Summary
of the
Technical Science Working Group
on
Soybean Rust (SBR) – Teleconference #6
Held on December 11, 2003

A. Purpose of Working Group
B. Range of SBR in Western Hemisphere
C. Management of SBR
   1) In Brazil
   2) In Zimbabwe
   3) In China
D. Section 18 Submission for SBR
E. SBR Meeting at USDA Economic Research Service
F. Aerobiology of SBR
G. Crop Insurance and SBR

Web resources on soybean rust:
APHIS SBR site and strategic plan - http://www.aphis.usda.gov/ppq/ep/soybean_rust/
APHIS risk maps - http://soybeanrust.zedxinc.com & http://aries.zedxinc.com/sbrust.php
Florida SBR Pest Alert - http://www.doacs.state.fl.us/%7Epi/enpp/pathology/soybeanrust.html
Illinois facts about SBR - http://www.ag.uiuc.edu/cespubs/pest/articles/200213k.html
Iowa State University Crop Advisor Institute module on SBR - http://www.cai.iastate.edu
IPM Centers SBR website (past Working Group meeting summaries, membership, action plan, SBR fungicide efficacy trials, and useful links) - http://www.ipmcenters.org/NewsAlerts/soybeanrust/
National Pest Alert (States & USDA) - http://www.ncpmc.org/soybeanrust
NC504 SBR Committee - http://www.lgu.umd.edu/project/home.cfm?trackID=3154
Ohio SBR facts - http://ohioline.osu.edu/ac-fact/0048.html
Quarantine Exemption (Section 18) - http://plantsci.sdstate.edu/draperm/SoybeanRustSection18
United Soybean Board SBR guide - http://www.unitedsoybean.org/soybeanrustguide.pdf

A. Purpose of Working Group – presented by Kent Smith, USDA/OPMP, Washington, DC

The basic purpose of this working group is to enhance communication between state and federal scientists concerning soybean rust. Specifically, we hope to better prepare state departments of agriculture and extension specialists to deal with soybean rust given that they will make the recommendations to growers concerning this disease when it arrives in the continental U.S.

B. Range of SBR in Western Hemisphere – presented by Morris Bonde, USDA/ARS, Ft. Detrick, MD

SBR arrived in Paraguay in 2001. It was found in the neighboring countries of Brazil and Argentina in 2002. It extended its range in 2003 to include most of the soybean-growing area in Brazil and was discovered for the first time in Bolivia.

In Bolivia, SBR is now present in 70% of the northern soybean crop area and 50% of the eastern soybean crop area. These are the principal soybean crop areas in Bolivia that comprise 100,000 hectares in the north and 500,000 hectares in the east. The first symptoms were observed in late August that in some areas quickly intensified to 95% incidence by mid-September. Fungicides were applied after infection, but were too late for good control, resulting in high disease levels. In San Marcos there was a report of severe SBR on red beans.

Thus far, SBR caused by *Phakopsora pachyrhizi* has not been verified in the Western Hemisphere above the equator.

C. Management of SBR – This section is devoted to management strategies in countries that have SBR. As such, these methods may or may not pertain to conditions in the U.S. and therefore should not be automatically extrapolated to the U.S. Consult with your state extension specialist concerning SBR management strategies for your area.

1) In Brazil by Jose Yorinori, Embrapa Soja, Brazil

Currently (as of November 5, 2003) – About 70%-80% of soybeans have been sown by this time in Brazil. SBR is starting much earlier this year because of uninterrupted production during fall and winter in central Brazil.

Following the severe outbreak of rust and delayed rainfall last year that reduced soybean production in central Brazil, many farmers planted a second crop of soybeans under central pivot irrigation. This allowed for continuous production of rust inoculum in the region. Thus, there was a carryover of spores to the new and early plantings of 2003/04-crop season. At this moment, in the states of Bahia, Mato Grosso and Goiás, soybeans at growth stages from V3 to R1/R2 are already starting to show rust. Those fields are being sprayed with fungicides. Two to three fungicide sprays may be required during this crop season.

Management – SBR has been present in Brazil for about three years. We are still developing our strategy to minimize the effects of soybean rust on our soybean crop, but these methods appear most promising.

It should be noted that kudzu complicates SBR management. In Paraguay, soybeans growing close to infected kudzu were showing rust symptoms this past year at the V3-V4 growth stages or 20-25 days after sowing.

