Ergot in cereals

Importance
Ergot is caused by the fungus, *Claviceps purpurea*. Although it can reduce the yields of crops, more serious problems occur when grain contaminated with ergot is eaten, either in its natural state (animals grazing) or after processing (baked cereal products or animal feed).

Ergot sclerotia contain significant levels of toxic alkaloids (mycotoxins). These have a number of harmful effects on humans and other mammals, including effects on the circulatory system and neurotransmission.

The increased scientific understanding and improvements in agricultural practices and milling techniques (grading, sieving and sorting) have eliminated the severe epidemic outbreaks of ergotism in the UK.

Crops affected
All cereals are susceptible. In order of decreasing susceptibility:
- rye
- triticale
- wheat
- barley
- oats

Ergot is also relatively common in wild grasses throughout the UK.

Legislative and contractual levels
Maximum levels for ergot sclerotia are currently defined for both intervention and within the Codex standards at a level of 0.05% (for human consumption).

In 2013, the European Commission (EC) started to consider setting maximum ergot levels for all traded grain. This is likely to be at the current intervention level, although it is not certain whether separate levels will be set for rye and other cereals.

In addition to setting maximum levels for sclerotia, the EC may also identify maximum levels for ergot alkaloids. These are unlikely to be adopted, however, until there is a ‘rapid method’ for testing.

Buyers of grain may set contractual levels for the number of ergot sclerotia accepted in traded grain. Most processors of grain for human consumption will reject loads if any sclerotia are seen. Some may offer a reduced price based on the time and effort required to clean the grain.

Latest information
- There is currently no EU legislation for maximum levels of ergot alkaloids but there are discussions in the European Food Safety Authority (EFSA) that may result in future legislative limits.
- Agricultural Industries Confederation (AIC) standards are 0.001% ergot by weight for feed grain and zero tolerance for all other grain.
- Buyers either reject contaminated grain or offer a reduced price.

Action
- Control grass weeds, especially black-grass.
- In heavily infected areas, harvest field headlands and tramlines separately from the bulk of the crop.
- Plant a non-cereal crop or plough to ensure ergots are buried to at least 5 cm depth.
- Avoid varieties with a long flowering period in high-risk situations.
- Avoid sowing contaminated seed. Clean farm-saved seed thoroughly to remove ergot.

Always consider your local conditions and consult a professional agronomist if necessary.
Symptoms and life cycle

The classic symptom of ergot contamination is the presence of hard black sclerotia growing out of the grain sites within the ear (Figure 1).

The life cycle (Figure 2) starts in the autumn when ergot sclerotia lay on or close to the soil surface, either from the previous crop where they have fallen out of the ear at harvest or from sowing contaminated seed.

In the spring, the sclerotia germinate, producing mushroom-like fruiting bodies that release wind-dispersed ascospores that infect the host crop (grasses/cereals) during flowering.

The spores infect the ovary, producing a second spore type (conidiospores) released in copious amounts in a sweet-smelling, sticky exudate known as ‘honeydew’ (Figure 3), which can cause secondary infection by physical contact between ears, rain-splash or insect spread.

The fungus then grows in place of the grain to form the visible ergot, completing the life cycle.

Ergots are either harvested with the grain or fall to the ground where they remain as a source of inoculum for the following year.

Generally, ergots only remain viable on the soil surface for one year but they may survive longer in stored grain.

Figure 1. Ergot in rye.

Figure 3. Honeydew.
Risk factors
Weather during flowering
Cool, wet conditions during flowering favour infection by prolonging the flowering period. Variable weather at flowering can explain some of the year-to-year fluctuations in ergot severity.

Black-grass
Black-grass is an important source of inoculum as it flowers earlier than the main cereal crop, allowing a buildup of inoculum (honeydew phase) that can be readily transferred during the cereal flowering period.

Varieties
There are no current varieties that have resistance to ergot infection. Varieties that have a longer or more open flowering habit will be more susceptible to infection due to easier access of spores able to infect the floret. Susceptibility to ergot infection persists for only a few days after fertilisation, after which point the ear becomes resistant to further infection.

