Approved: February 8, 2005
Date

MINUTES OF THE SENATE AGRICULTURE COMMITTEE

The meeting was called to order by Chairman Mark Taddiken at 8:30 A.M. on February 1, 2005 in Room 423-S of the Capitol.

All members were present except:
Derek Schmidt- excused

Committee staff present:
Raney Gilliland, Kansas Legislative Research
Lisa Montgomery, Office of Revisor of Statutes
Jacqui Jones, Agriculture Committee Secretary

Conferees appearing before the committee:

Professor Doug Jardine, Extension State Leader, Plant Pathology, Kansas State University
Duane Simpson, Director of Government Relations, Kansas Agribusiness Retailers Association

Others attending:
See attached list.

Chairman Taddiken presented the minutes of January 25 and January 26 early to allow the Committee time to go over them stating he would be requesting their approval at the end of the meeting.

The Chairman welcomed Professor Doug Jardine and asked him to make his presentation before the Committee regarding the background and impact analysis on Kansas soybean producers from Asian Soybean Rust.

Dr. Jardine gave a slide presentation along with his commentary on the subject (Attachment 1).

There are two fungal species that cause soybean rust. The more aggressive of the two species, Asian soybean rust, was first confirmed in the continental United States in November 2004. It spreads rapidly and may cause severe damage with yield losses from 10 to 80%.

Windborne spores are transported over long distances. Clouds of spores are released if infected plants are disturbed by wind. Individuals walking through rust-infected areas may transport the spores on clothing to uninfected locations.

Seedborne transmission of the disease has not been documented, although there is some concern that seed lots may contain small amounts of infected plant debris capable of spreading the pathogen.

Asian rust is capable of infecting more than 90 species of legumes. Kudzu could serve as a reservoir for the soybean rust pathogen. The broad host range of Asian soybean rust increases the likelihood of rapid spread once introduced into the United States.

The symptoms, disease development and identification of soybean rust are described in the National Pest Alert bulletin provided by Dr. Jardine.

If soybean rust is suspected, methods of sample collection and submission of samples to Kansas Department of Agriculture's diagnostic laboratory also are described. Early detection is required for the most effective management of the disease. Monitoring soybean fields and adjacent areas is recommended throughout the growing season. It was recommended that Kansas State University Extension personnel be contacted for information on fungicides labeled for use on soybeans.

Dr. Jardine showed the Committee a shirt pocket-size, laminated card identifying and describing soybean rust and other similar diseases that is widely available for distribution by Kansas State University Extension Offices throughout the state.

Dr. Jardine stood for questions from the Committee.

Chairman Taddiken thanked Dr. Jardine for his presentation.

Duane Simpson made a presentation on behalf of the Kansas Agribusiness Retailers Association. A copy of the testimony is attached hereto. (Attachment 2).

A copy of Soybean Rust Reference Guide: A Special guide for Growers and Agronomists from the American Soybean Association, January 2005 is attached hereto (Attachment 3).

Mr. Simpson stood for questions.

The Chairman thanked Mr. Simpson for his testimony.

Upon a Motion by Senator Pine and seconded by Senator Huelskamp the minutes of January 25 and January 26 were unanimously approved by the Committee.

The meeting adjourned at 9:30 a.m.

The next meeting is scheduled for February 2, 2005 at 8:30 a.m.

SENATE AGRICULTURE COMMITTEE GUEST LIST

DATE: 2/1

NAME	REPRESENTING
CV Cotsoradis	KDA
Jere White	KCGA
[illegible]	[illegible]
Duane Simpson	KARA
Leslie Kaufman	Ks Coop Council
Sean Miller	KS Dairy Assn
David Corbin	KDOR
Brad Harrelson	KFB

Soybean Rust: *Background and Impact Analysis on Kansas Soybean Producers*

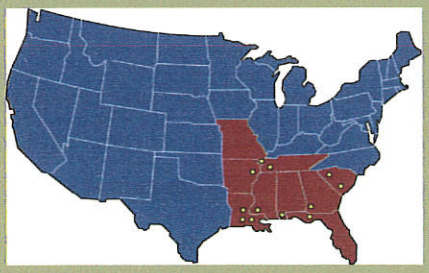
Doug Jardine
Extension State Leader, Plant Pathology
Kansas State University, Manhattan

First day of infection

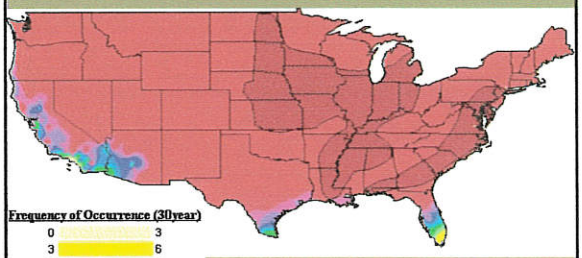
Six days after infection

Thirteen days after infection

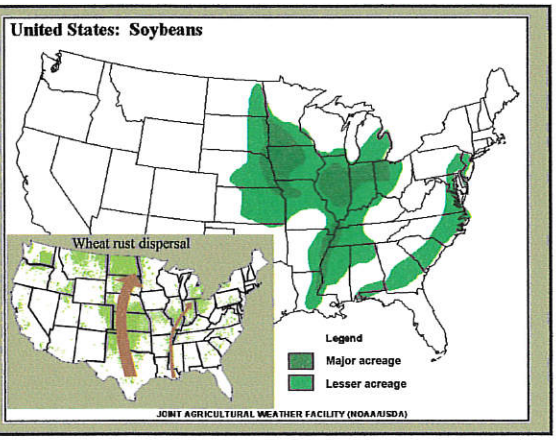
Current distribution of Asian soybean rust



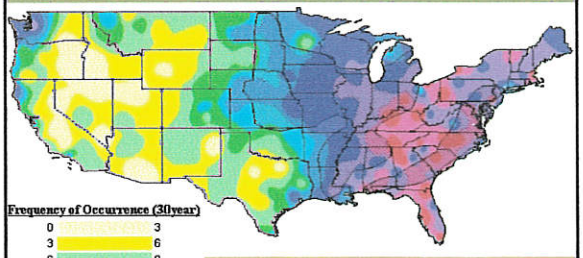
Overwintering



Probability of freezing temperatures in January and February



Suitability for epidemics

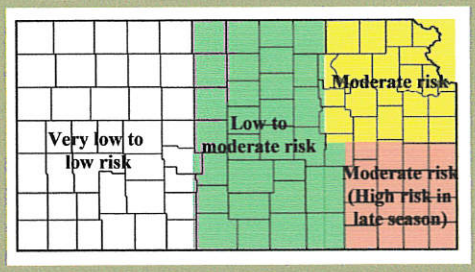


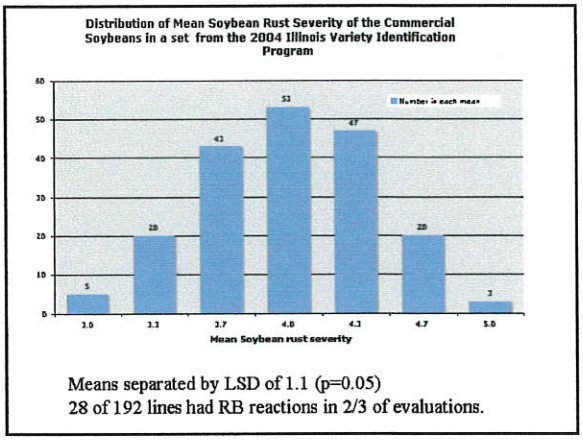
Greater than 15 favorable days

Senate Agriculture Committee
Date 2-1-05

Attachment # 1

Estimated impact of soybean rust by location





Fungicides Registered for Use on Soybean and Labeled for Control of Soybean Rust in the US

Chlorothalonil
- **Bravo 500** (Syngenta)
- **Echo 720** (Sipcan Agro)

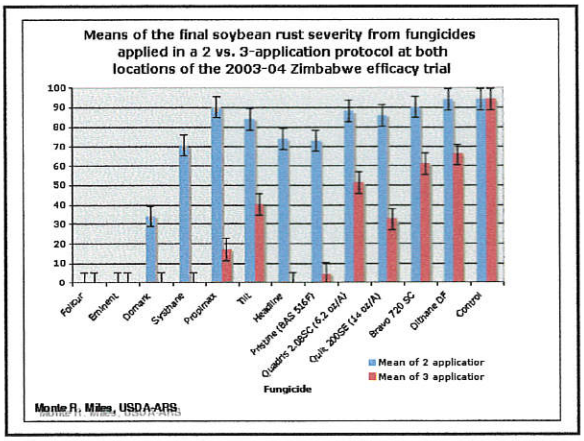
Strobilurins
- **Quadris - Azoxystrobin (Syngenta)**
- **Headline -Pyraclostrobin (BASF)**

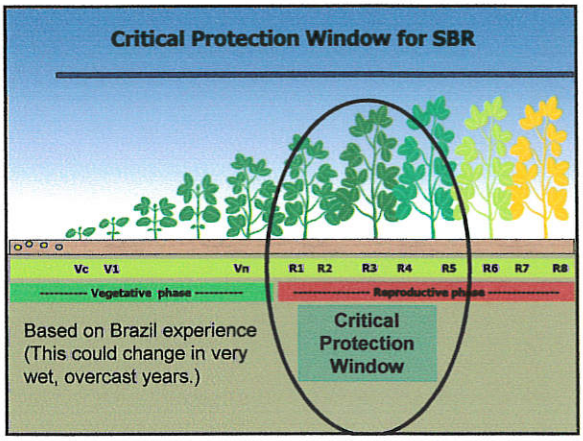
Fungicides on the Section 18 Emergency Exemption Request

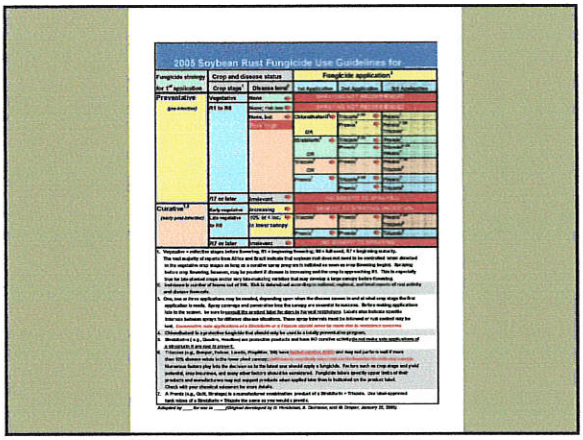
(Products in blue have been approved for use on soybean rust.)

