns will dictate the future of technological and market innovation—and of U.S. agriculture. Regardless of how those questions are answered, the fact remains that U.S. agriculture will have as big an impact on American competitiveness as any industry dreamed-up by entrepreneurs and venture capitalists. But can rural America capitalize on the economic opportunities created by future agricultural development? Unfortunately, past experience indicates that rural America is unlikely to benefit from agricultural development. To avoid repeating history, we must ensure that rural communities are aware of these opportunities and have access to the new and emerging technologies that will permit them to participate in the global marketplace.

## Evolution of a Sustainable Agricultural Industry

How does this fit into the agenda of the Southern Soybean Disease Workers? If you are committed to helping agriculture and rural America compete in a global environment—where competition for business, information, and technology is fierce—you need to ensure that your research and extension efforts are focused in ways that contribute to the development of a winning strategy.

There are several definitions of "strategy". The one that best fits our use here is: An adaptation or complex of adaptations that serves an important function in the achievement of evolutionary success. It is important to recognize that the concept of sustainability is evolutionary, not revolutionary. Revolution is "a sudden, radical, or complete change." Rather, the development of sustainable agriculture is a gradual change from production systems characterized by a single goal (e.g., profitability) to more complex systems that include social and environmental goals. There is no road map to guide us through this process—we will have to work the details out as we go.

One of the key elements in current sustainable agriculture strategies is building quality people involvement into the process of problem identification, program development, and program delivery. This is the key to effectively addressing public issues and solving real problems, whether we are addressing agricultural issues or any other issues on the social agenda. This is the reason public officials at all levels are implementing open communication processes that are linked to the appropriations process. This new way of doing business means that when an agricultural stakeholder—an individual or an organization—identifies a problem or opportunity confronting the industry, that stakeholder cannot successfully attract public sector support without building quality people involvement into the process; programs developed independently by a single individual or organization will be less likely to successfully attract public support. In fact, failure to involve all appropriate stakeholders in program development and implementation will 1) greatly reduce the potential for obtaining funding increases (this was one reason funding for the National Research Initiative was not increased in the 1993 Agriculture appropriations bill) and 2) frequently doom outstanding programs to mediocrity or failure. If we are truly interested in helping agriculture and rural America develop sustainable agricultural systems, all stakeholders must be involved in devising solutions to the problems and capitalizing on the opportunities. Levels of cooperation and coordination well beyond those reached in the past must be achieved in the future if U.S. agriculture is going to successfully maintain its status as an economic powerhouse. Farmers, environmentalist, conservationists, consumers, agricultural input suppliers, and urban and non-farm rural residents frequently differ in their assessment of how the economic, environmental, and social criteria should be balanced in a sustainable agricultural system. Therefore, development and implementation of successful sustainable agricultural systems will require quality people involvement that leads to informed public compromise negotiated through the political process.

## Quality Involvement, Compromise, and the Legislative Process

Subtitle B of Title XVI of the *Food, Agriculture, Conservation and Trade Act of 1990* "Sustainable Agriculture Research and Education" (SARE) is a good example of how public compromise is negotiated through the political process. This legislation replaced the 1985 "Agriculture Productivity Act" which became known as Low Input Sustainable Agriculture (LISA). In 1990, LISA supporters broadened the scope of their legislation and added a new chapter on training and education. This legislation moved smoothly through Congress until very late in the legislative process. Commercial agriculture spotted two key elements of this legislation they had been trying to achieve for over a decade through integrated management systems legislation. These two key elements were 1) an integrated systems approach to problem solving and 2) a place at the table (quality involvement) when decisions are made relative to funding agricultural research and education programs and projects.

Commercial agriculture representatives liked several elements of SARE, but they initially did not want to be associated with the sustainable agriculture movement. For this reason they pushed for separate legislation to fund integrated management systems research and education. However, when it became apparent that their efforts to achieve separate legislation had failed, they merged their legislation with the LISA legislation. The resulting legislation contains three chapters. The original LISA legislation became Chapter I and is titled "Best Utilization of Biological Applications" (BUBA). The integrated management systems legislation became Chapter II and is titled "Integrated Management Systems" (IMS). Chapter III, the final chapter of the legislation, is titled "Sustainable Agriculture Technology Development and Transfer Programs."

Rather than pleasing all of their constituents by passing separate legislation to satisfy both sides in the debate, Congress created a fire storm around this legislation very late in the legislative process. As a result, it was not able to achieve compromise on the SARE legislation. However, knowing that they were obligated to pass sustainable agriculture legislation in one form or another, they passed SARE without compromise and authorized $80 million for implementation. In essence Congress solved their problem by passing uncompromised legislation, but they saddled the USDA Cooperative State Research Service (CSRS) and the USDA Extension Service (ES) with implementation of the bill.

As far as anyone could remember, SARE was the first uncompromised legislation that had ever been sent to USDA for implementation. In fact, no one could remember Congress ever passing uncompromised legislation of any kind. As a result of the unusual nature of the SARE authorization, nearly a year of facilitated discussions were required before CSRS, ES and all of the legislation's stakeholders were able to develop guidelines for implementation. In the final analysis, the SARE guidelines that emerged did not fully please any of the stakeholders, but the basic elements were acceptable to everyone. All of the stakeholders agreed not to interfere with the efforts of separate groups to seek funding for either Chapter I or Chapter II. Perhaps most surprising, however, was the coalition of 27 of these organizations—from both sides of the fence—that joined forces to push for full funding for Chapter III of the legislation.

The point of this story is that the era of unshared decision making is rapidly disappearing. The quality people involvement and compromise behind the SARE legislation is not an exception to the rule, it is the reality of the future. The driving force behind the changes that have occurred in the decision-making process is the public's desire to balance economic competitiveness and environmental soundness in socially acceptable ways. Agriculture is only one of the many industries that has been impacted by this change in the decision making process.

## Definition and Classification of Sustainable Agriculture

An important feature of the SARE legislation is that Congress provides its definition of sustainable agriculture. In this legislation, Congress defines sustainable agriculture as

> "an integrated system of plant and animal production practices having a site-specific application that will, over the long-term— (A) satisfy human food and fiber needs; (B) enhance environmental quality and the natural resource base upon which the agriculture economy depends; (C) make the most efficient use of nonrenewable resources and on-farm resources and integrate, where appropriate, natural biological cycles and controls; (D) sustain the economic viability of farm operations; and (E) enhance the quality of life for farmers/ranches and society as a whole."

In reality, Congress has provided a conceptual framework for sustainable agriculture rather than a definition. This creates a problem for anyone who tries to develop sustainable agriculture research and education programs and projects. It is difficult for a researcher or educator to determine whether their work can be classified as "sustainable" based on Congress' definition alone. To assist in this process, CSRS, ES, and the USDA Agriculture Research Service (ARS) developed a classification instrument called the "Sustainable Agriculture Relevancy Classification Form". This instrument measures the sustainable relevancy of a project against seven criteria derived from Congress' definition of sustainable agriculture. All ARS research projects are now classified with this instrument, CSRS is preparing to classify each of its more than 3,000 research projects, and ES—along with its

State partners in the Cooperative Extension System—is now developing procedures that will be used to classify the sustainable relevancy of its agricultural extension projects.

The problem in designing a classification system is that it is difficult to define sustainable agriculture based on specific practices and methods. There are an array of methods and practices that can be blended together to produce a sustainable agriculture system. We should not be reluctant to borrow from all programs and management approaches that are available to use—each has something to offer. There is a wide variety of choices available to us: alternative, conventional, low-input, and regenerative agriculture; biological control; ecological management; integrated crop and pest management; and organic production. The development of a true sustainable agriculture system requires that the best elements of each of these approaches be combined into whole-farm systems through a complex balancing of many factors (e.g., farm resources, enterprises, inputs, methods, and activities) in a way that is economically, environmentally, and socially acceptable.

## Implementation of SARE

The SARE legislation establishes a National Sustainable Agriculture Advisory Council (NSAAC) and four Regional Administrative Councils (RACs). NSAAC is responsible to the Secretary of Agriculture through CSRS and ES. The specific responsibilities of NSAAC are to:

- make recommendations to the Secretary concerning research and extension projects that should receive funding;
- promote sustainable agriculture research and education programs at the national level;
- coordinate research and extension activities funded under SARE;
- establish general procedures for awarding and administering resources;
- consider recommendations for improving the program;
- facilitate cooperation and integration among sustainable agriculture, water quality, integrated pest management, food safety, and related programs; and
- prepare and submit an annual report to the Secretary.

Council members include farmers and ranchers that represent Chapter I (BUBA) and Chapter II (IMS) of SARE, non-profit organizations with demonstrable expertise in sustainable agriculture, USDA agencies, the U.S. Environmental Protection Agency, and the U.S. Geological Survey. Council members are appointed on a bipartisan basis and all indications are they plan to fully carry-out their legislated responsibilities. This sends a very strong message that "business as usual" will not dominate implementation of SARE.
The RACs are responsible to the Secretary of Agriculture through CSRS and ES. They are configured very similar to NSAAC except their membership is drawn from States in the

region they represent. The RACs have been functional since 1987, however, they were not legislatively certified until passage of SARE in 1990. Their specific responsibilities are to:

- appoint a regional host institution and a regional coordinator, subject to the approval of CSRS and ES;
- make recommendations to NSAAC concerning research and education projects that merit SARE funding;
- promote sustainable agriculture research and education programs at the regional level;
- establish goals and criteria for the selection of projects within the applicable region;
- appoint appropriate technical committees for evaluation of project proposals to be considered for funding;
- review and act on the recommendations of the technical committee and coordinate its activities with the regional host institution; and
- prepare and distribute an annual report on regional activities in sustainable agriculture.

It is obvious that the sustainable agriculture councils are an addition to the traditional land grant university mechanism for administering research and extension programs and projects, and this fact has created apprehension among some research and extension personnel. This reaction is an understandable reaction to change, but the councils should be viewed as a positive change that will lead to stronger support for the land grant university system and U.S. agriculture. It is likely that Congress will continue to support SARE because it has been receiving positive feedback from various agricultural and environmental constituencies for the way SARE funds are being administered. This is primarily a result of a key element contained in the SARE legislation—a place at the table when funding decisions are made. It is likely that Congress will further stress the SARE model of program administration in future legislation for other agriculture and non-agriculture programs.

