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Abstract
Since Asian soybean rust (Phakopsora pachyrhizi) was confirmed in Louisiana on November 10, 2004, a lot of questions have been raised on the impact of Asian soybean rust (ASR) on soybean yield and grain quality. No accurate yield losses due to ASR in the United States can currently be estimated. However, research from around the world has seen yield loss as high as 90 percent under the worst cases. We have summarized what we can expect from ASR on soybean yield and grain quality based on observations from other countries.

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Plant Diseases

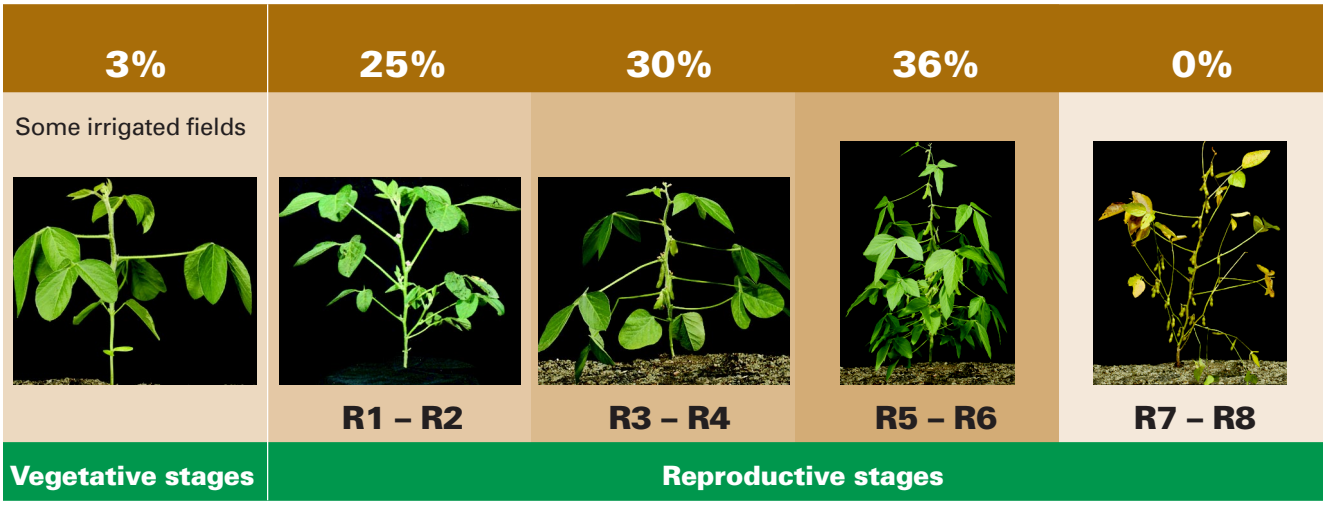
Effect of Asian soybean rust *(Phakopsora pachyrhizi)* on soybean yield and grain quality

by Palle Pedersen, Department of Agronomy

Since Asian soybean rust *(Phakopsora pachyrhizi)* was confirmed in Louisiana on November 10, 2004, a lot of questions have been raised on the impact of Asian soybean rust (ASR) on soybean yield and grain quality. No accurate yield losses due to ASR in the United States can currently be estimated. However, research from around the world has seen yield loss as high as 90 percent under the worst cases. We have summarized what we can expect from ASR on soybean yield and grain quality based on observations from other countries.

Soybean yield can be divided into three major components: number of pods per plant, number of seeds produced per pod, and seed size. Large yield increases most often result from increases in the number of seeds per pod and the seed size. Stressful conditions such as high temperature, moisture deficiency, or poor management practices decrease yield due to reduction of one or more of the yield components. The soybean plant is unique in the way a reduction in one component may be compensated for by another component so that yields are not significantly changed. Which yield component decreases or increases depends on the reproductive stage of the plant when the stress occurs. As the soybean plant ages from flowering through the middle of the seed-filling stage, its ability to compensate after a stressful condition decreases. Therefore, the potential degree of yield reduction from the stress increases. Stress early during the reproductive stages can be compensated for by increased numbers of pod or seed set later, if the stress is relieved. On the other hand, late season stress reduces seed size and therefore yield, although it does not have as severe an effect as pod and seed abortion. In general, increased seed size never fully compensates for reduced seed number.