Triazoles

Laredo EC and EW (Myclobutanil)
Tilt, Propimax, Bumper (Propiconazole)
Folicur (Tebuconazole)
Stratego (Trifloxistrobin + Propiconazole)
Pristine (Pyraclostrobin + Boscalid)
Domark (Tetraconazole)
Quilt (Azoxystrobin + Propiconazole)







Will fungicide use on soybeans be economical for Kansas farmers?

- Certainly when soybean rust is present before pod set
- Use in the absence of rust would depend on the price of soybeans and yield potential
- Disease pressure in Kansas is likely to be less than in states to the east of us in most years
  - 2004 would have been an exception

Will rust get to Kansas in 2005?

- Keys
  - Watch for the occurrence of rust in gulf coast states in the spring and early summer
    - This will determine the number of spores available to blow northward
  - The July-August weather conditions
    - Cooler temperatures (80's) and frequent dews are favorable
  - Northward movement of rust spores
    - Watch for reports from Arkansas, Missouri and Oklahoma

How is Kansas preparing for the arrival of rust?

- Identification cards are being distributed through various channels
- A national fungicide manual will be promoted and made available to local extension offices and via web download
- Surveillance systems and sentinel plantings will be established
- Fungicide trials will be established
- A rapid turn around time on diagnosis of submitted leaf samples (24-48 hours) to the KSU PDDL
- Asking growers to assess their ability or that of local custom applicators to spray all of the necessary soybean acres within three to four days

National Pest Alert

Soybean Rust

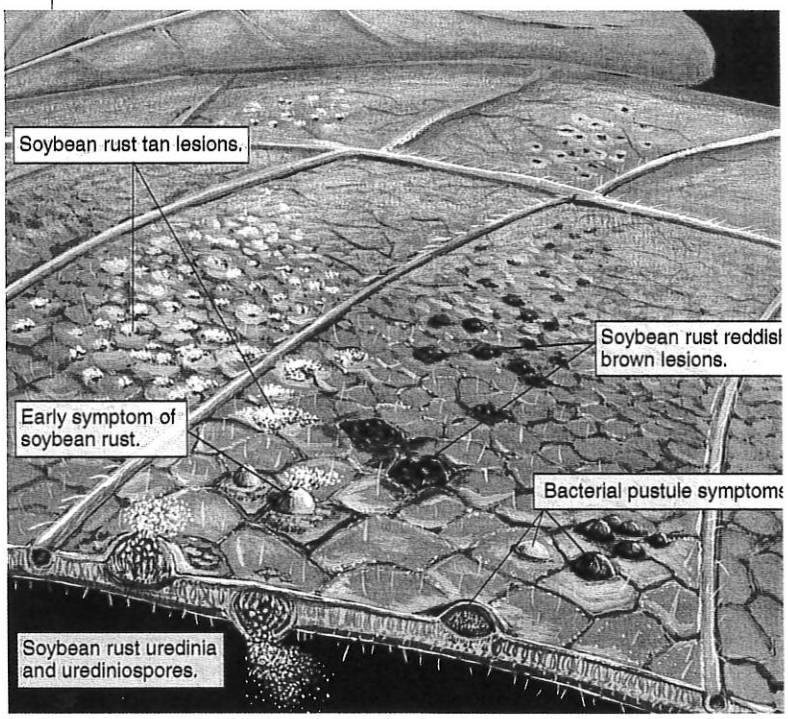
Phakopsora pachyrhizi and *P. meibomiae*

Distribution and Transmission

Two fungal species, *Phakopsora pachyrhizi* and *P. meibomiae*, cause soybean rust and are spread primarily by windborne spores that can be transported over long distances. Asian soybean rust, *P. pachyrhizi*, the more aggressive of the two species, was first reported in Japan in 1903 and was confined to the Eastern Hemisphere until its presence was documented in Hawaii in 1994. Currently, distribution of *P. pachyrhizi* includes Africa, Asia, Australia, Hawaii, and South America. *P. pachyrhizi*'s rapid spread and severe damage with yield losses from 10 to 80% have been reported in Argentina, Asia, Brazil, Paraguay, South Africa, and Zimbabwe. In November, 2004, the presence of *P. pachyrhizi* was confirmed in the continental United States.

Seedborne transmission of the disease has not been documented, but there is some concern that seed lots may contain small amounts of infected plant debris capable of spreading the pathogen. To date, seed lots have not proven to be a pathway for the disease. Clouds of spores are released if infected plants are disturbed by wind or by individuals walking through rust-infected areas. Individuals who are sampling for soybean rust may transport spores from one area to another on clothing. If clothing is exposed to spores, care should be taken to prevent the spread of soybean rust to uninfected locations.

Symptoms in non-tolerant (left) and tolerant (right) soybean infected with soybean rust.



Soybean rust lesion types and characteristics of early symptoms of soybean rust and bacterial pustule.

Host Range

P. pachyrhizi is capable of infecting more than 90 species of legumes; however, the number of legumes infected in nature is unknown. Kudzu is widespread in the United States and could serve as a reservoir for the soybean rust pathogen. The broad host range of this fungal pathogen increases the likelihood of rapid spread once introduced into the United States.

Symptoms and Disease Development

Soybean rust symptoms are similar for *P. pachyrhizi* and *P. meibomiae* species. Symptoms begin on the lower leaves of the plant as small lesions that increase in size and change from gray to tan or reddish brown on the undersides of the leaves. Lesions are most common on leaves but may occur on petioles, stems, and pods. Soybean rust produces two types of lesions, tan and reddish brown. Tan lesions, when mature, consist of

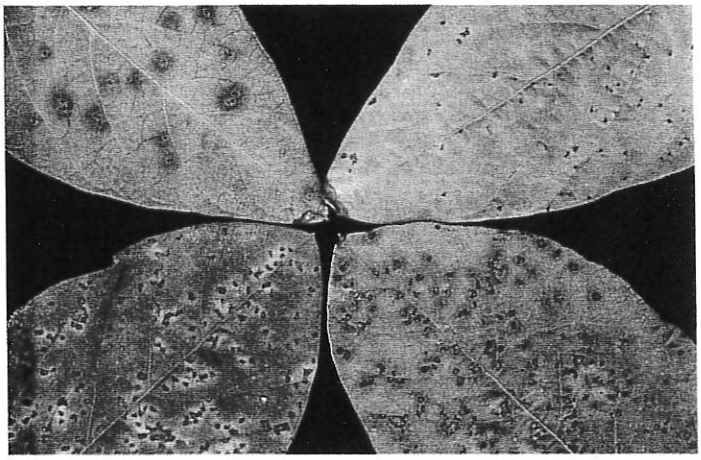
National IPM

small pustules (uredinia) surrounded by slightly discolored necrotic area with masses of tan spores (urediniospores) on the lower leaf surface. Reddish brown lesions have a larger reddish brown necrotic area, with a limited number of pustules (uredinia) and few visible spores (urediniospores) on the lower leaf surface. Once pod set begins on soybean, infection can spread rapidly to the middle and upper leaves of the plant.

Environmental conditions impact the incidence and severity of soybean rust. Prolonged leaf wetness combined with temperatures between 59 and 86°F and humidity of 75–80% is required for spore germination and infection. Under these conditions, pustules form within 5–10 days and spores are produced within 10–21 days. High levels of infection in soybean fields result in a distinct yellowing and browning of fields and commonly, premature senescence in plants.

Identification of Soybean Rust

Molecular analysis provides rapid and accurate identification to differentiate between *P. pachyrhizi* and *P. meibomiae*. Early symptoms of soybean rust resemble bacterial pustule (*Xanthomonas axonopodis* pv. *glycines*) and brown spot (*Septoria glycines*). Soybean



Various stages of soybean rust on soybean leaves.

rust can be distinguished from bacterial pustule and brown spot by examining the lesions under a hand lens (20×) or dissecting microscope. The mature soybean rust lesion contains cone-shaped pustules with a pore on the top with spores inside or on top of the cone.

Sample Collection Procedures

Collect samples immediately if you suspect soybean rust is present on soybean or other hosts. Place each plant sample in a self-locking plastic bag and maintain under cool conditions (refrigeration). Place samples in sealed paper bags if cool conditions are not available. Once refrigeration is available, each sealed paper bag should be placed inside a self-locking plastic bag before cooling. Leaves should be kept flat by placing them between paper towels or pieces of paper. Record the following information for each sample collected: date; host plant; collector's name; phone number; collection location within field; and location of field, including state, county, township, and nearest road intersection. Global positioning system location information is requested if available. Mark sample containers with a permanent marker and print all information.

