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MANAGEMENT OF SOYBEAN RUST IN ALABAMA

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Asian soybean rust, caused by the fungus *Phakopsora pachyrhizi*, has now been found in 18 Alabama counties. The list includes Baldwin, Blount, Cherokee, Cullman, DeKalb, Elmore, Escambia, Etowah, Henry, Houston, Lauderdale, Limestone, Madison, Marshall, Mobile, Monroe, Morgan and Tuscaloosa. Soybean rust has also been confirmed on soybeans in nine states including Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, Missouri, South Carolina and Tennessee. Most likely, spores of the pathogen were carried by winds from Hurricane Ivan into the Gulf Coast region.

In 1984, an economic risk analysis projected that the potential losses in the U.S. would be \$7.1 billion per year, once soybean rust was established in the main soybean growing area of the United States. A conservative prediction indicated yield losses greater than 10% in nearly all the U.S. soybean growing areas with losses up to 50% in the Mississippi delta and southeastern coastal states. How rust will actually effect soybean production in Alabama and the other southern states is unknown as only "time will tell" as the disease becomes established in the U.S.

We have been anticipating the arrival of this disease since 2002. Fortunately, the pathogen made its entrance into the continental U.S. at the end of the 2004 growing season causing no apparent yield reduction to this year's crop. Its late arrival also allows growers ample time to become familiar with the disease and the methods necessary to manage it this upcoming season.

Survival and Development

From what we know, it is unlikely that soybean rust will overwinter in Alabama. The pathogen survives on living plant material. Most likely, the pathogen will survive on alternate hosts such as kudzu in south Florida or possibly in the Caribbean. In South America, kudzu, growing along roadsides and in ditch banks in Brazil and Paraguay, was observed to be severely infected with rust, but showed no apparent loss of plant vigor. In the spring, soybean rust spores will likely be carried from its overwintering site into the gulf coast states on wind currents and on storms, eventually moving northward into the Midwest.

At least 31 species in 17 genera of legumes can be hosts of this fungus. Among the pathogens hosts in the United States are kudzu, yellow sweet clover, medic, vetch,

lupine, green and kidney bean, Lima or butter bean and cowpea or black-eyed pea. The full host range of Asian soybean rust has not been clearly identified and may be complicated by pathotypes and differential reactions within host species. It is unclear how these alternate hosts will impact the pathogen's survival and development or how the pathogen will affect production of these crops in Alabama.

The development of soybean rust is favored by prolonged periods of leaf wetness (6-12 hours) and temperatures of 46 to 82 degrees F. Extended periods of cool, wet weather during the growing season favor soybean rust development. Rust pustules appear on the leaf surface 9 to 10 days after infection, and spores are usually visible soon after. Each lesion can produce vast number of spores and spore production may continue for weeks. Spores are easily spread by wind. Soybean plants are susceptible to soybean rust at any stage of development, but symptoms are most common during and after flowering.

Symptoms

The most common symptom of soybean rust is a leaf lesion. On the upper leaf surface, initial symptoms may be small, yellow flecks or specks in the leaf tissue. These lesions darken and may range from dark brown or reddish brown to tan or gray-green in color. The lesions tend to be angular to somewhat circular in shape and may be concentrated near leaf veins. Initially, lesions are small, barely larger than a pin point. Mature lesions may be somewhat larger, and lesions may merge or run together, killing larger areas of leaf tissue. Symptoms may be more severe on the lower leaf surface.

Pustules form on the lower leaf surface. These may appear to be small raised blisters or calloused bumps. As the pustules mature, they begin to produce large numbers of light-colored, powdery spores which emerge through a hole in the cone-shaped pustule. Masses of spores may mound up out of the opening in the pustule. The pustules and spores are difficult to see without magnification. A high powered hands lens will aid greatly in the identification of this disease in the field.

