

# KARNAL BUNT

## Questions and Answers



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### WHAT IS KARNAL BUNT?

Karnal bunt is a fungal disease caused by *Tilletia indica* that infects common wheat, durum wheat (used for pasta), and triticale. Karnal bunt typically enters a wheat field on infected seed or possibly in soil from other infected fields. At heading time, if cool, wet weather conditions prevail during the boot and bloom stage of wheat, the fungus can infect individual wheat florets. Infection can then spread in the developing embryo end of the kernel, and progress along the crease (Figures 1 and 2). Infected portions of the kernel are replaced with masses of dark, powdery, fishy-smelling, fungal teliospores. Infection can vary from a trace to invasion of the entire kernel (Figure 1). Infected kernels are fragile and easily break open to release the teliospores.

Karnal bunt is difficult to detect in the field because, typically, only a few kernels per head are infected and overall infection rates are less than 1 percent. There may be a slight swelling or darkening of infected florets, which is normally difficult to find in a field setting. Therefore, Karnal bunt is easiest to detect by examining harvested grain.

Yield losses from Karnal bunt are usually minor, but grain quality may be reduced because of an unpleasant fishy odor. Grain with as little as 3 percent bunted kernels is usually considered unsatisfactory for human consumption. Studies have shown that infected grain poses no health risks to humans or animals.

The Karnal bunt fungus is native to the Asian subcontinent. It was originally reported in 1931 near the city of Karnal, India, from which it gets

its name. Since then, it has been reported in Pakistan, Afghanistan, Nepal, Iran, and Iraq. The disease was detected in Mexico in the early 1970s, and in 1996 it was found in the United States.

### WHY IS IT IMPORTANT?

Karnal bunt poses an economic threat to the U.S. wheat industry because of international quarantines in place in more than 70 countries.

Quarantines were established as a strategy to control the spread of Karnal bunt, which occurs primarily by contaminated seed. Karnal bunt is difficult to control by conventional methods such as using seed treatment fungicides and crop rotation. This is because the fungus can survive in a dormant state in the soil for 5 years or more. Soilborne teliospores germinate in the spring (Figure 2) when favorable environmental conditions prevail, and produce secondary spores, known as sporidia that directly infect heads. This circumvents seed treatment fungicides in fields already containing the inoculum.

Spring wheat varieties with high resistance to Karnal bunt have been developed in India and Mexico. The development of Karnal bunt-resistant winter wheat varieties in the United States has been difficult, since quarantines prevent breeders from screening for Karnal bunt in the United States. New breeding technology, known as molecular marker-assisted selection, will allow U.S. wheat breeders to build Karnal bunt resistance into new varieties without using the Karnal bunt fungus for screening. New winter wheat lines with high resistance can be tested and confirmed in Mexico or India.



Figure 1. Kernels with varying damage from Karnal bunt. Healthy kernel on left.

### WHAT IS THE U.S. QUARANTINE?

Following its discovery in the southwestern United States in 1996, the United States Department of Agriculture's (USDA) Animal and Plant Health Inspec-

tion Service (APHIS) quarantined Karnal bunt infested areas in an attempt to first eradicate the disease and, more recently, to contain its spread.

Fields within a regulated area are sampled at harvest time. If the samples are found to be negative for Karnal bunt, wheat from a quarantined field or regulated area can be cut and delivered in the grain market. If found positive for Karnal bunt, the grain may be cut, but must be delivered to an APHIS approved storage area until final disposal.

Any wheat or triticale seed produced in a regulated area must be tested and found to be free of Karnal bunt spores before being approved for planting. Seed samples are subjected to a wash-test, in which the wash solution is examined for teliospores of the Karnal bunt fungus. Detection of one or more teliospores for a seed sample is considered a positive test for Karnal bunt.