Sample Submission

Submit samples to your state's university diagnostic laboratory or Department of Agriculture diagnostic laboratory for identification (contact university extension personnel for the address of the diagnostic laboratory). Each state is developing an invasive species response program as part of the USDA National Plant Diagnostic Network. If samples are identified as soybean rust by state diagnosticians, species verification by molecular analysis will be required.

Management Recommendations

All commercial varieties currently available are highly susceptible. Current research includes screening germplasm for resistance and evaluating fungicide efficacy. Early detection is required for the most effective management of soybean rust. Monitoring soybean fields and adjacent areas is recommended throughout the growing season. Fungicide applications may reduce yield loss, depending on the plant developmental stage, time when soybean rust is detected, and fungicide application method. For efficacy information on fungicides labeled for use on soybean, consult university extension personnel in your state.

For more information on soybean rust, visit our Web site at

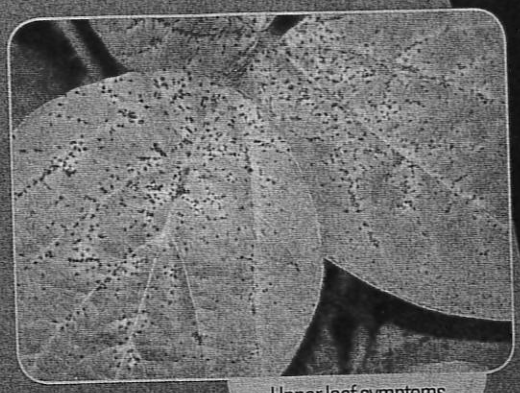
http://www.ncipm.org/soybeanrust

This publication was produced and distributed by USDA-CSREES Integrated Pest Management Centers in cooperation with the National Plant Diagnostic Network, APHIS, ARS, and the 1862 Land-Grant Universities. For more information regarding the development of this document, contact Susan T. Ratcliffe at sratclif@uiuc.edu or by phone at (217) 333-9656.

Photos courtesy of Glen Hartman (USDA-ARS) and David Riecks (University of Illinois, College of Agricultural, Consumer and Environmental Sciences); scanning electron microscopy of spores courtesy of Morris Bonde (USDA-ARS); and soybean rust illustration courtesy of Joel Floyd (USDA-APHIS-PPQ). Editor: Julie L. Todd (Department of Entomology, Iowa State University). Graphic designer: Gretchen Wieshuber (Studio 2D, Champaign, IL).

1862 Land-Grant Universities

Auburn University University of Alaska University of Arizona University of Arkansas University of California Colorado State University University of Connecticut University of Delaware University of the District of Columbia University of Florida University of Georgia University of Guam University of Hawaii University of Idaho University of Illinois Purdue University Iowa State University Kansas State University University of Kentucky Louisanna State University University of Maine University of Maryland University of Massachusetts Michigan State University University of Minnesota Mississippi State University University of Missouri Montana State University University of Nebraska University of Nevada University of New Hampshire Rutgers New Mexico State University Cornell University North Carolina State University North Dakota State University Ohio State University Oklahoma State University Oregon State University Pennsylvania State University University of Puerto Rico University of Rhode Island Clemson University South Dakota State University University of Tennessee Texas A&M University Utah State University University of Vermont University of the Virgin Islands Virginia Polytechnic Institute & State University Washington State University West Virginia University West Virginia State University University of Wisconsin University of Wyoming



Upper leaf symptoms

Pustules (spores) under 20X hand lens

When scouting for soybean rust, focus on:

- Early planted fields with early maturing varieties
- Low lying or protected fields with prolonged dew periods
- Fields with early canopy closure

For soybean rust detection on the plant:

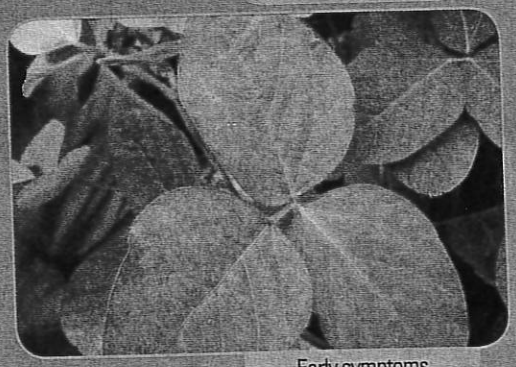
- Examine lower leaves of the plant
- Use a 10 to 20X hand lens to detect pustules (spores) on underside of leaves

Ontario
Ministry of Agriculture and Food

Our soybean checkoff.

IDENTIFYING SOYBEAN RUST

Back lit leaf



Early symptoms

For confirmation and diagnosis of soybean rust contact your state plant diagnostic lab.

www

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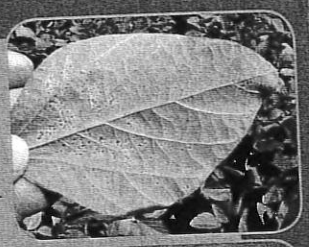
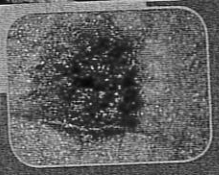
Senate Agriculture Committee
Date 2-1-05
Attachment # 1-6

SIMILAR LOOKING DISEASES

BACTERIAL BLIGHT

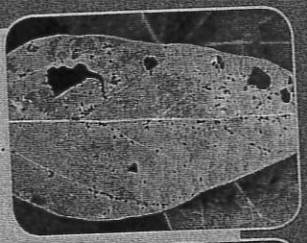


- Affects mid-to-upper leaves.
- Angular lesions, reddish-brown to black centers.
- Initial angular water-soaked lesions with yellow halo.

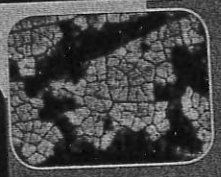


Difference from Soybean Rust: Water soaking; angular lesions; lesions on leaf underside are not raised.

BACTERIAL PUSTULE

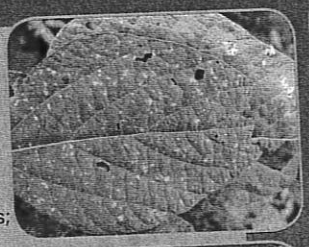


- Affects mid-to-upper leaves.
- Lesions — small spots to large irregular shapes without water soaking.
- Lesions associate with main veins; pustules form in lesion centers on leaf underside. (10X)

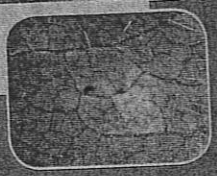


Difference from Soybean Rust: Pustules not always with each lesion; pustules do not have spores in openings; openings are cracks instead of circular pores.

DOWNY MILDEW



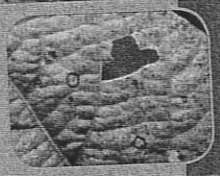
- Affects upper leaves.
- Spots on surface enlarge into yellow lesions.
- Older lesions turn brown with yellow-green margins; size varies with age of leaf affected.
- Fuzzy fungal gray tufts on leaf underside (20X).



Difference from Soybean Rust: Lesions larger than rust lesions; no raised pustules on underside; fuzzy fungal growth on underside.

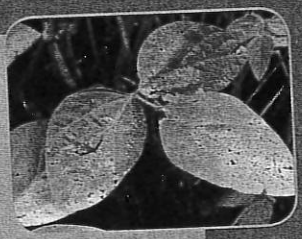
CERCOSPORA BLIGHT AND FROGEYE LEAF SPOT

- Blight affects upper leaves exposed to sun after seed set; Frogeye affects lower leaves first.
- Blight starts as light purple areas on upper leaf surface which expands to cover surface; leaves leathery and dark reddish purple on upper surface only.
- Frogeye lesions start as dark, water-soaked spots; can have light centers; circular to angular brown spots with dark red-brown margins.

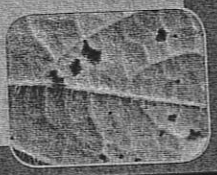


Difference from Soybean Rust: Blight — overall leaf area is discolored on upper surface only. Frogeye — discrete lesions larger than rust with defined lesion margins; no pustules evident on underside.

BROWN SPOT



- Affects lower leaves first.
- Irregular-shaped dark brown lesions on both leaf surfaces; size — small spots to large areas; adjacent lesions can form irregular shaped blotches.
- Infected leaves quickly yellow and drop.



Difference from Soybean Rust: No raised areas on leaf underside; angular lesions; if dark lesions, lack of uredia is key symptom; first symptoms can look like rust; has same canopy distribution as rust.

KANSAS AGRIBUSINESS RETAILERS ASSOCIATION

KARA is *"Committed to Professional Development and Business Viability for the Plant Nutrient and Crop Protection Retail Industry"*

Statement of the

Kansas Agribusiness Retailers Association

Presented to the

Senate Agriculture Committee

Regarding Asian Soybean Rust

Senator Mark Taddiken, Chairman

February 1, 2005

Presented by:

Duane Simpson
Director of Government Relations

Kansas Agribusiness Retailers Association
(785) 234-0463

Senate Agriculture Committee
Date 2-1-05

Attachment # 2

Chairman Taddiken and Members of the Senate Agriculture Committee, I am Duane Simpson appearing on behalf of the Kansas Agribusiness Retailers Association (KARA). KARA's membership includes over 700 agribusiness firms that are primarily retail facilities that supply fertilizers, crop protection chemicals, seed, petroleum products and agronomic expertise to Kansas farmers. KARA's membership base also includes ag-chemical and equipment manufacturing firms, distribution firms and various other businesses associated with the retail crop production industry. I am here today to discuss industry efforts to prevent and treat possible soybean rust outbreaks in Kansas. Specifically, I am going to discuss education efforts, products available to prevent or treat rust, and the likely availability of chemicals and equipment.