Non-fungicidal means of management – Strategies that look promising are rotation of soybeans with corn, avoidance of volunteer plants that may harbor inoculum, and planting early maturing varieties thereby avoiding pathogen inoculum. Because of the high price of soybeans very few farmers went into corn production. Normally, corn is planted after the early soybeans, in January-March. This was often not done this year, increasing available inoculum and increasing the risk of rust on soybeans.

Education is a key feature of any SBR management strategy. This past year, I have given more than one hundred talks on how to identify and control soybean rust in meetings held with agronomists and producers around the country.

Fungicidal management – Fungicides are sprayed at first detection of soybean rust, weather permitting. This year, because of continued rust in the field on winter-irrigated soybeans, the first spray must be applied at first detection of infection.
a) The fungicides that are recommended for 2003/04 season are 1) protective fungicides (before disease establishment) that are repeated at 10-15 days intervals, if needed: difenoconazole, azoxystrobin and fluquinconazole; and 2) protective/curative fungicides (before or after disease establishment) that are repeated at 20-25 days intervals: epoxyconazole + pyraclostrobin, tebuconazole, flutriafol, azoxystrobin + ciproconazole, trifloxystrobin + propiconazole and trifloxystrobin + ciproconazole.
b) Full canopy spray coverage is required. Skips will become diseased.
c) Application is made at first detection of soybean rust in the region. A second spray is applied 15-20 days later for protective fungicides and 20-25 days later for protective/curative fungicides, and other sprays are made if necessary.

There is no defined growth stage to start spraying. Rather, the first spray depends on when the first infection is detected, on weather conditions, and on the mode of action of the fungicide used (protective or protective/curative).

For indeterminate soybeans, timing of applications in relation to growth stage is much more difficult because the plants continue growing and putting out new leaves and flowers. Thus, indeterminate soybeans may require more sprays with shorter intervals between sprays, because new leaves may be exposed to infection every week.

2) In Zimbabwe by Clive Levy, Commercial Farmers Union of Zimbabwe

Soybean rust (SBR) has been present in Zimbabwe since early 1998. Over the years, a policy has been developed that minimizes the effects of soybean rust on the soybean crop at an economical price.

Shortly after SBR's arrival, meetings were held with all stakeholders involved to develop a coordinated national strategy. Farmer education was viewed as a priority – of the initial symptoms, disease development, and the need for control. Research, industry, agricultural consultants and farmers were in support of this strategy, and aware of the need to have spray equipment and chemical stocks in place.

Trap Crops – It is extremely difficult to accurately identify the first signs of infection, especially to the untrained eye. However, for chemical control measures to be effective, timely application is essential. Thus, an early-warning system was found necessary. A network of trap crops or sentinel plantings (about 0.5 acre) of soybeans was planted around the country about one month before the commercial crop. Upon arrival of SBR in an area, these plants would become infected first due to their greater maturity, and provide the necessary warning to farmers to spray their commercial crops. Cooperators were asked to examine their plants daily in these 'traps' from flowering onwards for SBR symptoms and to alert neighbors and other personnel once the disease was confirmed present. Some cooperators chose to differentially spray these trap crops after infection was detected. In so doing, they could be used as educational venues for farmers, agricultural consultants, and others to see the symptoms of SBR and relative benefits of spraying.

Other Non-fungicidal Management – Two main ways to manage SBR, other than using fungicides, were investigated. Foremost, it was appreciated that breeding resistance (if available) into agronomically-suitable cultivars would take a long time. Thus, breeders obtained soybean lines known to be resistant to SBR from several sources for local screening and selection. This exercise has now

developed into a full breeding program, with suitable lines currently being tested at multiple locations for commercialization

The other method tested was to change the planting date. The premise was that the plants would be less susceptible to infection when the environment was less suitable to SBR. Unfortunately, this measure did not work because reproductive growth was naturally modified and similar growth stages occurred under the same weather conditions despite various planting dates.

Changing plant spacing (inter-row, and densities) has not been attempted in Zimbabwe, but initial studies in South Africa have shown no practical benefit. Use of soybeans of different maturity groupings also have not been attempted in Zimbabwe due to its small land area and proximity to the equator. Preliminary research in South Africa, however, indicates there may be some merit to this strategy.

Fungicidal management – This has become the management device of preference. Over the six years since SBR's introduction into Zimbabwe, several triazole fungicides, a benzimidazole + triazole mix, and a morpholine have been utilized without any evidence of pathogen resistance. The fungicides registered are carbendazim + flusilazole, triadimenol, ciproconazole, tebuconazole, difenoconazole, propiconazole, and triforine – the first two having been used extensively.