The extent of the effect of ASR or damage depends upon the soybean growth stage at which it occurred. In most cases, ASR appears first on the lower leaves of the plants. Under normal conditions, actively functioning leaves are a major source of nutrients for seed growth. Proper leaf functioning is important in order to maximize seed yield and quality since the increase in seed weight is due to the translocation of materials from other plant parts to the seeds (mobilization). This translocation can be reduced with ASR because a severe outbreak of ASR will cause premature defoliation that will reduce the amount of photosynthate available to the plant. Premature defoliation will lead to a yield



Source: Analysis by Emerson and Yang with data from EMBRAPA Soja and Fundação ABC

Percentage of soybean rust detections in Brazil relative to crop stage. Values estimated are based on 518 detections in sentinel plots and fields scouted from November 2004 to February 8, 2005; 6 percent of detections are from unreported stages.
(ISU Extension and Palle Pedersen)

reduction because of a reduction in the number of filled pods, number of filled seeds, and a reduced seed size. Data from China show soybean rust reduces yield mostly through reduction in seed number and seed weight with moderate disease pressure. When rust was severe from the early reproductive stage, the number of pods was reduced. If an ASR epidemic occurs in Iowa, it is unlikely to attack soybean in early reproductive stages. This is more likely to affect seed weight and seed number.

As the soybean plant matures past R6 (full seed), the potential degree of yield reduction by ASR gradually declines. After R6, stress may cause yield reductions mostly by reducing seed size, but also by reducing pods per plant and beans per pod. Yield reductions from stress occurring late in R6 are much smaller because the seeds have already accumulated a sizable portion of their mature dry weight. Stress occurring at R7 (physiological maturity) or thereafter essentially has no effect on yield. The influence of ASR on seed quality is not as clear since it is influenced by the timing, severity, and duration of the infection. No reports from Brazil indicate that ASR influences grain quality.

Palle Pedersen is an assistant professor of agronomy with research and extension responsibilities in soybean production.

Plant Diseases

Homeland Security status of ASR

by Robin Pruisner, Iowa Department of Agriculture and Land Stewardship

Asian soybean rust (ASR) is listed in the Code of Federal Regulations (7 CFR 331) as a biological agent (see definition at the end of this article). This means possessing, using, and transferring anything infected with the fungus that causes the disease is currently regulated by federal law. Biological agents that affect agriculture can only be possessed by permitted entities with appropriate containment facilities and are governed by the United States Department of Agriculture (USDA).

However, that status is about to change. Following the confirmation of ASR in the United States in November 2004, the USDA began the process of removing ASR from the biologic agent list. Normally, the delisting of a biologic agent would take years, but the final rule was still in process. The USDA had an opportunity to amend it before finalization, effective upon signature by the APHIS administrator Ron Dehaven, with publication in the Federal Register at a later date. The final rule is to be released by the Office of Management and Budget very soon.

What does the delisting mean to Iowa producers? Once delisted, ASR is on equal footing with any other commonly occurring crop disease. Researchers wishing to move the pathogen across state lines need to apply for a USDA permit to do so. This will allow field research on control and prediction strategies here in the United States. Up until now, all research on this disease was being conducted in other countries. The delisting will allow researchers to polish recommendations best suited for the distinct environmental characteristics in the United States.

If ASR infects Iowa fields in the 2005 crop season, producers do not need to treat the crop as if it were a regulated pathogen under U.S. Homeland Security.

According to the Code of Federal Regulations, a biological agent is any microorganism (including, but not limited to, bacteria, viruses, fungi, rickettsiae, or protozoa), or infectious substance, or any naturally occurring, bioengineered, or synthesized component of any such microorganism or infectious substance, capable of causing:

- Death, disease, or other biological malfunction in a human, an animal, a plant, or another living organism
- Deterioration of food, water, equipment, supplies, or material of any kind
- Deleterious alteration of the environment.

Robin Pruisner is the bureau chief of entomology and plant science at the Iowa Department of Agriculture and Land Stewardship.

Left: Robin Pruisner, Iowa Department of Agriculture and Land Stewardship, John Kennicker, ISU Extension field specialist for crops, and Craig Grau, professor of plant pathology, University of Wisconsin, examine soybean leaves possibly infected with rust spores in Brazil, February 2005. *(Palle Pedersen)*