Grass margins
While it was thought that the increase in field margins could lead to an increase in inoculum build-up and subsequent infection of cereal crops, HGCA-funded research found no significant impact (PR456). However, grass margins do still pose a small risk by providing a reservoir of secondary inoculum that could infect wheat, particularly late tillers around the edge of the crop.

Prevention and control
Variety
While there are no cereal varieties with resistance to ergot infection, there are varieties that are more susceptible.

Infection risk is greatest for varieties with flowers that gape open wide during flowering. Florets that remain closed during pollination and for a few days afterwards provide a mechanical barrier to the entrance of spores and are more likely to escape infection.

While it has been previously investigated (PR456 and PR457), there is no system within the HGCA Recommended Lists to reliably score the openness of flowering and link this positively to reduced infection risk.

Historically, some varieties, for example, Rialto, Xi19, Mascot, Solstice, Gatsby, Dover, Tommi, Timber and Ochre, have been considered to be more susceptible.

The development of true tissue resistance continues to be an area for further research by the plant breeding community.

Fungicides
There are currently no fungicide sprays approved for use on cereals to control ergot infection.

Previous HGCA-funded work (PR254) using radio-labelled fungicides detected negligible movement of foliar-applied fungicides to the point source of infection, the ovary. This is not surprising as it would be undesirable to have products that could migrate into the grain.

Some azole-based seed treatments are recommended for ergot control and act by reducing fungal growth and development of the ergot. They do not provide complete control of germinating ergots and should be used in conjunction with other management options to reduce the risk of infection.

Grass weeds
Controlling grass weeds, especially black-grass, which have a key role in providing an early source of inoculum build-up, is important in minimising the risk of fungal spores available for secondary spread. Similarly, the risk of secondary infection from field margins can be minimised by sowing later-flowering grass species.

There are some grass species that pose a greater threat to cereal crops due to their ease of infection and flowering time, for example, cock’s-foot, couch grass, timothy, tall fescue and tall oat grass. It may be worth avoiding these species in grass margins, particularly in areas that have a history of ergot susceptibility.
**Husbandry**

Good crop husbandry continues to be the most reliable method of reducing the risk of ergot infection. In heavily infected crops, harvesting the field headlands and tramlines (where later tillers prevail) separately from the bulk of the crop will reduce contamination of the main crop. As ergots only remain viable for one year in soil, sowing a non-cereal crop or ploughing to ensure ergots are buried to at least 5 cm depth will reduce the amount of inoculum available in the next cereal crop.

Any susceptible grass weeds should also be controlled to get the full benefit of these practices. Keeping an accurate record of where ergot infection has been most prevalent on farm will help assist in future decisions on rotations. Sowing clean seed will prevent planting inoculum in the new crop.

To prevent ergot poisoning in animals, they should not be grazed on ergot-infected pasture or be fed ergot contaminated grain.

**Cleaning procedures**

In severe years and where there has been a poor level of control, the harvested grain can be cleaned. This can either be by a mobile cleaner on farm or by the trader/processor by prior agreement after delivery. The latter may result in a reduction of the price paid.

Several ‘cleaning’ methods may be used, including gravity separation with or without an air screen cleaner and mechanical sieves that remove foreign bodies on the basis of size. Sieves may be less effective where whole ergots or ergot fragments are the same size as the grain.

More recently, effective colour sorting systems have become available but are used mainly by processors and within central stores.

Grain in a colour sorter.

**Further information**

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IS30: Black-grass: solutions to the problem (HGCA, 2014)

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HGCA Project Report 456: Towards a sustainable whole-farm approach to the control of ergot (HGCA, 2009)

HGCA Project Report 254: Laboratory and field testing of fungicides for control of ergot in wheat and rye (HGCA, 2001)

HGCA Project Report 126: Screening of fungicides for the control of ergot (Claviceps purpurea) (HGCA, 1996)

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