Scab

'Scab-watch' will be early warning system

BY **LANCE NIXON**

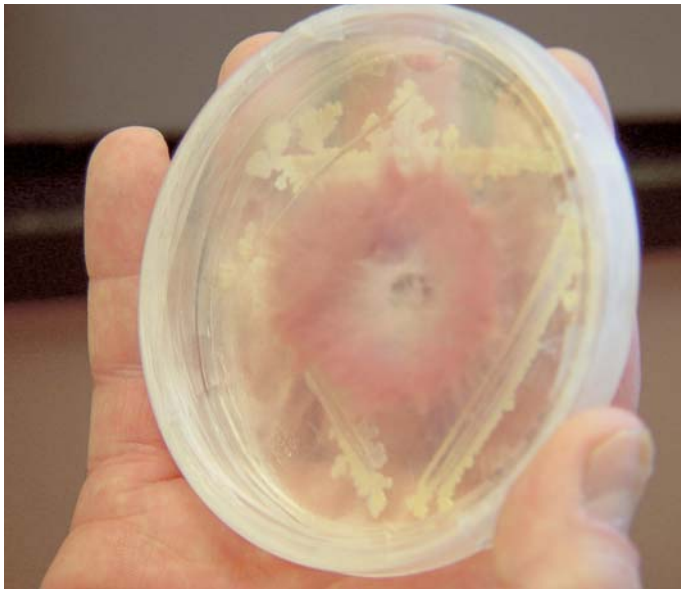
Nichole Baye, graduate research assistant, and Bruce Bleakley, SDSU microbiologist: Can bacteria become biocontrol agents against the scab fungus?

If next summer's rainfall returns to "normal," South Dakota farmers could have another problem—a disease on wheat and barley that farmers call scab and scientists call Fusarium head blight.

A succession of wet years starting in 1993 left South Dakota and much of the upper Midwest vulnerable to scab epidemics. In South Dakota, spring wheat epidemics in 1993 alone cost producers an estimated $80 million.

The next epidemic doesn't even need a wet "year." One rainy day at the wrong time could do it.

"Scab development doesn't take nearly as long a wet period during flowering as we once thought," says Marty



In the lab in a Petri dish, certain strains of bacteria (yellow) will stop the growth of the scab fungus (red). Some antibiotics and enzymes are probably involved. Will the bacteria show an economically worthwhile antagonism to the scab organism in the field?

Draper, Extension plant pathologist. "If you went back and looked at what we said 10 years ago, it would have been based on what was in the literature, which said it needed to be wet for 3 days during flowering to get significant scab.

"We know that that's not true anymore. It's a much shorter period. If we have a single rainfall event, a single day of showers, we can have a lot of scab if the crop is at full flower."

He adds that under such conditions he has seen South Dakota fields with as high as 50% damage.

"SCAB-WATCH" NETWORK BEING PREPARED

Federal, state, and private sector scientists have been working with the wheat and barley industries to get on top of scab problems. The USDA Agricultural Research Service-led U.S. Wheat and Barley Scab Initiative includes:

- use of resistant crop varieties developed through conventional plant breeding or biotechnology,
- alternative residue and rotation management schemes,
- crop protection through chemical and biological controls, and
- detoxification or alternative processing of grain contaminated with toxins, since the disease also causes problems for the food industry in handling the mycotoxin-contaminated grain that is often the result of scab infection.

Draper says the Initiative is perhaps the best example he has seen of land-grant institutions such as SDSU working together and cooperating with federal scientists and private industry to solve a common problem.

At SDSU and other land-grant universities, scientists are designing models that, if they work, will warn producers about conditions right for scab.

"We can take a look at weather data and eventually factor in the spore load in the air, much like we look at mold and pollen counts for allergy sufferers, and give producers in a specific area of the state an idea of whether they're at a higher or lower risk of the disease," Draper says. "That's being piloted this summer."

Draper adds that at least two other factors—no-till farming and the expansion of the corn-producing region northward—call for producers to be on guard against scab.

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The pathogen survives well in stubble, Draper says, and corn stubble is ideal. Similarly, no-till farming, because it keeps more stubble on the land, may require some additional management practices.

"It's probably going to increase your use of fungicides," Draper says. "It should force you to extend the period of time between like or susceptible crops. It may change how many years you allow to pass before you come back to wheat following corn or wheat."

