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Asian Soybean Rust: Background and Issues

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Summary

On November 9, 2004, Asian soybean rust (ASR) was discovered in the United States in an experimental field in Louisiana. In the following three weeks, it was discovered in eight additional southern states — Alabama, Arkansas, Florida, Georgia, Mississippi, Missouri, South Carolina, and Tennessee. Because ASR's arrival in the United States came late in the crop year, it is not thought to have had any measurable effect on 2004 soybean production. Furthermore, its detection has provided an early warning and has given the U.S. soybean sector time to prepare strategies to guard against possible ASR damage to the 2005 soybean crop.

ASR is a harmful fungal disease that affects the growth of several commercial plants, most notably soybeans. The rust spores, once windborne, can spread rapidly and have been known to infect an entire region the same year the disease is first detected. ASR has reduced soybean yields by 10% to 80% in infected areas. The disease's rapid transmission rate coupled with an abundance of host species suggests that eradication would be unlikely once the fungus is established in the United States. As a result, the most effective treatment is thought to be the development and use of resistant plant varieties. However, no commercial U.S. soybean cultivar is resistant to or tolerant of ASR. In the short term, the only effective responses are costly fungicides and the use of early-maturing soybean cultivars.

Three chemicals are presently registered with the U.S. Environmental Protection Agency (EPA) for treatment of rust on soybeans. In addition, EPA has approved several temporary emergency exemptions (under Section 18 of the Federal Insecticide, Fungicide, and Rodenticide Act) for additional fungicides. Estimates suggest that the U.S. currently has fungicide capacity to treat up to 12 million acres. During the past three years (2002-2004), U.S. soybean plantings have averaged 74.2 million acres. Thus, available fungicide appears sufficient to treat about 16% of average plantings. A shortage of fungicides could lead to a constituent call for congressional action.

The U.S. Department of Agriculture (USDA) is coordinating a plan to deal with ASR that encompasses various USDA agencies, state land-grant universities, and industry participants. Widespread ASR infection in the United States would likely have significant regional and national effects on domestic and international commodity markets. Timely fungicide applications can prevent national yields from declining dramatically; however, the added cost of fungicides would likely lead to a significant reduction in soybean production in lower-yielding southern states. A 2004 USDA study suggests that annual U.S. economic losses could range between \$240 million and \$2 billion, depending on the severity and extent of any outbreaks.

The arrival of ASR has implications for several public policies including pest control research (particularly the development of resistant varieties), pesticide regulation, disaster assistance, and crop insurance. This report will be updated as events warrant.

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Asian Soybean Rust: Background and Issues

Current Status of Asian Soybean Rust (ASR) in the United States¹

On November 9, 2004, ASR was discovered in the continental United States for the first time in an experimental field in Louisiana.² In the following three weeks, it was discovered in eight additional southern states — Alabama, Arkansas, Florida, Georgia, Mississippi, Missouri, South Carolina, and Tennessee.³ Most experts expect the pathogen to spread into the more northerly U.S. soybean-growing areas of the Corn Belt during the 2005 growing season (April-November), although there remains considerable uncertainty about the likely timing, location, and degree of infestation and its economic impact.

Experts suggest that ASR spores were carried to the southeastern United States from South America on upper elevation winds during the 2004 hurricane season. Because ASR arrived late in the crop year, it is not thought to have had any measurable effect on 2004 U.S. soybean production — by November 9, 2004, nearly 90% of the U.S. soybean crop had already been harvested.⁴ Furthermore, its detection has provided an early warning and has given the U.S. soybean sector time to prepare strategies for establishing regional sentinel crops⁵ and distributing information on methods for field scouting, detection, and treatment to guard against possible ASR damage to the 2005 soybean crop.

¹ For more information, see North Central Soybean Research Program (NCSRP), Plant Health Initiative (PHI), *Asian Soybean Rust*, at [<http://www.planthealth.info/rust/rust.htm>].

² A less harmful species of ASR, *P. meibomia*, was first reported in Puerto Rico in 1976. The more harmful species, *P. pachyrhizi*, was reported in Hawaii in 1994. U.S. Dept. of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Plant Protection and Quarantine (PPQ), *Strategic Plan to Minimize the Impact of the Introduction and Establishment of Soybean Rust on Soybean Production in the United States*, Nov. 2004, p. 3; hereafter referred to as USDA, APHIS, PPQ, *ASR Strategic Plan* (Nov. 2004).