## Agriculture's Response to New Political Realities

Helping people deal with issues is not a new concept to most agriculturists—after all, that is what research and education is all about. However, sophisticated new technological options and changing social demographics bring a new dimension to how today's issues are resolved. The change that has become so much a part of our world has resulted in people speaking-out as never before so that their voices are heard while the public agenda is developed and acted upon. This in turn makes it essential for forward-thinking individuals and organizations to be more receptive than ever before to the concerns and needs of these many voices.

How should members of the Southern Soybean Disease Workers respond to the concept of sustainable agriculture? Be as creative as possible. Sustainable agriculture includes the entire agricultural production, processing, marketing, and service system. This concept is not a return to the past. Sustainable agriculture is a move to a more complex knowledge, information, and management intensive system that strives to balance market response, free enterprise, technology adaptation and adoption, and environmental sensitivity in a socially acceptable way. Application of technologies, strategies, and approaches will vary based on current and future sets of local, national, and global needs and conditions.

Within this context, U.S. agriculture must adapt to broad economic, environmental, and social elements if it is going to survive as a world class economic powerhouse. Effective participation of U.S. agriculture in the global marketplace will require a good understanding of global markets. Currently, the marketing component of sustainable agriculture systems has been sorely neglected. We must ensure that global marketing goals and social goals are linked in a way that creates economic opportunities in rural communities. Unfortunately, global marketing goals frequently focus on contributions to Gross National Product and not to Gross Community Product (GCP) in rural communities. It is important that rural communities benefit from the jobs created by global marketing efforts. The creation of jobs in rural communities is not only essential to sustaining rural communities, it is critical to sustaining agriculture. A good example of how global marketing and sustainable agriculture pertain to members of the Southern Soybean Disease Workers. Which characteristics of soybean cultivars deserve the most attention by soybean breeders: cultivars that have the most potential to meet the demands of a local value-added niche market for processed soybean products or cultivars that produce the most bushels and leave the community as raw product? If the economic sustainability of the rural community is the goal, there is no question that it is the development of value-added niche markets that are preferable.

## Summary

Sustainable agriculture systems are market-driven systems that 1) profitably produce, process, and distribute environmentally-sound and socially-acceptable products demanded by society, 2) are responsive to changes in social needs and wants, and 3) develop new products and markets that have the potential to increase GNP and GCP. Sustainable agriculture is not only compatible with commercial agriculture, it is essential to the welfare of both agriculture and the general public. U.S. agriculture must determine the proper course for ensuring the sustainability of the industry. What is the future going to be like and what tools and technologies will be needed to compete in it? A single individual or organization cannot answer these questions alone—input is needed from all stakeholders. Collectively we can gain a better understanding of the environment in which we are operating and we will be more likely to choose a wise course for agriculture. Can we make agriculture more sustainable? You bet, IF we are serious enough about it to work together through shared decision-making and by exploiting the abilities of all stakeholders.

---------- DRAFT ----------

## Sustainable Agriculture Relevancy Classification Form

Project No.: ________________

Project Location: ____________ Project Title: ____________________

| | Detracting from Sustainability | No Direct Impact | Contributing to Sustainability |
|---|---|---|---|
| **Integrated System Of Plant And Animal Production Practices**<br>• Whole-farm System Analysis activities:<br>• Holistic and interdisciplinary, including:<br>• Noncontrollable variables (e.g., rain, soil texture),<br>• External inputs (e.g., fuel, fertilizer, seed),<br>• Farm/Ranch ecosystem dynamics, and<br>• System responses, with emphasis on use of on-farm resources | | | |
| **Satisfy Human Food And Fiber Needs**<br>• Research on long-term optimization of food or fiber production, that is<br>• Safe, and<br>• Nutritious | | | |
| **Enhance Environmental Quality**<br>• Studies of off-site impacts of agriculture on environmental quality, or<br>• Research designed to enhance environmental quality through the development of technologies and procedures that minimize degradation or restore the quality of soil, water, atmospheric, or organic resources | | | |
| **Natural Resource Conservation**<br>• Research that promotes the development of technologies and practices designed to conserve<br>• Soil • Plant • Nutrient • Water • Energy • and Organic Resources | | | |
| **Biological Resources Utilization**<br>• Research leading to development of technologies and practices that promote the use of beneficial biological resources, with<br>• Emphasis on use of on-farm resources | | | |
| **Economic Viability**<br>• Research to develop practices and systems that minimize risk and<br>• Enhance the economic viability of farming operations, and,<br>• Procedures to avoid overloading and depressing commodity prices, with<br>• Emphasis on the 21st century family farm | | | |
| **Quality of Life**<br>• Research designed to enhance quality of life for<br>• Farmers,<br>• Rural communities, and<br>• Society as a whole; through<br>• Emphasis on local value added technologies and<br>• Entry opportunities for beginning farmers | | | |
| See instructions for use of this form — Project Score: | | | |

---------- DRAFT ----------

Extras

Off-farm income as a percent of farm operator household incomes is 57, 33, and 22 percent for the three largest-sized farms in the U.S. Half of the 1.2 million small farm households in the U.S. average $37,276 of off-farm income per household. After they deduct the $3,387 they lose in farming their average household income is $33,889.

At the sustainable agriculture hearings held by Senator [ Doschle ] (South Dakota) in the Fall of 1992, the USDA Science and Education agencies (ARS, CSRS, and ES) were asked to provide details on how they classified research and education projects and programs as being "sustainable" or not sustainable. At this point the classification scheme being developed by the three agencies surfaced as the instrument that was being used for this purpose and it subsequently became the official instrument used to measure the sustainability of a program or project.

Milo provides a good illustration of what happens when we focus on yield potential rather than economic sustainability of rural communities. Plant breeders in the United States developed yellow endosperm milo. However, because it did not have the yield potential exhibited by the white endosperm cultivars it never succeeded commercially. What we did not take into consideration was that Africans eat milo and prefer yellow endosperm cultivars. We succeeded in selecting the milo cultivars with the highest yield potential, but we missed an opportunity to produce a cultivar with characteristics that could have been marketed as a higher value processed product. Instead, the yellow endosperm cultivars where developed for food use in Africa, and U.S. agriculture was left with a lower valued raw product.

We have to recognize how important, accessible, and usable information and management skills are and increasingly will be to retaining a globally competitive agricultural system. This challenge extends far beyond recognizing the every-growing potentials of computer hardware and software development. We must strive to be early adopters of open systems of communication and networking with both public and private cooperators and clients. We must develop deeper knowledge of human decision-making processes and deliver, not just information, BUT information that can be integrated and related so as to support decision-making and problem-solving.

Sustainable agriculture and natural resource programs must also recognize that (1) farm and off-farm income generating enterprises are linked through resource allocation decisions, (2) non-monetary household priorities influence farm operation decisions, and (3) farm households are enveloped by rural social communities, government policies, and overlapping networks of public and private institutional demands and services.

A growing number of farmers and agricultural scientists in both the public and private sector are seeking innovative ways to reduce costs and protect human health and the environment. However, as they do this, they need to recognize the complexity of sustainable systems continues to evolve. In the early 1970's we began the process of rediscovering system approaches to problem-solving using integrated teams. The components of systems were basically made up of production, marketing, business management and policy. In the 1980's with the advent of the 1985 Food Security Act, we then discovered that systems must also be resource conserving, profitable, environmentally-sound, and socially-acceptable. It has now come to our attention that these systems must be structured so they take into full account the jointly evolving ears of information, globalization, and biology. Psychologists are saying their research is telling them that mankind is going to have to learn to more effectively deal with complexity. Sustainable agriculture systems development conforms to this analysis. It is not for the "faint-hearted" who are unwilling to deal with complexity.

Effectively responding to the national need of a globally competitive sustainable agricultural system in the near and long-term, will require an integrated research-based educational and demonstration program focused on economic, environmental, and social concerns. This will necessitate creative interdisciplinary teamwork. Interdisciplinary teamwork will have to become the norm if we plan to succeed. However, as we institutionalize systems approaches to problem-solving, we must recognize that at any point in time, the policy-making process will be focused on only a few of the components of sustainable agriculture and natural resources. Examples of the factors that drive this process include 1) public response to technological change; 2) agricultural and natural resources policies of importing and exporting countries; 3) world weather and climatic patterns; 4) world food supply and demand. The challenge for those trying to enhance the sustainability of agriculture now and in the future is to be able to simultaneously address priority components of sustainability on the political agenda within the context of holistic sustainable systems.

A great deal is known about some of the physical, biological, economic, and social components of sustainable agricultural and natural resource systems. However, this knowledge must be integrated to effectively implement and more systematically reap the benefits. The approach to integrating these knowledge bases for effective decision-making demands a broader approach to research and education in both the public and private sectors than has ever before been attempted within U.S. agriculture.

# IMPACT OF PEST INTERACTIONS ON MANAGEMENT PROGRAMS

Joe Funderburk
North Florida Research & Education Center
University of Florida
Route 3 Box 4370
Quincy, Florida 32351

The concept of integrated pest management arose out of the pesticide crisis, originally embracing integrated insecticide use with natural enemies. The modern IPM concept has broadened and incorporated public and private interests related to agricultural production, the environment, and food supply and quality. Programs are developed from information on pest ecology, crop response to pests, and economics of management and production. Important considerations are the economic sustainability of agricultural production systems, sustainability of management tactics and mangement programs, and efficient utilization of natural resources.

The focus in current integrated pest management programs is on pest populations, and management activities usually are directed against individual pest species. The therapeutic approach is most commonly used for managing athropod pest damage. This approach is cost effective and has proved successful for most arthropod pests, especially occasional arthropod pests. These programs generally have been developed from only rudimentary knowledge of pest ecology, crop response to pests, and economics of production and management. However, tolerance of subeconomic pest densities and maximization of mortality from natural enemies and abiotic factors reduces the risk for environmental contamination and development of pesticide resistance in pest populations. The scientific evidence indicates that the food supply produced with new chemical pesticides is safe. Integrated pest management is widely accepted as the optimal approach for dealing with the deleterious effects of pests in all production situations.

Although future integrated pest management efforts must continue to be directed at managing pest populations, more emphasis on understanding plant response to pest injury is needed. Categorizing pest injury based on plant physiological response will simplify the research process and allow for improved accuracy of management decisions for pest guilds or species that produce the same injury to a crop. There is a lack of knowledge of the impact of multiple pest injuries on decision-making in current integrated pest management programs. Categorizing pest injury also will improve the ability to identify significant interactions between multiple arthropod, pathogen, weed, and nematode pests. This will enhance productivity and efficiency of the production system, and will enhance confidence of producers for IPM programs and result in greater adoption.