Education

KARA has added soybean rust to the topics discussed in our various training programs that we sponsor throughout the state. These seminars include information on identifying rust, preventative measures, and treatment options. In addition, each of the chemical manufacturing firms that produce fungicides have begun an extensive training effort for their customers including the agribusiness retailer, the professional applicator and the grower. The equipment manufacturers have developed training programs for dealers and customers to help set and adjust their current sprayers and to help decide the best tips and nozzles to use for application. The American Soybean Association (ASA) has released the Soybean Rust Reference Guide which I have attached to my testimony. This guide is designed for growers and agronomists. It gives a comprehensive guide to soybean rust including its background, application challenges, scouting for rust, defense strategies, appropriate fungicides and resistance management. Finally, the Environmental Protection Agency (EPA), United States Department of Agriculture (USDA), Kansas Department of Agriculture (KDA), and Kansas State University Extension are all working together with industry, ASA and the Kansas Soybean Commission to make sure retailers, applicators, and growers have the most up-to-date information available. I am confident that the Kansas soybean producer, their local retailer, professional applicator and extension officer have all been informed about soybean rust and the associated best practices to combat the pathogen.

Fungicides

Although research continues on rust resistant varieties of soybeans, the most effective treatment available to producers today is fungicide. The following chemicals have either been approved for use to combat soybean rust or have a pending application. Section 3 Registration refers to chemicals that the EPA has approved for use on soybeans to control rust. Section 18 Registration refers to temporary EPA approval. The temporary applications are set to expire on March 1, 2007. The chemicals will either receive full Section 3 Registration prior to that date or a new application will be made by the state for continued Section 18 "quarantine exemption". The National Soybean Rust Advisory Committee has ranked the Section 18 chemicals in order of greatest potential for availability and preference for use. The order of the Section 18 chemicals reflects the advisory committee's rankings. As you can see, producers have a wide variety of choices for combating soybean rust.

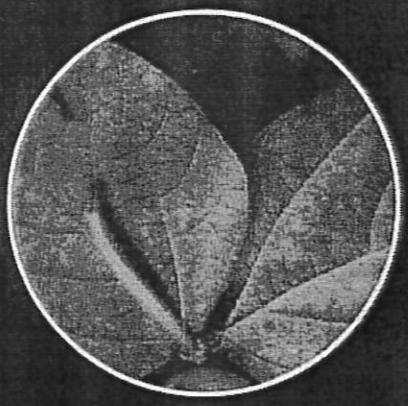
Chemical Name	Brand Name	Manufacturer	Registration (Number)
Azoxystrobin	Amistar	Syngenta Crop Protection	Section 3
Azoxystrobin	Quadris	Syngenta Crop Protection	Section 3
Chlorothalonil	Bravo Weather Stick	Syngenta Crop Protection	Section 3
Chlorothalonil	Echo 720	Sipcam Agro	Section 3
Chlorothalonil	Echo 90DF	Sipcam Agro	Section 3
Azoxystrobin & Chlorothalonil	Quadris Opti	Syngenta Crop Protection	Section 3
Pyraclostrobin	Headline	BASF Corporation	Section 3
Propiconazole	Tilt	Syngenta Crop Protection	Section 18 (100-617)
Propiconazole	Propimax	Dow AgroSciences	Section 18 (62719-346)
Propiconazole	Bumper	Makhteshim-Agan	Section 18 (66222-42)
Tebuconazole	Folicur	Bayer CropScience	Section 18 (3125-394)
Myclobutanil	Laredo EC	Dow AgroSciences	Section 18 (62719-412)
Myclobutanil	Laredo EW	Dow AgroSciences	Section 18 (62719-493)
Propiconazole & Trifloxystrobin	Stratego 2.08 F	Bayer CropScience	Section 18 Pending
Tetraconazole	Domark 125 SL	Sipcam Agro USA	Section 18 Pending
Pyraclostobin & Boscalid	Pristine 38% WDG	BASF Corporation	Section 18 Pending
Azoxystrobin & Propiconazole	Quilt	Syngenta Crop Protection	Section 18 Pending

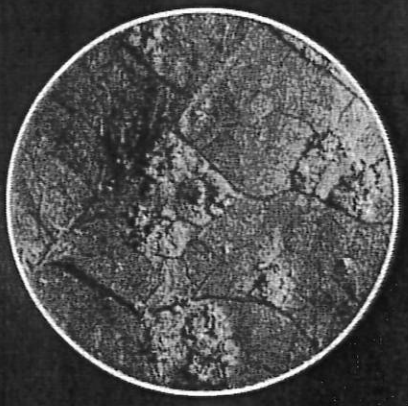
Availability of Chemicals and Equipment

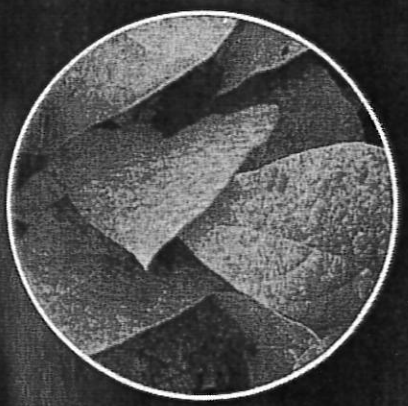
The industry has been preparing for Asian rust for at least two years, building up safety stocks and working closely with supply chains and production facilities. Knowledge gained from soybean rust in South America has better prepared us for this disease, and we will carefully monitor the situation. The U.S. was fortunate in finding rust last fall, which allowed the manufacturers time to produce and scale up for the potential needs this coming year. It is always a delicate balancing act to plan for just enough products to fill the needs, but not so much that you carryover large amounts of product. Manufacturers report that stocks will be adequate to meet anticipated needs. With several manufacturers of available products, the likelihood of a shortage of chemicals is relatively small.

As for equipment, we believe that the necessary equipment is available to meet the potential demand. Of course, weather conditions and available light will limit the ability of some fields to get sprayed. Our members will work where they can from first light in the morning until after dark to serve their customers in as timely a fashion as possible. In addition, many farmers now own their own spray rigs which will make it more likely that the necessary equipment is available.

Thank you for the opportunity to discuss this issue Mr. Chairman, I will be happy to stand for questions.







SOYBEAN RUST REFERENCE GUIDE

A Special Guide for Growers and Agronomists from the American Soybean Association, January 2005

ASA
American Soybean Association®

Meeting the Challenges of Asian Soybean Rust in the United States

Senate Agriculture Committee
Date 2-1-05

Attachment # 3

American Soybean Association®

12125 WOODCREST EXECUTIVE DRIVE, SUITE 100 ST. LOUIS, MO 63141-5009, PHONE: (314) 576-1770, FAX (314) 576-2786

Dear Soybean Producer,

On November 10, 2004, the American Soybean Association (ASA) received confirmation from the U.S. Department of Agriculture's (USDA) Animal and Plant Health Inspection Service (APHIS) that Asian Soybean Rust (Phakopsora *pachyrhizi*), had been found on soybean leaf samples collected from two research plots near Baton Rouge, Louisiana. By early December, the number of confirmed cases in the United States stood at 29, with the discovery of the fungus in a total of nine states: Louisiana, Alabama, Georgia, Florida, Mississippi, Arkansas, Tennessee, South Carolina and my home state of Missouri.

While the discovery of soybean rust will go down in history as a "red letter" event for agriculture in the United States, I firmly believe that the U.S. soybean industry is up to the challenge, and can, through education, innovation and determination, successfully maintain soybeans as a viable cropping opportunity throughout much of our the soybean growing area.

There are no rust-resistant or rust-tolerant soybean varieties currently available. Research is ongoing, but experts tell us that commercialization of such varieties is still 5 to 10 years away. Fungicide treatments currently represent the only option for containing soybean rust by lessening the risk for infection by spores. Fungicide use in other countries has been effective in keeping soybean rust below the economic threshold of yield loss.

From practical experience in other countries, the most important aspect is to get proper spray coverage of fungicide on the plant. More field-tested comparisons are needed to ensure best performance. Producers also require additional risk management tools, including crop insurance options. ASA plans to develop follow-up communications for its members on this topic in the near future.

The soybean industry also needs to build support with Congress and the Administration to obtain a far greater commitment to soybean rust research appropriations for the development of rust-resistant and rust-tolerant soybean varieties. ASA is taking the lead in these efforts and is counting on the strong support of its grassroots membership to help get the job done. If you are not already a member of the ASA, please join now and help us achieve this goal.

Lastly, I want to thank BASF, Bayer CropScience, Dow AgroSciences, DuPont, John Deere, Nitragin, Sipcam Agro USA, Inc., Syngenta, and TeeJet Spray Products for sponsoring this *"Soybean Rust Reference Guide,"* as well as a series of five regional soybean rust educational seminars that will be held across the country during January and February. These companies are to be commended for responding so quickly to the Association's request for financial support and product information. Please consider the products offered by each of these companies as you develop your own farm management plan to deal with soybean rust.

