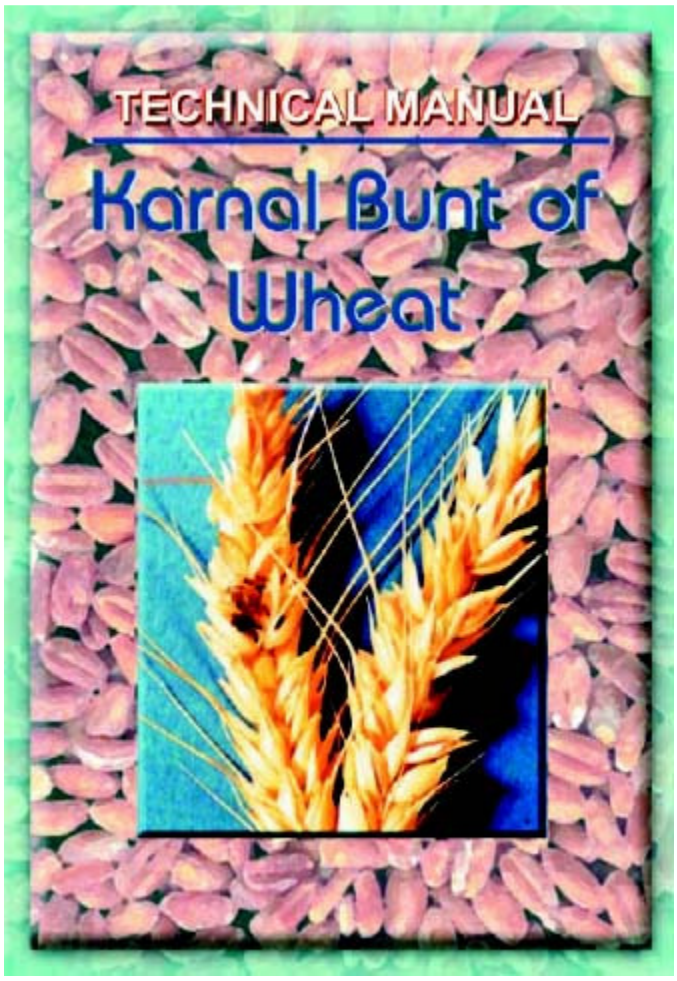


Compiled by Division Plant Health Promotion
Directorate Plant Health and Quality (DPHQ)
Department of Agriculture

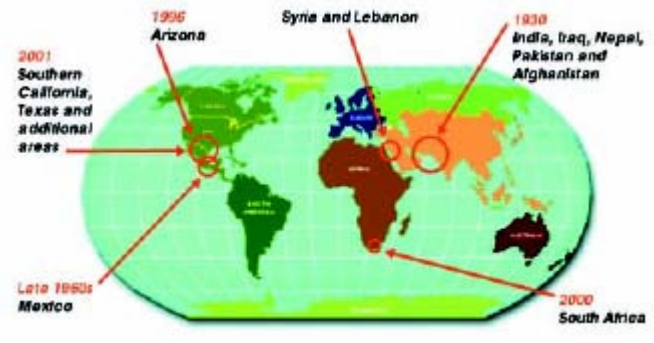
Introduction

The smut fungus Tilletia indica Mitra causes Karnal Bunt, also known as Indian Bunt or Partial Bunt of bread wheat, durum wheat and triticale. The disease is usually noticed only when the partly smutted and broken kernels are seen in threshed grain. Although infected wheat is not toxic to humans or animals, wheat grain containing more than 3% bunted kernels is generally considered unfit for human consumption. This is because the smut causes an unpleasant odour, colour and taste in wheat products.

Economic losses caused by the disease are mainly attributed to lower grain quality, therefore, as well as quarantine restrictions. Because most countries regulate the Karnal Bunt pathogen as a quarantine pest, it is imperative that effective control measures are implemented in South Africa to prevent disruption or losses in our international trade.

Distribution

Karnal Bunt was first discovered in 1930 near the town Karnal in northwest India. Since then, it has been identified in all the major wheat producing regions of India, Iraq, Nepal, Pakistan and Afghanistan. It has also been found in seed exported from Syria and Lebanon, and in the late 1960s it was introduced into Mexico. In the United States of America, the disease was first detected in 1996 in Arizona, and thereafter in Southern California and in Texas, where it has spread to additional areas in 2001. It was found in South Africa during December 2000 in the Herbert District near Douglas in the Northern Cape.



Biology

Tilletia indica infects its hosts at flowering. It replaces part or all of the seed with a spore mass that is identified as a black powder smelling like fish. This is made up of over- wintering propagules, or teliospores (Fig. 1). During harvesting and threshing, the teliospores are released from the infected wheat grains to contaminate seed and soil, where they may remain dormant for years.

Fig. 1. Teliospores of Tilletia indica (25- 45 µm) observed microscopically

Teliospores germinate whenever conditions are suitable. Each one can produce a short structure known as a promycelium, at the apex of which as many as 65- 185 primary sporidia may form. Secondary sporidia are produced from the mycelium (fungal threads) or by budding from the primary sporidia. Sporidia can be water- borne or wind- borne, and they infect the young wheat ears at the flowering stage of the host plant, for instance during wheat heading and floral development. Florets are infected directly through the young glumes and the ovary wall. This occurs when germ tubes from the sporidia penetrate

the epidermis of the glumes through the stomata and enter the developing wheat kernel. The fungus eventually ruptures the pericarp, producing large numbers of teliospores within infected kernels.