³ USDA, APHIS, PPQ, Pest Alert: Soybean Rust, News and Information, “Soybean Rust Updates,” available at [<http://www.aphis.usda.gov/lpa/issues/sbr/sbr.html>].

⁴ USDA, National Agricultural Statistics Service (NASS), *Crop Progress*, Nov. 14, 2004.

⁵ The sentinel crops are planted about one month prior to the commercial crops and scouted daily by the cooperator. Because of their greater maturity, these sentinel crops become infected first, giving area growers warning to start fungicide applications. Some of these sentinel crops are then turned into fungicide demonstration plots.

Most experts anticipate the pathogen's northward spread in 2005 into the Corn Belt states for three primary reasons. First, conditions (e.g., mild temperatures and year-round presence of host species) in the southern United States, where the ASR first appeared, tend to favor pathogen survival during the winter months. Second, spring planting occurs in the Southeast and Delta several weeks ahead of planting in the major soybean growing regions of the Corn Belt. This would give the pathogen time to establish itself and be available for windborne transmission as the primary soybean plantings of the Corn Belt reach vegetative stage. Third, rust spores are very light and move easily on winds, sometimes traveling hundreds of miles in a single day. A consolation to more northerly soybean producers is that, because ASR must have a living host to survive the winter, ASR will only successfully over-winter in the most southerly extremes of the United States and must be reintroduced each successive year into more northerly soybean production areas.

Background on ASR

Nature of the Disease. Asian soybean rust (ASR) is a harmful disease — caused by either of two fungal species *Phakopsora pachyrhizi* and *Phakopsora meibomia*e — that affects the growth of several plant species of commercial importance, most notably soybeans. *P. pachyrhizi* is a much more virulent pathogen of soybeans than *P. meibomia*e. Environmental factors are critical to the incidence and severity of ASR. Long periods of leaf wetness are needed for spore germination, as well as temperatures between 60° and 85° Fahrenheit and a high relative humidity of 75%-80%. As a result, ASR has been most destructive in the tropical and subtropical regions of Asia, Africa, Australia, and more recently South America.

ASR is an obligate pathogen, which means it needs living host cells to survive. The pathogen can infect and reproduce on 90 known plant species, 20 of which are found in the United States and are most common in southern states — including dry beans, kidney beans, peas, leguminous forage crops such as trefoil and sweet clover, and weeds such as kudzu.⁶ The rust spores, once windborne, can be moved long distances (reportedly up to 400 miles in a single day). Recent infestations in Africa have been widespread in the same year that they were first detected. In contrast, in South America, two to three years elapsed between detection and widespread onset.

Historical Expansion. Based on its recent history of geographic expansion, ASR was expected to enter the mainland United States sometime within the 2004-2007 period. The virulent form of ASR — *P. pachyrhizi* — was first discovered in Japan in 1902. The next reports were in 1934 from Australia and India and again in 1940 in China. The pathogen then showed up in Africa in 1997. Spores are believed to have crossed from Asia to Africa in wind currents of the upper atmosphere. It was initially identified in Uganda, Kenya, and Rwanda in 1997, then in Zimbabwe in 1998. Zimbabwe suffered significant yield loss to the aggressive form of rust. Much of what is known today about the effects and control of this pathogen has been learned from scientists and farmers in Zimbabwe. The pathogen subsequently showed up in South Africa in 2001. It is believed to have been spread throughout Africa by prevailing winds.

⁶ USDA, APHIS, PPQ, *ASR Strategic Plan* (Nov. 2004).

The rust surfaced in Argentina in 2000, then a year later in Paraguay along the border of Southern Brazil (although a major outbreak did not occur in either Argentina or Paraguay). By 2002, the pathogen is believed to have moved approximately 1,000 miles from the southern tip of Brazil to the heartland of soybean production in central Brazil, causing significant yield losses. One of the reasons the pathogen could have proliferated and spread so quickly in central Brazil is because the region experiences very humid conditions — ideal for the proliferation of the disease. Another potential factor is the discovery of rust reproduction on volunteer soybeans. Unlike in the U.S. Corn Belt, where harsh winter conditions preclude volunteer germination for several months, in Brazil's tropical climate fallen soybeans can germinate and grow into the vegetative stage shortly after harvest. This extends the window of spore production and enables the pathogen to move more quickly via prevalent winds. By September 2004, ASR spores had continued their northward travel, appearing near Cali, Columbia, about 5 degrees north of the equator.⁷

