Pest Management Strategic Plan for Soybeans in the Mid-South Region of Arkansas, Louisiana, and Mississippi

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Vicksburg, Mississippi

Sponsored by:

The Southern Region Pest Management Center

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(bold type indicates table)

EXECUTIVE SUMMARY

The purpose of a Pest Management Strategic Plan (PMSP) is to communicate, from an industry perspective, the role of pesticides and pest management strategies in crop production. To obtain broad-based industry input, PMSPs are developed for a commodity through the use of workshops which bring together producers, crop consultants, commodity groups, and pest management specialists from across the production region. Although PMSPs were originally intended for use by the Environmental Protection Agency (EPA), they have also proved valuable to the United States Department of Agriculture (USDA), Land Grant Universities, and pest management stakeholders at all levels.

This PMSP was prepared at a workshop held on the 1st of September, 2004, in Vicksburg, Mississippi. Nineteen participants, representing diverse aspects of soybean pest management and production regions, attended the meeting. This document is meant to be representative of pest management challenges faced by soybean producers in the Mid-South Region. In addition to providing input on pests and pest control methodologies, workshop attendees identified research, education and regulatory issues that impact producer profitability and environmental quality. As part of their final task at the meeting attendees prioritized the issues that they thought were the most critical to soybean pest management. As mentioned, the original intent of this report was to provide the EPA with the pest management perspectives of soybean producers, consultants, and other pest management specialists. As such, it primarily reflects the comments and inputs of those parties who attended the workshop. As with any group of individuals, the scope of knowledge as well as opinions of participants vary greatly, and in its current form this document captures that scope and diversity.

This Strategic Plan should be viewed as a work in progress as future versions will undoubtedly result in an improved product. Throughout the text of this document an effort has been made to identify regional differences in pests, their treatment, and the research, educational, or regulatory issues producers in those regions would like to see addressed. The "toolbox" approach we have used has focused on crop protection products and crop production tactics that are important for the economic management of key pests of soybean in the 3 mid-southern states. For some pests, there were variations throughout the region regarding which pests were considered "risk drivers" for pesticide use or for grower implementation of other "non-pesticide" practices.

High Priority Items for Research, Educational, and Regulatory Needs by Discipline

Below is a list of the high priority items by discipline. The entire list of identified priority items is found near the end of this document.

It should be noted that two items of discussion appeared to dominate the list of priorities: Asian Soybean Rust and the impact of glyphosate-tolerant soybeans on all pest pressures.

Very recently, many chemical companies and university researchers evaluated and registered fungicides for the control of Soybean Rust. The active ingredients and trade names are too new to include in this document. If detected early, it appears that the disease can be controlled sufficiently, but fungicide application timing is crucial. The increased cost due to an increase in number of fungicide applications could decrease the acreage grown in the region. However, the economic impact may not be felt for 2 or 3 years. Since this disease will persist, ongoing research on its biology and control will continue.

How glyphosate-tolerant soybeans influence different pest pressures appears to be an increasing problem in the region. Weed management has become more difficult with the advent of more tolerant/resistant weeds. Tank-mix options for glyphosate are a priority. The continual use of glyphosate is also affecting insect complexes. Some studies show a decline in beneficial insects due to continued glyphosate use. Some resistant weeds can be an alternate host for insect pests.

WEEDS

Research Priorities:

1. Options for late-season grassy weed control.
2. The need for residual herbicide research, both efficacy and crop rotational effects.
3. Investigation of differential tolerance/resistance of multiple species (marestail, ryegrass, and others) to glyphosate.

Educational Priorities:

1. Education on the proper management of Johnsongrass
2. Convey to the growers the weeds resistant to glyphosate.
3. Drift management of glyphosate.

Regulatory Priorities:

1. Adding over-the-top applications to the labels of residual graminicides.
2. Reducing the Pre-Harvest Intervals (PHI) for certain herbicides.
3. Addition to the label of Permit (halosulfuron) to include low-rate usage as a preemergence herbicide in soybeans for sedge control.

DISEASES

Research Priorities:

1. Soybean Rust biology and control.
2. Investigation of disease thresholds – exactly how much damage do soybean diseases cause, and when should fungicides be applied?
3. Disease complex shifts in glyphosate-tolerant soybeans.

Educational Priorities:

1. Soybean Rust awareness and preparedness.
2. Scouting, identification, and threshold levels for each disease.
3. Proper timing and rates of fungicides.

Regulatory Priorities:

1. Registration of fungicides for Soybean Rust control.
2. Label expansion on fungicides to include other crops where certain soybean diseases can occur.

NEMATODES

Research Priorities:

1. Identification of resistant soybean varieties.
2. Accurate determination of races of the Cyst nematode.
3. Nematode influence on disease incidence.

Educational Priorities:

1. Positive identification of nematodes and symptomology

Regulatory Priorities:

1. Addition of a seed treatment to the labels of present chemicals.

INSECTS

Research Priorities:

1. The influence of glyphosate-tolerant soybeans on insect complexes.
2. Re-evaluate sampling procedures and thresholds.
3. Evaluate seed treatments for grape colaspis.

Educational Priorities:

1. Proper timing of insecticide applications.
2. Proper insect identification and scouting.

Regulatory Priorities:

1. Full registration of acephate (Orthene) for stink bug control in Arkansas and Louisiana.
2. Registration of existing safe "green" chemistry such as methoxyfenozide (Intrepid) for use in soybean production – no known obstacles to registration.
3. Addition of seed treatments to presently labeled insecticides.

GENERAL PRODUCTION INFORMATION

- In 2003, Arkansas, Louisiana, and Mississippi harvested 2.9 million, 740 thousand, and 1.4 million acres of soybeans, respectively.

- The corresponding values of production for the three states were $797 million, $173 million, and $382 million on yields averaging 38, 34, and 39 bushels per acre.

CULTURAL PRACTICES

Soybeans are an annual legume with pubescent stems and large pinnate leaves. Flowers are white or purple and found in axillary racemic clusters. The seedpods are pubescent, bearing 1 - 4 spherical seeds. The seeds are harvested and used for vegetable oils, shortening, margarine, bread flour, soy milk, meat substitutes, fibers, plastics, ink, and as protein supplements for livestock feed. Minor uses also include: adjuvants, pesticide carriers, and bases for pharmaceuticals.

Soybeans are adapted to a wide range of climatic and soil conditions. The recommended planting depth for no-till soybeans is 0.75-1.0". For conventional till, the recommended depth is 1.5-2.0". Under dry conditions, growers plant a little deeper, but no deeper than 2.0". On sandy soils, seeds are planted about 2.0" deep. Planting deeper than 2.0" may be necessary to get to soil moisture but delays emergence and reduces stands of some varieties. On loam and clay loam soils where resistance to no-till planting is great, and crusting more likely than on sandy soils, soybeans are planted 1.0-1.5" inches deep. Planting generally takes place mid-April through mid-June with an optimal soil temperature of 60°F.

When selecting a variety, several characteristics should be considered. Yield, herbicide tolerance, disease resistance, salt tolerance, maturity, and seed quality are just a few of the important factors to consider. Row spacing varies from 7" up to 40" depending upon planting equipment used.

Growers sometimes use minimum till or no-till methods to prevent excessive soil drying, reduce soil erosion, and reduce runoff of fertilizers and pesticides. However, seeds must be covered adequately with soil or they will not germinate. Inadequately covered seed is also subject to herbicide injury. Adding weight to the planter may be necessary to obtain the proper depth. Most of the moisture for soybean germination comes from the soil beneath the seed. Soybeans in the three-state region are generally harvested in September, October, and November.

WORKER ACTIVITIES

Land Preparation/Planting Methods/Cultivation – In conventional tillage, using a moldboard followed by disking and harrowing are good prime tillage operations. Double disking or disking and rowing are done in small enough acreage to avoid soil moisture loss. Soybeans are usually drilled on flat ground, but raised beds will enhance root zone drainage. Row feet on raised beds are usually 1000 feet or less to facilitate good drainage.

Conservation tillage systems for soybeans have evolved in the last 15-20 years in the southeastern U.S. for a variety of reasons. This system is defined as that which leaves at least 30% of the soil covered with residue from the previous crop. Usually the residue is maintained with herbicides and not the plow. Planters are equipped with a variety of coulters and press wheels to allow planting in existing vegetation. Reduced erosion, cost savings in land preparation and labor, and ease of planting are just a few good reasons to implement this system.

The stale seedbed system has developed in the last 10 years for soils of high clay content such as those in the river bottoms of Arkansas, Louisiana, and Mississippi. In this system, farmers will till the land in the fall after harvest and form rows allowing the rows to sit "stale" over the winter. Herbicides are applied to control the winter vegetation before planting the following spring.

Fertilization – Soybeans are not usually side-dressed with fertilizer during the growing season. For fields that have been grown to soybean before (i.e. are infested with the bacteria for fixing nitrogen), no nitrogen is required. The most frequent fertilizer requirements are for phosphorus and potassium which would be applied before planting. Deficiencies of micronutrients are rare. In certain cases, molybdenum is required to help in nitrogen fixation. There have been reports of Boron required, but these have largely been restricted to sandy soils in the Southeastern states along the Atlantic coast.

Irrigation – There are several methods of soybean irrigation used. Currently, irrigation of soybeans in Louisiana is limited relative to Arkansas to Mississippi. Methods include furrow irrigation in which the soybeans are planted on raised beds, allowing a furrow between each row. Water is then directed down the furrows when irrigation is needed. This is usually done using a material called "poly pipe". Poly pipe is a plastic material that is rolled out across the top of a soybean field and connected to an irrigation riser. Workers simply punch holes in places along the poly pipe to allow water to go into the furrow. Another method is flood irrigation in which the farmer has soybeans planted on flat land and simply runs poly pipe along the top of the field and allows water to flow across the field. The problem with this method is getting the water to spread evenly over the field. If the field is not sloped and graded properly and/or has depressions in certain areas, the water will flow to some areas of the field and leave others with none. The farmer ends up with a field that is only partly irrigated. Difficulties with flood irrigation led to the development of the "border irrigation" method in which soybeans are planted on flat land, small levees are made (not big enough to interfere with planting the rows) at certain intervals across the land. The interval depends upon the capacity of the farmer's pump to put out water. The greater the capacity of the pump, the greater the levee intervals can be. Land again needs to be sloped so that water will run down from the top of the field. Development of these bordered areas for flood irrigation allows greater control for irrigation across the field relative to flood irrigation. Occasionally, regular-sized levees are used if conditions are dry enough. A fourth irrigation method is pivot sprinkler irrigation in which sprinklers mounted on rollers are moved across a field to irrigate.

The rule-of-thumb is that irrigation for soybean is necessary whenever the available soil water falls to 50%. Factors that influence available soil water level are: soil type, initial amount of water in the soil at the start of the growing season, rain during the growing season, crop canopy cover, relative humidity, temperature, wind, tillage methods and genotypic factors.

