# Best Practice Guide to Ergot Management

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## PollenPlus<sup>®</sup> Hybrid Rye

Pollen PLUS **KWS** SEEDING THE FUTURE **SINCE 1856** 



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# Ergot

## Ergot is a fungal disease affecting common cereals including rye.

- The ergot fungus (*Claviceps purpurea*) is spread via spores.
   These spores infect the floret of both common grasses and cereal ears during flowering.
- Species differ in their flowering biology. Barley normally flowers as ears emerge giving little opportunity for ergot ingress.
   Wheat has a similarly quick flowering period, self-fertilizing just after ears fully emerge.
- Rye has a more open flowering biology and greater reliance on pollen transfer.
- Ergot can still be a significant issue in wheat and barley if there have been natural or man-made stresses on the plant which lead to poor pollen production or sterility. The plants natural response is to open the flower to receive pollen from elsewhere.



Early infection can be observed as droplets of honeydew that contain fungal spores.

- Honeydew is attractive to aphids and other insects which act as a vector for secondary infection.
- Later infection is indicated by hard, purple-black sclerotia or 'ergots'.
- Ergot sclerotia contain dormant fungus which can remain viable in the soil for up to one year.

# Regulation

## Regulation of ergot is an important step in the process of protecting feed and food safety.

These regulations cover both elements of the disease – firstly the presence of **ergot sclerotia**, and second the presence of **ergot alkaloids**.

#### **Ergot sclerotia**

- Physical ergot pieces found in the grain sample indicate a contamination.
- Grain must be cleaned before it is deemed acceptable.
- Individual sclerotia contain around 1,800,000 ppb alkaloid\*.
- Excess handing of grain will cause sclerotia breakage leading to a risk of alkaloid contamination.



\*Source AHDB

#### **Ergot alkaloids**

- A rapid test is available for alkaloids in the grain sample.
- Future regulation is likely to specify maximum limits in processed cereal food products.
- Therefore avoiding the presence of ergot sclerotia, or sclerotia breakage during cleaning will directly reduce alkaloid levels.



# **Risk Factors & Management**

## It is key to take a proactive approach to prevent ergot infection.

- Foliar fungicides do not give commercially acceptable levels of control. Source: AHDB PR245
- Cold winter weather followed by wet summers, specifically high rainfall at flowering can contribute to higher ergot pressure.
- Agronomic management combined with the selection of high pollen shedding cultivars ensures ergot is effectively managed.



#### Influences of ergot spread and contamination

High pollen shed dramatically increases the rate of fertilization, providing effective protection against ergot.

Breeders can select parent restorer lines that maximize pollen shed; a vital requirement in modern day CMS hybrid rye breeding.

Viktor Korzun, Global Lead Scientific Affairs, KWS SAAT SE & Co. KGaA

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Risk Factors	Management
Grass weed pressure (blackgrass, ryegrass)	<ul> <li>Aim to reduce weed burdens e.g. crop rotation, herbicide, cultivation technique.</li> <li>Adopt a long-term strategy to reduce the grass weed seed bank.</li> <li>Consider rotational ploughing.</li> <li>Adopt a mixture of winter and spring cropping.</li> </ul>
Grass margins	<ul> <li>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, AHDB research found no significant impact. (Ref. Report PR456)</li> <li>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.</li> <li>This risk can be minimised by sowing later-flowering grass species. Some grass species such as, cocksfoot, couch grass, timothy, tall fescue and tall oat grass pose a greater threat to cereal crops due to their ease of infection and flowering time. (Source: AHDB)</li> </ul>
Infected seed	<ul> <li>Avoid farm saved conventional seed or illegal farm saved hybrid seed.</li> <li>Purchase certified seed each season.</li> </ul>
Minimum or zero tillage	<ul> <li>Shallow or direct drilling can pose an issue if sclerotia are present as they will readily germinate the following spring. Ideally sclerotia would be buried to a depth of 5-7cm.</li> </ul>



Use wide tramlines to eliminate back tillers to avoid unsynchronised flowering.



By applying T2 fungicides ahead of flowering, physical crop damage to the ears can be avoided – thus directly reducing ergot risk further.