Interstate movement of regulated articles requires a special permit issued by the USDA. Under the quarantine rule, regulated articles include:

- 1) conveyances (trucks, rail cars, and other containers used to move wheat, durum wheat, or triticale);
- 2) grain elevators/equipment/structures used for storing and handling wheat, durum wheat, or triticale;
- 3) manure from animals fed on wheat, durum wheat, or triticale;
- 4) milling products or by-products, except flour;
- 5) plants or plant parts, including grain, seed, or straw of all varieties of wheat, durum wheat, or triticale harvested after the soft dough stage of growth;
- 6) root crops with soil;
- 7) soil from areas where field crops are produced;
- 8) used bags, sacks, and containers;
- 9) used farm tools;
- 10) used mechanized cultivating equipment;
- 11) used mechanized harvesting equipment;
- 12) used seed-conditioning equipment;
- 13) used mechanized soil-moving equipment; and
- 14) the Karnal bunt fungus, *Tilletia indica*.

## **WHAT IS THE ANNUAL GRAIN ELEVATOR SURVEY?**

APHIS coupled their quarantine strategy with an annual voluntary survey of grain elevators so that certificates can be issued to export customers indicating that U.S. wheat is grown in areas where Karnal bunt is not known to occur. APHIS adopted a standard of one bunted kernel in a 4-pound sample as the definitive (positive) test for the disease. The survey design involves one elevator sample per million bushels and only counties with more than 1 million bushel of wheat production are included in the survey.

## **WILL THE UNITED STATES DISCONTINUE ITS QUARANTINE?**

In response to the 2001 outbreak of Karnal bunt in north Texas, APHIS held public hearings to build an industry consensus behind a strategy that would preserve the U.S. wheat export market while minimizing economic hardship for producers and grain handlers in and surrounding quarantine areas. Participants were unanimous in their opinion that USDA must undertake the challenge of overcoming the classification of Karnal bunt as a quarantine pest (deregulation) while preserving wheat export markets. As an outcome of this approach, APHIS developed a “Karnal Bunt Strategic Plan, Overcoming Karnal Bunt as a Quarantine Pest While Preserving Export Markets FY 2003 - 2007.” The APHIS plan calls for complete deregulation of Karnal bunt as a quarantine pest by 2007 while negotiating with foreign trading partners to drop their quarantines. If negotiations go slowly, it is possible that deregulation will be delayed. If deregulation eventually occurs, Karnal bunt may remain a factor that limits wheat exports to some countries.

## **WHAT CAN WHEAT PRODUCERS DO?**

Wheat producers should implement best management practices to reduce the potential for contamination from Karnal bunt including:

- Purchase and plant only high-quality seed that has been tested for Karnal bunt or is produced in an area known to be free of the disease.
- Only use equipment known to be free of the disease (including tillage, planting, and harvesting equipment). Thoroughly steam clean any equipment entering your farm from

an unknown source (e.g. purchase of used equipment).

- Make certain that animals grazing wheat fields have not previously been in infected fields or been fed with infected wheat or triticale grain or hay past the soft dough stage of growth. A five-day “clean out” on a diet known to be free of Karnal bunt is considered adequate to remove danger of transmission through livestock.
- Don’t purchase wheat, durum, or triticale hay harvested after soft dough from infected or suspected fields.
- Growers should ask custom harvesters if they have worked in a regulated area.

Specific recommendations on ways to develop a quality assurance program to minimize the spread of Karnal bunt by seed producers, custom harvesters, and wheat growers are contained in the following fact sheets: *Karnal Bunt SOPs for Seed Procurement and Planting* and *Karnal Bunt SOPs for Harvest Equipment*. Wheat producers should demand that suppliers (seed and customer harvesters) comply with the guidelines contained in these fact sheets.

### HOW CAN KARNAL BUNT INFECTED WHEAT BE USED?

Contaminated wheat must be steam flaked and used for animal feed, or milled using APHIS approved transportation and processing procedures. “Host crop hay/straw testing positive for bunted kernels or baled from a field that tested positive for bunted kernels can move out of the regulated area under the following conditions:

- The host crop hay/straw must be destined to an approved establishment.
- Program personnel must be contacted before moving host crop hay/straw. If movement is approved, a Limited Permit will be issued for movement to the approved establishment out of the regulated area (APHIS 2002).”