Yield Loss. Once a soybean plant is infected, rust lesions tend to cover most of the leaf, stem, and pods. The lesions cause premature defoliation, thereby reducing photosynthesis and the number of days to maturity. Heavily infected plants have fewer pods and lighter seeds. Marketable yields are further reduced by the resulting poor seed quality.⁸ The pathogen has been shown to reduce soybean yield as much as 80% when left untreated. Yield losses of 10% to 50% are quite common. During the 2002/03 crop year, soybean producers in Mato Grosso and other Brazilian states were caught unaware by ASR. In most cases, fungicides either were not available or were applied too late. Brazil's soybean crop losses in 2002/03 were estimated at 3.4 million metric tons (mmt) out of a total crop of 52.6 mmt — a loss of value of about \$1.3 billion.⁹ The Brazilian government subsequently took measures to alleviate the ASR problem — Brazil's agricultural research network was mobilized, and effective fungicides were identified and made available on the marketplace. The following year, soybean yield damage in 2003/04 in Brazil due to ASR was difficult to assess due to the simultaneous occurrence of drought and flood across major soybean-growing areas; however, some analysts suggest that soybean rust damage had grown to nearly 5 million metric tons.¹⁰

Treatment and Control. According to an expert at USDA's Agricultural Research Service (ARS), the disease's rapid transmission rate coupled with an abundance of host species suggests that eradication would be unlikely once the fungus is established in the United States.¹¹ As a result, the U.S. soybean industry

⁷ *The Corn & Soybean Digest*, Vol. 64, No. 8, "Soybean Rust Marches North," by Greg Lamp, Sept. 1, 2004.

⁸ Glen Hartman, USDA, ARS plant pathologist, quoted in Rob Wynstra, "Researchers Prepare for Threat from New Soybean Disease," *Agriculture, Consumer and Environmental Sciences (ACES) News*, Univ. of Illinois, Apr. 22, 2002.

⁹ Reuters, "Big Asian Soy Rust Loss Ruled Out in Brazil Crop," Jan. 20, 2004, reported by @agriculture Online, at [<http://www.agriculture.com>].

¹⁰ *ProFarmer*, "Lessons Learned Brazil," by Editor Chip Flory, Nov. 20, 2004.

¹¹ APHIS scientist Mary Palm, quoted in Bill Tomson, "Plans Made to Fight Soybean (continued...)

and scientific community agree that the best long-run strategy for minimizing the effects of ASR is the development of resistant varieties. However, current commercial U.S. soybean cultivars are not resistant to or tolerant of ASR.

In the short run, industry participants and the scientific community suggest that access to registered fungicides and the planting of early-maturing soybean cultivars are the primary means of mitigating production losses due to ASR. Fungicides have been used effectively in other countries to mitigate the impacts of ASR on soybean production. In addition, the planting of early-maturing soybean cultivars has been found to reduce ASR's harmful effects by minimizing the extent of growing time under warm-humid conditions when the disease proliferates.

Responding to ASR's Arrival

What Is Being Done to Prepare? USDA has taken the lead in coordinating activities to prepare for the introduction of ASR into the United States. Since May 2002, an ad hoc working group composed of USDA agencies — APHIS, ARS, and the Cooperative State Research Extension and Education Service (CSREES) — and the National Plant Board, as well as several major land-grant universities and industry participants, has been working to develop and implement a four-pronged approach to ASR that includes protection, detection, response, and recovery.¹²

Protection. Initially, this component involved identifying and protecting possible pathogen entryways into the United States to slow or prevent the arrival of ASR. In particular, APHIS sought to use its legislative authority under the Plant Protection Act (Title IV of P.L. 106-224) to control the importation of commodities that may serve as pathways for the introduction of foreign plant and animal pests and diseases. During the 108th Congress, legislation was proposed (H.R. 3775), with the support of both the American Farm Bureau Federation and the American Soybean Association, to ban soybean imports from countries known to harbor the pathogen. However, no action was taken as the confirmed arrival of ASR into the United States has refocused work to the remaining three components of the plan.

Detection. The detection plan is designed to ensure the early detection and rapid identification of ASR once it reaches the United States. Specifics include the distribution of information concerning field characteristics about the disease, details on collection and submission of specimens, as well as diagnostics, and confirmation procedures. According to USDA, accurate and timely identification is the key to determining whether a response will be attempted and, if so, the extent, direction, and magnitude of that response.