The number of man hours required for irrigation depends upon the irrigation method. Simple flood irrigation requires the least effort, but also has the highest risk of failure (i.e. leaving certain areas of the field un-irrigated). All the other methods require more work because of greater land preparation and more irrigation management required. In some cases it is impossible to get a 100% accurate estimate of man-hours needed for irrigation, because of all the possible things that may go wrong during irrigation. For example, if a farmer is furrow irrigating, he may have some furrows that simply do not allow water to get to the end of the field, while all the others do. Therefore, he will have to be constantly opening and closing different pores in the poly pipe to get an even irrigation across the field. Then, there is an additional problem of getting water off the field to avoid water-logging stress. All these factors make prediction of man-hours difficult.

Scouting – Farmers or consultants are used for scouting. The recommendation is that soybean fields should be scouted at weekly intervals beginning with R1 (first flower) through to the end of seed filling (R7). Generally, for defoliating insects, farmers usually start checking for these in late August or early September, because this is usually when the loopers, velvet bean caterpillars, and green cloverworms begin to cause problems. Stink bugs become a problem around R5 stage (seed initiation), and this date can vary depending on variety and planting date.

Pesticide applications – Approximately 98% or more of the 100 HP and larger tractors used on modern farms have cabs and air conditioning. You will be hard-pressed to find any combine or self-propelled sprayer manufactured during the past five years that does not have a cab and AC. A few smaller farms may have older tractors that do not have cabs and AC. This situation exists on a very small percentage of the total acreage.

After-market activated charcoal filters can be purchased for the air conditioner on most tractors, combines and sprayers. This type filter is very helpful on sprayers if it is changed at recommended intervals. Keeping windows and door gaskets and latches in good condition will reduce operator exposure to dust and pesticides. Use of spray nozzles that minimize misting or creation of small drops is also helpful.

A large percentage of the burndown herbicide applications in conservation and stale seedbed preparation are applied aerially and almost exclusively by commercial means. Approximately 75% of herbicide applications within the crop are applied by the farmer using ground equipment. Others will contract aerial or custom applications. Approximately 70% of all insecticide applications are applied by air.

Harvesting – Basically, it only takes a combine and a truck to harvest soybeans. This can be done with as few as 2 people, one to drive the combine and the other to drive the truck. How many acres could be harvested in a day depends on the skill of the combine operator, how soon in the morning the pods can be threshed, equipment breakdowns, etc.

Worker Injuries - Possible injuries can occur from a variety of sources: tractor overturning in a ditch, harm caused by spray drift or a mistake in preparing agricultural chemicals for application, or physical injury from using hand tools (cuts, bruises, abrasions) in repairing equipment.

INSECT MANAGEMENT

Soybeans can be damaged by insects any time from plant emergence until near harvest. Many kinds of insects feed on leaves, stems, roots, nodules, and pods, but only a few require insecticides. Soybean plants can compensate for considerable insect injury, and naturally occurring predators and parasites frequently control insect pests adequately. However, they are often overwhelmed by insect numbers in late season. To prevent severe yield reductions or a total crop loss, an insecticide must be applied.

Cultural Control

Cultural control of insects involves agricultural practices such as crop rotation, planting dates, tillage practices, row patterns, etc., which may help in the control of a pest. It is important to remember that such practices must be in harmony with agronomic practices that promote maximum economic yield.

Biological Control

Biological control in soybeans is, for the most part, the conservation and utilization of natural enemies of insect pests to keep them from reaching damaging levels. In the soybean IPM system, the major objective is to allow natural enemies to do their work without disruption from insecticides. Growers who make insecticide applications only when they are absolutely necessary take full economic advantage of the natural enemies. Also, when insecticides are needed, consideration should be given to products that are less disruptive to beneficial insects. *Bacillus thuringiensis* may be used for pests such as velvetbean caterpillar, green cloverworm and soybean looper.

Chemical Control

Insecticides should be thought of as a "last resort" to prevent insect damage when cultural and biological controls have failed to keep insect pests below economically damaging levels.

All classes of chemicals listed in this report indicate present practices in the three-state region of Arkansas, Louisiana, and Mississippi.

Bean leaf beetle (*Certoma trifurcata*)

Bean leaf beetles are about 0.25" long, with considerable variation in color patterns. The background color may be yellow, green, tan, or red. Most beetles have four black spots and black stripes along the edges of the wing covers. A black triangle is always present at the base of the wing covers just behind the prothorax. The larvae are white, with dark-brown areas at both ends. When mature, the larvae are about 0.375-0.5" long. Bean leaf beetles overwinter as adults under debris in protected areas. When temperatures warm in the spring, the beetles fly into alfalfa and clover fields to feed but do not lay eggs. As soon as beans begin emerging, the beetles abandon alfalfa and clover fields to colonize bean fields. Females lay eggs in the soil around the base of the plant. The lemon-shaped eggs are laid in clusters of 12-24 and are orange in color. The eggs hatch in 1-3 weeks depending on the weather. The larvae feed on the roots and nodules of the plants. When the larvae finish feeding, they form an earthen cell in which to pupate. The pupal stage lasts approximately one to two weeks. Adults feed on the soybean foliage. The injury caused by the bean leaf beetle is two-fold. The adults feed on the leaves of the plants causing the characteristic "shot hole" appearance on the leaves. Late in the season, bean leaf beetles may chew on pods but rarely consume the seeds. Their feeding creates scars that open the way to spores of some fungal diseases. Mild infection results in seed staining while severe infection results in seed contamination.

Control:

- Cyhalothrin (Karate Z) 0.02-0.025 lb. ai/A (REI: 24 hr. PHI: 45 days)
- Esfenvalerate (Asana XL) 0.03-0.05 lb. ai/A (REI: 12 hr. PHI: 21 days)
- Methyl Parathion (Methyl 4 EC) 1.0 pt./A (REI: 5 days PHI: 20 days)
- Permethrin (Ambush 25W) 0.075-0.1 lb. ai/A (REI: 12 hr. PHI: 60 days)
- Thiodicarb (Larvin) 0.45 lb. ai/A (REI: 48 hr. PHI: 28 days)
- Carbaryl (Sevin) 0.5 lb. ai/A (REI: 12 hr. PHI: 21 days)
- Gamma-cyhalothrin (Prolex) 0.01-0.0125 lb. ai/A (REI: 24 hr. PHI 45 days)

Three-cornered alfalfa hopper (*Spissistilus festivus*)

The adult three-corned alfalfa hopper is green, triangular-shaped, and less than 0.25” long. Young hoppers or nymphs are green to light brown and wingless. They can be found feeding around the stems (phloem) of young plants, girdling the stem near the soil surface. Young seedling plants may lodge from being girdled or die as a result of stem girdling near the soil surface. Girdling can also result in lower weight and number of seeds, lower nitrogen fixation and yield loss due to lodging. When bean pods are set, maturing plants may break over from early seedling damage. Both adults and nymphs will also feed on the petioles of leaves, blooms, and pods, thus reducing yields.

Control:

A strepsipteran is the only reported parasitoid of adult three-cornered alfalfa hoppers. Mymarid and trichogrammatid egg parasitoids have been reported, but parasitism rates are difficult to assess. The fungus *Pandora delphacis* has recently been isolated from the three-cornered alfalfa hopper, but its impact on population is limited depending upon environmental conditions. Other natural enemies include ants, mites, nabids, bigeyed bugs, robber flies, spiders, toads, and birds.

- Cyhalothrin (Karate Z) 0.025 lb. ai/A (REI: 24 hr. PHI: 45 days)
- Esfenvalerate (Asana XL) 0.03-0.05 lb. ai/A (REI: 12 hr. PHI: 21 days)
- Acephate (Orthene) 0.75-1.0 lb. ai/A (REI: 24 hr. PHI: 14 days) label status uncertain in soybeans
- Gamma-cyhalothrin (Prolex) 0.0125 lb. ai/A (REI: 24 hr. PHI 45 days)
- Zetamethrin (Mustang Max) 0.017-0.025 lb. ai/A (REI: 12 hr. PHI: 21 days)
- Cyfluthrin (Baythroid) 0.025-0.04 lb. ai/A (REI: 12 hr. PHI 45 days)

Velvetbean caterpillar (*Anticarsia gemmatalis*)

The velvetbean caterpillar larva varies from light to dull green, with white lines running the length of the body. The lines on the sides of this larva are usually much broader than those on the green cloverworm or looper. It has four pairs of abdominal prolegs and is about 1.5" long when full grown. When knocked to the ground, it becomes very active and wiggles about. This insect damages primarily by feeding on interveinal leaf tissue. The younger larvae feed on the bottom part of upper leaves. Middle and lower leaves are consumed following the upper leaves. Later instars defoliate the leaf leaving only veins and midribs. If the infestation is high, stems and pods may be attacked.

Control:

- Cyhalothrin (Karate Z) 0.015-0.025 lb. ai/A (REI: 24 hr. PHI: 45 days)
- Esfenvalerate (Asana XL) 0.03-0.05 lb. ai/A (REI: 12 hr. PHI: 21 days)
- Methyl Parathion (Methyl 4 EC) 1.0 pt./A (REI: 5 days PHI: 20 days)
- Carbaryl (Sevin) 0.25-0.5 lb. ai/A (REI: 12 hr. PHI: 21 days)
- Methomyl (Lannate SP) 0.125 lb/A (REI: 48 hr. PHI: 14 days)
- Permethrin (Ambush 25W) 0.05-0.1 lb. ai/A (REI: 12 hr. PHI: 60 days)
- Thiodicarb (Larvin) 0.25-0.4 lb. ai/A (REI: 48 hr. PHI: 28 days)
- *Bacillus thuringiensis* (Use according to label)
- Chlorpyrifos (Lorsban 4E) 1-2 pt./A (REI: 24 hr. PHI: 28 days)
- Spinosad (Tracer) 0.031-0.062 lb. ai/A (REI: 4 hr. PHI: 28 days)
- Gamma-cyhalothrin (Prolex) 0.0075-0.0125 lb. ai/A (REI: 24 hr. PHI 45 days)
- Zetamethrin (Mustang Max) 0.017-0.025 lb. ai/A (REI: 12 hr. PHI: 21 days)
- Cyfluthrin (Baythroid) 0.028 lb. ai/A (REI: 12 hr. PHI 45 days)
- Diflubenzuron (Dimlin) 0.031 lb. ai/A (REI: 12 hr. PHI: 21 days)

Stink bugs (*Nezara sp., Acrosternum sp., Euschistus sp.*)

Adult stink bugs are about 0.5" long and may be either green or brown, depending on the species. The most common species found in soybean are the green, southern green, and brown stink bugs. In recent years, the brown stink bug appears to be more prevalent than the other two species. These insects overwinter as adults. During spring and early summer, they feed and reproduce on weeds, corn fields, and in home gardens. Stink bugs will not seriously damage soybeans until after pods set. Nymphs and adults damage the crop by piercing the pod hulls, leaving brown or black spots, and sucking juices from the developing beans. They attack stems, foliage, blooms, and seeds. However, younger tissues and developing seeds seem to be their favorite. Feeding of this type can result in unfilled pods, severely shrunken seed, or discolored seed at the puncture site. These malformed seeds cause a lower grade (less profit) and usually have low germination and viability qualities. Sometimes, stink bug feeding results in a delay of maturity known as 'green bean syndrome'.

Nymphs are typically orange and black, but colors vary considerably before the adults develop. Older nymphs (fourth and fifth instars) can cause as much damage as adults. Populations of brown stink bugs generally peak late in the season and are seldom high enough to require control measures. However, the brown stink bug is often more difficult to control than other stink bugs that attack soybeans.