NEW SOURCES OF RESISTANCE

The testing of new fungicides that could offer better control than the products now available to farmers and the development of new varieties of scab-resistant spring and winter wheats are projects at SDSU, other land-grant universities. and federal research facilities.

Among the entities funding South Dakota State University's ongoing scab research are the South Dakota Wheat Commission, USDA-ARS National Wheat & Barley Scab Initiative, and the Minnesota Wheat & Barley Research & Promotion Council.

Plant pathologist Yue Jin says some of his work at SDSU involves looking for new sources of resistance from exotic materials. Jin coordinates a regional program for germplasm evaluation. Each year he evaluates 1,000 to 1,500 wheat varieties and landraces from around the world in search of scab resistance.

"We are trying to find out how many genes are controlling resistance and how easily we can incorporate that resistance into breeding materials," Jin says. His team also evaluates some 5,000 to 6,000 breeding lines of wheat each year for scab resistance.

NEED FOR OPEN BORDERS

The fight against scab vividly illustrates the need for open borders and the free flow of scientific information, Jin says. Partly because scab is most persistent in rice and wheat rotations in places such as India, Nepal, China, and Japan, some of the best scab resistant sources in wheat are found in germplasm from China, where breeders have been addressing the problem longer.

Similarly, scab resistance in barley is coming from germplasm from China, Japan, Korea, and Europe—and virtually none from U.S. lines of barley.

Ravindra Devkota, research associate, says although the Chinese sources of resistance in spring wheat have given a moderate response—especially through a wheat called Sumai 3 or its derivatives—scientists still have a long way to go.

"There is nothing like a very high level of resistance or immunity. The best that we have right now is an intermediate level of resistance," he said.

Devkota says the search for scab resistance at SDSU, as elsewhere, involves close cooperation between plant pathologists and plant breeders. Plant pathologists such as Yue Jin evaluate materials for scab resistance and pass on the best materials to the breeders.

"I make crosses using those sources," Devkota says. "Once we make those crosses, it takes 8 to 10 years to make a variety."

A BIGGER THREAT

Amir Ibrahim, a winter wheat breeder at SDSU, also puts a lot of time and effort into breeding for scab resistance, even though diseases such as stem rust, leaf rust, and wheat streak mosaic virus have been a greater problem historically for growers of winter wheat in South Dakota.

"We cannot ignore a single disease," Ibrahim says, adding that scab could become a bigger threat to South Dakota producers in the future if weather patterns change or if the use of winter wheat in rotations increases.

In addition, Ibrahim says, SDSU has a responsibility to breed for the region, just as breeders in other states can expect some of their wheats to be grown in South Dakota.

In fact, one South Dakota winter wheat, 'Harding,' has shown scab resistance in some tests in other states. However, SDSU scientists are not yet convinced that what they are seeing is true resistance.

"Harding is a late-maturing winter wheat. It could escape the disease pressure," Ibrahim says. "It might be just missing the scab."

HELP FROM BACTERIA

Ongoing research at SDSU also looks at biocontrol agents that potentially can fight scab.

Several years ago SDSU microbiologist Bruce Bleakley, with the help of George Buchenau, retired SDSU plant pathologist, isolated bacteria from wheat foliage and residues from several South Dakota wheat fields. About six of those strains of bacteria showed what Bleakley describes as "antagonism" to scab and to another wheat disease caused by a fungus, tan spot.

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"We're not 100% sure yet how the antagonism happens. It might be some antibiotic that the bacteria produce, it might be an enzyme, it might be nutrient competition, or it could be a combination," Bleakley says. "We're pretty sure that some antibiotics are involved, and perhaps some enzymes."

It would be a big step forward, Bleakley says, if science and industry could put bacteria to work fighting scab. And, adds Draper, such research could yield biocontrol agents that may be acceptable to organic producers.

As part of the scab initiative, Bleakley and Draper will field test bacteria from locations such as Illinois and Nebraska, while SDSU will provide its bacteria for testing in other states. Bleakley says such cooperation is important because location makes a difference, and some strains may be more effective in one state than another.

More about the U.S. Wheat and Barley Scab Initiative can be found online at www.scabusa.org.◆