Sentinel soybean plantings (made about three weeks prior to commercial plantings) throughout major soybean growing areas will be used to provide early detection, thereby allowing time to control the pathogen in commercial plantings

¹¹ (...continued)
Disease," *Wall Street Journal*, Nov. 30, 2003.

¹² USDA, APHIS, PPQ, *ASR Strategic Plan* (Nov. 2004).

before the disease becomes epidemic. APHIS has identified and is training key participants throughout the soybean industry with respect to detection survey procedures and best crop management practices to ensure effective ASR detection and treatment methods. In addition, scouting and other detection information is available through the North Central Soybean Research Program's (NCSRP's) Plant Health Initiative (PHI) website.¹³

Response. To help minimize the potential impacts, APHIS has established a communication network for facilitating a response once ASR has been detected in a particular locality. Also, NCSRP's PHI provides recommendations for rust management and directs interested parties to other useful information sources. Finally, APHIS's Plant Protection and Quarantine (PPQ) is implementing a forecasting system¹⁴ to provide information about the probability of rust occurring within a specific region based on current detection sites, weather patterns, crop plantings and growth stage, and other information.

Recovery. The principal component of recovery involves the research and development of improved, lower-cost fungicides and fungicide application practices, as well as the research and development of disease-resistant soybean cultivars. Personnel from USDA's APHIS, ARS, and CSREES are collaborating with Iowa State University and with USDA's Foreign Disease-Weed Science Research Unit at Fort Detrick, Maryland, to examine options for controlling the disease and developing new sources of genetic resistance. ARS and CSREES also have been working with seed companies to develop commercially acceptable rust-resistant or -tolerant soybean varieties. This research has been supported by USDA and the Homeland Security Department, as well as the state soybean checkoff boards (represented by the North Central Soybean Research Program) and the United Soybean Board.¹⁵ More recently, Congress appropriated \$800,000 for research on soybean rust and specifically included language encouraging USDA to accelerate research on plant varieties that improve tolerance to soybean rust pathogens in the Consolidated Appropriations Act, 2005 (P.L.108-447). The joint research objectives include:

- Determine resistance of U.S. commercial germ plasm to rust.
- Identify resistant germ plasm from international sources.
- Determine efficacy of fungicides against soybean rust, as well as the optimum stage of disease development for applying a fungicide treatment to maximize the effectiveness of treatments and to minimize the costs and environmental risks associated with chemical use. Tests are underway in countries with heavy rust infestations.

¹³ NCSRP, PHI, *Asian Soybean Rust*, at [<http://www.planthealth.info>].

¹⁴ For more information see, APHIS, PPQ, Pest Alert: Soybean Rust, "U.S. Soybean Rust Detection and Aeriobiological Modeling, Nov. 2004; at [http://www.aphis.usda.gov/ppq/ep/soybean_rust/].

¹⁵ *The Corn and Soybean Digest*, "Fight Against Soybean Rust," October 1, 2003.

- Develop Climate Prediction Models to identify the potential rust pathway within the United States to determine which resistant varieties should receive research emphasis.
- Develop an international network of collaborators and collect soybean rust isolates.

According to the United Soybean Board, USDA scientists have already screened more than 20,000 lines of U.S. and exotic germ plasm for resistance to rust.¹⁶ Of the lines screened, 700 lines appear to show at least partial resistance to rust. Yet, the availability of cultivars with good resistance and other characteristics desired in soybeans for commercial production is still thought to be six to eight years away.¹⁷

Fungicide Registration Status in the United States. The sale of any pesticide (including fungicides) is prohibited in the United States unless it is registered and labeled in accordance with the regulations of the U.S. Environmental Protection Agency (EPA).¹⁸ New uses (for example, on soybean rust) for pesticide active ingredients previously registered with the EPA must also be reviewed and registered. As of November 19, 2004, three chemicals were registered with the EPA for treatment of soybean rust.¹⁹ In addition, EPA had approved several emergency exemptions for fungicides for the treatment of soybean rust under Section 18 of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). Section 18 registrations grant temporary emergency use rights in specifically named states.

Chemical companies, university researchers, and the soybean industry are searching for additional efficacious chemicals, formulations, and application rates and methods. Selection, testing, and eventual registration with EPA of potential fungicides for use in treating ASR can be a slow process that may take months or years. Major chemical companies that already have fungicides on the market are making efforts to get labeling changes approved through the EPA. However, labeling changes can often require additional testing for residues and tolerance levels, particularly if dosage rates and application methods for ASR vary greatly from currently labeled uses.