Control:

- Cyhalothrin (Karate Z) 0.025-0.03 lb. ai/A (REI: 24 hr. PHI: 45 days)
- Methyl Parathion (Methyl 4 EC) 1.0-2.0 pt./A (REI: 5 days PHI: 20 days)
- Acephate (Orthene) 0.75 lb. ai/A (REI: 24 hr. PHI: 14 days) label status uncertain in soybeans
- Gamma-cyhalothrin (Prolex) 0.0125-0.015 lb. ai/A (REI: 24 hr. PHI 45 days)
- Zetamethrin (Mustang Max) 0.02-0.025 lb. ai/A (REI: 12 hr. PHI: 21 days)
- Cyfluthrin (Baythroid) 0.025-0.044 lb. ai/A (REI: 12 hr. PHI 45 days)

Soybean looper (*Pseudoplusia includens*)

The soybean looper sometimes occurs in large numbers and is almost an annual problem in soybeans. The larva has a characteristic looping movement when crawling. It is light green, with thin white lines running the length of the body on the sides and top. The body tapers toward the head. The larva has two pairs of abdominal prolegs. This insect has developed resistance to some insecticides but is often controlled by disease organisms.

The larvae of the soybean looper feed in the lower part of the canopy. As they age, they tend to prefer more mature foliage. They begin feeding inside the plant (lower portion) moving towards the top as defoliation occurs. The damage looks like a "window pane" since the first and second larval instars feed on the undersides of leaves. Other instars produce a "lacelike" damage since they feed on everything but the leaf veins. The most damaging instars range from the fourth to the sixth (95% of the total feeding). This insect is considered a defoliator, however sometimes it feeds also on soybean pods, seeds, or stems when the population is so high that that plant is almost defoliated.

Control:

- Thiodicarb (Larvin) 0.45-0.75 lb. ai/A (REI: 48 hr. PHI: 28 days)
- Methoxyfenozide (Intrepid) 0.06-0.16 lb. ai/A Has had section 3 exemption for last 3 years
- Methomyl (Lannate SP) 0.125-0.45 lb/A (REI: 48 hr. PHI: 14 days)
- *Bacillus thuringiensis* (Use according to label)
- Spinosad (Tracer) 0.031-0.062 lb. ai/A (REI: 4 hr. PHI: 28 days)
- Indoxacarb (Steward) 0.055-0.11 lb. ai/A (REI: 12 hr. PHI: 21 days)

Green cloverworm (*Plathypena scabra*)

The green cloverworm larva has the same looping movement as the soybean looper and is similar in appearance. It is uniformly pale green, with white stripes running along the sides. However, it has three pairs of abdominal prolegs, and its body is not tapered. The green cloverworm feeds on the leaf leaving large holes. In heavy infestations, only the main veins remain intact. When disturbed, this insect becomes very active. It is attacked by a number of predators, parasites, and diseases and rarely requires chemical control.

Control:

- Methyl parathion (Methyl 4 EC) 1.0 pt./A (REI: 5 days PHI: 20 days)
- Carbaryl (Sevin) 0.25-0.5 lb. ai/A (REI: 12 hr. PHI: 21 days)
- Methomyl (Lannate SP) 0.125 lb/A (REI: 48 hr. PHI: 14 days)
- Permethrin (Ambush 25W) 0.05-0.1 lb. ai/A (REI: 12 hr. PHI: 60 days)
- Thiodicarb (Larvin) 0.25-0.40 lb. ai/A (REI: 48 hr. PHI: 28 days)
- Spinosad (Tracer) 0.031-0.062 lb. ai/A (REI: 4 hr. PHI: 28 days)
- *Bacillus thuringiensis* (Use according to label)

Corn earworm (*Helicoverpa zea*)

The corn earworm may appear in various colors from yellow or pink to green, and sometimes almost black. Alternating light and dark stripes usually mark the body which is covered with small spines. Regardless of body color, they always have yellow-brown head capsules, except when newly hatched. A fully developed larva is 1.5-2" in length. Adult moths are grayish-brown with a wingspread of about 1.5". Most adult moths are considered to migrate north from the southern states in the spring. Individual female moths lay a single off-white colored egg. Corn earworms feed on pods and seeds.

Control:

- Esfenvalerate (Asana XL) 0.03-0.05 lb. ai/A (REI: 12 hr. PHI: 21 days)
- Spinosad (Tracer) 0.047-0.062 lb. ai/A (REI: 4 hr. PHI: 28 days)
- Methyl parathion (Methyl 4 EC) 1.0-2.0 pt./A (REI: 5 days PHI: 20 days)
- Permethrin (Ambush 25W) 0.1 lb. ai/A (REI: 12 hr. PHI: 60 days)
- Carbaryl (Sevin) 0.75-0.1 lb. ai/A (REI: 12 hr. PHI: 21 days)
- Methomyl (Lannate SP) 0.25-0.45 lb/A (REI: 48 hr. PHI: 14 days)
- Acephate (Orthene) 0.75 lb. ai/A (REI: 24 hr. PHI: 14 days) label status uncertain in soybeans

Saltmarsh caterpillars (*Estigmene acrea*)

Saltmarsh caterpillars (often called "woolly worms") feed in the larval stage in groups on soybean foliage. Seedling soybeans may also be attacked. They usually feed on the leaves on the upper third of the soybean canopy. Infestations seldom reach levels that require control as they are often limited to the field margins.

Control:

- Methomyl (Lannate SP) 0.45 lb/A (REI: 48 hr. PHI: 14 days)
- Acephate (Orthene) 0.75 lb. ai/A (REI: 24 hr. PHI: 14 days) label status uncertain in soybeans
- *Bacillus thuringiensis* (Use according to label)

Blister beetle (*Epicauta sp.*)

These elongated beetles have soft wing covers that leave the tip of the abdomen exposed. They can be black, gray, or yellow with black stripes. The larva is a predator of grasshopper eggs but is harmless to soybeans. Adults feed in groups mainly on the intervein of leaves and usually occur in clusters or 'hot spots'. Rarely do they attack other plant parts such as flowers, young pods, or stems. Soybean fields should be scouted for migrating blister beetles if alfalfa or weeds have been cut in nearby fields.

Control:

- Methyl Parathion (Methyl 4 EC) 1.0 pt./A (REI: 5 days PHI: 20 days)
- Carbaryl (Sevin) 0.8 lb. ai/A (REI: 12 hr. PHI: 21 days)

Grasshoppers (*Melanoplus sp.*)

Several species of grasshoppers will feed on foliage usually during prolonged dry periods. Nymphs are smaller than adults and show incompletely formed wings. These insects feed on leaves, pods and seeds. Large populations can cause high yield loss. Pod feeding leaves the plant tissue vulnerable for fungus attack. Usually infestations are more severe following 2-3 years of drought.

Control:

The use of insecticides is the most common way of grasshopper control. Applications should be based on scouting fields and estimating grasshopper density and extent of crop damage.

- Carbaryl (Sevin) 1.0 lb. ai/A (REI: 12 hr. PHI: 21 days)
- Cyhalothrin (Karate) 0.025 lb. ai/A (REI: 24 hr. PHI: 45 days)
- Esfenvalerate (Asana XL) 0.03 lb. ai/A (REI: 12 hr. PHI: 21 days)
- Methyl Parathion (Methyl 4 EC) 1.0-2.0 pt./A (REI: 5 days PHI: 20 days)
- Tralomethrin (Scout X-tra) 0.024 lb. ai/A

<u>Lesser cornstalk borer (*Elasmopalpus lignosellus*)</u>

Larvae attack the stem at the soil surface. One larva can damage several seedlings by tunneling which, in turn, causes wilting. More mature plants can resist the attack by larvae. However, yield will be decreased. More problems occur in late planted soybeans that followed wheat or ryegrass. Drought and high temperatures are also usually associated with the problem.

Control:

- Chlorpyrifos (Lorsban 15G) 8 oz/1,000 feet of row. (REI: 24 hr. PHI: 28 days)

<u>Armyworm complex (*Spodoptera exigua, Spodoptera frugiperda*)</u>

Beet armyworm larvae have black spots on each side of the second body segment, four pairs of abdominal prolegs, and is about 1.25" long when full grown. The worms curl up when knocked to the ground. The larvae vary from grayish-green to near black, with pale lines running the length of their bodies.

The beet armyworm prefers to feed on foliage of soybean plants. However, they will occasionally feed on bloom buds, blooms, and small pods. The damage is seen as irregular holes in the leaves.

Fall armyworm larvae vary in color from light tan or green to nearly black and have a prominent inverted "Y" on the front of the head. They can reach 1.5" long. The pupae are reddish and about 0.5" long. The adult moth is gray with a wingspan of 1.5".

Feeding occurs all through the growing season. Normally this insect feeds on the foliage, leaving large holes. Severe infestations skeletonize or completely destroy the leaves. The larvae also clip the stems of seedling soybeans decreasing plant numbers.

Control:

- Thiodicarb (Larvin) 0.6-0.75 lb. ai/A (REI: 48 hr. PHI: 28 days)
- Chlorpyrifos (Lorsban 4E) 1-2 pt./A (REI: 24 hr. PHI: 28 days)
- Spinosad (Tracer) 1-2 fl oz/A (REI: 4 hr. PHI: 28 days)
- Methyl Parathion (Methyl 4 EC) 1.0 pt./A (REI: 5 days PHI: 20 days)
- Carbaryl (Sevin) 0.5 lb. ai/A (REI: 12 hr. PHI: 21 days)
- Methomyl (Lannate SP) 0.3-0.45 lb/A (REI: 48 hr. PHI: 14 days)

<u>Banded cucumber beetle (*Diabrotica balteata*)</u>

Adults are about 0.25" in length, greenish yellow in color with a red head and black thorax. Usually there are three transverse bands across the front wing, green in color, sometimes with a bluish tint, and a thin green band running down the center of the insect's back. The banding pattern is variable, and sometimes almost absent.

Banded cucumber beetles damage soybeans by eating holes in the leaves. Their damage is not severe, and large numbers are required before insecticides are necessary.

Control:

- Cyhalothrin (Karate) 0.025 lb. ai/A (REI: 24 hr. PHI: 45 days)
- Methyl Parathion (Methyl 4 EC) 1.0 pt./A (REI: 5 days PHI: 20 days)
- Carbaryl (Sevin) 0.5 lb. ai/A (REI: 12 hr. PHI: 21 days)
- Gamma-cyhalothrin (Prolex) 0.01-0.0125 lb. ai/A (REI: 24 hr. PHI 45 days)

Mexican bean beetle (*Epilachna varivestis*)

The Mexican bean beetle is a native of the semiarid southwestern states and has spread throughout much of the area east of the Mississippi River since 1920. Both larvae and adults feed by sucking plant juices on the lower surface of leaves. Damage caused by the adults has an open lacy appearance while the damage caused by the larva has a skeletonized appearance. Defoliation can be severe. Adults also feed on stems and pods. Injured tissue is vulnerable to the attack of pathogens like pod and stem blight.