Of all approaches developed to address pest problems, only integrated pest management has the scientific and practical basis to provide long term, sustainable solutions. This is not to say integrated pest management is without deficiencies. Viable integrated pest management programs still are lacking for many important pests, and IPM programs are not as widely adopted as is desirable. In part, these problems reflect the legacy of the pesticide era, and a desire to control pests rather than manage them. Also, the substantial research requirements in developing integrated pest management programs and the knowledge required in using IPM are barriers to its wider acceptance. Nevertheless, with continued pest problems and greater constraints on our ability to management pest populations (because of pest resistance, fewer pesticides, and more restricted pesticide use), the importance of integrated pest management is likely to increase in the future. Ultimately, management efforts must address the entire array of stressors affecting plants and their interactions. Consequently, greater integration of management tactics in integrated pest management and more integrated understandings of the impact of all types of plant stressors are needed to move integrated pest management towards this goal of sustainable stress management.

## Introducing Producers to Sustainable Agriculture, A Team Approach

John F. Bradley, Superintendent
Milan Experiment Station
Milan, Tennessee

The University of Tennessee Agricultural Experiment Station and Extension Service, along with other government agencies and private industry, started encouraging the use of no-tillage in the late seventies. These practices related directly to sustainable agriculture were based on research conducted at the Milan Experiment Station. Twenty-five years of research with no-tillage and conservation tillage at the Milan Experiment Station have proven that these farming systems can produce food and fiber as successfully as those systems with several tillage trips. There have been no consistent differences in average yields of corn, cotton, soybean, wheat and grain sorghum since research began in 1965. In many years, no-tillage systems have yielded the highest.

Research has proven that there are several advantages for no-tillage systems that should be considered: (1) seedbed preparation is eliminated thus reducing the cost of production, since as many as six to eight tillage operations can be eliminated; (2) crops can be produced on slopes not normally used for conventional tillage under the Farm Bill; (3) soil erosion is effectively reduced on sloping land, no-tillage is the most cost effective means of controlling erosion; (4) all fertilizer and lime can be broadcast on the soil surface; (5) soil is firmer for field accessibility (planting, spraying, and harvesting); (6) soil structure and moisture holding capacity is improved over time; (7) reduced labor at planting time enables the producer to expand his operation or reduce labor load (reduces labor by fifty percent); (8) less trips mean less fuel and less equipment investment.[1]

### Transfer of Tillage Technology

Before we can comfortably transfer tillage technology, we must have proven technology from a research or demonstration base and we must have confidence in the data and the source data base. Many state experiment station programs have this base and of course others do not. No-till will work, it has been proven and it will be the way to farm now and in the future.

Work with industry. This includes the equipment industry, and the crop protection (chemical) industry. Presently, almost every major manufacturer of planters and drills has a model that works well in no-tillage. Compare makes and models in field demonstrations. Work through soil and water conservation districts to make good no-tillage equipment available for rental or loan purposes. Learn the adjustments of these planter and drills (weights, down pressure springs, coulter settings, double disc opener settings, speed, selection and setting of down pressure springs).

Every major manufacture of crop protectants (herbicides, insecticides, fungicides) have products that perform well in no-tillage situations. These companies provide literature, videos, research and demonstration material. Become comfortable with the material and relate to it.

Work with other agencies. We are all in this together, if we cannot help each other to help producers meet compliance, Who is going to? Share with the Soil Conservation Service what you know and what you are learning. In your state you may learn from them. Work with the water quality people and the state department of agriculture.

Work with no-till farmers, learn from them and with them. Every county in the United States has farmers who are letting no-tillage work for them. Visit them, be interested in what they are doing. Encourage them and let them encourage you. Find out what works for them and why.

Use the proven extension methods. These include: mass media, on the farm no-till demonstrations, field days, no-till yield contest, no-till variety contest and demonstrations, no-till clubs and associations. Recognize no-till leaders and first time no-tillers, use newsletters and postcards, invite no-till speakers (professionals and producers) to address faculty.

Work with other researchers and specialists in other states. Learn from each other. Write and call professionals in other states that can supply the information you need.

Get your hands dirty, go out on experiment stations and farms and help set the planter or drill. You gain confidence and can handle requests by telephone on subsequent calls.

Gain practical and applied knowledge of no-tillage systems and distribute the technology through the extension educational system.

No-Till is the greatest revolution in agriculture since tractors replaced the mule. It is happening, it is going to continue to grow and you should become leaders in your county to make it grow profitably for your producers while preserving our soil base for future generations.

## Results

The Tennessee Agricultural Statistics reported no-tillage usage in 1992 increased significantly from a year ago, particularly for corn. Tennessee farmers used the no-till practice on 28.3 percent of the total acreage devoted to corn, soybeans and grain sorghum compared to 23.5 percent in 1991. Ten years ago this practice was used on only 15.5 percent of the acreage planted to these crops. Farmers used the no-tillage practice on 13.6 percent of the cotton acreage in 1992. Other conservation tillage practices accounted for over 28 percent of the acreage seeded to corn, soybeans and grain sorghum.[2]

## References

Shelton, Curtis H., and Bradley, John F. 1987. Controlling Erosion and Sustaining Production with No-Till Systems. TN Farm and Home Science, Winter 1987, Issue 141.

Tennessee 1992 Tillage Systems. Tennessee Agricultural Statistics Service, July 1992.

# Sustainable Agricultural Practices and Their Impact on Plant Diseases

Craig Rothrock
University of Arkansas

Agricultural research has often concentrated on inputs to maximize crop yields or production efficiency. Sustainable agricultural practices are increasingly being investigated as a result of government policy, interest in reducing purchased inputs, and public concern over the use of pesticides. Although sustainable agriculture is a loosely defined term, the goal of sustainable agriculture is to develop farming systems that are profitable, conserve natural resources, protect the environment, and enhance human health. Plant pathologists play an important role in the development and implementation of sustainable systems by identifying the benefits and risks associated with these systems. Plant pathologists can participate in sustainable agricultural research in at least three areas; 1) integrated pest management, 2) impact of residue management, and 3) assessing ecosystem status.

Adoption of sustainable agricultural practices implies a reduction in pesticides previously applied on a recommended or insurance basis. This will require the identification of fungicide applications that are unnecessary or environmentally and/or economically unsound. Reduced reliance on pesticides will require a greater research effort in many areas of integrated pest management including; economic thresholds, resistance, disease forecasting, and biological and cultural pest control.

Many of the cultural practices associated with sustainable agriculture involve residue management. In order to restore or preserve the productivity of land, organic matter content needs to be maintained or increased through cultural practices such as conservation tillage, crop rotation, cover crops, and the application of organic amendments. Residue management may affect disease by; 1) providing a site for pathogen survival and reproduction, 2) changing the physical environment for plant growth and pathogen activity, and 3) influencing the soil microflora (1). Several soybean diseases and nematode problems have been demonstrated to be influenced by cultural practices that are considered sustainable agricultural practices. In situations where disease is adversely affected by these practices, alternative control strategies will need to be developed or implemented.

- Crop rotation has long been recommended as a control practice for the management of diseases having a limited host range, are short lived in the absence of a host, and have limited dispersal. A nonhost crop, resistant cultivar, and susceptible cultivar rotation effectively controls soybean cyst nematode and maintains resistant soybean cultivars (5).

- The adoption of conservation tillage is very effective in reducing soil erosion and contamination of surface waters, and may reduce energy use and improve soil water status. Southern stem canker of soybean is a disease which increases under no tillage (3,4,6). Resistant cultivars can effectively limit stem canker severity and yield reductions under no tillage (4). In contrast, soybean cyst nematode was found in lower populations under no tillage than several other tillage regimes (6).

☼ Although cover crops and organic amendments are not used for maintaining soil fertility in soybean production, cover crops may be used for reducing soil erosion as part of crop sequences in multiple-cropping systems. Rye or wheat reduced galling from the root-knot nematode, Meloidogyne incognita, in doublecropping systems compared to soybean monoculture (2). Southern stem canker increased in Georgia under a wheat-soybean doublecropping system compared to soybean monoculture (3,4). Numerous publications have demonstrated the potential to manage soilborne plant pathogens and plant-parasitic nematodes with organic amendments.

Plant pathologists are uniquely qualified to play an important role in assessing the status of the agroecosystem. The diversity and population dynamics of soil flora and fauna serve as biological indicators of natural factors or toxic substances that affect living organisms. By monitoring the status of microbial populations, plant pathologists can contribute vital knowledge regarding the health of the agricultural environment.

REFERENCES


1. Cook, R. J., Boosalis, M. G., and Doupnik, B. 1978. Influence of crop residues on plant diseases. In Crop residue management systems. W. R. Oschwald (ed.). ASA Spec. Publ. 31. American Society of Agronomy, Madison, WI, pp. 147-163.
2. Minton, N. A. 1992. Nematode management in minimum-till soybean with resistant cultivars, rye rotation, and aldicarb. Nematropica 22:21-28.
3. Rothrock, C. S., Hobbs, T. W., and Phillips, D. V. 1985. Effects of tillage and cropping system on incidence and severity of southern stem canker of soybean. Phytopathology 75:1156-1159.
4. Rothrock, C. S., Phillips, D. V., and Hobbs, T. W. 1988. Effects of cultivar, tillage, and cropping system on infection of soybean by Diaporthe phaseolorum var. caulivora and southern stem canker symptom development. Phytopathology 78:266-270.
5. Slack, D. A., Riggs, R. D., and Hamblen, M. L. 1981. Nematode control in soybeans: rotation and population dynamics of soybean cyst and other nematodes. University of Arkansas Agricultural Experiment Station Report Series 263.
6. Tyler, D. D., Overton, J. R., and Chambers, A. Y. 1983. Tillage effects on soil properties, diseases, cyst nematodes, and soybean yields. J. Soil Water Conserv. 38:374-376.

## The Effect of Increasing Initial Inoculum Levels of *Rotylenchulus reniformis* on Soybean

J.J. Cornelius and G.W. Lawrence, Department of Plant Pathology and Weed science, Mississippi State University.

A microplot test was established to determine the initial population density of the reniform nematode, *Rotylenchulus reniformis*, that would significantly reduce the yield potential of soybean.