EPA receives its authority to regulate pesticides under FIFRA, the Federal Food, Drug, and Cosmetic Act (FFDCA), and the Food Quality Protection Act (FQPA). Under FIFRA, EPA registration requires more than 100 different scientific studies and tests from applicants to ensure that a pesticide, when used according to label directions, can be used with a reasonable certainty of no harm to human health or the

¹⁶ *Production Quarterly*, "Soybean Checkoff Remains on the Front Lines in the Battle Against Rust," Dec. 2004; available at [http://www.unitedsoybean.org/f_public.htm].

¹⁷ NCSRP, PHI, *Asian Soybean Rust*.

¹⁸ For information on the registration of pesticide products, see CRS Report RL31921, *Pesticide Law: A Summary of the Statutes*.

¹⁹ EPA, Pesticides, Pesticide News Stories, "EPA's Pesticide Program Ready For Soybean Rust Threat to Soybean Crop," Nov. 19, 2004; available at [http://www.epa.gov/oppfead1/cb/csb_page/updates/soybean_rust.htm].

environment.²⁰ For pesticides that may be used on food or feed crops (as is the case for soybeans), EPA is required by FFDCFA and FQPA to set tolerances (maximum pesticide residue levels) for the amount of the pesticide that can legally remain in or on human foods or animal feed.²¹ However, under certain circumstances a state may be granted an emergency exemption from the complete battery of testing necessary for full pesticide registration. Under Section 18 of FIFRA (codified as 7 U.S.C. 136p), EPA can allow state and federal agencies to permit the unregistered use of a pesticide in a specific geographic area for a limited time if emergency pest conditions exist.²² Crisis exemptions are available if a need is more immediate, but allow for unregistered use for only a 15-day period unless the applicant follows up with a specific exemption request.

Fungicide Availability. One market watcher estimates that the United States currently (as of November 13, 2004) has fungicide capacity to treat up to 12 million acres.²³ During the past three years (2002-2004), U.S. soybean plantings have averaged 74.2 million acres. Thus, sufficient fungicide is available to treat about 16% of average plantings. How widespread will ASR outbreaks be? How intense will any infestation be (i.e., how many times will fungicides have to be applied to the same field)?

Fungicide producers confront these uncertainties when they make fungicide production decisions well in advance of knowing what demand will be. Soybean producers, on the other hand, are unlikely to purchase costly fungicides until they learn of the appearance of ASR in their locality, at which point they will want to purchase fungicide immediately. A shortage of fungicides or even the perception of a fungicide shortage could lead to a constituent call for congressional action. The response of local, state, and federal agencies is limited because the U.S. fungicide market is in private hands. For a discussion of government response during the 2004 influenza shortage (an apparently analogous situation), see CRS Report RL32655, *Influenza Vaccine Shortages and Implications*.

Crop Insurance. According to USDA's Risk Management Agency (RMA) — the agency charged with administering the federal crop insurance program — unavoidable loss of production due to plant disease (including ASR) is a covered peril under the crop insurance program, provided it was due to natural causes and the producer followed recognized good farming practices in applying recommended, available control measures (i.e., fungicides).²⁴ Failure to purchase and apply

²⁰ EPA, "Pesticides — Pesticide Registration Program: Evaluating Potential New Pesticides and Uses," retrieved on Feb. 5, 2004, from [<http://www.epa.gov/pesticides/regulating/index.htm>].

²¹ Ibid.

²² EPA, "Pesticides: Regulating Pesticides — FIFRA Section 18 Emergency Exemptions," retrieved on Feb. 5, 2004, from [<http://www.epa.gov/opprd001/section18/>].

²³ *ProFarmer*, "Asian Soybean Rust Makes its Way to U.S.," by Chip Flory, Editor, Nov. 13, 2004.

²⁴ USDA, RMA, *Risk Management Agency Remains Concerned About Soybean Rust*, (continued...)

recommended control measures will result in assessing uninsurable causes of losses. If no effective control measures are available or there are insufficient amounts of chemicals available for effective control, the resulting loss of production is covered. However, producers are responsible to keep informed of soybean rust outbreaks in their area.