Control:

- Cyhalothrin (Karate) 0.015 lb. ai/A (REI: 24 hr. PHI: 45 days)
- Methyl parathion (Methyl 4 EC) 0.75-2 pt./A (REI: 5 days PHI: 20 days)
- Permethrin (Ambush 25W) 0.05 lb. ai/A (REI: 12 hr. PHI: 60 days)
- Methomyl (Lannate SP) 0.25 lb/A (REI: 48 hr. PHI: 14 days)

Cutworms (*Agrotis sp*.)

Cutworms are not usually serious pests in soybeans but occasionally can cause considerable stand loss in localized areas of a field. The most common species is the black cutworm. Black cutworms are more likely to be found in fields with a history of cutworm damage, those planted under reduced or no-tillage practices, fair to poorly drained fields, or fields covered with winter annual weeds prior to planting.

Cutworms are active at night, feeding first on leaves. Larger cutworms cut small plants and may pull parts of them into their burrow. Symptoms are cut or wilted, or missing plants.

Control:

- Chlorpyrifos (Lorsban 4E) 1.0-2.0 pt./A (REI: 24 hr. PHI: 28 days)
- Carbaryl (Sevin) 1.0-1.5 lb. ai/A (REI: 12 hr. PHI: 21 days)

- Esfenvalerate (Asana XL) 0.03 lb. ai/A (REI: 12 hr. PHI: 21 days)
- Thiodicarb (Larvin) 0.6-0.75 lb. ai/A (REI: 48 hr. PHI: 28 days)

Garden webworm (*Loxostege similalis*)

Although present in all soybean growing states, the garden webworm is usually only a minor pest. These pests eat soybean leaves, and severe defoliation will cause a reduction in yields. Infestations occur sporadically as these are generally feeders on a number of cultivated crops.

Control:

- Methyl parathion (Methyl 4 EC) 0.75-2 pt./A (REI: 5 days PHI: 20 days)
- *Bacillus thuringiensis* (Use according to label)

Soybean aphid (*Aphis glycines*)

The soybean aphid is a recently introduced pest of soybean. It is the only aphid in North America able to develop large colonies on soybeans. When the tiny, sap-sucking insects are present in large numbers (several hundred per plant), their feeding can cause stunting, puckered yellow leaves, reduced pod set, and smaller seed. The soybean aphid is also capable of transmitting soybean viruses from plant to plant.

Yield loss is related to aphid density at specific crop stages and on the condition of the crop. Risk of yield loss is greatest when aphid populations peak at beginning flower because of the impact on pod set.

Control:

- Chlorpyrifos (Lorsban 4E) 0.5-2 pt./A (REI: 24 hr. PHI: 28 days)
- Esfenvalerate (Asana XL) 0.015-0.05 lb. ai/A (REI: 12 hr. PHI: 21 days)
- Permethrin (Ambush 25W) 0.05-0.20 lb. ai/A (REI: 12 hr. PHI: 60 days)

Soybean thrips (*Sericothrips variablilis*)

Thrips are minute, slender-bodied insects ranging from 1/32 to 1/5 inch (0.8 to 5 mm) in length. Their wings, when present, are fringed with close-set long hairs. Although rarely noticed, thrips are probably the most numerous insects found in soybean. They make tiny, linear, pale-colored scars on soybean leaves where they penetrate individual leaf cells and feed on the contents. Many generations occur each year.

Control:

- Thiodicarb (Larvin) 0.25-0.75 lb. ai/A (REI: 48 hr. PHI: 28 days)
- Spinosad (Tracer) 1-2 fl oz/A (REI: 4 hr. PHI: 28 days)
- Methomyl (Lannate SP) 0.125-0.5 lb/A (REI: 48 hr. PHI: 14 days)

Dectes stem borer (*Dectes sp.)*

Dectes stem borer larvae tunnel through the stalks of soybeans causing injured plants to fall over (lodge) making plants difficult to harvest potentially reducing yield. They are usually late-season pests. Adult damage to soybeans is negligible and consists of light foliage feeding. Insecticides have not been shown to control the larval stage, and resistant varieties may be an option if the problem intensifies.

Grape colaspis (*Colaspis brunnea*)

Grape colaspis larvae feed on roots of seedling soybean plants as they move up to the soil surface prior to pupation. Populations may develop in soybeans following forage crops or following soybeans when a high population of adults was present the previous season. If seedling soybean plants are stunted and plant mortality is prevalent, grape colaspis could be the problem. Dig up the soil around plants in these areas and sift to determine if the small white grape colaspis larvae (grubs) are present. There are no effective pesticides for control of grape colaspis. When stands have been reduced to critical levels, replant the infested area 7 to 10 days after damage was observed.

Two-spotted spider mite (*Tetranychus urticae*)

Whenever hot, dry weather persists, large spider mite populations may develop on soybeans. The two-spotted spider mite is named for the two dark spots on the sides of the abdomen which are digested food visible through the translucent body. Three or four spots may be apparent and are most prominent on adult mites. Spider mite injury to soybeans can resemble herbicide injury or a foliar disease; however, characteristic signs are tiny yellow spots, or stipples, on leaves. As the injury becomes more severe, leaves turn yellow then brown or bronze, and finally die and drop off.

Control:

- Chlorpyrifos (Lorsban 4E) 0.5-2 pt./A (REI: 24 hr. PHI: 28 days)
- Dimethoate (Dimethoate 4 EC) 1 pt./A (REI: 48 hr. PHI: 21 days)

NEMATODE MANAGEMENT

With the exception of rice, plant-parasitic nematodes can be of economic concern in all of the major crops grown in the mid-South. Surveys conducted during the past ten years indicate that one species of the root-knot nematode (*Meloidogyne incognita*), the soybean cyst nematode (*Heterodera glycines*), and the reniform nematode (*Rotylenchulus reniformis*) are common throughout the region and may infest 50% or more of production fields in some areas. Although numerous other plant-parasitic nematode species may also be found associated with crops in the mid-South, only these three are considered to be of major economic importance in soybean production.

Root-Knot Nematodes. The root-knot nematode is perhaps the easiest of the nematodes to diagnose in the field. Root-knot gets its name because infection of roots of susceptible hosts results in the formation of galls or swellings on the roots. These galls are readily visible to the naked eye from about mid-season through harvest time. Aboveground symptoms of root-knot also are relatively apparent in many fields. Symptoms include stunting and poor growth of plants in areas within infested fields. Heavily parasitized plants may exhibit nutrient or water stress symptoms, particularly during the latter half of the growing season. This nematode species is of major economic concern in both cotton and soybean. It is common in the sandy soils along the Mississippi River.

Cyst Nematodes. The soybean cyst nematode continues to be an important nematode pest of soybean throughout the region. Fortunately, soybean cyst nematodes have a narrow host range that includes soybean and a few legume weeds. The nematode can, however, survive for 7-10 years in soil in the absence of a host. Soybean cyst nematodes are also relatively easily diagnosed in the field from mid-season through harvest. The nematodes infect soybean roots and swell to form tiny (but visible with a hand lens) cysts that are attached to roots. Cysts are white in color early on, but as they age, they change to a yellow and then a brown color. Cysts can be distinguished from other structures that may be seen on soybean roots such as nodules because they are much smaller and are lemon-shaped. Aboveground symptoms of soybean cyst nematode damage range from large irregular spots of poorly developing plants to virtually no readily apparent foliar symptoms. Even without visible plant symptoms, studies in western Tennessee have documented at least 10 bu/acre yield reductions due to the nematode without visible symptoms.

Reniform Nematodes. The reniform nematode is a relative newcomer to the mid-South. This nematode has historically been of concern primarily in tropical and sub-tropical areas of the world, and in 1960 reniform was thought to occur in the U.S. only in extreme southern Texas, Louisiana, and Florida. Incidence of the reniform nematode, unfortunately, has changed during the past 40 years–moving steadily northward. In 1999, the reniform nematode was named the most important nematode pest of cotton in the states of Mississippi and Louisiana. This nematode has now been identified in every cotton producing county or parish in these two states. In addition, since 1990, the reniform nematode has been identified in 10 major cotton producing counties in Arkansas, from the Louisiana line to the Missouri boot heel. The nematode has also been reported in western Tennessee, and appears to be on the increase there as well.

Nematode Control

The most important single factor in managing a nematode problem in any crop is accurate diagnosis of the presence and identity of the species involved. Although visual inspection may indicate the presence of root-knot or soybean cyst nematodes, the reniform nematode is almost impossible to identify based on field symptoms or root inspection. Soil sampling for assay by a nematology laboratory is the most accurate and dependable means of determining whether or not a nematode problem exists. Public (university) or private nematology laboratories that provide assays on a fee basis are available in virtually all parts of the U.S. These laboratories can also provide advice on timing and methods for sampling fields and the procedures for handling and shipment of the samples. Nematodes must remain alive until the assays are conducted. Consequently, handling samples properly is as important as the sampling process itself. Results of nematode assays are always only as good as the sample that was submitted.

In the mid-South, nematode management is primarily accomplished through one or a combination of methods. Options include the use of resistant cultivars, crop rotation with resistant or poor hosts to lower nematode population densities, or the use of chemical nematicides. Selection of the method or methods for managing nematodes in any individual field must be determined based on the nematode species that is present, the crops that may be grown, and the economics of the management program. For most of the major crops, threshold levels have been established to aid in determining the magnitude of a nematode problem. These levels vary considerably from state to state, and should be used as general guides only. Experience with crop performance in individual fields should always be included in considerations when formulating nematode control strategies.

Resistant Cultivars

The least expensive and many times most effective means of managing nematode damage to crops is through the use of nematode resistant cultivars. Both root-knot and reniform nematode resistant soybean cultivars are available, although few are highly resistant. Recent studies in Arkansas indicate that severe root-knot may suppress soybean yield by as much as 50%. These studies also indicated that selection of a moderately resistant cultivar resulted in yield improvement of 15-25 bu/acre depending on the infestation level. There are only a few reniform nematode resistant soybean cultivars available, none are highly resistant, and some population increase can be expected during the season on these cultivars.

There are numerous soybean cultivars with resistance to the soybean cyst nematode. A complicating factor, however, in managing this nematode with resistant cultivars is the existence of races or biotypes of the nematode. There are currently 16 possible races of the soybean cyst nematode, each of which is characterized by their ability to reproduce on different resistant soybean types. Historically, soybean cyst nematode race 3 was predominant in much of the area, but within the past few years, races 4, 5, 6, 9, and 14 have increased in frequency. Continued production of any given resistant cultivar (or cultivar representing a particular type of resistance) may exert sufficient selection pressure on the local soybean cyst nematode population to force a change in race, resulting in the ineffectiveness of the resistant cultivar. Consequently, resistant cultivars must be used judiciously in combination with crop rotation to avoid undue selection pressure and loss of effectiveness of the resistant cultivar.

Crop Rotation

Crop rotation may be an effective means of lowering nematode population densities and the accompanying crop loss. Selection of rotation crops and cropping sequences must be determined based on the nematode species in question and on the economic feasibility of using the rotation program. Rice is perhaps the most effective rotation crop across all of the economic nematode species. Rice is susceptible to at least 2 races of the common root-knot species (2 and 4). However, the flooded culture of rice keeps them from ever becoming a problem, presumably by lowering the oxygen concentration in the soil for long periods of time during the summer months. In the mid-South, a common rotation is a soybean-rice system. This rotation may be very effective in controlling root-knot and reniform nematodes, and is also somewhat effective in lowering soybean cyst nematode densities. Research has shown, however, that a significant number of soybean cyst nematodes may survive a year of rice. Combinations of rice-soybean rotation and use of resistant and susceptible soybean cultivars appear to be the most effective long-term solution to soybean cyst nematode problems.

