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KARNAL BUNT

Tilletia (Neovossia) indica

Current as of February 14, 1997

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Karnal bunt, also known as partial bunt, is caused by the fungus *Tilletia indica.* It is a member of the smut fungi. These fungi cause several important diseases on small grains including loose smut and common or stinking smut of wheat. This fungus infects common wheat, durum wheat, and triticale. Durum wheat is grown only in the western US and little or no triticale is grown in Georgia. Barley, rye, and oats are not susceptible to Karnal bunt. The disease was first found in the Karnal region of northern India in 1931 and was confined there and in areas of Pakistan, Nepal, Afghanistan, and Iraq for about 40 years. Karnal bunt was found in the Yaqui Valley in the state of Sonora in northern Mexico in the 1970s. Strict quarantine measures were put into place by the Mexican government and the USDA Animal and Plant Health Inspection Service (USDA-APHIS) by the early 1980s to prevent spread to the US and other countries. Karnal bunt-infected wheat was found in southern Arizona in March, 1996. It has recently been identified on grain samples harvested in 1996 in parts of southeast California. Also, based upon the presence of suspect teliospores from sampled wheat, this fungus may infect parts of Alabama, Florida, Georgia, and Tennessee.

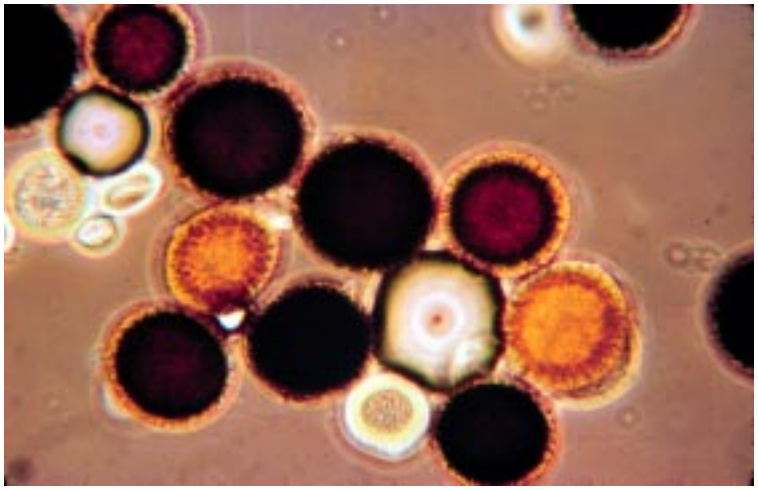

Figure1. Teliospores of *Tilletia indica*, 400x.

Karnal bunt produces black, thick-walled powdery spores (teliospores) which replace part, if not all, of the infected kernals and which are typical of smut fungi (Figure 1). These spores are the survival structures of the fungus. They are resistant to dry conditions, sunlight, and a wide range of temperatures, and most fungicides. Teliospores may survive as long as five years in soil. Dormant spores buried in soil on contaminated seed or free in soil can be brought to the surface by tillage operations over a period of several years. Temperatures which are favorable for emergence of wheat heads are also favorable for the germination of teliospores. Whenever moisture is available over a period of several weeks, teliospores on the soil surface germinate to produce small spores called primary sporidia. The primary sporidia are deposited on leaves or remain on the soil where they germinate to form a microscopic mass of fungal tissue which quickly produces secondary sporidia (Figure 2). These sporidia are ejected into the air and infect the tissue surrounding the developing seed. Sporidia are short-lived and require moisture for infection.

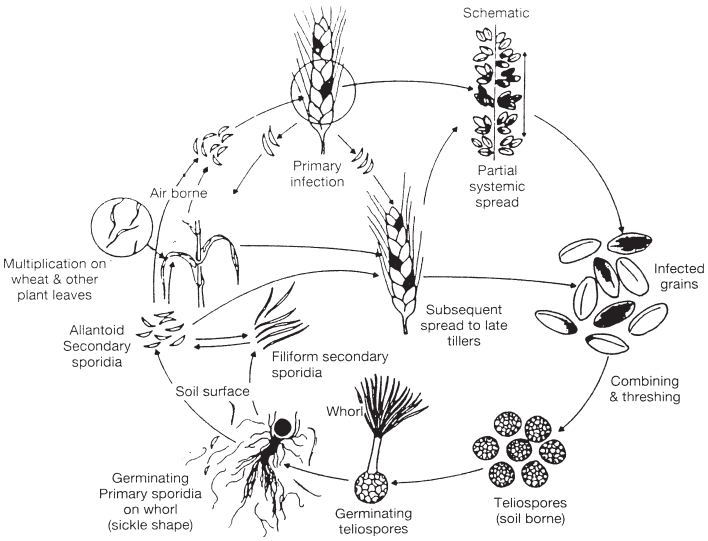

Figure 2. Disease cycle of Karnal bunt caused by *Tilletia indica*.