Disaster Assistance. A widespread and severe loss of soybean production due to ASR may encourage legislation to assist growers if a 2005 rust outbreak is severe. There is substantial precedent for ad hoc disaster payments being made to assist growers who suffer yield loss due to plant disease.²⁵ Most recently, payments were made to producers of any 2003 or 2004 crop with significant losses caused by any natural disaster.²⁶

ASR-Related Market Issues

Soybean production represents a vital economic activity in a large portion of the United States. Soybeans rank second only to corn as the most important field crop grown in the United States, both in terms of planted area and value. Soybean harvested area has exceeded corn harvested area in every year since 1999. From 1999 to 2003, U.S. soybean planted area averaged nearly 74 million acres, while the value of soybean production averaged nearly \$14 billion.²⁷ During that same period, over half of the states derived important economic returns from soybean production — the value of average annual soybean production was between \$14 million and \$90 million in 11 states (AL, DE, GA, MD, NJ, NY, OK, PA, SC, TX, VA); between \$100 million and \$950 million in 14 states (AR, KS, KY, LA, MI, MO, MS, NC, ND, NE, OH, SD, TN, WI); and greater than \$1 billion in 4 states (IA, IL, IN, MN).

During the 1999 to 2003 period, the soybean processing sector annually produced over \$7 billion in soybean meal (nearly 98% of which was destined for use as animal feed) and \$3.5 billion in soybean oil.²⁸ In addition, soybeans, soybean oil, and soybean meal averaged a combined \$7.4 billion in exports during that same period, which was nearly 14% of all U.S. agricultural exports.²⁹

Given soybean production's widespread economic significance, government policy makers, commodity market participants, and the U.S. soybean industry are concerned by the pathogen's recent arrival in the United States, its tendency to spread, and its detrimental effects on soybean yields. In addition to the potential

²⁴ (...continued)

Dec. 30, 2004; available at [<http://www.rma.usda.gov/news/2004/12/soybean-rust.html>].

²⁵ For more information, see CRS Report RL31095, *Emergency Funding for Agriculture: A Brief History of Supplemental Appropriations, FY1989-FY2005*.

²⁶ For details, see the section "Agricultural Disaster Assistance" in CRS Report RL32581.

²⁷ USDA, National Agricultural Statistics Service (NASS), *Crop Value*, various issues.

²⁸ Annual averages are for 1999 to 2003; USDA, ERS, *Oil Crops Yearbook*.

²⁹ USDA, Foreign Agricultural Trade of the United States (FATUS), available online at [<http://www.fas.usda.gov/ustrade/>].

economic harm, the arrival of a new pest of a major U.S. crop has implications for several public policies, including pest control research, pesticide regulation, disaster assistance, and crop insurance.³⁰

Potential Effects of ASR Entry into the United States. ASR is potentially devastating to temperate soybean producers because it easily adapts to diverse environments, it is prolific under the right environmental conditions, and it is very mobile. In April 2004, USDA's Economic Research Service (ERS) completed a simulation modeling exercise to project the potential economic losses associated with various degrees of ASR infestation in the United States.³¹ According to ERS, "The extent of economic impacts will depend on the timing, location, spread, and severity of rust establishment and outbreaks, and on how soybean and crop producers, livestock producers, and consumers of agricultural commodities respond."³²

Early ASR detection combined with widespread fungicide availability can greatly reduce yield losses and economic damage. However, the added cost of fungicide application would lower soybean returns relative to other field crops such as corn that are unaffected by the pathogen. As a result, it is likely that the presence of ASR would lead to some acreage shifting away from soybeans and toward other crops. These effects would vary regionally and would depend on relative expected returns of different crops and alternate land-use activities. Corn would likely be the primary beneficiary of displaced soybean acres, especially in the Corn Belt. In the Plains states, wheat, other small grains, and possibly pastureland could gain some area. In the Delta and Southeast, cotton probably would be the primary beneficiary of soybean acreage shifts.

ERS medium-term results (which assume that ASR is already established and endemic to the United States) suggest that annual economic losses could range between \$240 million and \$2 billion, depending on the severity and extent of subsequent outbreaks. The large range of damage estimates reflects the uncertainty associated with the eventual effects of soybean rust in the United States. Under a high-infestation scenario, ERS assumes national average yield losses of 9.5%. In contrast, under a low-infestation scenario ERS actually assumes some yield gains due to shifting of soybean area out of lower-yielding regions (such as the Southeast and Delta states). The ERS simulation model suggests that soybean producers would bear most (60% to 70%) of the costs of adjusting to soybean rust, while consumers and livestock producers assume the remainder of the economic cost. Although not specifically included in the ERS model, the U.S. oilseed-crushing industry would also likely see its profit margins squeezed by high soybean prices relative to meal and oil prices.