Rust pustules are most common on the underside of leaves but may also develop on petioles, pods and stems. Leaves may turn yellow and drop prematurely. Losses are due to a reduction in photosynthetic area of the plants resulting in a reduction in pod and seed numbers and in seed weight.

Soybean rust is usually found first on the lower leaves of plants, especially at or near flowering. As the soybean plant matures, lesions may be found in the middle and upper canopy. When conditions are favorable for disease development, yellowing of the foliage may be evident and defoliation and premature death of plants may occur.

Management

In the long term, resistant varieties may be the more practical, economical means of managing soybean rust. However, all commercial varieties of soybeans currently available are highly susceptible to the disease. Both public and private soybean breeders are working to identify sources of resistance and to incorporate resistance in soybean varieties suitable for U.S. production.

Soybean rust can be managed with the judicious use of fungicides. Fungicide applications can reduce yield loss, depending on the plant developmental stage, time when soybean rust is detected, and fungicide application method. Several factors will impact your fungicide options. Some fungicide are preventative, meaning they will protect the crop from infection if applied before the disease reaches a field. Other fungicides are curative meaning they can be applied soon after infection has taken place and still be effective.

Growers in Alabama will have three fungicide groups to work with in 2005: **Chlorothalonils.** These products are purely preventative and must be applied prior to a rust infection. Bravo and Echo are currently labeled for use on soybeans in Alabama. Chlorothalonil fungicides offer multiple sites of action; are not absorbed and remain on the leaf surface. They have a longer residual period and a longer pre-harvest interval (42 days) than other available fungicides.

Strobilurins. These chemistries must be applied as a preventative prior to infection. Azoxystrobin (Quadris) and pyraclostrobin (Headline and Pristine) will be available in this group and others are pending Section 18 approval. Strobilurins are absorbed by the soybean leaf and slowly translocate within the plant. Since they have a single-site mode of action, resistance is a concern if the products are overused or misused. Strobilurin fungicides will be restricted to one application per season, unless combined with another active ingredient.

Triazoles. These chemistries range from protective to curative. Curative in this case means the fungicide will kill new rust infections, but it does not mean it will cure infections already in existence. Triazole compounds Laredo, Folicur, Tilt, PropiMax and Bumper should receive section 18 exemptions prior to the growing season. Triazoles are also single-mode-of action materials, but they tend to have short residual periods and move through the plant faster than strobilurins. All triazole products are not created equal. Some have more curative properties than others. Because of rapid absorption, some triazoles move beyond the leaf to other parts of the plant. However, none of the products available are true systemics, basically, they protect the tissue they are deposited on and in some cases do a little more.

When to Spray

This year will be the beginning of a learning process for Alabama farmers as we try to get a handle on the most effective times to spray a fungicide for optimum protection against the disease. Waiting for the disease to show up in your field before initiating your spray program could result in significant yield losses. Once an epidemic

reaches 10% severity, very few of the products that are available will provide yield protection.

We plan on establishing monitoring plots throughout the state which will be scouted weekly to allow us to determine initial soybean rust outbreaks and to send out early warning alerts to growers in the immediate area and around the state. However, as stated earlier, waiting for the disease to show up in a field before starting a fungicide program can be risky due to the ability of the disease to spread from field to field quickly, and to develop rapidly once on the plant.

Research has shown that fungicide applications soon after flowering are generally considered the most economical. The timing of the first application is critical. Initial research suggests that the best program in high rust pressure areas, which we'll assume Alabama will be, will likely be a fungicide application at first flowering, followed by one or two more applications at 21-day intervals.

In 2005, Alabama soybean farmers should use one of the following fungicide spray programs for management of soybean rust. Applications should begin at flowering and any subsequent applications should be made 21-days apart. For aerial applications, use a minimum of 5 gallons of water/acre. For ground applications, use a minimum of 15 gallons/acre. The addition of an adjuvant will help the material penetrate through the crop canopy.