Because the infection process takes place over an extended period of time, varying degrees of Karnal bunt infection occur in developing seed (Figures 3 and 4). If infection begins just as the seed is forming, the entire seed is replaced by fungal teliospores. If infection occurs as the seed is maturing, only a small portion of the seed is infected and the seed can still germinate. This is the reason for the name partial bunt. Other smut fungi causing loose smut and stinking smut

Figures 3 and 4. Karnal bunt infected wheat seeds showing varying severities of disease.

invade the embryo or germinating seedling and subsequently destroy the entire seed head. Also, other smut fungi destroy all heads on a plant. The Karnal bunt fungus may invade only a few heads and only a few spikelets on an individual head (Figure 5). Because of this, the disease is difficult to detect in the field. The fungus may be present for several years and build up slowly before it is recognized.

Teliospores are airborne and easily disseminated during the harvesting process. Seed and soil in an entire field can be contaminated from a few bunted kernels during the harvesting process. Teliospores may be disseminated hundreds of miles or more by wind, but no precise information about long-distance dissemination is available.

Karnal bunt seldom causes significant economic losses to wheat in the field. Typically, the disease causes less than 1% loss. Karnal bunt affects flour quality only if more than 3% of the grain is diseased because, like the stinking smut fungus, it produces the compound trimethylamine which gives off a fishy odor. The fungus does not produce any toxic compounds in leaf and stem tissue or in the seed. Crop rotation, resistance, seed certification, and fungicides applied as seed treatments or as applications to wheat heads can be used to adequately manage the disease. However, these methods may not eliminate the disease. Because the disease is limited to only a few geographic areas, the major economic cost is due to bans on importation of grain into countries which do not have the disease from areas where Karnal bunt occurs. Currently 37 countries prohibit importation of seed contaminated with Karnal bunt. Many of these countries may accept grain produced in areas where Karnal bunt is not present. Therefore, the disease will potentially have a significant effect on US wheat exports. A problem in identifying the fungus on seed is that the teliospores of other smut fungi which infect rice and several common species of grasses are similar in size and shape to teliospores of *T. indica*. Recently, teliospores similiar in appearance to Karnal bunt have been found in ryegrass seed grown in Oregon. Tests are being conducted to determine if this is the same fungus which causes Karnal bunt on wheat. To determine if a "seed lot" is contaminated with teliospores, a sample of grain is collected at harvest. The seed is washed thoroughly in a solution which is centrifuged to concentrate spores into a few drops of liquid. This liquid is then examined under a microscope. If teliospores suspected to be *T. indica* are found, the sample is sent to USDA for verification by microscopic examination and analysis of fungal DNA by the polymerase chain reaction (PCR) method.

Figure 5. Karnal bunt infected wheat head.

An intensive survey of fields and wheat seedlots in Georgia and neighboring states will be conducted in 1997. Planting wheat in infested fields may be prevented for up to five years under current USDA guidelines. Regulatory measures, if needed, will be administered by the Georgia Department of Agriculture and USDA-APHIS. Further information about Karnal bunt can be found on the USDA Karnal bunt Internet homepage http://www.aphis.usda.gov/oa/bunt/kbhome.html and at http://www.scisoc.org.

PHOTO CREDITS:

Figure 1: Arizona Department of Agriculture in cooperation with USDA-APHIS-PPQ.

Figures 2, 3, and 4: S. B. Mathur and Barry M. Cunfer. 1993. Seed-borne Diseases and Seed Health Testing of Wheat. Danish Institute of Seed Pathology.

Figure 5: Arizona Department of Agriculture in cooperation with USDA-APHIS-PPQ.

For his review of this fact sheet, appreciation is expressed to:

Larry Hawkins
Regional Public Affairs Specialist
APHIS Legislative and Public Affairs
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FOR MORE INFORMATION CONTACT YOUR LOCAL COOPERATIVE EXTENSION OFFICE

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