Sincerely,

Neal W. Bredehoeft

Neal Bredehoeft
ASA President

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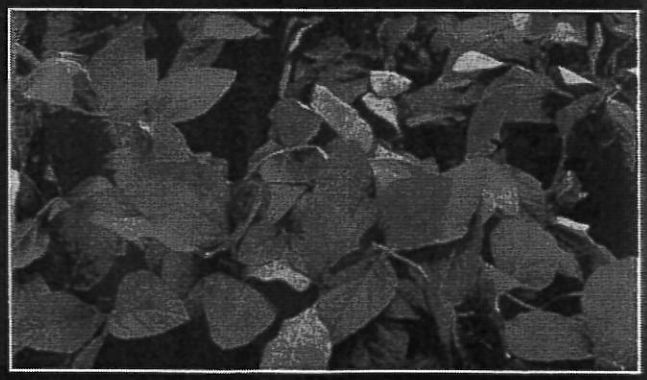


One key to fighting soybean rust disease with fungicides is to effectively reach under the canopy. (ASA Photo by Bob Callanan)

Soybean Rust Background Information

The discovery of Asian Soybean Rust (Phakopsora *pachyrhizi*) in the continental United States signals yet another element of risk associated with the production of soybeans. If soybean rust becomes widespread in U.S. soybean production areas, it could cause large crop and economic losses to soybean growers and associated industries.

A U.S. Department of Agriculture Economic Research Service report in April, 2004, regarding wind-borne entry of Asian soybean rust into the U.S., estimated net economic losses ranging from $640 million to $1.3 billion in the first year of the pathogen's establishment in this country, and estimated annual losses in the ensuing years of between $240 million and $2.0 billion, depending on the severity and extent of subsequent outbreaks.

Soybean rust spores are easily transported in air currents and spread rapidly over wide distances. Limited data are available on how long spores can survive, but studies have shown that under the right circumstances, spores can be viable for more than 50 days. Growers returning from, or hosting visitors from, rust infected soybean production areas should be extremely careful that the disease is not transmitted to their fields.

Soybean rust attacks the foliage of a soybean plant causing the leaves to drop early, which inhibits pod setting and reduces yield. The amount of damage depends on how early in the growth of the soybean plant the infection occurs.

Host plants infected with soybean rust first exhibit small lesions that gradually increase in size and turn from gray to tan or brown. Once lesions appear, defoliation is rapid, resulting in fewer pods, fewer seeds per pod, lower seed weight and early plant maturity. Soybean rust poses no health risk to humans or animals.

Soybean rust is caused by one of two fungal species, either the "New World" variety, or the "Asian" variety that is also known as "Australasian" rust, which is the more aggressive of the two pathogens and the one of greatest concern to U.S. soybean producers.

Asian rust, *Phakopsora pachyrhizi*, has been reported in various countries including Argentina, Australia, China, Korea, Malaysia, Indonesia, Sierra Leone, Cambodia, New Guinea, Vietnam, Ghana, India, Japan, Nepal, Taiwan, Thailand, the Philippines, Mozambique, Nigeria, Rwanda, Uganda, Zimbabwe, South Africa, Brazil, Paraguay and Bolivia, and in Hawaii.

Recent introductions of *P. pachyrhizi* in other parts of the world show a rapid spread causing severe damage in Zimbabwe (2000), South Africa (2001), Paraguay (2001), and Brazil (2002), where yield losses from this species have been reported from 10 percent to 80 percent.

Infestations in Africa have been widespread in the same year in which they were first detected. However, in South America, two to three years were required from the time of detection for widespread occurrence. What will happen next year in the U.S. is anyone's guess at this point.

Because of the wind-borne distribution of the spores and the rapid rate of disease spread, it is unlikely that an eradication program designed to eliminate the pathogen or disease would be appropriate or effective. It is likely that once soybean rust establishes itself in the U.S., it will likely remain an ongoing production problem until rust-resistant soybean varieties can be developed.

In countries where rust is a problem, fungicides have been used effectively to reduce its impact on soybean production. In addition to four fungicides that are labeled for Asian rust on soybeans, the American Soybean Association (ASA) has been successful in working during the past two years with the Environmental Protection Agency (EPA) and states' departments of agriculture to obtain Section 18 registrations in the United States for a number of fungicides that are presently used in other countries to combat soybean rust.

There are 30 species in 17 genera of legumes, other than soybeans, reported to be hosts for soybean rust in nature; 60 species in 26 genera of legumes have been successfully inoculated under greenhouse conditions.

One widespread host in the United States is kudzu. It is believed that kudzu could serve as an inoculum reservoir for soybean rust. Additionally, there are a variety of other important hosts that are leguminous crops or weeds that have shown varying degrees of susceptibility to soybean rust.

Soybean rust requires living plant tissue to reproduce. The good news is that the freezing temperature typically found in most middle to northern soybean production states will limit the ability of soybean rust to survive or over winter. The bad news is that soybean rust will most likely survive the winter months in southern states, making the potential threat of soybean rust a very real possibility for all North American soybean producers.

The first step in being prepared is to learn as much as possible about the disease, and the recommended practices and products that can be used to lessen the impact of soybean rust. Next spring and summer, growers will also need to be vigilant about soybean rust outbreaks by paying attention to news reports and weather models that predict the spread of soybean rust spores.

Beginning in January 2004, ASA launched a series of grower education efforts that included a national soybean rust conference and a series of seven regional soybean rust educational seminars during the summer. These events were supplemented with numerous printed and electronic publications on soybean rust, as well as a comprehensive *Soybean Rust Crisis Communications Plan* that was utilized by ASA leaders several times prior to and then during the eventual confirmation of the disease in the U.S. in November.

At one point last year, ASA was even criticized for "crying wolf" because the Association was being so aggressive in its grower communications about Asian Soybean Rust. As it turned out, ASA did the absolute right thing in pressing for preparedness on all fronts.

Application Challenges

When rust arrived in Brazil, growers had one advantage over their U.S. counterparts because Brazilian growers were already accustomed to spraying fungicides on their soybeans to combat other diseases.

Fungicide applications are the primary tool used to control soybean rust. Questions remain regarding the availability of sufficient quantities of fungicides and the equipment to apply them. There is a further need to determine the timing, minimum number of applications, and effective rates for each compound, as well as the economics of using fungicides on soybeans.

This *Soybean Rust Reference Guide* from the American Soybean Association is the first comprehensive source of information for North American producers regarding the practices and products that will be available during the 2005 growing season to combat soybean rust. Producers will need to carefully review the manufacturer's recommendations and the label for each product to determine what course of action offers the best solution.

Current fungicide application methods may not be sufficient to completely control the pathogen. Early in the season, the pathogen is found on the lower leaves of the plant where lesion numbers increase and inoculum builds up. As the plants start to flower, this build up of inoculum increases and the infection moves up the plant as the lower leaves die and drop off.

To get maximum yields, the crop needs protection from flowering through pod fill. During this period the plant canopy is very dense, and can be an effective barrier to penetration from fungicides applied over the top of the canopy. Narrow-row planting increases the difficulty of reaching lower leaves.

One key to fighting the disease with fungicides is to effectively reach under the canopy. Not all of the available fungicides are systemic, or if systemic, will not move down in the plant. Until more is known or specialized equipment is available, growers should consider spray nozzles mounted on dropdown hoses, and hooded sprayers that help direct chemicals to the lower regions of the plant. Additional information and manufacturer's recommendations are included later in this publication.

Aerial application experiments were conducted to evaluate canopy penetration using different volumes of water with various fungicides. Ground application experiments compared canopy penetration and coverage with different application volumes and nozzle types, within and above the canopy. When soybean rust is present, both ground and aerial applications will start at flowering with additional applications at intervals of about 10 to 20 days, depending on disease severity.

Growers need to continue watching for the latest available application information while considering what equipment could be used to best advantage if a soybean rust outbreak occurs in their area this year. Visit www.SoyGrowers.com/rust for updates throughout the year.

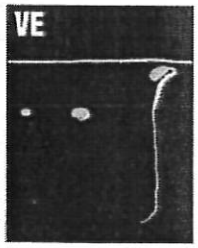
Timing of a Soybean Rust Outbreak

The specific timing of a soybean rust outbreak will influence how growers should respond since the amount of potential yield loss depends on the growth stage when the soybean plant is infected, which will also impact fungicide application methods and the grower's ability to effectively apply fungicides to combat the disease.

In general, an infection in late August to mid-September would probably cause minimal losses compared to an introduction early in the season, coupled with favorable environmental conditions, when the disease could be devastating if fungicides are not immediately and effectively applied. During the growing season, producers will need to monitor national and regional news about the spread of soybean rust to facilitate advance planning to effectively combat the disease.

For the purpose of managing soybean rust, ASA has categorized the disease into four predefined plant growth stages. This approach has been given critical review and support by plant growth and soybean plant pathologists. ASA has determined that the timing of an outbreak of soybean rust disease should be addressed in these four (4) general stages.

Stage A would include all vegetative stages from emergence (VE) up to just before flowering begins (V6) when the plants are often 12 to 15 inches tall. A 50 percent leaf loss at V6 will have minimal affect on yield. At this stage plant size is small, which will allow fungicides to be applied and effectively reach the majority of the plant. Soybean rust infections at this early stage are less likely to occur. Although treatment at this stage will have negligible yield benefits, it may reduce inoculum and lessen the severity of the disease later in the season. However, there is no current information that indicates that fungicide applications prior to flowering are economically beneficial.



Stage B is the period when the plants begin to bloom (R1) until they are in full bloom (R2) and the plants are around 15 to 23 inches tall. Defoliation of the plant of 50 percent at R2 will have minimal affect on yield. At this stage fungicides can be effectively applied, but the degree of difficulty in reaching the lower regions increases as the plants grow taller and denser.

Stage C starts when pods begin to form (R3) and plants are 23 to 32 inches tall, through full seed (R6), the "green bean" period when total pod weight will peak. Full pod (R4) is the most crucial period for seed yield. During the early part of seed filling (R5) leaf loss of 100 percent may reduce yields by as much as 80 percent. At this stage it will be more difficult to effectively apply fungicides to the lower reaches of the plants with the spray application technologies widely available. However, fungicide reaching the top and middle canopy will protect those leaves and slow the progression of the disease.