³⁰ For more information, see USDA, ERS, *Economic and Policy Implications of Wind-Borne Entry of Asian Soybean Rust into the United States*, OCS-04D-02, by M. Livingston, R. Johansson, S. Daberkow, M. Roberts, M. Ash, and V. Breneman, April 2004, p. 2; hereafter referred to as USDA, ERS, ASR Study (April 2004).

³¹ Ibid.

³² Ibid., p. 2.

Market analysts suggest that the discovery of ASR in the United States is not likely to have any impact on U.S. soybean exports because nearly every major soybean producing country in the world also is infected by ASR.³³

Regional Disparities. Under the ERS simulation model, the impact of an ASR infestation falls heaviest on those regions that grow the most soybeans — the Corn Belt, the Delta, Appalachia, the Northern Plains, and the Southeast.³⁴ When soybean rust is assumed to infest a given region, soybean acres and soybean net returns decline. Livestock producers in all regions suffer economic losses due to higher feed costs.

USDA's research suggests that, because of the potential severity of the disease and fungicide costs needed to control field infections, a significant share of soybean production in the southernmost states could become unprofitable. During the 1996 to 2002 period, soybean yields in Appalachia (AP), the Delta (DL), and the Southeast (SE) averaged about 26% below the national average (see **Table 1**). Yet soybean production has been a valuable agricultural activity for both regions. During that same period, the AP, DL, and SE regions (combined) averaged more than 10 million acres planted to soybeans, with annual production valued at \$1.6 billion.³⁵ The loss of a significant share of soybean production in these regions likely would adversely affect their growing pork and poultry sectors, due to the regions' growing disparity between feed production and demand.

Conclusion. Anticipatory work headed by USDA's APHIS to mitigate the adverse effects of ASR's arrival in the United States is well underway. Until ASR-resistant soybean varieties are developed, soybean producers will have to rely on fungicides and early-maturing varieties to diminish potential yield losses. The resultant higher production costs are expected to have important regional effects, particularly in lower-yielding southern states, while livestock producers nationwide are expected to suffer economic losses due to higher feed costs.

³³ *World Perspectives, Inc.*, "Asian Soybean Rust Arrives in the U.S.," by John Baize, Nov. 12, 2004.

³⁴ Appalachia = KY, NC, TN, VA, WV; Corn Belt = IA, IL, IN, MO, OH; Delta = AR, LA, MS; Northern Plains = KS, ND, NE, SD; and Southeast = AL, FL, GA, SC.

³⁵ USDA, National Agricultural Statistics Service (NASS), Agricultural Statistics Database.

**Table 1. U.S. Regional Soybean Comparisons,
1996-2002 Averages**

	Category	Corn Belt & Lake States	No. & So. Plains States	North- east	Appalachian, Delta, & Southeast	United States
Planted	million ac.	40.3	11.3	1.1	10.0	62.8
Harvested	million ac.	40.0	11.0	1.1	9.6	61.6
Yield	bu./ac.	41.5	35.1	34.0	28.8	38.2
Production	million bu.	1,658	386	39	277	2,358
Price	\$/bu.	5.32	5.07	5.30	5.66	5.32
Value	\$ million	8,821	1,957	205	1,566	12,542

Source: USDA, NASS, Agricultural Statistical Database.

Note: Appalachia = KY, NC, TN, VA, WV; Corn Belt = IA, IL, IN, MO, OH; Delta = AR, LA, MS; Northeast = PA, NY, MD, NJ, DE; Northern Plains = KS, ND, NE, SD; and Southeast = AL, FL, GA, SC; and Southern Plains = OK, TX.

For More Information

North Central Soybean Research Program (NCSRP), Plant Health Initiative (PHI), *Asian Soybean Rust*, at [<http://www.planthealth.info/rust/rust.htm>].

USDA, Animal and Plant Health Inspection Service (APHIS), Plant Protection and Quarantine (PPQ), *Pest Alert: Soybean Rust*, News and Information, "Soybean Rust Updates," available at [<http://www.aphis.usda.gov/lpa/issues/sbr/sbr.html>].

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