Full-canopy spray coverage is required to protect the upper trifoliates and kill the spore load in the lower and middle canopy. Skips become rapidly diseased, and very noticeable leading to severe localized yield losses. The timing of spray applications is critical to effective disease control. The whole of reproductive growth needs to be protected. In Zimbabwe, the recommendation developed is to apply the first spray at first flowering (R1 growth stage, approximately 50 days after planting), a second spray applied 20 days later, and a third 20 days thereafter. Generally three sprays work best, but two may be adequate under low disease pressure. Spraying earlier during reproductive growth is more beneficial than delayed applications.

3) In China – presented by X.B. Yang, Iowa State University, Ames

In terms of latitude, China is very similar to the U.S. Over several years, the Chinese have observed epidemics of SBR at various intensities in different regions of their country. Severe and frequent epidemics have been observed up to latitude of 30° north. Above this latitude epidemics are still frequent, but not severe, up to 37° north. Above 37° north, epidemics only occasionally occur.

Normally, fungicidal spraying is only necessary twice per season in the area where SBR is frequent. If environmental conditions are not conducive to disease, only one spray is necessary. In the most productive region in the north, above 37° latitude, fungicidal sprays are rarely necessary.

Resistant varieties have been developed in China and are holding up quite well. As the origin of soybeans it is understandable that the best resistance would reside within China. Hosts other than soybeans are not well known at this time.

D. Section 18 Submission for SBR – presented by John Sierk, Minnesota Department of Agriculture, St. Paul

A Quarantine Exemption (Section 18) has been submitted by Minnesota and South Dakota to manage SBR on soybeans when it arrives. As a Quarantine Exemption it will be in force, once approved, for three years. It will be activated when a sample collected in the continental U.S. is confirmed by the national USDA identifier in APHIS.

Fungicides (trade names in parentheses) listed in the requested Section 18 are propiconazole (Tilt, Propimax, Bumper), tebuconazole (Folicur), myclobutanil (Laredo), trifloxystrobin + propiconazole (Stratego), tetraconazole (Eminent), pyraclostrobin (Headline), and boscalid + pyraclostrobin (Pristine).

This submission, once approved, will serve as a "master" or "generic" application that other states can reference. States can add their name to the soybean rust Section 18 by making a formal request to EPA in which they reference the MN/SD application and supply a limited amount of state specific information. EPA has asked other states to hold off on "me too" submissions until the MN and SD submission is approved. EPA plans to produce a letter for interested states that outlines what data will be needed in order to submit a "me too" submission. This process is designed to minimize paperwork and thereby speed up the approval process.

The submission can be viewed at: http://plantsci.sdstate.edu/draperm/SoybeanRustSection18/

E. SBR Meeting at USDA Economic Research Service (ERS) – presented by Stan Daberkow, USDA/ERS, Washington, DC

On November 25, 2003, a meeting was held at ERS in Washington, DC to discuss several spatial aspects of SBR that will be critical to the present study undertaken by ERS on the potential economic impact of SBR on American agriculture. About 25 people were present, principally from USDA, but also various universities. Several biological researchers and administrative personnel made presentations.

The study being undertaken by ERS is an update of a similar study completed in 1984 by ERS economists. In order to refine their models of possible impact, ERS is looking for the best data available on likely scenarios of SBR entrance into the U.S., basic fungicide efficacy, and potential yield impacts.

The following three presentations on aerobiology are abbreviated versions of some of the meeting's presentations.

F. Aerobiology of SBR

1) Overwintering potential – presented by Shimon Pivonia, Iowa State University, Ames

Shimon and XB developed a predictive model for year-round survival of SBR. It is based on climate (monthly averages of rainfall, temperatures and humidity) and the pathogen response – its ability to reproduce and survive. Conditions for survival do not necessarily match with conditions for an epidemic.

Estimates of the model are that SBR might become established year-round in south Texas, south and central Forida, the Caribbean, and south, central-eastern, and north-eastern Mexico. The model is conservative. In warmer than average years, SBR would be expected to overwinter further north.

Central China and central Argentina may be similar to the United States in terms of the dependence on an external source of inoculum for long distance dispersal to soybean production regions where epidemics may occur. China experiences frequent, severe epidemics in its south (below 30° north in latitude), frequent but not always severe epidemics in the center of the country (between 30 and 37°), and occasional but mild epidemics in the north (above 37°). Argentina has experienced limited SBR epidemics on its northern border with no apparent movement further south.