As indicated earlier, grain sorghum may also be a rotational crop with either cotton or soybeans for lowering reniform, soybean cyst, and root-knot nematodes. However, there have been mixed reports about grain sorghum and its reaction to root-knot nematode. The length of the rotation (number of years needed) may vary according to the nematode population density that is present in a field. A single year of rotation may be very effective at lowering populations that were initially moderate to high. Two years may be necessary, however, in some fields with extremely high initial population densities.

Corn can provide a very effective and possibly more economically attractive rotation crop for growers who need to manage either soybean cyst or reniform nematodes in soybeans. As in the Midwest, corn-soybean rotations are becoming more popular in the mid-South. Before this rotation regime is adopted, an accurate identification of the nematode problem is necessary. Although corn will lower soybean cyst or reniform nematodes, it may increase the severity of a root-knot problem. Where root-knot is a problem in soybeans, use of resistant soybean cultivars may allow this rotation to be continued. Many soybean cultivars are not highly resistant to the nematode and may still show yield suppression if root-knot populations increase to high levels on the corn.

Nematicides

Chemical nematicides are available to help control nematodes in soybeans. They usually work by killing or disturbing populations early enough in the growing season to allow soybeans to get a head start on root development. However, depending on the state in the growing region, nematicides may not be considered cost effective. These are listed in charts appearing later in this report.

DISEASE MANAGEMENT

Diseases continually affect the soybean crop and have partially been responsible for a reduction in acreage during the late 1980's and early 90's. Seed treatments in soybean production have been used very little in the past for disease control but are on the rise due to an increase in early varieties.

The diseases described below are commonly found in the mid-south growing region, and most have caused significant economic losses at one time or another. Included are symptoms and control methods used in the three-state region.

Soybean Rust

The U.S. Department of Agriculture announced on Nov. 10, 2004, the presence of Asian soybean rust (*Phakospsora pachyrhizi*) on soybean leaf samples taken from two plots associated with a LSU AgCenter's Ben Hur Research Farm. This is the first instance of soybean rust to be found in the continental United States. As of December 1, 2004, it was confirmed in Louisiana, Mississippi, Florida, Georgia, Alabama, Arkansas, South Carolina, and Missouri, clearly supporting the theory that the rust spores entered on storm winds associated with Hurricane Ivan. More investigation into the biology and control measures of this pest is extremely important and the number one priority of soybean researchers in the southern United States.

Soybean rust causes lesions on cotyledons, stems, petioles, leaves, and pods of soybean and other host plants. The main effects on the soybean plant are destruction of photosynthetic tissue which in turn causes premature defoliation, early maturation, and severe yield reductions through reduction in the number of pods and seeds, and decreased seed weight.

The soybean rust life cycle begins with inoculum in the form of urediospores being blown onto healthy soybean plants. Under prime conditions, uredinia mature 6-7 days after infection of healthy soybean plants and urediospores are produced for the next 10-11 days. These urediospores may germinate and increase the amount of infection on the plant, or be carried to and infect other soybean plants or an alternative host plant.

Chemical control using fungicides has been shown to be effective at controlling soybean rust in many countries, and may be the best short-term alternative until adapted, resistant soybean varieties can be released. As this document is being prepared, fungicides are being screened by researchers in the southern region. In areas favorable for rust development, the rapidly repeating life-cycle of the soybean rust fungus requires that detection be early and fungicide application be made immediately in order to effectively control the infection. Release of resistant varieties are presently said to be five years away.

Seedling Disease
(*Rhizoctonia solani, Phytophthora, Pythium,* etc.)
Symptoms: Seed decay and postemergence "damping off." Roots and basal portion of stem may be killed. Source of Inoculum: Most of these organisms are soil borne and persist in crop residue. Control: See chart under seed treatment.

Charcoal Rot
(*Macrophomina* sp.)
Symptoms: Initial infections from charcoal rot fungus occur early in the growing season. Young plants 3-4 weeks old may die. Most of the damage occurs late in the season as plants senesce several weeks earlier than normal. This results in the formation of small, light-weight seed and yield loss of 20-40% in some cases. In any given season, as much as 25% of plants may show damage. This is a hidden and very subtle problem. Young plants may die if hot, dry conditions exist or survive in wet weather with disease symptoms reappearing during hot dry spells. In older plants, a light-brown discoloration of internal tissue occurs. Plants turn yellow and "mature" very early. Below the epidermis, at the soil line, small black bodies called sclerotia appear, giving the tissue a grayish-black "charcoal" appearance. Control: Avoid excessive seeding rates. Rotate with non-host crops. Maintaining good fertility will reduce the incidence of this disease. Avoid plant stress as much as possible by using good management practices.

Phytophthora Root Rot
(*Phytophthora* sp.)
Symptoms: Attacks roots and stems of infected plants at any stage, resulting in rapid death. Older plants turn yellow and leaves wilt. A brown discoloration develops in the stem. Source of Inoculum: Soil borne. Damage is most severe on heavy clay soils or on poorly drained soils. Control: Avoid planting susceptible varieties on poorly drained soils. Use crop rotation.

Red Crown Rot
(Black Root Rot)
(*Calonectria* sp.)
Symptoms: First symptoms appear as an interveinal, blotchy yellowing of the tops of individual plants, generally when plants are in the early pod stage. Later,

interveinal tissue of leaves turns brown followed by defoliation. On the stems, reddish fruiting structures appear at the soil surface and up to 3 inches above. Stem tissue appears reddish. Control: Research and field observations indicate there are differences in varieties but ratings are difficult to achieve because of the sporadic nature of the problem. Delay planting until later part of recommended planting time.

Southern Blight
(*Sclerotium* sp.)
Symptoms: Scattered plants wilt suddenly and die. White mold appears at the base of the plant and girdles the stem. Tan to brown sclerotia (resting bodies) about the size of mustard seed appear in the mold. Source of Inoculum: The fungus is soil borne and occurs widely in many soils. It is capable of persisting on almost any type of organic matter. Losses to this disease are usually very minimal and does not warrant control measures.

Aerial Blight
(*Rhizoctonia* sp.)
Symptoms: Typically the infected area involves the lower third of one or more of the three leaflets. The necrotic areas may vary in shape from circular to irregular with reddish-brown margins. Leaf blight, leaf spots, and defoliation are symptoms of the disease. Lesions may vary from reddish-brown to brown or tan. Petioles, stems and young pods also are attacked. Source of Inoculum: Weed hosts, field trash and soil. Control: Fall cultivation of stubble. Use good seedbed preparation and weed control. Research and field observations indicate there are differences in varieties. Azoxystrobin fungicide is applied at first appearance of disease development.

Brown Leaf Spot
(*Septoria* sp.)
Symptoms: Angular brown to reddish-brown spots appear first on lower leaves causing yellowing, and later defoliation. Sizes of spots vary from pinpoint to 0.25” in diameter. Source of Inoculum: The fungus overwinters in crop residue and in infected seed. Control: Plant disease-free seed. Rotate crops. Bury crop residue deep as soon as possible. Development of the disease is limited by warm weather and not a problem for the most part. Foliar fungicides thiophanate, azoxystrobin, or chlorothalonil can be applied if needed.

Downy Mildew
(*Peronospora* sp.)
Symptoms: Indefinite yellowish-green areas on upper leaf surface. Grayish tufts of mold growth on lower leaf surface beneath chlorotic spots. Source of Inoculum: Overwinters in soil, on seed, and in soybean residue. Control: Crop rotation. Use disease-free seed. Does not usually cause economic loss.

Frogeye Spot

(*Cercospora* sp.)
Symptoms: An eyespot type of lesion with a gray or light tan center and a narrow reddish-brown border forms on the leaves. May cause premature defoliation. Source of Inoculum: Seed and airborne. Control: Use resistant varieties. Foliar fungicides thiophanate and azoxystrobin are sometimes needed for control.

Cercospora Leaf Blight (Purple Seed Stain)
(*Cercospora* sp.)
Symptoms: Pink or light purple to dark purple discoloration of seed. Cracks may occur in discolored areas. Reddish-brown angular lesions, approximately $^{1}/_{16}$" in diameter, may occur on leaves, stems or pods late in the growing season. Causes purple streaks in foliage and petioles. Leaves may fall prematurely, leaving petioles sticking up, and causing plants to stay green. Source of Inoculum: Overwinters on crop residue and in infected seed. This disease has become a major problem within the last 4 or 5 years causing heavy losses with 25-30% of fields showing damage. Control: Plant disease-free seed. Treat seed with fungicides. Foliar fungicide chlorothalonil is sometimes needed for control.

Anthracnose
(*Colletotrichum* sp.)
Symptoms: Symptoms appear as irregular brown areas most frequently on stems and pods. In advanced stages, affected tissues are covered with black fruiting bodies. The disease may cause serious losses, especially during rainy periods. Seed may fail to form or be wrinkled and moldy. Control: Plant disease-free seed. Some benefit may be derived from seed treatment. Plow under crop residue. Foliar fungicides thiophanate, azoxystrobin, or chlorothalonil are sometimes needed for control.

Pod and Stem Blight
(*Diaporthe phaseolorum* var. *sojae*)
Symptoms: Numerous, small black fruiting bodies appear on the pods and stems of mature plants usually in linear rows on the stem. Under favorable environmental conditions for the disease, it can be observed as a white mycelial growth on seed. Source of Inoculum: Fungus is seed borne and overwinters on diseased plant tissue in the field. Control: Plant disease-free seed. Some benefit may be derived from seed treatment. Rotate crops. Foliar fungicides thiophanate, azoxystrobin, or chlorothalonil are sometimes needed for control.

Stem Canker
(*Diaporthe phaseolorum* var. *caulivora)*
Symptoms: Attacks cotyledons or leaves early in the growing season and spreads into the lower stems. Infection usually starts as a small lesion at the leaf scar after the petiole has fallen. Lesions enlarge rapidly to form a slightly sunken reddish-brown canker. Plants are brittle and break at the canker. Leaves in the upper canopy show interveinal chlorosis. Late in the season, the stems become completely girdled and plants die. Control: Use resistant varieties. Delay

planting until later part of recommended planting time. Avoid stress. Maintain good fertility.

Soybean Mosaic Virus
Symptoms: Symptoms of soybean mosaic virus (SMV) vary depending on the soybean cultivar, the age of the soybeans, the virus strain, and the temperature. Symptoms are most noticeable under cool temperatures of 18 to 24°C. When temperatures rise above 30°C, leaf symptoms may be masked. The youngest and most rapidly growing leaves show the most severe symptoms. Leaves of infected plants are distorted and narrower than normal and develop dark green swellings along the veins. Infected leaflets are puckered and curl down at the margin. Plants infected early in the season are stunted with shortened petioles and internodes. Diseased seed pods are often smaller, flattened, less pubescent, and curved more acutely than pods of healthy plants. Infected seed are mottled brown or black, usually smaller than seeds from healthy plants, and germination may be reduced. Soybean Mosaic Virus is spread by aphids.

