Karnal bunt (also known as partial bunt) is a quarantine disease of wheat (*Triticum aestivum*), durum wheat (*T. durum*) and triticale (*x Triticosecale*). It is caused by the fungal pathogen *Tilletia indica*. The pathogen is not present in the UK or in any EU member state. However, it has been intercepted in grain imports from countries already known to have Karnal bunt. If the pathogen were to be introduced it could establish and cause serious damage in the UK.

**What is it?**

Karnal bunt ear showing an exposed seed infected with *Tilletia indica* (Karnal bunt): infected seeds are unlikely to be seen in the crop as they are usually hidden within the glumes.

*Photograph courtesy of M. Valvassori, ISPaVe, Italy.*

**Why the concern?**

Karnal bunt has the potential to reduce grain quality and marketability significantly; therefore quality bread-making wheat may become downgraded to feed, resulting in large financial losses for the producer. The loss in quality results from infected grain having an objectionable ‘rotting fish’ odour and taste, as do products made from the grain. This is due to the presence of trimethylamine. Reports of localised direct losses on yield vary from less than 1% to 20%.

An indirect effect of Karnal bunt is its potential to cause significant damage to export markets, since many countries regulate against *Tilletia indica*. Even where import of grain is permitted from countries where the pathogen occurs, the cost of inspection and testing for the exporting country to ensure freedom from the pathogen is considerable.
Beginning at the germ end of the seed, the Karnal bunt fungus spreads within the periderm layer of the seed. The infection may be limited to just the germinal end of the seed (point infection) or may spread along, and outwards from, the groove. The pathogen produces dark-coloured spores (teliospores) under the surface of the grain. Heavily infected grain often smells of rotting fish. However, this is not a feature unique to Karnal bunt as other bunt fungi also produce this smell, e.g. common bunt (*Tilletia tritici*).

During harvest and handling, the grain ruptures, disseminating the teliospores and leaving behind a grain that is broken or hollow at the germ end, or eroded along the groove.

The disease is not readily detected in the field since typically only a few grains in an ear become infected and infected grains are usually hidden within the glumes. Karnal bunt is more easily found when inspecting grain after harvest, either by visual inspection of a seed sample or, more reliably, by conducting a seed wash test for teliospores in the laboratory.

Symptoms of Karnal bunt on wheat can be confused with two other diseases of the grain, namely common bunt (*Tilletia tritici*), and black point (mainly *Alternaria* species). Confirmation requires laboratory testing.
Where is it found?

The disease was first formally reported on wheat in the Karnal district of northern India in 1930. Since then it has also become established in northern and central India where relatively low temperatures and high humidity prevail during the infection period around ear emergence. It has become established in other parts of Asia including Pakistan, Afghanistan, Nepal, Iraq and (since 1996) Iran. It was first confirmed outside of Asia in 1969-70 in the state of Sonora, Mexico, and is now also found there in the states of Sinaloa and Baja California Sur. More recently, in 1996, the disease was reported from areas within the following southern and eastern states of the USA: Arizona; a small area of California; and Texas (where it appears to have since spread northwards). Parts of these states are subject to regulatory controls against the disease, enforced by the Animal and Plant Health Inspection Service (APHIS) of the United States Department of Agriculture (USDA).

The first report of the disease in South Africa occurred in Douglas in 2000 and by the end of 2004 it was reported to be present in Douglas, Herbert, Hopetown, Koffiefontein and Prieska.

How does it develop and spread?

The cycle of disease starts when infected seed is harvested. The mechanical action of harvesting causes infected grains to rupture, liberating the resting spores (teliospores) of the fungus from the infected grains. The teliospores fall to the ground, together with infected or contaminated seed shed during harvest. Teliospores can survive in the soil for at least 5 years, or in/on stored seed for longer periods.

Teliospores in contaminated or infected feed (grain, or bran from milled grain) can survive ingestion by animals, so the faeces of stock fed on such feed is also a source of inoculum for infecting susceptible crops.

Given relatively cool and moist conditions, teliospores on or near the soil surface germinate to produce numerous spores called basidiospores (primary sporidia). These non-infective basidiospores are dispersed by rain-splash and germinate on plant surfaces, or other surfaces, to produce superficial colonies. These superficial colonies produce secondary sporidia which are dispersed to...
produce further epiphytic colonies. When teliospore germination and sporidial production coincides with the ear emergence period of a susceptible cereal crop, air currents and water-splash can disperse the infective spores (secondary sporidia) onto the upper leaves and ultimately to the florets of the emerging ear.

In cool wet conditions, the sporidia germinate, invade the floret tissues and then enter the developing grain to produce a mass of black teliospores within the seed. When these teliospores are liberated at harvest onto the soil surface, or dispersed on or in the grain, the cycle begins again.

What is being done in the UK?

The most likely source of inoculum is infected or contaminated seed or grain of wheat, durum wheat, or triticale from areas where the pathogen is known to occur.

EC and UK Plant Health legislation requires that seed of wheat, rye (now no longer considered a natural host) and triticale must originate from an area where *T. indica* is known not to occur. Imported grain for feed or milling must either come from an area where *T. indica* is known not to occur, or the grain has been found free from the pathogen during visual crop inspection and in post-harvest and pre-shipment testing of the grain for the pathogen.

In order to ensure that these requirements are being met all imported grain and seed from countries where this pathogen occurs is being sampled by the Plant Health and Seeds Inspectorate (PHSI) and tested for the presence of *T. indica* at Defra’s Central Science Laboratory (CSL).

Keep a good look out

*Tilletia indica* is a notifiable pathogen resulting in statutory action to prevent its introduction and spread. It is difficult to control in areas where it is currently established. It is not present in the EU and the aim is to avoid its entry and establishment in the UK or other EU Member States. In order to achieve this, vigilance is necessary.

If you suspect the presence of this disease, you should immediately inform your local Defra Plant Health and Seeds Inspector or:

PHSI HQ, York
Tel: 01904 455174
Fax: 01904 455197
Email: planthealth.info@defra.gsi.gov.uk
web: www.defra.gov.uk/planth/ph.htm