Initial inoculum levels of 0, 500, 1,000, 2,500, 5,000, 7,500, and 10,000 juveniles and vermiform adult *R. reniformis*/500 $cm^3$ soil were used to inoculate soybean cultivar Coker 156. The microplot test was planted 17 June 1992 and harvested 30 October 1992. *R. reniformis* numbers increased in all increasing Pi levels. Nematode populations increased to the highest levels in September with a density of 81,800/500 $cm^3$ soil in Pi=7,500. At harvest, populations had decreased in all Pi levels except Pi=500 which increased. Final reniform population densities ranged from 34,848 to 58,882 nematodes/500 $cm^3$. Nematode reproduction factors (Rf=final population/initial population) decreased with increasing Pi.

*Rotylenchulus reniformis* significantly affected soybean growth and subsequent yield. Plant height ranged from 30.67 to 26.47 inches tall at Pi=0 and Pi=2,500, respectively. All soybeans inoculated with *R. reniformis* were shorter than plants in uninoculated plots. Significantly fewer nodes were recorded at Pi=10,000 compared with Pi=0. Pod development ranged from 41.0 to 26.0 pods/plant with significantly fewer pods at Pi=5,000 than Pi=0. Soybean yield decreased with increasing Pi levels. Yield ranged from 30.53 bu/acre in plots with Pi=500 to 20.84 bu/acre in plots with Pi=10,000. Compared to control plots, soybean yields were 4.98, 6.79, 7.08, and 9.26 bu/acre less than Pi=0 at Pi=2,500, Pi=5,000, Pi=7,500, and Pi=10,000, respectively.

# EFFECT OF FROGEYE LEAF SPOT ON YIELD OF SOYBEAN LINES NEAR-ISOGENIC FOR RESISTANCE

P. F. Pace, D. B. Weaver, L. D. Ploper, and P. A. Backman. Department of Agronomy and Soils and Department of Plant Pathology, Auburn University, AL 36849.

Frogeye leaf spot (caused by *Cercospora sojina* Hara) is a common foliar disease of soybean in the southeastern USA that is easily controlled with qualitative resistance genes. At least six physiologic races occur in the USA. Yield loss due to frogeye has been estimated at 10-30%, but resistance to frogeye has always been confounded with background genoype in these studies. The objective of our research was to compare lines near-isogenic for resistance genes to better determine potential yield loss due to this disease. Eleven pairs of near-isogenic lines originating from two crosses were used as experimental materials for the study. The crosses G80-1515 (susceptible) × N81-1121 (resistant) and 'Stonewall' (resistant) × 'Coker 6738' (susceptible) were made in 1986 at Tallassee and advanced by single-seed descent to the $F_5$ generation. Single $F_5$ plants were harvested, and $F_{5:6}$ lines heterogeneous for disease reaction were identified under natural infection at Tallassee. These lines are homozygous for most other loci due to the drive to homozygosity during inbreeding. Resistant and susceptible plants were labeled, harvested and planted in progeny rows the next year. Pairs of sublines that were agronomically similar and homogeneous for disease reaction were selected and increased. Lines were grown in a randomized complete block design with split plots at Tallassee and Fairhope, AL in 1991 and 1992. Whole plots were lines and split plots were resistant and susceptible sublines. An additional split, inoculated and not inoculated, was imposed at Tallassee. Natural infestation was relied upon in Fairhope. Race 5 (obtained from D. V. Phillips) of *C. sojina* was used to inoculate plots in 1991 at a rate of 4-6 × $10^4$ spores $mL^{-1}$. In 1992 spores and mycelial fragments (unquantified) of an isolate of undetermined race collected at Tallassee from 'Kirby' was used. Isolates were grown on V-8 juice agar (0.15 mg streptomycin sulfate $L^{-1}$ agar) at 25 °C for 7-10 d. The fungus and conidia were scraped from the plates or the plates were blended and this solution was sprayed onto the plants during periods of high humidity. Disease progress was measured as percent defoliation (percent necrotic leaf area) on 4, 10, and 25 August.

Disease development was low at Tallassee in 1991. Yield of susceptibles was reduced by 6.3% and inoculation had no effect on yield. In 1992 disease development was much greater and yield of susceptibles was reduced by 37.9%. Among susceptibles, inoculated plots yielded significantly less than noninoculated plots. Area under the disease progress curve was negatively correlated (P=0.01) with yield (r=-.76). At Fairhope, little infection occurred either year; resistant and susceptible sublines did not differ significantly in yield.

Heritability and Genotype x Environment Interaction of Partial Resistance to Soybean Sudden Death Syndrome (SDS).

V.N Njiti, M.A Shenaut, R.J. Suttner, J.H Klein, W.J. Matthews, and P.T Gibson. Plant and Soil Science Department, Southern Illinois University at Carbondale

Soybean (Glycine max (L.) Merr.) sudden death syndrome has recently become a problem of great concern especially for growers along the Mississippi river and major tributaries. Soybean cultivars with resistance to soybean cyst nematode (SCN) generally show low SDS disease incidence (DI) and disease severity (DS). This observation led to the design of this study. The objectives of the study were: (1) to explore the apparent relationship between SDS and SCN response, (2) to determine the pattern of inheritance of partial resistance to SDS, and (3) to calculate the magnitude of heritability to SDS response. The study included 90 random F6:8 lines derived from Pyramid x Douglas (Pyramid-SCN race 3&14 res. and low DI; Douglas-SCN susc. and high DI), and 100 F5:7 lines derived from Essex x Forrest (Essex-high DI and SCN susc.; Forrest-SCN race 3 res. and low DI). By greenhouse screening, derived lines were assigned to SCN-resistant and SCN-susceptible groups. Field testing for SDS from 1990 through 1992 involved four different environments.

The SCN resistant group had lower DI means than the SCN susceptible group in each cross. SDS response in both crosses appears to be polygenic and moderately to highly heritable. Parent-offspring heritability estimates for DI in the Pyramid x Douglas cross on a line-mean basis were 0.37 overall, 0.57 within the SCN-susceptible group and 0.36 within the SCN-resistant group. Corresponding estimates for Essex x Forrest were: 0.75 overall, 0.71 within susceptible, and 0.68 within resistant. Environmental instability resulted in a large genotype x environment interaction especially with the Pyramid x Douglas cross. Site-specific responses were evident in Pulaski 1991 where the SCN-susceptible group slightly outperformed the SCN-resistant group. Further analysis suggested that the environmental instability in SDS response might be associated with SCN race 14 resistance. In order to establish the genetic basis of the response, RFLP markers are being compared with SCN and SDS responses in each environment. Localization of specific genes involved in SDS resistance would accelerate cultivar improvement.

# SOYBEAN-COTTON ROTATIONS FOR THE MANAGEMENT OF PLANT-PARASITIC NEMATODES

D.G. Robertson and R. Rodríguez-Kábana

Auburn University, Alabama Agricultural Experiment Station
Auburn, Alabama 36849

A three-year experiment was conducted to determine the effects of a soybean-cotton rotation on populations of phytonematodes and on yields of selected cotton cultivars. The experiment was established in a cotton field near Tallassee, Alabama. The field was infested with *Meloidogyne incognita* and *Hoplolaimus galeatus* as the main nematode species with small populations of *Helicotylenchus dihystera, Paratrichodorus minor, Pratylenchus* spp., and *Tylenchorhynchus claytoni*. In 1990 the field was divided into 16 sections each 9 x 28 m one half of which were planted with 'Deltapine 50' cotton and the other half with 'Kirby' soybean. The sections were planted to have each section with cotton next to one with soybean following a split plot design. The sections were planted in 1991 in the same manner as in 1990. In 1992 a selection of cotton cultivars was planted in the sections that had 'Kirby' soybean the previous two years (rotation system) and the same cultivars were planted in the sections that had 'Deltapine 50' (monoculture system). Cotton cultivars chosen for the study were: 'Deltapine 20', 'Deltapine 50', 'Coker 320', 'Coker 315', 'Stoneville 453', 'DES 119', and 'S 1001'. Each cultivar in every section was planted with and without an at-plant application of aldicarb at 23 g a.i./100 m row. When no nematicide was used the rotation increased yield of all cotton cultivars; however, application of aldicarb resulted in no yield differences between the monoculure and the rotation systems. The use of nematicide in the monoculure system increased yields for all cotton cultivars but only for some of the cultivars ('Coker 315', 'Coker 320', and 'Stoneville 453') in the rotation system. Soil juvenile populations of *M. incognita* determined at cotton-harvest time, were generally lower with cultivars in the rotation system than in monoculture. The magnitude of the suppressive effect of the rotation system on *M. incognita* juvenile populations was cultivar dependent. For most cultivars application of aldicarb reduced numbers of *M. incognita* juveniles in soil in both the rotation and the monoculture systems. Neither cropping system nor nematicide use had any significant effects on populations of the other phytonematode species in the soil.

# SOYBEAN-PEANUT ROTATIONS FOR THE MANAGEMENT OF NEMATODE PROBLEMS IN PEANUT

P.S. King and R. Rodríguez-Kábana

Auburn University, Alabama Agricultural Experiment Station
Auburn, Alabama 36849

The value of 'Kirby' soybean as a rotation crop for the management of root-knot nematode (*Meloidogyne arenaria*) in 'Florunner' peanut was studied for seven years (1985-1992) in a field experiment at the Wiregrass Substation near Headland, Alabama. The field had been in peanut and winter fallow for the preceeding five years and was heavily infested with the nematode. The experiment contained the follwing treatments: 1. Peanut monoculture with no nematicide [P(-)]; 2. Peanut monoculture with at-plant application of nematicide [P(+)]; 3. Soybean with no nematicide followed by peanut with no nematicide [S(-)-P(-)]; 4. Soybean with nematicide followed by peanut without nematicide [S(+)-P(-)]; 5. Soybean with no nematicide followed by peanut with nematicide [S(-)-P(+)]; 6. Soybean with nematicide followed by peanut with nematicide [S(+)-P(+)]. Aldicarb was applied in a 20-cm-wide band at 20 g a.i./100 m row. Every year the field was left fallow in winter. There were eight replications (plots) per treatment in a randomized complete block design. A plot was eight rows wide and ten m long with an area of 73 $m^2$. [S(-)-P(-)] and [S(-)-P(+)] rotations did not differ in peanut yield but both rotations resulted in higher yields than the yield obtained with P(-). Highest peanut yields in the experiment were obtained with the [S(-)-P(+)] and [S(+)-P(+)] rotations which were superior to the yield obtained with P(+). There was no advantage in peanut yield for the [S(+)-P(+)] system over the [S(-)-P(+)] system. When all plots were in peanut all treatments in the experiment resulted in end-of-season numbers of *M. arenaria* juveniles >100/$cm^3$ soil and there were no differences among treatments in numbers of juveniles in soil.