Risk Factors	Management
Continuous rye	<ul> <li>Ensure no more than 2 rye crops are grown in succession.</li> <li>Avoid rye volunteers in subsequent rye crops, as a shallow germinating seed volunteers should be controlled using 'light' stale seedbed techniques.</li> </ul>
Unsynchronised flowering	<ul> <li>Use wide tramlines to eliminate back tillers.</li> <li>Drill at the optimum depth of 2 – 3 cm to promote uniform establishment + flowering.</li> <li>Avoid damaging established crops by keeping spring traffic, after GS31-33, to a minimum (e.g. slurry application with wide tyres).</li> </ul>
Physical damage of the crop at flowering	<ul> <li>Traveling through the crop at flowering could increase ear damage and ergot risk.</li> <li>T3 fungicides are normally applied at flowering, however the fusarium risk in rye is much lower compared to wheat. As such a fusarium application is generally not required. For specific site/season requirements, we recommend chemistry that does not have growth regulatory effects if applied at flowering.</li> <li>Strong brown rust resistance helps to reduce the requirement for fungicide inputs at flowering, and growers are advised to use a robust T2 application ahead of flowering.</li> <li>If brown rust pressure is high, many fungicides have label timings up to the milky ripe stage of grain fill, after pollination is complete.</li> </ul>

# Other sources of UK technical information

## Rye for grain production has until recently only been grown for specialist contracts including for Jordans Ryvita.

Rosemary Hall, Independent Technical Consultant at Crop Research Services has been leading rye agronomy research for Jordans Ryvita, and can be considered a leading knowledge on rye growing in the UK.

We asked Rosemary for her thoughts around ways to practically reduce ergot risks.

- Avoid rye after rye where possible; If sequential cropping is planned ploughing is strongly advised to ensure sclerotia burial.
- Sclerotia can survive in the soil for up to a year in the right conditions. Do not assume sclerotia will disappear on every occasion.
- Avoid growing rye after other susceptible crops such as spring barley. Where
  ergot infections have occurred in spring barley, adapt the rotation or plough.



Rye after rye (plough situation)



Rye after rye (min till situation)



Rye after spring barley

- Liquid fertiliser: Avoid applying liquid fertiliser directly behind the sprayer wheels.
   This will help to avoid secondary tillers which are at greater risk of ergot infection.
- Field selection: Fields close to water sources, generally sit wetter/damper throughout the season, and are at higher risk than fields positioned away from water sources. Field selection may be limited (eg; due to rotation) therefore other actions to reduce ergot must be implemented.
- Crop Establishment: In 2016, ergot levels were much higher where rye had not established well, leaving thin or bare areas particularly on headlands and within tramlines. The increased ergot levels in these areas was due to the spores being able to easily infect the grain sites due to lack of pollen in the crop.
- Micronutrients: Boron and Copper are key for fertility. Previous work has found no conclusive results however, any potential for trace element deficiency should be corrected.
- Cleaning: Consider the ability to clean grain on farm, and practical implications, should ergot be present.



# Breeding

- PollenPlus<sup>®</sup> KWS recently filed an 'ergot' patent in hybrid rye.
- The enhanced restorer gene Rfp1 used in hybrid rye to produce large quantities of pollen is now secured. By producing pollen in such large quantities, it improves the rate of fertilisation thereby providing effective protection against ergot.



 The gene originates from an old Iranian rye landrace. The latter gives only very low yields, but is of great value as a genetic resource because it contains the powerful Rfp1 gene.



#### **PollenPlus®**

The amount of pollen released by a competitor Hybrid (left) v. A PollenPlus® hybrid (right)

Learn more about the 2017 patent on the KWS website.



Ergot contamination (AKS) in Hybrid Rye (%)

Source: Trial from Flakkebjerg (DK) with artificial infection of powdery mildew. In the experiment, the number of ergot particles has been assessed out of 100 in two repetitions. 7/7 (1st assessment) and 10/7 (2nd assessment), respectively. Source: www.landbrugsinfo.dk (2019)



#### The benefit of PollenPlus®

(On the left) is KWS Magnifico (100% F1 hybrid with PollenPlus®), compared with (right) SU Mephisto (90% Hybrid) + Dukato (10% Population).

Source: KWS 2012



**Farmer experience** David Lord - Earls Hall Farm, Clacton on Sea.

## Ergot is the curse of rye, but since moving to a fully hybrid variety this has become less of a concern.

We moved to KWS Bono a few years ago partly for the higher yield potential, but also because the higher quantities of pollen these PollenPlus® varieties produce means there is a far lower risk of ergot infection occurring.

It's not completely risk-free, but with milling wheat on the farm too we need to be proactive and PollenPlus<sup>®</sup> varieties have helped greatly.

# Conclusions

- Ergot management should be proactive.
- Total resistance is not available in any region of the world, as such proactive crop management implementing all cultural control measures will be the key to minimising ergot risks.
- Modern day genetics allow rye to 'escape' the risk of ergot contamination via surplus pollen production, when combined with correct agronomic practice.
- KWS believe the investment in 100% F1 PollenPlus® hybrids allows for maximum ergot resistance and yield performance, benefiting both farmers and end users now and in the future.



For more information please contact the KWS team!

### **KWS UK LIMITED**

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