Bean Pod Mottle Virus
Symptoms: Diseased plants with bean pod mottle virus (BPMV) show a mild yellow mottling on young actively growing leaves. As these leaves approach maturity the mottling becomes masked. Plants infected with both soybean mosaic and pod mottle are stunted, have distorted foliage, misshapen fruit, and necrotic tissue. Seed from plants infected with pod mottle are smaller than normal. This virus is transmitted mainly by the feeding of certain insects, particularly the bean leaf beetle. However, the virus is not seed transmitted.

Tobacco ringspot virus
Symptoms: Infected plants with tobacco ringspot virus (TRV) are stunted and the pith of stems and branches show a brown discoloration, first near the nodes, then throughout the stem. Leaves on infected plants are smaller, wrinkled, and have a bronze discoloration. Buds become brown, necrotic, and brittle; hence the name bud blight. The most striking symptom is the curving of the terminal bud to form a crook. Diseased pods are often aborted or contain no seed. In the field, plants that are infected remain green after healthy plants have matured. Yields may be reduced 25-100% depending on the time of infection. The virus is spread by planting infected seed, but the amount of infected seed produced is usually extremely low.

Seed treatment fungicides can be used for the management of early season seed rot and damping off caused by *Rhizoctonia solani, Phytophthora,* and *Pythium.*

Fungicides and Nematicides presently used in the three-state region of AR, LA, and MS.

Fungicides	Rates	REI	PHI
Seed Treatments:			
Thiram (Arasan 50R)	2 oz./cwt	-	-
captan (Captan 4L and others)	2-4 oz/bu	-	-
fludioxonil (Maxim 4FS)	0.08-0.16 oz./cwt	-	-
PCNB, metalaxyl, *B. subtilis* (System 3 Seed Treatment)	4-6 oz./bu	-	-
metalaxyl (Allegiance)	0.37 oz./cwt	-	-
carboxin+thiram (Vitavax CT)	12 oz./cwt	-	-
mefenoxam (Apron XL LS)	0.16-0.64 oz./cwt	-	-
azoxystrobin+metalaxyl (SoyGard)	0.32-0.43 oz./cwt	-	-
carboxin+thiram+metalaxyl (Vitavax CT + Allegiance)	12 oz.+0.37 oz./cwt	-	-
mefenoxam+fludioxonil (Apron Maxx RTA)	5 oz./cwt	-	-
carboxin+thiram+molybdenum (Vitavax M)	12 oz./cwt	-	-
mefenoxam+fludioxonil+molybdenum (Apron Maxx RTA + moly)	5 oz./cwt	-	-
Foliar Treatments:			
azoxystrobin (Quadris)	0.1-0.25 lb. ai/A	4 hours	14 days
thiophanate-methyl (Topsin M 70WP)	0.38-0.75 lb. ai/A	12 hours	21 days
chlorothalonil (Bravo Ultrex)	0.75-1.8 lb. ai/A	48 hours	6 days
Nematicides:			
aldicarb (Temik 15G)	10-20 lb./A	48 hours	90 days
1,3-dichloropropene (Telone II)	12 gal/A	5 days	-

WEED MANAGEMENT

Soybeans, like most other crops, are sensitive to competition from weeds. Weeds can reduce yields by competing for space, water, nutrients and sunlight. They also complicate harvesting procedures.

Weed surveys reveal several things. Some weeds are region-wide, while others tend to be more localized.

The use of herbicides will remain in the forefront of soybean weed control. However, every effort should be made to use no more herbicide than necessary to obtain acceptable weed control.

Roundup Ready Soybeans

Currently >80% of soybeans grown in the region are Roundup Ready. The initial application of Roundup Ultra is applied at 1.0 qt/acre when weeds are less than 4 inches tall. If the first application is made to weeds 5-12 inches tall, then the rate increases to 1.5 qt/acre. At these higher rates on larger weeds, yield losses can be felt due to weed-crop competition.

Often another formulation of glyphosate is used if the labels states it is approved for Roundup Ready soybeans. Sequential treatments may be needed, depending upon weed pressure, growing conditions and other factors. Sequential treatments are also timed to weed size: 2-3 inch weeds need 12 to 16 oz/A, 3-6 inch weeds need 24 oz/A, and 6-12 inch weeds need 32 oz/A. Tank-mix combinations with differing modes of action can help prolong weed resistance issues and glyphosate technology.

Annual grasses and sedges:

Fall panicum (*Pancium dichotomiflorum*) is a native weed. Seeds are the only source of reproduction. It flourishes in warm conditions. Common in cultivated fields, waste areas, roadsides, abused pastures, and disturbed areas.

Giant foxtail (*Setaria faberi*) native of Asia**.** Seeds are the only source of reproduction. Common on cultivated soils, waste places, roadsides and degraded rangeland and pastures.

Crabgrass (*Digitaria spp.*) native of Europe. Seeds are the only source of reproduction. Common in lawns, cultivated fields, gardens, roadsides, pastures, and waste places. This weed flourishes in warm conditions.

Barnyardgrass (*Echinochloa crusgalli* L.) originally from Europe. Seeds are the only source of reproduction. It flourishes in warm conditions. Common particularly in moist areas high in fertility, such as irrigated fields and old feedlots.

Broadleaf signalgrass (*Brachiaria platyphylla*) A spreading summer annual that commonly is found growing along the ground but with tips ascending (decumbent growth habit). Broadleaf signalgrass may reach as much as 3 feet in height and is found most commonly as a weed of several agronomic crops of the southeastern United States.

Goosegrass (*Eleusine indica*) is a prostrate-growing summer annual. The leaves are folded in the bud. Goosegrass grows in a clump with the base of the leaves being distinctively white to silver in color. It produces seeds that germinate later in the season when compared to other annual grasses.

Red rice has been a weed problem in much of the rice-growing area for a number of years. Recently, as rice acreage has expanded, red rice has become an even more serious weed problem in soybean rotations. Botanically, red rice is the same species as cultivated rice, *Oryza sativa* (L.). It is actually a variety of rice with slightly different morphological characteristics.

Annual ryegrass (*Lolium multiflorum*) is a winter annual found throughout the United States that may reach 3 feet in height with a fibrous root system. Stems are often tinged red at the base, and leaves are rolled in the bud with claw-like auricles in the collar region. Annual ryegrass control has declined due to the development of resistance to some herbicides.

<u>Annual broadleaf weeds:</u>

Cocklebur (*Xanthium strumarium* L.) is a native weed. Seeds are the only source of reproduction. Found in open fields, gardens, pastures, and waste areas. Cocklebur is especially abundant in areas where retreating water has exposed previously submerged land. Confirmed resistance to ALS inhibiting herbicides.

Woolly croton (*Croton capitatus*) is found on dry prairies, hills, and open woodlands and in fields, pastures, and roadsides. It is usually associated with sandy or calcareous soils and is toxic to livestock.

Velvetleaf (*Abutilon theophrasti*) originated from India. Seeds are the only source of reproduction. Found in summer crop fields such as sorghum, corn, and soybeans, in waste places, roadsides, and fence rows.

Palmer amaranth (*Amaranthus palmeri*) is a native weed. Seeds are the only source of reproduction. Confirmed resistance to triazine and ALS inhibiting herbicides. Found in cultivated and fallow fields, gardens, waste ground, and roadsides.

Pigweeds (*Amaranthus spp.*)
Pigweeds are prolific seed producers, and one female can produce over 100,000

seeds in one growing season. The seeds of this plant may remain viable for years. Pigweeds are a problem in no-till systems because undisturbed soils favor germination of the minuscule seeds, and the debris keeps the field moist and allows for extended germination. Other favorable germination locations are where excess nitrogen is available, and where no soil applied herbicides have been used. Localized populations of some biotypes of pigweed have shown triazine or ALS-inhibitor resistance.

Common Ragweed (*Ambrosia artemisiifolia*)
Common ragweed is a summer annual that is favored by moist soils and can be a serious problem in individual fields. Control of common ragweed with tillage or row cultivation is effective in controlling small seedlings.

Jimsonweed (*Datura stramonium*)
Jimsonweed produces several hundred hard-coated seeds per plant which may remain viable in the soil for years. This summer annual grows best under warm temperatures and moist soils. Jimsonweed infestations harm soybean crops via competition for water, especially in dry years. The shade of its leaves in shorter crops increases yield loss due to decreased nutrient uptake. Even small amounts of jimsonweed can cause harvest problems.

Smartweed (*Polygonum pensylvanicum* L.) is a native weed. Seeds are the only source of reproduction. Found in wet soils or sometimes flooded soil of roadsides, ditches, cultivated ground, waste ground, waste places, and pond banks.

Horseweed (*Conyza canadensis* L.) Seeds are the only source of reproduction. Found on rangeland, open cultivated fields, gardens, waste ground, and disturbed sites.

Prickly sida (*Sida spinosa*) Seeds are the only source of reproduction. Abundant throughout the southeast to Texas into Kansas and Missouri.

Pitted morningglory (*Ipomoea lacunose*), **Ivyleaf morningglory** (*Ipomoea hederacea*), and **Tall morningglory** (*Ipomoea purpurea*) are often found growing in combination. Seeds are the only source of reproduction. Found on gardens, waste places, and in corn and soybean fields.

Hemp sesbania (*Sesbania exaltata*) Erect annual, reaching 3-6 feet in height, with distinctive seed pods and showy yellow flowers. It is primarily a weed of agronomic crops found in the coastal plain.

Sicklepod (*Senna obtusifolia*) has long been considered a troublesome weed in southern soybean. This weed germinates soon after soybean is planted and continues to germinate until mid-season. Seeds that are harvested with soybean can shatter to re-infest the field.

Northern jointvetch (*Aeschynomene virginica*) is upright and usually bushy, growing up to 3-4 feet tall. Pea-like flowers can be distinguished from hemp sesbania because of a smaller size and more delicate appearance. Leaflets fold when touched.

Spurred anoda (*Anoda cristata*) is an erect annual with alternate, triangular-shaped leaves that are coarsely toothed. Spurred anoda is freely branching from the base and may reach 3.5 feet in height. It is primarily a weed of agronomic crops found in the southern United States.

Balloonvine (*Cardiospermum halicacabum*) takes its name from its inflated, three-sided fruit, which resembles a hot-air balloon. It poses a problem in fields where the soybean crop is produced for seed. It is believed that balloonvine was introduced as an ornamental.

Texas Gourd (*Cucurbita texana*), is an annual vine of yellow showy flowers that is native to Texas and Mexico. It is thought to be either the wild progenitor of the cultivated squashes, gourds, and pumpkins or an early escape from cultivation.

Cutleaf groundcherry (*Physalis angulata*). This annual occurs in fields, pastures, roadsides and open woodlands throughout Florida to eastern Texas and northward to Pennsylvania. It prefers disturbed sites. It can be controlled by cultivation while plants are small.

Rice flatsedge (*Cyperus iria)* is an erect annual sedge that is often mistakenly identified as a grass or as one of the perennial nutsedges. It is more problematic as a weed of container ornamentals, nurseries, landscapes, and turf. It is found from Florida eastward to Texas and northward to southeastern Missouri and southern Virginia.