As soybean plants mature and set pods, infection may progress rapidly under favorable environmental conditions to cause high rates of infection in the middle and upper leaves of the plant. Soybean rust thrives on moisture, high humidity and moderate temperatures. Clouds of spores may be observed within and above canopies of highly infected fields. Fields with high infection rates may begin to look yellow or brown.

Stage D starts at the beginning of maturity (R7), which is indicated when one normal pod on the main stem turns brown or tan, through full maturity (R8) when the crop is ripe and soybean rust will no longer reduce yields. In nearby fields that are not rust infected, growers will need to decide whether to take any preventative steps, however, this late in the growing season, there is little economic benefit to be gained for the current year's crop from the application of fungicide products after the pods are set.

However, soybean rust disease can be hosted on other legumes, such as kudzu, that could serve as an inoculum reservoir with potential for winter carryover in regions where temperatures do not drop below freezing. The risk of an outbreak during the next growing season will depend on how early soybean rust emerges in the southern U.S. and how quickly prevailing weather conditions promote the dispersal of soybean rust spores.

Soybean Vegetative Growth Stages Photography by North Dakota State University/NDSU Extension Service.

Scouting for Soybean Rust

Inspection for soybean rust will consist of a thorough visual examination of soybean plants in the field and other host plants in the vicinity of the fields being surveyed. Inspection can begin at anytime during the growing season, however, inspection of plants with well-developed leaflets is preferable.

Rust infects the petioles, pods, stems, and leaves, especially the undersides of leaves (Figure 1). The disease is caused by an obligate parasite that consists mainly of one spore type called "urediniospores." Rust thrives on moisture, high humidity and moderate temperatures.

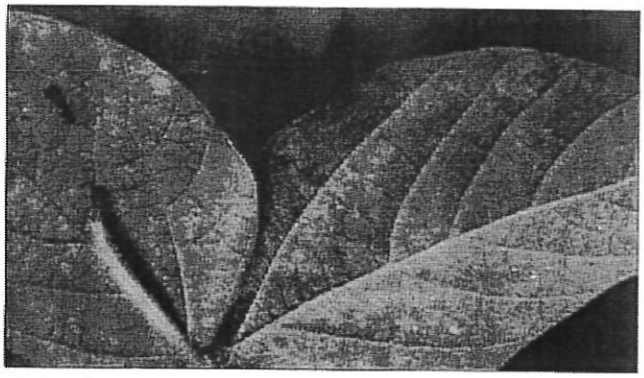


Figure 1: *The earliest stages of soybean rust are found on the undersides of the first leaves in plants near the flowering stage.* (Photo courtesy of Clive Levy, Commercial Farmers Union of Zimbabwe)

Plants infected with soybean rust first exhibit small lesions that gradually increase in size and turn from gray to tan or brown. Infection begins on the lower most leaves of plants and appears as mosaic-like areas with Uredinia observed usually at or before the plant flowering stage, usually as clusters of lesions on unifoliate leaves. Lesions may appear on most above-ground plant parts, but are most common on the underside of the leaves.

Plants show two different lesion reactions to infection by soybean rust. Tan lesions (Figure 2) consisting of small uredinia are surrounded by slightly discolored dead tissue areas on leaf surfaces. Early stages show a small hole where urediniospores emerge. As uredinia become larger, they release masses of tan colored urediniospores that appear as light brown or white raised areas. Uredinial pustules become more numerous with advancing infection and often will combine into larger pustules that break open releasing masses of urediniospores.

The other type of lesion that occurs with soybean rust infection is the reddish-brown lesion (Figure 3). These lesions have larger areas of localized dead tissue that are reddish brown surrounding a limited number of uredinia. A few urediniospores are usually visible on the surface.

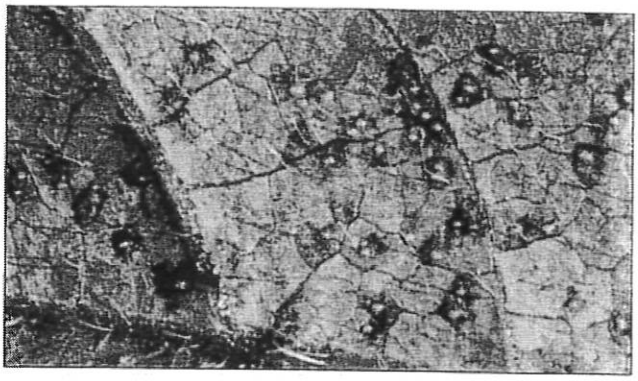


Figure 3: *Soybean rust tan lesions with reddish brown lesions in the center.* (Photo courtesy of Joe Hennen, Botanical Research Institute, Ft. Worth, TX)

For early detection, growers should check for the disease by inspecting the underside of the lower leaves for Uredinial pustules (blisters or lesions) that are powdery and buff or pale brown. Lesions and Uredinia on the underside of the lower leaves of soybean plants are apparent before flowering.

Later on, it is expected that individuals working in the field or driving along the road would likely see visual signs of infection. Information from South America indicates a distinct yellowing or browning of fields with high infection rates. This characteristic might be useful in pin-pointing areas needing further investigation.

As the plant matures and sets pods, infection may progress rapidly under favorable environmental conditions to cause high rates of infection in the middle and upper leaves of the plant. Clouds of spores have been observed within and above canopies of highly infected fields.

Figure 2: *Tan lesion of soybean rust on a soybean leaf.* (Photo courtesy of Reid Frederick, USDA, ARS, Ft. Detrick, MD)

Figure 4: *Soybean rust damage that appears on upper leaves of soybean plants when advanced.* (Photo courtesy of Reid Frederick, USDA, ARS, Ft. Detrick, MD)

Lesions on the upper leaf surfaces (Figure 4) are generally fewer and smaller. As the plants develop after flowering and the frequency of rainfall events increase, the severity of the disease may increase as well. Lesions will be found in the middle and upper canopy in more advanced infections. Eventually, leaf drop will occur.

Diseases with Similar Symptoms

Early symptoms of soybean rust are easily confused with bacterial pustule or bacterial blight, and brown spot. These diseases also occur often on the underside of soybean leaves and cause a raised light brown blister within a lesion. These leaf lesions vary from small specks to large irregular brown areas that form when small lesions join together.

Bacterial pustule forms small, light colored pustules with yellow halos around lesions usually on the undersides of leaves. The spots can vary from specks to large, irregular brown areas that develop when lesions combine. Bacterial lesions usually appear angular between veins. The same holds true for symptoms of bacterial blight that is sometimes known as angular leaf spot.

The two bacterial diseases can be distinguished from soybean rust by looking for multiple Uredinia per lesion under magnification, using a hand lens or dissecting microscope. Look for the soybean rust Uredinia with a pore at the top and masses of spores both within and around and possibly on top of the Uredinia, and usually no yellow halo around the lesion.

However, both soybean bacterial disease symptoms under magnification appear as a yellow halo surrounding a pustule that may be open on the top by means of a fissure rather than a pore, and spores are visible within or on top. Under a compound microscope, a sectioned bacterial pustule will show bacterial streaming from the inside of the pustule.

Another disease seen on the lower leaves of soybean plants that can be confused with soybean rust symptoms is brown spot.

Developing a Soybean Rust Defense Strategy

Growers in areas near a soybean rust outbreak should survey their fields to inspect for symptoms of soybean rust disease. Inspection consists of a thorough visual examination of soybean plants in the field and of other host plants in the vicinity of the fields being surveyed. A good 14-power hand lens is recommended to inspect the underside of the lower leaves in the lower canopy to determine the presence of Uredinia and Uredinia spores.

Growers with soybean fields near soybean rust infected fields should assume some level of infection in their own fields due to the fact the disease is easily spread from one field to the other and plants can remain symptom-less after infection for about 10 to 14 days, depending on the environment. Growers will need to decide whether to take any preventative steps to reduce the risk of yield loss.

If a nearby field is populated with less mature plants, because it was planted later, and soybean rust is found, the grower should contact a state extension specialist, crop advisor, or local ag dealer for recommendations on fungicide products and application methods to reduce the spread of soybean rust fungus and control disease development.

Growers should contact their county extension agent or crop advisor to help rule out other diseases. If Asian soybean rust is still suspected after ruling out these other possible diseases, growers will have to decide whether to collect and submit samples to the land grant university in the state where the samples were collected, or spray with an appropriate fungicide.

To confirm the presence of Asian soybean rust, collectors should place adequate quantities of diseased leaf, stem, and pod samples between paper towels or pieces of paper to keep them flat, seal them in a self-locking plastic bag, and store in cool conditions. Take care to ensure the outsides of the bags are not contaminated by the soybean rust samples. Include a collection information form with the samples, or a piece of paper that provides information such as the date, location of the field, including county and state, and collector's name and telephone number.

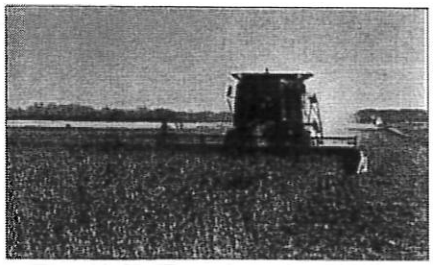
Collected samples should be driven or shipped for overnight delivery directly to a designated state diagnostic laboratory. Growers should contact their state extension specialist for more information.

As a precaution, growers can contact their county extension agent, crop advisor, or local ag dealer for recommendations on fungicide products and application methods. Each grower will need to decide whether to take preventative steps prior to confirmation of the disease.

Securing Appropriate Fungicides

After the presence of Asian soybean rust has been confirmed, producers will have to decide whether to spray, and where they can obtain an adequate supply of fungicide in time to minimize yield loss.