# VELVETBEAN FOR THE MANAGEMENT OF NEMATODE PROBLEMS IN SOYBEAN

C.F. Weaver, R. Rodríguez-Kábana, and D.B. Weaver

Auburn University, Alabama Agricultural Experiment Station
Auburn, Alabama 36849

The value of velvetbean (*Mucuna deeringiana*) as a rotation crop for the management of nematode problems in soybean (*Glycine* max) was studied in a field experiment near Elberta, Baldwin County, Alabama. The field was infested with *Heterodera glycines* and *Meloidogyne arenaria* and had been in soybean for three years before the experiment was established. In 1991 the field was divided into four 24 X 91 m sections, two of which were planted with 'Florida' velvetbean and the other two with 'Kirby' soybean. In 1992 a selection of seven soybean cultivars was planted in each section to have a split-plot design with soybean following velvetbean (rotation) and soybean after soybean (monoculture). The cultivars were 'Braxton', 'Brim', 'Bryan', 'Kirby', 'Leflore', 'Stonewall', and 'Thomas'. Each cultivar was planted in every section with and without at-plant application of aldicarb (17 g a.i./100 m row). There were 16 plots (replications) representing each cropping system-cultivar-nematicide combination in the experiment. Plots were each two-row wide and six m long for an area of 9 $m^2$. Velvetbean suppressed juvenile populations of *H. glycines* and *M. arenaria* in soil in 1991. The rotation increased yields of all soybean cultivars. The magnitude of the percent increase in yield relative to the yields obtained with monoculture was cultivar dependent and varied from 80% for 'Leflore' to 145% for 'Brim'. The interaction between nematicide treatment and cropping system on yield was not significant; however, a significant interaction on yield between nematicide treatment and cultivar was observed. Thus, while yields of some cultivars ('Bryan', 'Leflore') were not affected by aldicarb application, the yields of other cultivars ('Brim', 'Thomas') were increased by the nematicide. The rotation did not suppress numbers of *M. arenaria* juveniles in soil with any of the cultivars. For most cultivars soil juvenile populations of the nematode at harvest time were higher in plots with the rotation than in those with monoculture. The rotation suppressed numbers of juveniles of *H. glycines* in soil; however, this effect was cultivar dependent and was most pronounced for 'Braxton' and 'Stonewall' but not significant for 'Leflore'. Aldicarb had no effect on *H. glycines* juvenile populations in soil.

# THE MANAGEMENT OF NEMATODE PROBLEMS WITH CORN AND SOYBEAN ROTATIONS: A TEN YEAR STUDY

R. Rodríguez-Kábana

Auburn University, Alabama Agricultural Experiment Station
Auburn, Alabama 36849

A study was initiated in 1983 to compare corn-soybean rotations with "rotations" based on changes in soybean cultivars for their effects on yields and on populations of *Meloidogyne incognita*. The study comprised four experiments in a field infested with the nematode at the Gulf Coast Substation, near Fairhope, Baldwin County, Alabama. The field had been in soybean with winter fallow for at least five years. The experiments had the same treatments and studied the effects of the rotations on a principal soybean cultivar. In the experiment with the 'Davis' cultivar the treatments were:1. 'Davis' every year without nematicide; 2. 'Davis' every year with at-plant nematicide application; 3. one year of 'Davis' followed by one year of corn;4. one year of 'Davis' followed by two years of corn;5. one year of 'Davis' followed by one year of 'Braxton'; 6. one year of 'Davis' followed by one year of 'Foster' (or 'Kirby'). Nematicides used were EDB (1983-1986) in-the-row at 17 l/ha or aldicarb (1987-1992) at 17 g a.i./100 m row in a 20-cm-wide band. Each treatment was represented by eight replications (plots) arranged in a randomized complete block design. A plot was 45 $m^2$ being eight rows wide and six m long. In the other three experiments the 'Davis' cultivar was substituted by cultivars 'Braxton', 'Foster', or 'Ransom'. Treatment 6 in the 'Foster' experiment consisted of one year of 'Foster' followed by one year of 'Ransom'. Treatment 5 in the 'Braxton' experiment was one year of 'Braxton' followed by one year of 'Foster' (or 'Kirby'). Soybean yields in plots with the corn rotations were the highest among all the treatments; differences in yield between the two corn rotation systems were not significant. Rotations of 'Davis' or 'Ransom' followed by 'Kirby' resulted in higher yields than those with 'Braxton' following 'Davis' or 'Ransom'. Rotations of 'Kirby' followed by 'Ransom' yielded higher than when 'Braxton' followed 'Kirby'. Yields of the Braxton-Kirby system were superior to those of the Braxton-Ransom system. Application of nematicide increased yields of 'Davis' and 'Ransom' but did not affect those of 'Braxton' or'Kirby'. The lowest numbers of *M. incognita* juveniles in soil, determined near the end of the soybean season, were in plots with 'Braxton', 'Foster' or 'Kirby'. Plots with soybean after corn had higher soil juvenile populations of the nematode than plots in monoculture without nematicide. Application of nematicide reduced numbers of *M. incognita* juveniles in plots with 'Davis' or 'Ransom' but had no effect on the nematode in plots with 'Braxton' or 'Kirby'.

## Effect of Wheat Residue and Tillage on Soybean Cyst Nematode and Soybean Yield in Doublecrop Soybeans in Kentucky

D. E. Hershman and P. R. Bachi
Department of Plant Pathology
University of Kentucky, Princeton, Kentucky

Field studies were conducted, 1990-1992, to determine the effects of wheat residue associated with wheat-soybean doublecropping systems and tillage (no-till vs. minimum tillage) on soybean cyst nematode (SCN) development and soybean yields. Across the three years of the study, 64.3% (range = 60.6 - 69.4%) fewer viable cysts developed by the end of the season in soybeans planted no-till into standing wheat stubble, as compared with identical plots, but without wheat stubble. Minimum tillage of the stubble resulted in significantly higher SCN densities than no-tillage in two out of three years. Nonetheless, plots with wheat residue, regardless of tillage, always had significantly fewer cysts at harvest than plots without wheat residue. In contrast, across residue treatments, tillage alone did not significantly effect harvest densities of SCN in any year. Thus, it appears that the main influence on SCN harvest densities is the result of wheat residue being present and not tillage, per se. Tillage, however, is apparently important as it relates to the disturbance of the wheat residue prior to planting doublecrop soybeans. In 1990, the residue effect was noted as early as six weeks after planting. In 1991 and 1992, however, the effect did not become evident until the latter part of the growing season. Soybean yields in 1991 and 1992 were not enhanced by the residue effect, possibly because of the lateness of its onset. Yields in 1990 could not be obtained because of extensive deer feeding to plots. Preliminary studies in 1992 indicated that both wheat straw and wheat crowns/roots must be present if the maximum residue effect is to be obtained. However, significantly lower SCN densities developed in plots containing either component of the harvested wheat crop, as compared to plots with no wheat residue. Significantly lower soil temperatures and higher soil moistures were found to exist in plots with wheat residue as compared to plots without wheat residue. However, these factors did not completely account for the residue effect. Studies into the cause of the residue effect on SCN will be expanded in 1993.

Riggs, R. D. Survival of Soybean Cyst Nematode

Much of the Pine Tree Station has been planted in pasture for 40 or more years. The pasture consisted of a mixture of grasses and nongrasses, including a sprinkling of common lespedeza. Soil samples were taken from pasture areas and nematodes were extracted. In a few instances cyst nematode juveniles were extracted but they reproduced on clover, not on soybean. When the pasture was tilled and soybean was planted, within 2-3 years soybean cyst nematodes (SCN) were found, often in high numbers. In 1987 blocks 1-5 and 7 in pasture areas and blocks 6 and 8 in wooded areas, blocks 3.0 meters square, were worked with equipment that was free of soil containing cyst nematodes and planted with an SCN-susceptible soybean cultivar. No cyst nematode cysts or juveniles were extracted from soil samples taken before the blocks were planted. In 1988, at harvest no cysts or J2 were extracted from samples from any plots. In 1989 a few cyst J2 were extracted from a few plots. In 1991 populations levels of cysts were: block 1, 10; 2, 29; 3, 1; 4, 0; 5, 0; 6, 0; 7, 31; and 8, 0/100 $cm^3$ soil; eggs counts were: block 1, 1,440; 2, 3,120; 3, 0; 4, 0; 5, 0; 6, 0; 7, 2,000; and 8, 0/100 $cm^3$ soil. In 1992 cyst counts were 97; 193; 1; 70; 0; 0; 680; and 0/100$cm^3$ soil in blocks 1-8, respectively; egg counts were 8,640; 40,320; 0; 16,080; 0; 0; 261,600; and 0/100$cm^3$ soil in blocks 1-8, respectively. The question that remains unanswered is "were the cysts residual from an earlier time (40-50 years ago) when soybean was grown or "were the cysts blown in by the wind or carried by birds?" Department of Plant Pathology, University of Arkansas, Fayetteville,AR.

Riggs, R. D. Effects of Planting Date on Population Dynamics of Soybean Cyst Nematode on Soybean

Soybean cultivars in Maturity Groups (MG) III and IV have shorter growing seasons than cultivars usually grown in Arkansas. Shorter season cultivars are being grown to extend the planting and harvest seasons and to escape the late summer drought. Much of the soil on which soybean is grown in Arkansas is infested with soybean cyst nematodes (SCN), and the cultivar affects the population dynamics of SCN and the consequent soybean yield. Cultivars in MG III and IV were compared with cultivars in MG V, VI and VII usually grown in Arkansas. All cultivars were planted in April, May and June in three locations. All 5 cultivars were susceptible to SCN. Little SCN reproduction (Pf/Pi) occurred on the MG III cultivar planted in April or May but the least reproduction was on the MG V cultivar planted in June. The average reproductive index (RI) for April-planted soybean was less than 1 with the MG VII cultivar having the highest RI at 0.85 for cysts, 0.87 for eggs and 0.89 for eggs plus juveniles combined. The highest RI occurred on the MG VII cultivar regardless of the nematode stage considered, planting time, or location. The second highest RI were on the MG VI cultivar. Yields were generally lowest on April-planted and highest on May-planted cultivars. The MG V and VI cultivars yeilded the most when months were averaged together. Only in 1 of 4 tests were yeilds negatively correlated with nematode counts. In 3 of the 5 cultivars final cyst counts were negatively correlated with yields. Department of Plant Pathology, University of Arkansas, Fayetteville, AR.