Hophornbeam copperleaf (*Acalypha ostryifolia*) is a summer annual species and a member of the spurge plant family. This plant is native to the United States and can be found in fields, gardens, and wasteland areas stretching from New Jersey to Kansas and south to Florida and Texas. It may also be referred to as three-seeded mercury. Shade provided by a crop canopy can help suppress growth of hophornbeam copperleaf.

Perennial weeds:

Johnsongrass (*Sorghum halepense* L.) is a perennial grass originated from the Mediterranean region that flourishes in warm conditions. Rhizomes and seeds are the source of reproduction. Found in moist soil of waste places, cultivated fields, pastures, and roadsides.

Nutsedge (*Cyperus esculentus* and *Cyperus rotundus*) Eurasian native. Rhizomes, tubers, and seeds are the source of reproduction. Found in cultivated fields, gardens, and roadsides.

Leafy spurge (*Euphorbia esula*) is a deep-rooted, Eurasian perennial that is adapted to a wide range of conditions. It is tolerant of a wide range of habitats, from damp to very dry soils. The plant's extraordinary seed dispersal mechanisms also contribute to its success.

Herbicides presently used in the three-state region of AR, LA, and MS.

Herbicides	Control Spectrum	Rates	REI	PHI
Preplant:				
glyphosate	both	0.5-3.0 lb. ai/A	12 hr.	-
paraquat (Gramoxone)	both	0.66-0.95 lb. ai/A	12 hr.	-
2,4-D	broadleaf weeds	0.5-1.0 lb. ai/A	48 hr.	-
sulfentrazone+chlorimuron (Canopy XL)	both	0.11-0.13 + 0.02-0.03 lb. ai/A	12 hr.	-
metribuzin (Sencor/Lexone)	both	0.25-0.75 lb. ai/A	12 hr.	-
chlorimuron+metribuzin (Canopy SP)	both	4.5-9.0 fl. oz/A	12 hr.	-
thifensulfuron+tribenuron (Harmony Extra)	broadleaf weeds	0.015-0.03 lb. ai/A	12 hr.	-
PPI/Preemergence:				
alachlor (Lasso)	both	2-3 lb. ai/A	12 hr.	-
metolachlor (Dual)	both	1.5-2.5 lb. ai/A	24 hr.	-
metribuzin (Sencor/Lexone)	both	0.25-0.75 lb. ai/A	12 hr.	-
sulfentrazone+chlorimuron (Canopy XL)	both	0.15+0.23 – 0.03-0.05 lb. ai/A	12 hr.	-
imazaquin (Sceptor)	both	0.125 lb. ai/A	12 hr.	-
imazaquin+pendimethalin (Squadron)	both	0.12+0.75 lb. ai/A	24 hr.	-
Chlorimuron+metribuzin (Canopy SP)	both	4.5-9.0 fl. oz/A	12 hr.	-
flumioxazin (Valor)	both	0.063-0.09 lb. ai/A	12 hr.	-
dimethenamid (Outlook)	both	0.76-1.3 lb. ai/A	12 hr.	-
trifluralin (Treflan)	both	0.5-1.5 lb. ai/A	12 hr.	-
pendimethalin (Prowl)	both	0.5-1.5 lb. ai/A	24 hr.	-
flumetsulam (Python)	broadleaf weeds	0.0625-0.067 lb. ai/A	12 hr.	-
Postemergence:				
acifluorfen (Blazer)	broadleaf weeds	0.25-0.5 lb. ai/A	48 hr.	50 days
bentazon (Basagran)	broadleaf weeds	0.75-1.5 lb. ai/A	48 hr.	30 days
chlorimuron (Classic)	broadleaf weeds	0.008-0.012 lb. ai/A	12 hr.	60 days
cloransulam-methyl (Firstrate)	both	0.016 lb. ai/A	12 hr.	65 days
imazaquin (Sceptor)	both	0.125 lb. ai/A	12 hr.	90 days
cloransulam+flumetsulam (Frontrow)	broadleaf weeds	0.013+0.005 lb. ai/A	12 hr.	70 days
lactofen (Cobra)	broadleaf weeds	0.15-0.19 lb. ai/A	12 hr.	45 days
fomesafen (Reflex)	both	0.25-0.38 lb. ai/A	24 hr.	Pre-bloom
sethoxydim (Poast Plus)	grasses	0.19-0.47 lb. ai /A	12 hr.	75 days
fluazifop (Fusilade)	grasses	0.125-0.5 lb. ai/A	12 hr.	Pre-bloom
Fenoxyprop-ethyl+fluazifop (Fusion)	grasses	0.06-0.22 lb. ai/A	24 hr.	Pre-bloom
quizalofop (Assure)	grasses	0.10-0.20 lb. ai/A	12 hr.	80 days
clethodim (Select)	grasses	0.09-0.25 lb. ai/A	24 hr.	60 days
imazethapyr (Pursuit)	both	0.06 lb. ai/A	12 hr.	85 days
glyphosate	both	0.5-3.0 lb. ai/A	12 hr.	7 days
2,4-DB (Butyrac, Butoxone)	broadleaf weeds	0.2 lb. ai/A	48 hr.	60 days
Preharvest:				
paraquat (Gramoxone)	both	5.4-10 fl. oz/A	24 hr.	15 days
sodium chlorate	both	1 gal/A	12 hr.	7 days
glyphosate	both	0.5-3.0 lb. ai/A	12 hr.	7 days
carfentrazone (Aim)	broadleaf weeds	0.023 lb. ai/A	12 hr.	3 days

Research, Educational, and Regulatory Priorities by Pest in order of Importance

WEEDS

Research Priorities:

1. Options for late-season grassy weed control.
2. The need for residual herbicide research, both efficacy and crop rotational effects.
3. Investigation of differential tolerance/resistance of multiple species (marestail, ryegrass, and others) to glyphosate.
4. Biology of new surfacing resistant weeds.
5. Late applications of glyphosate and impacts on the crop plant.
6. Generation of data on soil seed bank dynamics of weed species.
7. Weed species shifts of early-maturing soybean varieties.
8. Emergence patterns of weeds vs. crop maturity.
9. The influence of glyphosate-tolerant soybeans on insect and disease complexes.
10. Weed control in non-GMO soybeans with conventional herbicides and the resurgence of traditionally grown soybeans to manage weeds.

Educational Priorities:

1. Education on the proper management of Johnsongrass
2. Convey to the growers the weeds resistant to glyphosate.
3. Drift management of glyphosate.
4. Scouting and identification of weed species.
5. Use of burndown and residual herbicides to better control weeds.
6. Emphasis on early-season weed control and the proper timing of herbicide applications.
7. Inform the growers of tank-mix partner options for better weed control.
8. Explain that early-maturing varieties require different management strategies

Regulatory Priorities:

1. Adding over-the-top applications to the labels of residual graminicides.
2. Reducing the Pre-Harvest Intervals (PHI) for certain herbicides.
3. Addition to the label of Permit (halosulfuron) to include low-rate usage as a preemergence herbicide in soybeans for sedge control.
4. Maintain registration of conventional herbicides used in soybean production.

DISEASES

Research Priorities:

1. Soybean Rust biology and control.
2. Investigation of disease thresholds – exactly how much damage do soybean diseases cause, and when should fungicides be applied?
3. Disease complex shifts in glyphosate-tolerant soybeans.
4. Screening of crop varieties for resistance.
5. Exploring the impact of simultaneously occurring disease complexes.
6. How environmental conditions impact disease incidence and proliferation.
7. Fungicide evaluations, including application technology and the influence of row spacing on fungicide efficacy.
8. Biology and genetics of causal organisms – under what conditions do these organisms occur, especially root and seedling diseases?
9. How early-season crop stress influences disease incidence of some diseases such as Charcoal rot.
10. The influence of fertility on disease incidence.
11. How planting dates, late vs. early planting, influence disease incidence.
12. Seed quality issues relevant to pathogen resistance.

Educational Priorities:

1. Soybean Rust awareness and preparedness.
2. Scouting, identification, and threshold levels for each disease.
3. Proper timing and rates of fungicides.
4. Encourage the planting of resistant varieties.
5. Use and benefits of seed treatments.
6. Utilize the National Plant Diagnostic Network (NPDN)

Regulatory Priorities:

1. Label expansion on fungicides to include other crops where certain soybean diseases can occur.
2. Registration of fungicides for Soybean Rust control.

NEMATODES

Research Priorities:

1. Identification of resistant soybean varieties.
2. Accurate determination of races of the Cyst nematode.
3. Nematode influence on disease incidence.
4. How cropping patterns and rotations influence populations of the Root knot and Reniform nematodes.
5. Nematicide efficacy.

6. Precision Ag techniques such as spot treatments with nematicides.

Educational Priorities:

1. Positive identification of nematodes and symptomology

Regulatory Priorities:

1. Addition of a seed treatment to the labels of present chemicals.

INSECTS

Research Priorities:

1. The influence of glyphosate-tolerant soybeans on insect complexes.
2. Re-evaluate sampling procedures and thresholds.
3. Evaluate seed treatments for grape colaspis.
4. Use of remote sensing to improve scouting techniques.
5. Seeding rate evaluation as an influence on insect populations.
6. Cultural controls and impacts of cultural practices on populations.
7. Insecticide efficacy for new compounds.
8. Termination of insecticide spraying – when to stop spraying for a particular insect.
9. Green Bean Syndrome and the relationship to stink bugs.
10. Soybean aphid biology
11. Biology of *Piezidorus guildini*, red shouldered stink bug, a new pest in LA.

Educational Priorities:

1. Proper timing of insecticide applications.
2. Proper insect identification and scouting.

Regulatory Priorities:

1. Full registration of acephate (Orthene) for stink bug control in Arkansas and Louisiana.
2. Registration of existing safe "green" chemistry such as methoxyfenozide (Intrepid) for use in soybean production – no known obstacles to registration.
3. Addition of seed treatments to presently labeled insecticides.

Pesticides Used on Mid-south Soybeans and Acres Treated (2004)
As reported by Soybean Specialists and Researchers

Insecticides Used and Percentage of Acres Treated by State.

Insecticides	Percentage of Acres Treated by State		
	Arkansas	Louisiana	Mississippi
cyhalothrin (Karate Z)	25	9	60
esfenvalerate (Asana XL)	<1	3	5
methyl parathion (Methyl 4 EC)	10	50	15
permethrin (Ambush, Pounce)	<1	0	5
thiodicarb (Larvin)	<1	30	1
carbaryl (Sevin)	<1	0	0
methomyl (Lannate)	1	1	0
chlorpyrifos (Lorsban)	<1	0	0
spinosad (Tracer)	1	2	1
acephate (Orthene)	0	8	50
methoxyfenozide (Intrepid)	3	5	15
gamma-cyhalothrin (Prolex)	<1	<1	<1
Bacillus thuringiensis	0	1	0
cyfluthrin (Baythroid)	<2	9	30
indoxacarb (Steward)	3	8	1
zeta-cypermethrin (Fury, Mustang Max)	5	9	20
dimethoate (Dimethoate 4 EC)	1	0	0
diflubenzuron (Dimilin)	<1	<1	<1

Percentage of Insect Infested Acres for Each State and the Estimated Yield Loss Using Current Control Methods.