If soybean rust is confirmed within the producer's own county, or within 300 miles of his farm, a product with preventative properties should be considered. However, if rust is confirmed in the producer's own field, a product with curative properties will be required. Since rust is a new threat to U.S. soybean production, growers should collect and maintain a file of product information on every available fungicide that has been proven effec-



Until rust-tolerant or rust-resistant soybean varieties are available, the goal of any soybean rust management plan is to protect the plants until the soybeans reach full maturity when soybean rust will no longer reduce yields. (ASA Photo by Bob Callanan)

tive on Asian rust and is registered for use on soybeans in the U.S.

The time factor is again the most critical determinant in preserving crop yields. In simple terms, the earlier that rust attacks the plant during the growing season, the greater the incentive for growers to spray. Early rust outbreaks in some areas of South America have resulted in yield losses of 80 percent or more. Conversely, if the pods are already set and filled, there will be less economic benefit to the application of fungicides.

Once the decision to spray has been reached, producers will need to locate a supply of fungicide and the proper application equipment. Some states allow farmers to use chemicals on a crop even if it doesn't have the disease on the label, other states do not. Check with your local state department of agriculture to be sure.

There are eight chemicals approved for foliar application to combat Asian rust on soybeans. Four chemicals that have full label approval are azoxystrobin (Quadris® by Syngenta), chlorothalonil (Bravo® by Syngenta and Echo® by Sipcam Agro), pyraclostrobin (Headline® by BASF) and pyraclostrobin plus boscalid (Pristine® by BASF).

There are more than two makers of chlorothalonil, but only Bravo and Echo have soybean rust on the label. Chlorothalonil is effective against soybean rust if applied before infection takes place, but is not a curative or eradicative fungicide.

Fungicides granted Section 18 emergency use include myclobutanil (Laredo® EC and Laredo EW by Dow AgroSciences), propiconazole (Tilt® by Syngenta, PropiMax® EC by Dow AgroSciences, and Bumper® by Makhteshin-Agan), tebuconazole (Folicur® by Bayer CropScience), and trifloxystrobin (Stratego® by Bayer CropScience), which must be combined with propiconazole for use on soybean rust.

Tetraconazole (Domark™ by Isagro USA, another formulation of which is marketed on other crops as Eminent® by Sipcam Agro), is pending EPA approval under Section 18 emergency use.

Growers need to read and compare efficacy data for each compound based on company or independent trials on soybean rust in other countries to help determine which product or combination of products will offer the best results for each specific application. The American Soybean Association makes no judgment about a manufacturer's product claims.

ASA Soybean Rust Preparedness Pays Off

For more than two years, the American Soybean Association has worked to protect the United States soybean industry from a deliberate or accidental human introduction of soybean rust disease, and has placed a high priority on preparedness for an eventual outbreak of the disease as the result of spores being carried on wind currents or storms from West Africa or northern South America and the Caribbean.

ASA urged USDA to more rapidly undertake development of a national strategy for controlling and mitigating the potential for an Asian soybean rust infestation in the continental United States. ASA leaders called for much more aggressive and coordinated action from the Administration to prevent potentially adverse consequences to the U.S. soybean industry.

On August 20, 2004, ASA was the only organization to go on record confirming a reported case of Asian soybean rust that was identified north of Cali, Colombia, about five degrees north of the equator in South America. Confirmation of soybean rust above the equator signaled the advancement of spores in the direction of the continental United States.

For various reasons, several government agencies declined to publicly authenticate the discovery, but weather modeling would later suggest that this area was in fact the most likely source of the soybean rust spores that were discovered on November 10, 2004, in Louisiana. Based on predictive models, it is believed that the detection in the U.S. was related to a very active hurricane season.

ASA's efforts included working closely with USDA's Animal and Plant Health Inspection Service (APHIS) on their soybean rust action plan, and with USDA's Agricultural Research Service (ARS) on soybean rust research, including fungicide efficacy and breeding for rust resistance.

And in a year where the United States Congress chose to fund virtually no new research programs, ASA members can be proud that their Association helped secure more than $1 million in new funding for soybean rust research within the Omnibus Appropriations bill (H.R. 4818, the Consolidated Appropriations Act of 2005), signed by President Bush. ASA and state soybean affiliate leaders and staff worked for many months to convince legislators that research leading to rust-resistant and rust-tolerant varieties is essential to the long-term success of the U.S. soybean industry.

In addition, ASA worked with USDA's Office of Pest Management Policy on activities of the Soybean Rust Technical Working Group, and on monitoring the Section 18 applications for emergency fungicide use, as well as working with the Environmental Protection Agency (EPA) to encourage its cooperation in quickly approving emergency registrations. ASA also worked with the chemical companies to identify fungicides that are effective on soybean rust and helped get them labeled for use.

Last year at this time there were only two chemicals approved for use on soybeans for Asian rust. As of mid-December, there were eight chemicals approved, with at least 12 different fungicide products available for farmers to buy. EPA approval is also pending on one additional chemical under Section 18.

This is the first time in U.S. history that the EPA has granted prior approval of products needed for emergency treatment of a plant disease before that disease was confirmed in the United States. This unprecedented level of preparedness would not have been possible without the tireless efforts of the ASA, CropLife America, and the EPA.

Now, because the outbreak of soybean rust in the United States happened in November, there is time for industry to increase fungicide production before the next season, and ASA is already working with industry to ensure

ASA List of Soybean Rust Fungicide Products
Updated December 16, 2004

Fungicide	Trade Name	Status	Manufacturer	Mode of Action
azoxystrobin	Quadris®	already registered	Syngenta	Strobilurin
chlorothalonil	Bravo®, Echo®	already registered	Syngenta, Sipcam Agro	Chlorothalonil
boscalid + pyraclostrobin	Pristine®	granted full registration	BASF	Analide + Strobilurin
pyraclostrobin	Headline®	granted full registration	BASF	Strobilurin
myclobutanil	Laredo® EC, Laredo EW	granted section 18	Dow AgroSciences	Triazole
propiconazole	Tilt®, PropiMax® EC, Bumper®	granted section 18	Syngenta, Dow AgroSciences, Makhteshin-Agan	Triazole
tebuconazole	Folicur®	granted section 18	Bayer CropScience	Triazole
trifloxystrobin + propiconazole	Stratego®	granted section 18	Bayer CropScience	Strobilurin + Triazole
tetraconazole	Domark™	section 18 decision pending	Isagro USA	Triazole

that sufficient quantities of approved fungicides are readily available to farmers.

Company Recommendations

To learn more about the present situation, ASA asked companies about their efforts to ensure that adequate supplies of fungicide products and application equipment will be available to combat soybean rust disease during the 2005 North American growing season, and to provide recommendations regarding the best methods, equipment and techniques for combating soybean rust.

John R. French, Technical Director at Sipcam Agro USA, Inc. told ASA that Sipcam has scheduled production of additional supplies of their principal fungicide active ingredient, chlorothalonil, in order to increase their total offering of Echo® brand chlorothalonil products to the U.S. agricultural markets.

Sipcam is advising growers to review the use recommendations included on their product label, which provides application information for hydraulic tractor-mounted sprayers, aircraft, and chemigation techniques that have proven to be effective with Echo brand chlorothalonil products.

French said, "Our recommendations are designed to optimize coverage of foliage, stems and pods, such that the chlorothalonil active ingredient in Echo is deposited evenly over the surfaces of the soybean plant that are susceptible to infections by rust and other fungal diseases. The first application of Echo brand chlorothalonil products should be made during late vegetative (V5) to early reproductive (R1) stages of soybean crop development. If a second application of fungicide is to be used, it should be an effective triazole product."

Sipcam estimates that grower-level cost of Echo brand chlorothalonil products is expected to be from $5 to $10 per acre when applied within the label rate range, although pricing may vary slightly among soybean growing regions.

Syngenta Crop Protection Corporate Communications representative Michael Vanausdeln told ASA that Syngenta has been preparing for soybean rust in the U.S. for the past few years, building up safety stocks based on their experience with how the disease has spread in Brazil and other countries. Of course, conditions such as climate and use rates in these other countries vary from those in the U.S. With this in mind, Syngenta will continue to carefully monitor the situation to allow it to meet the needs of the U.S. marketplace for the 2005 season.

Syngenta's experience in Brazil shows that ground or aerial applications will be effective in controlling soybean rust. In both cases, good coverage is critical. The company recommends 10-20 gallons per acre by ground, and a minimum of five gallons per acre by air. As a general rule, Syngenta also advocates careful scouting, followed by early action to minimize the impact of the disease, and choosing the most appropriate fungicide tools.

As with any fungicide, recommendations on spraying are determined by individual considerations, including potential for infection, climate conditions, the time of year and any residual control of the fungicide. A fungicide program that protects the plant during pod fill is needed to prevent early defoliation and resulting yield loss. Syngenta recommends spraying Quadris((azoxystrobin), a preventive fungicide with full EPA approval for use on soybeans, and Tilt((propiconazole), a curative fungicide currently on the EPA's

U.S. soybean growers will have the benefit of knowledge and experience gained by fungicide product trials in Brazil to help them combat soybean rust.. (ASA Photo by Bob Callanan)

Section 18 list, at the R2 stage for optimum results.

Vanausdeln said, "Prices for the 2005 season have not been determined, but growers are generally looking at a cost of $13 per acre of product plus $5 per acre on application. Syngenta fungicides, like all of our products, are price competitively and create additional value to growers and retailers by giving customers the day-to-day assistance that's important in having optimum efficiency."