SELECTION OF SOYBEAN CYST NEMATODE RESISTANT CULTIVARS TO OPTIMIZE YIELD

Lawrence D. Young, USDA, ARS, Nematology Research, Jackson, TN 38301-3201

Producers have a multitude of soybean cultivars to select among for planting in fields infested with the soybean cyst nematode (SCN), Heterodera glycines Ichinohe. Some of the cultivars have resistance to Race 3 only, some have resistance to two races, and some have resistance to all SCN races. These cultivars vary in yield potential as evidenced by results of state yield trials. The highest-yielding cultivars in the 1990 University of Tennessee yield trials with these various combinations of SCN resistance were chosen to determine the consequence of selecting the different resistant cultivars for fields with differing SCN races.

'Asgrow A5979' (resistant to Races 3 and 14), 'Cordell' (resistant to Races 3 and 5), 'Deltapine 415' (resistant to Race 3), 'Hartwig' (resistant to all races and considered the best selection when the SCN race in a field was unknown) and 'Hutcheson' (susceptible to all races) cultivars were grown in three fields for two years. One field was infested with Race 3, one field was infested with Race 14 , and one field was infested with a population which typed as Race 9 in 1991 and as Race 4 in 1992. Cyst densities in the different fields ranged from 45 to 225 cysts per pint. Across all tests, yield of Asgrow A5979 (47.3 bu/A) was significantly greater than the other cultivars, and Hutcheson (39.4 bu/A) yielded significantly less than both A5979 and Deltapine 415 (43.2 bu/A). However, there were significant interactions between years, cultivars, and trials. Significant differences among cultivars occurred in four of the six tests; A5979 had greater yield than Hutcheson in all four of these tests. Hartwig yielded significantly less than Asgrow A5979 in three of the tests with significant yield differences.

Selecting the highest-yielding cultivar in the state yield trial that also had resistance to the nematode race present in a particular field gave the highest yield in these tests. However, this technique of cultivar selection requires knowledge of the nematode race infesting each field. Hartwig (42.0 bu/A) averaged 5.3 bushels per acre less than Asgrow A5979 in these tests. The difference in yield between these two cultivars on one acre would cover the cost of a race determination test for an entire field.

KIM, D.G. and R.D. RIGGS. Effects of carriers of ARF18 fungus on the control of soybean cyst nematode.

Seven different carriers of ARF18, Na alginate pellets, diatomaceous earth, southern clay, millet, pea, rice, and wheat grain were tested for the control of soybean cyst nematode (SCN), Heterodera glycines in a greenhouse. Na alginate pellets was formulated from ARF18 mycelium grown in shaker culture with pea juice. Others were cultured in 500 ml flask for 1 month. The products were dried under a hood and applied directly. Each carrier was applied at the rate of 2, 5, and 10 g/10-cm-d pot, mixed with 7,000 eggs of SCN, and planted with a Lee 74 soybean. Equal amount of autoclave-sterilized alginate pellets and no treatment served as controls. Nematodes were extracted and counted after 2 months. All carriers at all rate were effective (Waller's k=500) in controlling SCN with population level reductions of 90-99% (eggs) and 60-99% (cysts). Diatomaceous earth was the most effective carrier reducing the egg population levels by 98, 99, and 99% at the rate of 2, 5, and 10 g/pot.
Department of Plant Pathology, University of Arkansas, Fayetteville, AR 72701.

*Simultaneous Screening in Greenhouse for Frogeye Leaf Spot and Cyst Nematode in Soybeans*

**W. K. Cork and S. C. Anand**
**University of Missouri**
**Delta Center**
**Portageville, MO 63873**

Soybean cyst nematode (SCN), *Heterodera glycines* and Frogeye Leaf Spot (FLS), *Cercospora sojina* are two of the major diseases of soybeans. Greenhouse techniques have been developed to isolate resistant lines, however, time, space, labor and seed supply often limit a breeders ability to screen for multiple pest species. The present study was undertaken to determine if concurrent screening could be done for varietal response to both diseases.

Nine varieties with different combinations of resistant/susceptible reactions to FLS and SCN were planted in sterile soil. Five days after planting, seedlings were inoculated with 0, $1 \times 10^3$ or $2 \times 10^3$ eggs from a Race 3 population of SCN. At 14 days, plants were topped above the unifoliate leaves which were then sprayed with a FLS Race 5 conidial suspension of 0, $7 \times 10^3$, $1.5 \times 10^4$ spores/ml using a freon propelled atomizer. The inoculated plants were placed within a plastic humidity tent for 3 days after which they were placed on a greenhouse bench. At 30 days the plants were rated by counting number of cysts/plant on the roots and for FLS lesion number and size of lesion on the unifoliate leaves. A split-split plot design was used with variety as the mainplot, SCN egg number as the subplot, and spore number as sub-subplot. Analysis was conducted on COSTAT.

Results showed the expected varietal differences in cyst numbers and lesion numbers as resistant and moderately resistant varieties showed a lower disease rating than susceptible ones. Inoculation with $2 \times 10^3$ SCN eggs produced significantly greater number of cysts/plant compared with those inoculated with $1 \times 10^3$ eggs. Similarly, inoculation with $1.5 \times 10^4$ FLS spores produced more lesions than did $7 \times 10^3$ spores. There was no interaction between SCN and FLS disease ratings as the disease incidence remained almost constant at the two inoculation levels. These results indicate that screening for soybean cyst nematode and Frogeye Leaf Spot reaction could be done in the greenhouse simultaneously without any detrimental effects. This would save time and labor required to test them separately.

## CORRELATION OF STEM CANKER SUSCEPTIBILITY TO SOYBEAN YIELD LOSS

G. L. Sciumbato, Delta Research and Extension Center, MAFES, Stoneville, MS 38776

Soybean cultivars (maturity groups (MG) IV-VIII) grown in the 1992 Mississippi yield trials were evaluated for stem canker (*Diaporthe phaseolorum* var. *caulivora*) susceptibility using both the toothpick and grain sorghum methods in replicated plots. For the toothpick method, four twelve-plant replicates of each cultivar were inoculated in the upper one-third of the plant with a toothpick infested with the stem canker fungus five weeks after planting. Lesion length was determined at the R5 growth stage. For the grain sorghum method, the fungus was grown on sterile white grain sorghum which was spread out to dry and stored in paper bags after the fungus had overgrown it. Plots were inoculated by spreading 60 ml of this material over 20 ft of row at one and three weeks after planting. Twenty-four of the thirty-one MG IV entries were resistant to stem canker. Yields were not correlated to stem canker susceptibility. Twenty of the sixty entries in MG V were resistant to stem canker. Stem canker rating and yield were not strongly correlated in this group ($R= -0.13$, $P=0.06$); possibly, the correlation is much stronger in late-maturing members of MG V. Cultivars rated S-VS yielded in the lower one-fourth of the sixty entries. Seventeen of the sixty entries in MG VI and thirteen of the thirty-one entries in MG VII-VIII were resistant to stem canker. Yield loss was strongly correlated (Group VI, $R = -0.49$, $P = .001$, Group VII and VIII $R = -0.52$, $P = .001$) with stem canker susceptibility in these maturity groups.

The toothpick method correlated strongly with yield loss potential from stem canker in MG VI, VII and VIII. Soybeans in the MG IV and some of the MG V may have escaped symptom expression and yield loss by maturing before the disease had developed.

# EFFECT OF CROP ROTATION, TILLAGE AND PLANTING DATE ON STEM CANKER INCIDENCE IN SOYBEAN

J. H. Edwards, D. B. Weaver, P. A. Backman, and M. E. Ruf. USDA-ARS, Department of Agronomy and Soils, Department of Plant Pathology, Sand Mountain Substation, Auburn University, AL 36849

Effects of tillage and planting date on southern stem canker (caused by *Diaporthe phaseolorum* f. sp. *meridionalis*) severity are well known. Because infested crop debris serves as the major source of primary inoculum, any tillage system that leaves crop debris on the soil surface, such as no-till, increases stem canker incidence. Delayed planting can reduce stem canker severity by avoiding initial inoculum spread. Effects of crop rotation on stem canker are not well documented, however. Our objective was to determine the effect of crop rotation and the interaction of crop rotation with tillage on two soybean cultivars, 'Essex' (moderately resistant) and 'Forrest' (moderately susceptible). A severe epiphytotic of stem canker occurred during 1992 in the 12th year of a cropping system and tillage experiment. The experimental design was a randomized complete block with four replications. Factorial treatments were tillage (conventional, strip-till, and no-till) (whole plots), crop rotation (continuous soybean, soybean following corn and soybean planted late following wheat for grain) (split plots), and cultivar (split-split plots). Plot size was 4 rows .76 m wide and 15 m long. Plots were rated for stem canker development at the R6 development stage using the pretransformed arc sine scale (Plant Dis. 69:641-647) and harvested for yield.

Stem canker ratings were higher for the strip- (2.1) and no-till (1.7) than for conventional tillage (0.8) averaged over cultivars. Stem canker ratings averaged 2.8 for continuous soybean, 1.8 for soybean following corn and 0 for soybean planted late behind wheat, however, the tillage × crop rotation interaction was large and significant for both cultivars. Under conventional tillage stem canker ratings were not affected by rotation, but under strip- and no-till, rotation with corn greatly reduced stem canker incidence. Thus crop rotation had no added benefit for stem canker control under conventional tillage. Yields were related to the stem canker resistance of the two cultivars. Essex yield was unaffected by tillage, but was higher following corn or wheat than continuous soybean. Forrest yield was higher under conventional tillage than strip- or no-till, highest when planted late after wheat and lowest under monoculture. The tillage × crop rotation interaction was significant for both cultivars, with crop rotation having less effect on yield under conventional tillage than under strip- and no-till. Overall, Essex yielded more than Forrest. We concluded that crop rotation may be an effective method of managing stem canker, particularly under tillage systems that tend to leave crop debris on the soil surface. Under conventional tillage stem canker ratings were low, and rotation offered no added benefit for stem canker control.