In diseased grain, the kernels may be partially or completely replaced by masses of black teliospores. At the time of harvest, the teliospores drop to the surface of the soil and the cycle repeats itself in the next year. Even if the levels of soilborne spores are high at flowering, however, Karnal Bunt will not infect wheat unless the environmental conditions are favourable. Accordingly, it is possible to have Karnal Bunt in an area and not detect its presence.

Karnal Bunt outbreaks are generally associated with average air temperatures ranging from 9.4 to 23.9º C, and optimal soil temperatures of between 17 and 21º C. Favourable conditions for disease development include cool, rainy weather or regular irrigation and high humidity at the time of heading. The severity of the disease can also increase when favourable temperatures occur during ear emergence. Irrigation contributes by increasing relative humidity levels.

Dispersal

Karnal Bunt is spread by means of its teliospores (Fig. 1). Besides being seed-borne (Fig. 2 and 3), these spores can be carried to new areas on anything they cling to, including plants and plant parts, clothes, farm equipment, tools and vehicles, such as combine harvesters.

Fig. 2. On the left is a healthy ear, and on the right is an infected ear with the infected area arrowed

They may also be dispersed by rain water and animals, including insects and birds, both as surface contaminants and through faeces. Spores can survive for many years in the soil, and wind can spread them over long distances, for instance in the updrafts of hot air caused by fire when the debris of infected wheat fields is burnt. Contaminated grain elevators and grain are important pathways.

Host range

Triticum aestivum (bread wheat) is the most common host of Tilletia indica, although the fungus also infects Triticum durum (durum wheat) and X Triticosecale sp. (triticale, a hybrid of wheat and rye).

Fig. 3. Ear with spikelet broken open to show bunted kernel within

Symptoms and identification

In the field

Disease symptoms are difficult to detect in the field because of the irregular distribution of infected kernels. If the weather in the production area has been favourable for disease development, one should be on the look out for bunt symptoms like fishy odours and black spore masses during harvesting. Besides this, infected plants may be dwarfed. Infected spikes may also be reduced in the number of spikelets and in length. It is best to first remove grain from the head before it is examined for bunt symptoms.

In the handling and grading process

The degree of bunting or damage can vary from a slight blackening at the tip of the kernel to complete erosion and hollowing out of the kernel (Fig. 4, 5). Bunted kernels are normally fragile, dark in colour and have a fishy odour. Cracks in the surface of the kernel reveal a black powdery spore mass at the embryo end or along the kernel groove (Fig. 6).

Fig. 4. Healthy grain left and infected grain right

Fig. 5. Varying degrees of bunting

Fig. 6. A severely bunted kernel

Identification

Karnal Bunt symptoms are difficult to detect and are sometimes confused with those of other wheat diseases. This means that the pathogen must be identified by observation and characterization of the teliospores with a compound microscope. It is imperative that suspect wheat samples be assessed by experts.

Important

Please contact the
Department of Agriculture
or the
Agricultural Research Council
immediately if you suspect
that you have found
Karnal Bunt!

Disease management

Seed that is free from Karnal Bunt should be used. This is important because seed treatments will only provide limited control of the disease if the seed is contaminated. Once the disease is known to occur, cultural practices that help to limit its spread can be implemented. These include scheduling irrigation to prevent conditions that favour disease development, as well as weed control and crop rotation. A foliar spray of triazole fungicides may be applied as a preventative measure in an area where Karnal Bunt is known to occur. CIMMYT (the International Wheat and Maize Research Programme) in Mexico recommends the use of propiconazole (T1H 250 EC) at 0.5 l/ ha as a foliar spray. A first spraying is done

at 25% heading and a second one 10 days later. Durum and barley are suitable alternative crops, since durum is resistant (though not immune) and barley is immune to Karnal Bunt. Machinery and farm equipment should be cleaned with pressurized water before leaving a Karnal Bunt area.

Phytosanitary measures

Because of its strict international quarantine status, Karnal Bunt is regarded as a serious disease. For this reason, the Department of Agriculture has implemented control measures in the affected areas to inhibit its spread. Furthermore, a National Karnal Bunt Survey is being undertaken to determine the precise locations of the disease in this country. The intention is to test all wheat that is produced in SA in order to monitor the situation and institute appropriate measures.

Official control measures, in terms of Section 6 of the Agricultural Pests Act of 1983, to ensure effective management and to limit the effect of the outbreak of Karnal Bunt, were published in the Government Gazette on 2001- 01- 22.

Conclusion

Yield losses due to Karnal Bunt are usually insignificant (0.3- 0.5%), even under epidemic conditions. Flour quality is affected, however, and grain with more than a 3% infection is considered unfit for human consumption due to changes in colour, odour and dough strength. Most importantly, Karnal Bunt has potentially serious phytosanitary implications for wheat production and agricultural trade in South Africa. To achieve effective management of this disease, it is vital for all role players in the wheat industry to cooperate fully.

Sources of information

For more information, or if you suspect that you have found Karnal Bunt, please contact:

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