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Scab of Wheat and Barley

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During the past 15 years, scab has severely damaged soft red winter wheat crops in several Corn Belt states, hard red spring wheat and spring barley in the Red River Valley of the northern plains, and soft white wheats in Michigan, New York, and Ontario. In Indiana, scab was a major problem in 4 of the past 10 years: 1986, 1990, 1991, and 1995. Scab is not a new disease. J. C. Arthur, the first plant pathologist at Purdue, described the disease in 1891. He said the disease was new to science but was familiar to farmers as "scab." Until the last decade, scab was regarded as a sporadic disease that might be seen only once in 10 or 15 years, and then only in scattered fields. It is now regarded as a chronic disease in the eastern half of the US and one of the most critical problems for production of quality wheat and barley. Development of scab is sensitive to weather. Several fungi of the genus *Fusarium* cause scab, but the principal pathogen is *Fusarium graminearum*. This fungus is a pathogen of corn (Gibberella ear and stalk rot) as well as wheat and barley. The main site for infection of wheat and barley is the anthers just after flowering. If weather is wet and warm when the crop is flowering, and there is a local source of abundant fungal inoculum, a high incidence of infection will result.

Because the period of vulnerability to infection is short, only a few days after flowering, secondary infection -- the spread of infection from a scabbed head to a healthy head -- is probably rare. However, scab may increase in severity during the grain filling period. Even only a single spikelet of a head is infected, the fungus can subsequently invade the entire head and even grow down into the neck. This invasion, like initial infection, is faster in warm weather (80-85 F), but invasion does not require wet weather. What accounts for the greater frequency and severity of scab in the past 10 to 15 years? The most obvious change that has occurred in the Corn Belt during this time is the widespread adoption of reduced tillage for grain and soybean production. *Fusarium graminearum* survives in crop residue of small grains and corn. Corn stalk residue, because of its longevity, may be the most important substrate on which the fungus survives between crops. Leaving this residue on the soil surface, rather than plowing it down, greatly increases the number of fungal spores capable of infecting wheat and barley in the spring. The cultivation of short-season corn hybrids in areas north of the traditional Corn Belt may be why scab of wheat and barley has become a more frequent problem in the northern plains.

Under the most favorable weather conditions, incidence of infection and invasion of the entire head is so rapid that grain has little chance to develop and heads will be mostly blank. If invasion is slower, grain will develop, but it will be shriveled and chalky, with correspondingly low test weights. Scab is doubly detrimental to wheat and barley. It not only reduces yield and test weight, but the fungus can produce toxins in the grain. The principal toxin is deoxynivalenol (DON or vomitoxin). The concentration of DON often increases as kernels develop and the toxin persists through processing of food or feed.

Although the increasing problem of scab may be an undesired side effect of reduced tillage, production economics and soil conservation issues make it unlikely that farmers will return to plowing for control of scab. Plowing of individual fields prior to seeding wheat would probably not do much to reduce the potential for scab if neighboring fields have corn or small grain residue on the surface. One of the unanswered questions in scab epidemiology is how far spores of the fungus can be carried by wind or rain splash. Although long distance spread is not well understood, there is ample evidence that spores of the scab fungus are carried at least from one field to another. In any case, even when plowing was the common tillage method, scab outbreaks occasionally occurred, so eliminating residues of corn and small grains would not be a curefor scab.

Crop rotation can afford some protection. At least, planting wheat or barley after corn should be avoided. Fungicides have not shown great promise for scab control. There are a few reports of reduced scab after application of a fungicide, but many other studies show no benefit. This is an area of current research.

The most promising method of control is development of resistant varieties. Several varieties of wheat from the Yangtze Valley of China were found to have a high degree of resistance. Wheat breeders at the Jiangsu Academy of Agricultural Sciences have bred several agronomically improved varieties of wheat with resistance to scab. Breeders of winter and spring wheat in the US have been using this Chinese germ plasm, as well as some moderately resistant varieties from South America, in their programs. The inheritance of scab resistance is not overly complex genetically, and reliable screening methods are being developed. Within a few years, varieties of wheat adapted to scab-prone areas of North America should be available to farmers.

Selected References

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