2) Climatology – presented by Zaitao Pan, St. Louis University, Missouri

Zaitao is looking at SBR prediction from the meteorological point of view. He is interested in year-to-year variations rather than long-term climatology. He is developing a model that can project mean (not day-to-day) wind conditions three or four months ahead thereby allowing farmers to project needs and expectations that far ahead.

Prevailing wind movement may prove a useful tool for SBR dispersal modeling but its importance is unclear at this point. Typically, wind movement above the equator is from east to west with little movement from south to north.

Land bridges may be an important component of any predictive model. If all other movements fail, this mechanism of pathogen movement is likely to occur even if it is relatively slow.

3) Risk Analysis – presented by Roger Magarey, USDA/APHIS/CPHST, Raleigh, NC

Roger and other members of his Soybean Rust Research Group have been developing a predictive model for SBR. The other members are Charlie Main, NCSU; Scott Isard, UIUC; Joe Russo, ZedX, Inc.; and Scott Redlin, APHIS/CPHST. Several components are involved in their investigations, including: overwintering, suitability for epidemics in U.S., source areas of SBR, and potential aerobiology of spores over moderate and long distances.

Phakopsora pachyrhizi, the causal agent of SBR, is an obligate parasite, therefore it requires living host tissue to grow and reproduce. Furthermore, the only important spores of *P. pachyrhizi*, urediniospores, are limited to six to eight weeks of viability after production. Based upon the probability of freezing temperatures in January and February, a map has been developed that color codes the U.S. for frequency of occurrence of those freezing temperatures over the past 30 years. Areas that are likely to support SBR year-round are southern Florida, southern Louisiana, southern Texas, southern California, and southern Arizona.

The suitability for epidemics of SBR in the U.S. was estimated by looking at the frequency of experiencing 15 or more favorable days during the growing season over the past 30 years. Favorable days were defined by the pathogen's requirements (temperature and wetness) for infection. All the states east of the Mississippi and most states in the Great Plains were very suitable for SBR epidemics. Unfortunately, this coincides with the major production areas for soybeans in the U.S.

The current range of SBR is described in South America. The described area will serve as the source of spores of SBR. Based on 30 years of historical air movement in and from the source areas, a precise

analysis has been constructed, on a daily basis, to show the path of spore movement. This model assumes that spore survival is unlimited. Later, plans are to include source regions from Africa and include more biological detail in the model, such as spore survival as affected by UV radiation, temperature, moisture, and the influence of environmental factors on spore production and the escape of spores from the soybean canopy.

Websites that display information concerning these risk analysis can be viewed at: http://soybeanrust.zedxinc.com & http://aries.zedxinc.com/sbrust.php

G. Crop Insurance and SBR – presented by Dave Bell, USDA Risk Management Agency (RMA), Kansas City, Missouri

Crop insurance is a valuable risk management tool for soybean producers. When a producer is insured and follows good farming practices, losses attributed to disease, including SBR, are often insurable.

Written documentation is required to determine good farming practices. Written documentation includes any written information in hard copy or compatible electronic format (including facsimile) that was provided by the participant to the insurance provider or used by the insurance provider in making the determination of failure to follow recommended good farming practices or provided by the participant to support the cultural practices actually carried out. Such documentation will include but is not limited to: published research from a university, Cooperative State Research, Education, and Extension Service (CSREES), and National Resources Conservation Service (NRCS). Good farming practices may involve applying fungicide in the first year of an infestation. If fungicides are recommended and available, only farmers following the applicable fungicide's spray schedule are following a good farming practice.

In 2002, crop insurance covered about 78% of the U.S. soybean acreage. There are three main types of crop insurance: Actual Production History (APH), revenue, and group risk. Producers' may select APH crop insurance covering 50 to 90% of their historic yield. The majority of contracts are between 65 and 75%. For example, assuming an APH plan of insurance with a 70% buy-up level, a producer must sustain yield losses of more than 30% before a loss occurs, and at the 90% buy-up level they must sustain yield losses of more than 10%. Revenue plans of insurance rely not on the number of bushels produced but the revenue derived from the crop's sale. Group risk protection plans rely on the county's data and is not producer specific.

A producer must purchase insurance by the sales closing date (SCD). The SCD in the southern most production areas is January 15 and is progressively later as one goes north. In the southern most production areas soybeans are commonly planted in early March and may be planted as late as June in northern soybean production areas.

Additional information about RMA programs can be obtained at www.rma.gov or by contacting Dave Bell, Chief Loss Adjustment Standards at 816.926.2397 or Dave.Bell@rma.usda.gov.