Insect	Percentage of Infested Acres			Percentage Yield Loss Using Current Control Methods		
	AR	LA	MS	AR	LA	MS
Banded cucumber beetle	5	1	5	0	0	0
Bean leaf beetle	100	25	60	2	0	2
Three-cornered alfalfa hopper	100	90	100	2	1	1
Velvetbean caterpillar	10	30	25	<1	1	1
Stink bugs	100	90	100	10	3	5
Soybean looper	75	50	20	<1	1	2
Green cloverworm	100	15	25	<1	0	1
Corn earworm	75	2	5	3	<1	1
Saltmarsh caterpillar	15	1	5	0	0	1
Blister beetle	5	1	1	0	0	0
Grasshoppers	100	1	40	<1	0	1
Lesser cornstalk borer	<5	0	0	0	0	0
Armyworm complex	20	5	5	1	<1	1
Mexican bean beetle	<1	1	0	0	0	0
Cutworms	50	0	1	0	0	0
Garden webworms	30	0	1	0	0	0
Spider mites	0	0	0	0	0	0
Soybean aphid	30	0	5	0	0	0
Thrips	100	30	60	<1	0	0
Grape colaspis	25	1	10	<1	0	0
Dectes stem borer	75	<1	20	3	0	1

Percentage of Weed Infested Acres for Each State and the Estimated Yield Loss Using Current Control Methods.

Weed	Percentage of Infested Acres			Estimated % Yield Loss Using Current Control Methods		
	AR	LA	MS	AR	LA	MS
crabgrass	>40	20	50	<1	<5	1
broadleaf signalgrass	>50	20	20	<1	<5	1
pigweeds	90	20	25	<3	<10	1
Palmer amaranth	90	20	25	<3	<5	2
cocklebur	>40	15	5	<1	<10	1
morningglories	>75	80	50	5	<5	4
Johnsongrass (seedling)	<20	70	25	0	<5	2
Johnsongrass (rhizome)	<20	40	25	<1	<15	2
hemp sesbania	>30	80	1-10	<10	<15	2
sicklepod	<40	80	<1	<1	<15	4
prickly sida	>50	40	<1	<1	<10	4
wild poinsettia	1	30	0	0	<5	1
barnyardgrass	90	90	<4	<4	<15	5
goosegrass	<30	40	<4	<4	<5	1
giant foxtail	1-5	40	0	0	<5	1
fall panicum	<10	20	<1	<1	<10	1
woolly croton	<10	15	<1	<1	<10	1
smartweed	>40	15	<2	<2	<10	2
northern jointvetch	<30	30	0	0	<10	1
spurred anoda	<10	15	0	0	<5	1
balloonvine	>10	15	<4	<4	<5	2
Texas gourd	0-1	5	0	0	<5	1
cutleaf groundcherry	20	80	<1	<1	<10	1
common ragweed	<10	60	0	0	<10	2
nutsedge	70	100	4-5	<5	<10	10
flatsedge	<20	50	<5	<5	<5	5
velvetleaf	30	40	<3	<3	<5	5
jimsonweed	0-1	20	0	0	<5	1
red rice	>25	50	<1	<1	<10	2
spurge	>5	80	0	0	<5	3
hophornbeam copperleaf	<20	40	<3	<3	<5	3
ryegrass	5	10	1	<1	<1	0
marestail (horseweed)	10	3	2	1	2	1

Herbicides Used and Percentage of Acres Treated by State.

Herbicides	Control Spectrum	Percentage of Acres Treated by State		
		Arkansas	Louisiana	Mississippi
Preplant:				
glyphosate	both	50	90	50
paraquat (Gramoxone)	both	5	50	20
2,4-D	broadleaf weeds	10	10	20
sulfentrazone+chlorimuron (Canopy XL)	both	10	15	5
metribuzin (Sencor/Lexone)	both	<5	5	5
chlorimuron+metribuzin (Canopy)	both	<5	5	1
thifensulfuron+tribenuron (Harmony Extra)	broadleaf weeds	>5	20	5
PPI/Preemergence:				
alachlor (Lasso)	both	0	5	2
metolachlor (Dual)	both	5	5	10
metribuzin (Sencor/Lexone)	both	3	5	10
sulfentrazone+chlorimuron (Canopy XL)	both	5	20	5
imazaquin (Sceptor)	both	5	5	10
imazaquin+pendimethalin (Squadron)	both	<3	0	5
Chlorimuron+metribuzin (Canopy SP)	both	<3	0	2
flumioxazin (Valor)	both	<5	5	5
dimethenamid (Outlook)	both	1	5	2
trifluralin (Treflan)	both	1	5	1
pendimethalin (Prowl)	both	2	5	5
flumetsulam (Python)	broadleaf weeds	1	5	3
Postemergence:				
acifluorfen (Blazer)	broadleaf weeds	<3	15	5
bentazon (Basagran)	broadleaf weeds	<3	5	2
chlorimuron (Classic)	broadleaf weeds	30	20	5
cloransulam-methyl (Firstrate)	both	1	10	5
imazaquin (Sceptor)	both	<3	10	5
cloransulam+flumetsulam (Frontrow)	broadleaf weeds	0	10	10
lactofen (Cobra)	broadleaf weeds	1	5	2
fomesafen (Reflex)	both	10	20	10
sethoxydim (Poast Plus)	grasses	<2	5	1
fluazifop (Fusilade)	grasses	1	5	1
Fenoxyprop-ethyl+fluazifop (Fusion)	grasses	1	5	1
quizalofop (Assure)	grasses	1	10	1
clethodim (Select)	grasses	3	10	5
imazethapyr (Pursuit)	both	0	10	2
glyphosate	both	92	90	90
2,4-DB (Butyrac, Butoxone)	broadleaf weeds	2	5	1
Preharvest:				
paraquat (Gramoxone)	both	<5	60	20
sodium chlorate	both	<5	10	15
glyphosate	both	<5	10	15
carfentrazone (Aim)	broadleaf weeds	<4	5	2

Percentage of Disease and Nematode Infested Acres for Each State and the Estimated Yield Loss Using Current Control Methods.

Disease	Percentage of Infested Acres			Estimated Yield Loss Using Current Control Methods (%)		
	AR	LA	MS	AR	LA	MS
Charcoal rot	40	100	100	4	2	1
Phytophora root rot	50	50	75	5	<1	<1
Red crown rot	0	5	1	0	<1	<1
Southern blight	5	5	40	<1	<1	<1
Aerial blight	25	40	25	10	2	1.5
Brown leaf spot	50	50	80	0	<1	1
Downy mildew	80	50	60	<1	<1	<1
Frogeye spot	100	100	80	12	1	3
Cercospora leaf blight	40	100	80	10	6	3
Anthracnose	80	100	100	5	1.5	1
Pod and stem blight	60	100	100	3	2.5	4
Stem canker	10	40	20	20	1	<1
Purple seed stain	100	100	50	2	1	2
Bacterial blight	10	0	20	<1	<1	1
Bacterial pustule	5	2	3	<1	<1	<1
Sudden death syndrome	50	2	1	10	<1	<1
Fusarium rot	25	1	5	<1	<1	1
Rhizoctonia root rot	20	100	100	0	<1	<1
Pythium root rot	100	100	100	1	<1	1
Viral Diseases:						
Soybean mosaic virus	50	25	50	5	<1	<1
Bean pod mottle virus	100	50	100	5	<1	<1
Tobacco ringspot virus	10	5	20	<1	<1	<1
Nematodes:						
Root knot	10	25	<1	5	5	<1
Reniform	<1	50	15	5	4	<1
Cyst	70	20	<1	5	5	<1

Fungicides and Nematicides Used and Percentage of Acres Treated by State.

Fungicides	Percentage of Acres Treated by State		
	Arkansas	Louisiana	Mississippi
Seed Treatments:			
Thiram (Arasan 50R)	<1	<1	<1
azoxystrobin (Quadris)	0	0	<1
captan (Captan 4L and others)	0	0	<1
fludioxonil (Maxim 4FS)	0	0	<1
PCNB, metalaxyl, *B. subtilis* (System 3 Seed Treatment)	0	0	2
metalaxyl (Allegiance)	0	1	2
carboxin+thiram (Vitavax CT)	0	0	2
mefenoxam (Apron XL LS)	0	0	2
azoxystrobin+metalaxyl (SoyGard)	0	0	1
carboxin+thiram+metalaxyl (Vitavax CT + Allegiance)	0	0	30
mefenoxam+fludioxonil (Apron Maxx RTA)	30	25	2
carboxin+thiram+molybdenum (Vitavax M)	1	1	2
mefenoxam+fludioxonil+molybdenum (Apron Maxx RTA + moly)	30	5	35
Foliar Treatments:			
azoxystrobin (Quadris)	25	35	20
thiophanate-methyl (Topsin M 70WP)	<1	30	3
chlorothalonil (Bravo Ultrex)	1	0	0
Nematicides:			
aldicarb (Temik 15G)	<1	<1	0
1,3-dichloropropene (Telone II)	<1	0	0

Advisory Committee Members for Pest Management Strategic Plan for Midsouth Soybeans by Affiliation

University of Arkansas

Bob Scott, Weed Science
Brandy Carroll, Commodity Specialist, Arkansas Farm Bureau
Carl Hayden, Extension Staff Chairman, Chicot County
Chris Tingle, Agronomy
Cliff Coker, Plant Pathology
Dwayne Beaty, Agronomy
Hank Chaney, Extension Staff Chairman, Prairie County
John Rupe, Plant Pathology
Ken Smith, Weed Scientist
Lance Honeycutt, Private Consultant
Mark Trent, Plant Pathology
Chuck Farr, Private Consultant
Rick Cartwright, Plant Pathology
Trey Reaper, Agronomy
Gus Lorenz, Entomology
Blair Griffin, Extension Staff Chairman, Johnson County
Ples Spradley, Pesticide Assessment Specialist

Louisiana State University

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Jack Baldwin, Entomology
Matt Baur, Entomology
James Board, Agronomy
James Rabb, Agronomy
David Lanclos, Weed Science
Donnie Miller, Weed Science
Charles Overstreet, Nematology
Raymond Schneider, Plant Pathology
Ken Whitam, Plant Pathology
Matt Shipp, Entomology

Mississippi State University

David Ingram, Plant Pathology
Al Rankins, Weed Science
Don Parker, Entomology
Billy Moore, Plant Pathology
Dan Poston, Extension Soybean Specialist

Alan Blaine, Extension Soybean Specialist
John Corraro, Extension Area Program Leader/ANR
Buddy Douglas, Producer
Terry Rector, County Extension Agent
Gabe Sciumbato, Plant Pathology
Mark Silva, Delta Research Experiment Station
Elmo Collum, Pesticide Education Coordinator

Attendees of the Soybean PMSP meeting held in Vicksburg, MS, on September 1, 2004

Buddy Douglas, Producer, MS
Chuck Farr, Crop Consultant, AR
Elmo Collum, MSU
David Ingram, MSU
James Board, LSU
Matt Shipp, LSU
Ples Spradley, U of Ark
Clifford Coker, U of Ark
James Rabb, LSU
Dan Poston, MSU
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