Tracy Linbo, Market Manager, Plant Health and Herbicides for Soybean, at BASF Corporation told ASA that if rust is present or suspected in a field, or in the area, growers should use 6 ounces per acre of Headline® plus an EPA, state approved triazole. Headline provides preventative residual activity while the triazole provides curative control.

Linbo said that growers should continue to monitor and scout after the first application, and if further monitoring shows disease or local presence of spores, a second application of Headline at 6 ounces per acre plus a triazole should be used 21 days after the first application, or earlier if monitoring shows disease.

As a preventative measure when soybean rust is not currently present or suspected in a field or area, Linbo said Headline should be applied at a rate of 6 to 9 ounces per acre from R1 to R3 (beginning bloom to beginning pod), and if rust arrives in the area, make a second application of Headline at 6 ounces per acre plus a triazole and an adjuvant should be used 21 days after the first application, or earlier if monitoring shows disease.

Growers should contact local authorities for information about EPA and State approved triazole, and consult the triazole label for specific adjuvant recommendations. As always, growers should read and follow the most restrictive label.

John Smith, Business Unit Manager, Fungicides at Bayer CropScience, told ASA that the company has been preparing for the possibility of Asian soybean rust in the United States for some time now. Part of that preparation includes production planning so that the company can meet the fungicide needs of soybean growers confronted with Asian soybean rust. Smith said that Bayer CropScience is working with distribution, retail and commodity groups to meet grower demands.

Smith said, "Most fungicides used for Asian soybean rust control should be applied before the disease develops to ensure optimum biological activity and yield protection. Soybeans are most susceptible to yield losses from early flowering through pod development (R1 to R5). This is the timeframe when the plant is most susceptible and must be protected from disease infestations."

With all fungicides for soybean rust control, spray coverage is critical. Complete coverage of lower leaves in the canopy is required for optimum disease control. Folicur®, which currently has Section 18 approval for use on soybeans, offers both preventative and curative activity, and may be used prior to disease detection or at early infection levels, according to Smith.

Folicur label rates range from 3 - 4 oz. per acre applied prior to or at the first appearance of Asian soybean rust, up to R5 stage. Folicur must be applied with a minimum of 10 gallons per acre spray solution by ground sprayer, or 5 gallons per acre spray solution by aerial application. Smith said that if necessary, increase the spray volume per acre for complete coverage.

On December 15, 2004 EPA approved Stratego®, for use on soybeans. Stratego offers preventative activity and should only be used before the detection of Asian soybean rust. Specific rates for use of Stratego will be available soon now that the Section 18 exemption has been granted. Smith said the prices of Bayer CropScience fungicide products are competitive with other products growers might need to control Asian soybean rust.

Bob Gordon, marketing specialist for Dow AgroSciences, says the company has had experience worldwide combating rust with the formulation used in Laredo EC, and that it is ramping up supplies of both Laredo EC and PropiMax to meet demand this coming year.

Laredo EC and PropiMax are triazole chemistries containing both preventive and curative activity. Since signs of infection may not be visible for up to 7 to 10 days after spores infect plants, Gordon recommends the use of Laredo EC or PropiMax as the first spray in a rust management program. Both products are registered under Section 18 labels, and growers should consult their state agencies for label recommendations.

"Depending upon whether the plant was infected by rust at time of application and subsequent levels of rust spores, Laredo EC can provide up to 21 days of residual," Gordon says. "If a second application is necessary, we recommend rotating to a different mode of action as part of a resistance management strategy."

Another way to help soybeans defend against soybean rust is start with the strongest, healthiest plants possible. Nitrogen fixation is one of the most critical components for increasing early season plant vigor and producing higher yields. The soybean plant is able to take up nitrogen from either the soil, or from the atmosphere through the fixation process.

Dr. Scott Fleetwood, Vice President of Sales and Marketing with Nitragin, gives this insight, "Based on research we have conducted in Brazil, over the last year, the combination of *Optimize*™ Promoter Technology™ for soybeans, plus a fungicide treatment, showed up to a 14 percent improvement in soybean yields over a fungicide treatment without *Optimize*."

By treating with *Optimize*, growers will be better able to grow healthy soybeans right from the start, which gives their crop an opportunity to fight Asian Soybean Rust. "It's an additional risk management tool that's needed when you consider what's at stake," Fleetwood said.

According to Fleetwood, the early-season vigor from the use of *Optimize* results in stronger, healthier plants that are better able to respond when foliar fungicides are applied to combat Asian Soybean Rust.

"This strong start is a natural enhancement of the plants' ability to withstand disease stress that continues into the season," Fleetwood said. "The result is a potential for additional days to scout for a fast-moving disease like Asian Rust, and field conditions such as uniform height and stand that help improve control from a foliar fungicide application when needed. *Optimize* is an ideal complement to foliar fungicide applications."

Barry Nelson, Manager, Public Relations, Advertising & Marketing Communications for John Deere, told ASA that Deere recently introduced a new line of self-propelled sprayers to the marketplace. The 4720 and 4920 sprayers

have more capacity, new guidance technology, and boom suspension performance features that will ensure full spray coverage of fungicide on the soybean plant.

"These machines are being shipped now and throughout 2005 for retail customers throughout the U.S. and Canada," Nelson said. "More importantly, John Deere will be developing training programs for dealers and customers to help set and adjust their current sprayers-regardless of brand-and help decide on the best tips and nozzles to use on Asian Soybean Rust."

Marty Heyen, Marketing and Customer Relations Manager for TeeJet® spray products, told ASA that it is unknown at this point in time as to how much more spraying will be needed in the 2005 growing season. Heyen said Spraying Systems Co. is planning to increase production on TeeJet products that will be used to spray for soybean rust. In addition, the company is already working on a couple of new products that will complement their existing product offering. He recommends that growers, applicators and distributors plan ahead where necessary and purchase products before the season hits.

There are many TeeJet nozzles available that will work when spraying fungicides. Heyen advises growers begin by understanding that spraying for soybean rust is much different than spraying Roundup® or other post-emergence herbicides on soybeans. For rust, smaller drops with good velocity are needed to penetrate crop canopies and deliver surface area coverage.

Three TeeJet products currently available stand out as being excellent in spraying for soybean rust. The first is the TwinJet® spray nozzle that encompasses two flat sprays from a single nozzle; one spraying forward and one spraying backward. With this nozzle, the crop is actually sprayed twice in a single pass.

The second nozzle is the Turbo TeeJet® Duo. This is actually two Turbo TeeJet flat fan tips installed on a Quick TeeJet® cap adapter to allow for spraying the crop twice in a single pass. Like the TwinJet, the Turbo TeeJet Duo will have one flat spray pattern in the forward direction and one flat spray pattern spraying backward. The Turbo TeeJet nozzles have a wider spray angle and can provide better coverage in heavy canopy situations.

The third choice is the AirMatic®, AirJet® Nozzle Control System. This system integrates a pneumatic system that works in conjunction with the conventional liquid system on a sprayer. This "liquid plus air" nozzle control system gives the operator full control of the droplet size being sprayed. By independently controlling the air pressure and liquid pressure, the AirMatic AirJet system will maintain a constant drop size, even when forward speeds and liquid spray pressures fluctuate.

In addition, the operator has the ability to change droplet size on the fly with a simple push of a switch. This system can be used on the smaller droplet size settings to give better coverage and penetration into the soybean canopy where the rust fungus is present.

The total price to equip a sprayer with nozzles will vary based on the size of the boom and the nozzle spacing present. Many applications can be made once a set of nozzles is purchased and installed. Contact your local TeeJet dealer for specific prices.

Resistance Management

The Plant Health Initiative of the North Central Soybean Research Program (NCSRP) offers the following incites into fungicide resistance management for soybean rust. The fungicide chemistry class is listed first, followed by the fungicide trade names. If any fungicide seems to become less effective with use, contact a company representative, extension specialist or crop advisor for further investigation.

Analides/Strobilurines/Pristine

Pristine is a mixture of two fungicides with different modes of action (see strobilurin fungicides). Integrate fungicide use into an overall disease management program including cultural practices to reduce disease development. If rust is present or suspected in a field or area, growers should include an EPA, state approved triazole with Pristine. Monitor the fungicide efficacy.

Chlorothalonil/Bravo, Echo

Chlorothalonil is a broad-spectrum fungicide. No resistance to chlorothalonil has been reported in other crops after 35 years of use. Do not exceed a total of three applications per season, or more than 4.5 lbs active ingredient per season.

Strobilurin/Headline, Quadris, Pristine, Stratego

Close monitoring of the efficacy of strobilurin fungicides is important. Strobilurin fungicides have a single-site mode of action, which means a single genetic change in the pathogen can cause resistance to develop. Alternating or tank mixing between strobilurin-fungicides and other labeled fungicides that have a different mode of action is essential to prevent pathogen populations from developing resistance (Note: Pristine and Stratego are formulated in combination with a second fungicide with a different mode of action). Do not tank mix with a fungicide to which resistance has developed.

Use no more than two foliar applications of any strobilurin fungicide per growing season.

Integrate into an overall disease management strategy that includes varieties with disease tolerance, optimum plant populations, proper fertilization, plant residue management and crop rotation. These fungicides should be used with disease forecasting which recommends application timing based on environmental conditions favorable for disease development.

Triazole/Tilt, Propimax, Bumper, Folicur, Laredo, Stratego, Domark

Plant pathogens are known to develop tolerance to triazole products used repeatedly for control. Rotate or tank mix with products with different modes of action. Do not mix or alternate with other triazole fungicides. Use in conjunction with other cultural practices that reduce disease severity. These fungicides should be used in conjunction with disease forecasting, which recommends application timing based on environmental conditions favorable for disease development.

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