Flour made from contaminated wheat can be shipped freely, but milling by-products must be heat-treated or moved under special restrictions.

Milling by-products from quarantined areas to be used for animal feed are required to be heat-treated in order to minimize the risk of spreading the disease. Approved treatments include raising the temperature of by-products by steam treating to raise the temperature to 170 degrees Fahrenheit.

Wheat from quarantined areas that twice tests negative for Karnal bunt can move to flour mills outside quarantine areas if accompanied by proper permits. Flour from this wheat can move freely once it is processed.

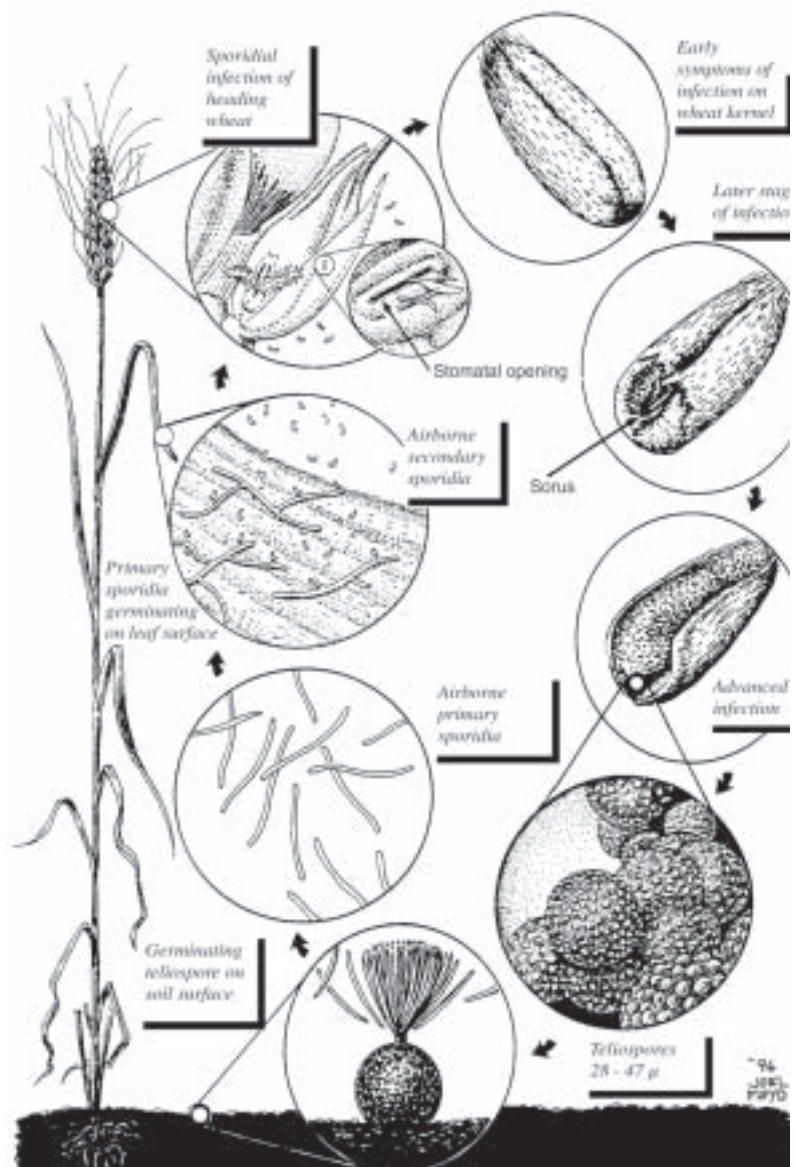


Figure 2. The life cycle of Karnal bunt fungus.

## ACKNOWLEDGMENTS

Figures 1 and 2 were obtained from the USDA Karnal bunt homepage at [www.aphis.usda.gov](http://www.aphis.usda.gov)

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