# INFECTION TIMING AND THE DEVELOPMENT OF STEM CANKER IN SOYBEAN

E.A. Sutton and J.C. Rupe, University of Arkansas
Fayetteville, AR

Stem canker, caused by *Diaporthe phaseolorum* var. *caulivora*, is a mid-season disease that can cause dramatic yield losses. Highly dependent on the environment, stem canker only occurred in a few fields in Arkansas before 1989. While disease loss in these fields was severe, most growers did not manage their crop for the control of stem canker believing that they either did not have the disease or that it was of no importance. In 1989, the combination of the widespread use of very susceptible cultivars and optimum weather conditions led to dramatic disease losses statewide. Since 1989 no such outbreaks of stem canker have occurred, but the potential for another epidemic exists.

Research conducted in the early 1980's by various scientists indicated that stem canker has a prolonged latent period. Stem canker symptoms, which include canker formation, interveinal chlorosis and necrosis, and plant death, develop during pod set only if infection had occurred during vegetative growth. Fungicides were shown to be effective if applied during vegetative growth, but the results were variable, suggesting that application timing is critical for the effective use of fungicides. The purpose of the research presented here is to define the period of plant growth in which infection leads to disease.

The experiment was conducted in microplots at the University of Arkansas experiment farm in Fayetteville and consisted of 6 treatments: non-inoculated control and inoculated at either V1, V4, V6, V10, or R2. The microplots consisted of plastic, 19 L barrels filled with fumigated soil. The microplots were planted to the susceptible soybean cultivar, Forrest on 11 May and thinned to 10 plants/plot after the first inoculations. Inoculum was produced by growing an isolate of *D. phaseolorum* var. *caulivora* collected in southwest Arkansas on Phillip's selective medium in which sterilized soybean stems had been added. After incubating for a month at room temperature, the plates were flooded with sterile water, rubbed with a rubber policeman, the suspension was filtered through cheesecloth, Tween 20 was added (6 drops/L) and the inoculum concentration adjusted to $10^6$ conidia/ml. Plants were sprayed to runoff and a white garbage bag secured over the microplot to retain moisture. To monitor the effectiveness of the inoculations, a 4 inch pot of 2-week-old Forrest seedlings were placed in the center of each inoculated plot at the time of inoculation. After two days the bag was removed and the potted seedlings removed. The stems and petioles of these seedlings were plated on the selective medium to determine the level of infection by *D. phaseolorum* var. *caulivora*. The microplots were monitored weekly for during reproductive development for disease. Yields were taken from each microplot.

Infection of potted plants ranged from 60 to 100% for all inoculated treatments. Stem canker symptoms appeared first on 4 August in the V4 and V6 treatments followed by the V1 treatment on 8 August, the V10 treatment on 1 September, and the R2 treatment on 15 September. Cankers formed in the top of the plant in the R2 treatment instead of on lower nodes as with the other treatments. Disease developed fastest in the V6 treatment, but by late R6 (22 September) there was no significant differences between any of the treatments inoculated during vegetative growth. There was a significant negative correlation between the amount of disease on 22 September and yield (R=-0.88).

FURTHER EVALUATION OF EARLY-SEASON FUNGICIDE SPRAYS FOR SOYBEAN STEM CANKER CONTROL

Albert Y. Chambers, Department of Entomology and Plant Pathology, University of Tennessee, Jackson, TN 38301-3200

Early-season applications of half normal rates of fungicides reduced stem canker severity and increased soybean yields significantly in 1988-89. In 1990-92, Benlate (benomyl) fungicide was applied at 0.25 lb/A at V4 growth stage to a highly susceptible cultivar ('RA 604'), to a moderately susceptible cultivar ('Essex', 1990; 'Deltapine 105', 1991; 'Coker 6955', 1992), and to a moderately resistant cultivar ('Deltapine 415', 1990; 'TN 5-85', 1991; 'Pioneer 9551', 1992). An additional sub-plot of each cultivar main plot in a split-plot design was sprayed twice (Benlate, 0.25 lb/A, V4 stage and two weeks later). One sub-plot was unsprayed. Fungicide applications were made with a field sprayer with three spray nozzles per row. In 1990, stem canker severity was low. Fungicide applications reduced the low level of stem canker significantly compared to no treatment, but yields were not increased. Ratings of stem canker severity were lower in Essex than in RA 604 while those in Deltapine 415 were lower than in Essex or RA 604. Single application was less effective than two applications in all cultivars, but differences were not large except in RA 604. Stem canker severity was moderate in 1991. Fungicide applications reduced disease severity significantly in all cultivars compared to untreated. Yields were increased significantly (ca. 10 bu/A) in fungicide-treated RA 604 but were not increased in Deltapine 105 and TN 5-85. Stem canker severity was lower in Deltapine 415 than in RA 604 and was lower in TN 5-85 than in the other two cultivars. Single application was again slightly less effective in reducing disease severity than two; yields in RA 604 were not significantly different with one or two applications. In 1992, stem canker was severe but appeared relatively late. Applications of the fungicide reduced stem canker severity significantly in all three cultivars. Yields were increased significantly (almost two-fold, ca. 20 bu/A) in RA 604 that received fungicide applications but were not increased in Coker 6955 and Pioneer 9551. Stem canker severity was lower in Coker 6955 than in RA 604; severity in Pioneer 9551 was lower than in the other cultivars. The single application was less effective than two in reducing stem canker severity in all cultivars, but yields in RA 604 were not significantly different between one and two applications. Results indicate that if it were necessary, or desirable, to plant a cultivar highly susceptible to stem canker, early-season fungicide applications could give effective disease control. One application would probably be more economical although generally slightly less effective.

# SOUTHERN UNITED STATES SOYBEAN DISEASE LOSS ESTIMATE FOR 1992

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 1992, soybean yield losses due to diseases were below normal and yields were above normal. The crop loss estimate from all pathogens in 1992 was 11.11 percent. This resulted in a 54,090,000 bushel loss worth 311,050,000 dollars.

Soybeans and soybean products continue to be very important southern agricultural commodities. In 1992, 559,795,000 bushels were harvested from 17,350,000 acres. Average yields (bu/A) for each southern state in 1992 were as follows: Alabama, 27; Arkansas, 33; Delaware, 32; Florida, 32; Georgia, 27; Kentucky, 37; Louisiana, 29; Maryland, 37; Mississippi, 32; Missouri, 36; North Carolina, 27; Oklahoma, 22; South Carolina, 22; Tennessee, 33; Texas, 31 and Virginia, 31.

## 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 solicited annually 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 at a cost of $5.75 per bushel times the estimated loss.

## RESULTS AND DISCUSSION

Soybean growing conditions were ideal in most southern locations in 1992. Nematodes reduced yields by an estimated 21.63 million bushels worth 124.38 million dollars. It is estimated that soil diseases reduced yields by 9.36 million bushels worth 53.82 million dollars, less than one-half the amount of loss recorded in 1991. Foliage, pod, and stem diseases cost growers about 132.85 million dollars by reducing yields 23.10 million bushels. At the established average annual price received by southern soybean growers ($5.75/bushel), the 54.09 million bushel loss due to diseases cost growers an estimated 311.05 million dollars.

Total average percent soybean disease loss in the southern states in 1992 is estimated at 11.11. Florida reported the highest disease loss at 27.5 percent. States reporting disease losses of 10 percent or over were Arkansas (13.6), Florida (27.5), Georgia (11.0), Louisiana (16.0), Maryland (10.5), North Carolina (15.8), South Carolina (16.4), Tennessee (10.5) and Texas (12.9).

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

Table 1. Estimated percent loss of soybean yields in 1992 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 | 1.0 | TR* | 2.5 | .25 | .1 | TR | -- | TR | TR | .1 | .3 | .2 | 1.5 | .5 | .2 | .43 |
| Root & stem rots | .2 | .5 | TR | 10.0 | .25 | .1 | .5 | -- | TR | TR | .5 | .3 | 1.75 | .5 | 2.0 | .1 | 1.04 |
| Diaporthe-pod & stem blight | .5 | .1 | TR | 1.0 | .5 | 1.5 | 2.0 | .5 | .5 | -- | .1 | 1.75 | 1.0 | .01 | 3.0 | .1 | .79 |
| Charcoal rot | .3 | .1 | .5 | TR | -- | .2 | 1.0 | -- | 2.0 | 1.5 | .1 | 2.0 | .05 | 1.0 | .3 | -- | .57 |
| Sudden death syndrome | .2 | .5 | -- | -- | -- | .8 | TR | -- | .25 | TR | -- | -- | -- | .5 | .1 | -- | .15 |
| Stem canker | .2 | .4 | -- | -- | -- | TR | .5 | -- | TR | -- | -- | -- | .01 | .5 | .1 | -- | .11 |
| Anthracnose | 1.4 | .5 | TR | 1.0 | .25 | .3 | 1.0 | TR | TR | -- | .01 | 2.0 | 1.5 | 1.5 | 4.0 | -- | .84 |
| Downy mildew | .2 | 1.0 | TR | TR | -- | TR | TR | -- | TR | -- | TR | TR | .1 | .2 | -- | -- | .09 |
| Cercospora-purple seed stain and blight | .1 | .5 | TR | .5 | .75 | TR | 2.0 | 5.0 | .3 | -- | .01 | 1.0 | .5 | .01 | 1.0 | .1 | .74 |
| Brown leaf spot | .5 | 1.0 | -- | TR | .5 | .3 | TR | TR | TR | -- | .1 | .3 | .2 | 2.0 | .1 | .2 | .33 |
| Foliar diseases (other) | .5 | 1.0 | -- | -- | 1.5 | -- | 1.0 | -- | TR | -- | .02 | 1.0 | .5 | .1 | 1.0 | -- | .41 |
| Bacterial diseases | .1 | 2.0 | -- | -- | -- | TR | TR | -- | TR | -- | -- | .05 | .05 | -- | TR | -- | .14 |
| Virus diseases | .1 | 1.0 | TR | -- | 1.0 | .1 | 1.0 | -- | .01 | .2 | .6 | TR | .5 | -- | .1 | .1 | .29 |
| Soybean cyst nematodes | 1.5 | 3.0 | 3.0 | 1.0 | 2.5 | 2.6 | 2.0 | 4.0 | .05 | 4.0 | 7.0 | .7 | 3.0 | 2.5 | .1 | 3.0 | 2.50 |
| Root-knot nematodes and ecto-parasitiac types | 1.0 | 1.0 | 1.0 | 11.5 | 3.5 | -- | 2.0 | 1.0 | .05 | TR | 1.7 | TR | 7.0 | .1 | .5 | .4 | 1.92 |
| Other diseases** | 1.5 | -- | -- | -- | -- | -- | 3.0 | -- | -- | 1.0 | 5.6 | -- | -- | .1 | .1 | .8 | .76 |
| Total Percent Loss*** | 8.5 | 13.6 | 4.5 | 27.5 | 11.0 | 6.0 | 16.0 | 10.5 | 3.16 | 6.7 | 15.84 | 9.4 | 16.36 | 10.52 | 12.9 | 5.0 | 11.11 |

* TR = Trace

** Other diseases or yield loss include Rhizoctonia foliar blight (LA), Fusarium root rot (MO), air pollution (NC), Frog eye leaf spot (AR) and (TN) and Red crown rot (VA).