If the disease is expected, but not yet present (preventative program) follow one of these options:

*Treat with propiconazole + trifloxystrobin (Stratego) or pyraclostrobin + boscalid (Pristine). **If a second application** is needed treat with chlorothalonil or a Section 18 triazole product (propiconazole, tebuconazole, myclobutanil or tetraconazole)

OR

Treat with azoxystrobin or pyraclostrobin. **If a second application is necessary, treat with a Section 18 triazole product.

If the disease is expected, but not yet present, and develops after initial treatment:

Treat with azoxystrobin or pyraclostrobin. **If a second application** is needed, treat with a Section 18 triazole product. **If a third application** is needed, treat with chlorothalonil, if pre-harvest interval allows, or a Section 18 product.

If the disease is already established on site or if a near-by field is infected (curative program):

Treat with Section 18 triazole product. **If a second application** is needed, retreat with a Section 18 triazole product. If the disease is at a minimal level, treat with azoxystrobin. **If a third application** is needed, treat with chlorothalonil, if the pre-harvest interval allows. If the second application was with a triazole, then a strobilurin (azoxystrobin, pyraclostrobin or trifloxystrobin) compound can be used for the third treatment.

Following is a list of fungicide for Asian soybean rust control in Alabama. Quadris, Pristine, Bravo, Echo and Headline are currently labeled for use on soybeans in Alabama. The fungicides marked with an (*) are Section-18 fungicides that should be approved for use on soybeans in Alabama in 2005.

| Trade Name | Manufacturer | Active Ingredient | Fungicide Group |
|-------------------|---------------------|---|-------------------------------------|
| Quadris | Syngenta | azoxystrobin | strobilurin |
| Bravo | Syngenta | chlorothalonil | chlorothalonil |
| Echo | Sipcam Agro | chlorothalonil | chlorothalonil |
| *Stratego | Bayer | propiconazole+ trifloxystrobin | strobilurin+ triazole |
| Pristine | BASF | pyraclostrobin+ boscalid | strobilurin+ carboximide |
| Headline | BASF | pyraclostrobin | strobilurin |
| *Laredo | Dow Agro. | myclobutanil | triazole |
| *Tilt | Syngenta | propiconazole | triazole |
| *PropiMax | Dow Agro. | Propiconazole | triazole |

| Trade Name | Manufacturer | Active Ingredient | Fungicide Group |
|-------------------|---------------------|--------------------------|------------------------|
| *Bumper | Makhteshim | propiconazole | triazole |
| *Folicur | Bayer | tebuconazole | triazole |
| *Laredo | Dow Agro. | myclobutanil | triazole |

Comparison of rust control fungicides (developed by Dr. G. Sciumbato, D. Poston, and A. Henn, Mississippi State University, and modified by Dr. E. Sikora, Auburn University. The fungicides marked with an (*) are Section-18 fungicides that should be approved for use on soybeans in Alabama in 2005.

| Trade Name | Rate Range | Probable Use Rate | Cost Per Acre | Post Harvest Interval |
|-------------------|--------------------|--------------------------|----------------------|------------------------------|
| Quadris | 6.2-15.4 oz | 9.2 oz | \$13-32 | 14 days |
| Echo | 1.3-2.25pt | ----- | \$7-12 | 42 days |
| Headline | 6-12 oz | ----- | \$11-21.5 | 21 days |
| *Laredo | 4-8 oz | 8 oz | \$6-12.5 | 28 days |
| *Tilt | 4-8 oz | 6 oz | \$10-20 | no later than R5 |
| *PropiMax | 4-8 oz | 6 oz | \$10-20 | no later than R5 |
| *Bumper | 4-8 oz | 6 oz | \$10-20 | no later than R5 |
| *Folicur | 3-4 oz | ----- | \$8-11.5 | 21 days |
| *Stratego | 5.5-10 oz | ----- | \$6.5-12 | unknown |

R5 - Beans beginning to develop at one of the four uppermost nodes.