*** Rounding errors present.

Table 2. Estimated reduction of soybean yields in 1992 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 | .01 | 1.05 | TR | .04 | .04 | .04 | TR | -- | TR | TR | .04 | .02 | .03 | .47 | .06 | .03 | 1.83 | 10.52 |
| Root & stem rots | .01 | .53 | TR | .16 | .04 | .04 | .17 | -- | TR | TR | .19 | .02 | .23 | .16 | .24 | .02 | 1.81 | 10.41 |
| Diaporthe-pod & stem blight | .04 | .11 | TR | .02 | .09 | .64 | .70 | .10 | .28 | -- | .04 | .09 | .13 | .003 | .35 | .02 | 2.61 | 15.01 |
| Charcoal rot | .02 | .11 | .03 | TR | -- | .09 | .35 | -- | 1.12 | 2.30 | .04 | .11 | .007 | .31 | .04 | -- | 4.53 | 26.05 |
| Sudden death syndrome | .01 | .53 | -- | -- | -- | .34 | TR | -- | .14 | TR | -- | -- | -- | .16 | .01 | -- | 1.19 | 6.84 |
| Stem canker | .01 | .42 | -- | -- | -- | TR | .17 | -- | TR | -- | -- | -- | .001 | .16 | .01 | -- | .77 | 4.43 |
| Anthracnose | .10 | .53 | TR | .02 | .04 | .13 | .35 | TR | TR | -- | .004 | .11 | .20 | .47 | .47 | -- | 2.42 | 13.92 |
| Downy mildew | .01 | 1.05 | TR | TR | -- | TR | TR | -- | TR | -- | -- | TR | .01 | .06 | -- | -- | 1.13 | 6.50 |
| Cercospora-purple seed stain and blight | .007 | .53 | TR | .008 | .13 | TR | .70 | 1.0 | .17 | -- | .004 | .05 | .07 | .003 | .12 | .02 | 2.81 | 16.16 |
| Brown leaf spot | .04 | 1.05 | -- | TR | .09 | .13 | TR | TR | TR | -- | .04 | .02 | .03 | .63 | .01 | .03 | 2.07 | 11.90 |
| Foliar diseases (other) | .04 | 1.05 | -- | -- | .26 | -- | .35 | -- | TR | -- | .008 | .05 | .07 | .03 | .12 | -- | 1.98 | 11.39 |
| Bacterial diseases | .007 | 2.10 | -- | -- | -- | TR | TR | -- | TR | -- | -- | .003 | .007 | -- | TR | -- | 2.12 | 12.19 |
| Virus diseases | .007 | 1.05 | TR | -- | .17 | .04 | .35 | -- | .006 | .30 | .23 | TR | .07 | -- | .01 | .02 | 2.25 | 12.94 |
| Soybean cyst nematodes | .11 | 3.15 | .21 | .02 | .43 | 1.11 | .70 | .81 | .03 | 6.10 | 2.65 | .04 | .40 | .78 | .01 | .47 | 17.02 | 97.87 |
| Root-knot nematodes and ecto-parasitiac types | .07 | 1.05 | .07 | .18 | .60 | -- | .70 | .20 | .03 | TR | .64 | TR | .92 | .03 | .06 | .06 | 4.61 | 26.51 |
| Other diseases | .11 | -- | -- | -- | -- | -- | 1.04 | -- | -- | 1.50 | 2.12 | -- | -- | .03 | .01 | .13 | 4.94 | 28.41 |
| Total Disease Loss** | .62 | 14.28 | .31 | .44 | 1.90 | 2.55 | 5.57 | 2.12 | 1.77 | 10.25 | 6.00 | .50 | 2.16 | 3.30 | 1.52 | .80 | 54.09 | |
| Dollar loss x $10^6$*** | 3.57 | 82.11 | 1.78 | 2.53 | 10.93 | 14.66 | 32.03 | 12.19 | 10.18 | 58.94 | 34.50 | 2.88 | 12.42 | 18.98 | 8.74 | 4.60 | | 311.05 |

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

** Rounding errors present.

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

Table 3. Southern states soybean disease loss estimate total in bushels and dollars, 1992.

| DISEASE | BUSHEL LOSS x $10^6$* | DOLLAR LOSS x $10^6$** |
|---|---|---|
| Soil-borne diseases | | |
| Seedling | 1.83 | 10.52 |
| Root and lower stem rots | 1.81 | 10.41 |
| Charcoal rot | 4.53 | 26.05 |
| Sudden death syndrome | 1.19 | 6.84 |
| SUBTOTAL | 9.36 | 53.82 |
| Nematodes | | |
| Soybean cyst nematodes | 17.02 | 97.87 |
| Root-knot and other nematodes | 4.61 | 26.51 |
| SUBTOTAL | 21.63 | 124.38 |
| Foliar diseases | | |
| Diaporthe pod and stem blight | 2.61 | 15.01 |
| Stem canker | .77 | 4.43 |
| Anthracnose | 2.42 | 13.92 |
| Downy mildew | 1.13 | 6.50 |
| Cercospora | 2.81 | 16.16 |
| Brown leaf spot | 2.07 | 11.90 |
| Bacterial diseases | 2.12 | 12.19 |
| Other foliar fungi | 1.98 | 11.39 |
| Virus | 2.25 | 12.94 |
| Others | 4.94 | 28.41 |
| SUBTOTAL | 23.10 | 132.85 |
| TOTAL | 54.09*** | 311.05*** |

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

** The dollar loss is derived by multiplying bushel loss by $5.75/bushel.

*** Rounding errors present.

SSDW TREASURERS REPORT
12/31/1991 TO 12/31/1992

OPERATIONAL ACCOUNT [redacted]
1ST NATL. BANK OF OPELIKA

BALANCE ON 12/31/1991..............................$ 22,477.75

RECEIPTS FROM 12/31/1991 TO 12/31/92

INTEREST ON OPERATIONAL ACCOUNT ...................$ 580.53

PUBLICATION REVENUES ..............................$ 324.00
1990 MEETING RECEIPTS .............................$ 3300.00

AND HOSPITALITY CONTRIBUTIONS......................$ 475.00
STANDARDIZED SEED TREATMENT RECEIPTS...............$ 0.00

TOTAL RECEIPTS AS OF 12/31/1992 ...................$ 4679.53

---

DISBURSEMENTS FROM 12/31/91 TO 12/31/92

STANDARDIZED SEED TREATMENT DISBURSEMENTS $14,925.00
POSTAGE AND PRINTING COSTS ........................$ 521.96
SECRETARIAL FEES ..................................$ 91.00
SSDW MEETING EXPENSES .............................$ 2000.55
STUDENT AWARDS ....................................$ 750.00
MEETING AWARDS ....................................$ 233.30
CPA FEES ..........................................$ 325.00
BANKING CHARGES ...................................$ 61.00

TOTAL DISBURSEMENTS AS OF 12/31/1992 ..............$ 18907.81

---

SSDW ASSETS AS OF 12/31/1992

TOTAL 1992 REVENUES ...............................$ 4,679.53
BALANCE OF OPERATIONAL ACCOUNT ON 12/31/1991 .....$ 22,477.75
TOTAL DISBURSEMENTS FOR 1992 OPERATING YEAR ....- $ 18,907.81
NET ASSESTS OF SSDW AS OF 12/31/1992 $ 8,249.47
BANK BALANCE AS OF 12/31/1992 $ 8,249.47

[redacted] 12/31/1992

GLENN G. HAMMES TREASURER SSDW

# SOUTHERN SOYBEAN DISEASE WORKERS

## 1992-1993 COMMITTEE CHAIRS

| | |
|---|---|
| AUDIT | Robert Mulrooney<br>University of Deleware |
| AWARDS | Donald E. Hershman<br>University of Kentucky |
| DISEASE LOSS | Gabe Sciumbato<br>Mississippi State University |
| DISEASE RESISTANCE | Paul Gibson<br>Southern Illinois University |
| EDUCATIONAL RESOURCES | Patrick D. Colyer<br>Louisiana State University |
| GRADUATE STUDENT PAPERS | Joe Fox<br>Mississippi State University |
| HOSPITALITY | Chip Graham<br>Gustafson |
| LOCAL ARRANGEMENTS | Bill Gazaway<br>Auburn University |
| NEMATOLOGY | Terry Niblack<br>University of Missouri |
| NOMINATIONS | J. Allen Wrather<br>University of Missouri |
| PROGRAM | John C. Rupe<br>University of Arkansas |
| PUBLIC RELATIONS | Melvin Newman<br>University of Tennessee |
| SEED PATHOLOGY | Bill Gazaway<br>Auburn University |
| SITE SELECTION | Phillip Pratt<br>Oklahoma State University |
| STEERING | Patrick D. Colyer<br>Louisiana State University |

# SOUTHERN SOYBEAN DISEASE WORKERS

## 1992 AWARD RECIPIENTS

| | |
|---|---|
| Past President Award | J. Allen Wrather<br>University of Missouri |
| Distinguished Service Award | |
| Junior Award | Gary W. Lawrence<br>Mississippi State University |
| Senior Award | Glenn G. Hammes<br>DuPont |
| Graduate Student Award | |
| 1st Place | K.S. McLean<br>Mississippi State University |
| 2d Place | S.R. Kendig<br>University of Arkansas |