

# Seed production and certification

## Certified seed

All seed bought and sold in the UK must be certified. Barley quality standards (including varietal and species purity, germination, loose smut and ergot) are prescribed in Cereal Seed Regulations issued by the four UK governments within the EU-wide framework.

EU member countries can prescribe stricter standards than the EU minimum. Thus the UK sets a Higher Voluntary Standard (HVS) with higher standards for varietal and species purity, ergot and loose smut. HVS seed is sold at a premium.

Seed can be certified at various stages as a variety is commercialised. Second generation certified seed (C2) is the category normally bought for commercial production.

## Certification and seed-borne disease

The Cereal Seed Regulations state: "Harmful organisms which reduce the usefulness of the seed shall be at the lowest possible level". Standards exist for loose smut and ergot contamination but none for leaf stripe, net blotch, covered smut, or seedling blights that are seed-borne. Although not a requirement, most certified seed is treated. The diseases controlled depend on the treatment.

## Farm-saved seed

Quality seed can be grown and processed on farm. The aim should be to meet at least the minimum certified seed standards. Static units or mobile contractors can process seed on farm. Alternatively it can be processed off farm.

### Note, by law farm-saved seed cannot be sold, shared or bartered.

Farmers must declare any use of farm-saved seed to the British Society of Plant Breeders (BSPB). All varieties are eligible for farm-saved seed payment. This must be paid via a registered processor or directly to BSPB. Payments for zero-rated varieties will be refunded immediately.

## Organic seed production

Organic certified seed must meet the same quality standards as conventionally produced seed. No conventional seed treatments should be used on organic certified or farm-saved seed. All seed considered for organic production should be tested for germination and seed-borne diseases.



# Seed sampling, testing and treatment

## Seed sampling and testing

By law, seed must be officially sampled and tested before it can be certified. Sampling and testing are also important for grain intended for farm-saved seed.

### Sampling

- Sample grain before cleaning or drying; ideally with a single or multi-chamber stick sampler.
- Wash equipment with water and detergent, before and between lots, where there is a risk of covered smut contamination.
- Keep grain intended for sowing separate from larger grain bulks.
- Only use seed from one field to reduce variability within a seed lot.
- Subdivide seed lots over 30 tonnes into smaller lots.
- Sample across the bulk, or trailer, at different depths (see table below for number of samples required).
- Thoroughly mix all samples from a lot in a clean bucket; divide to create a composite sample for testing.

Alternatively, consider employing a trained agronomist to undertake sampling.

## Germination testing

Low germination, due to disease, sprouting, drying, mechanical or chemical damage, is a major cause of poor quality in UK seed. Where time is limited the tetrazolium test (TZ) is recommended. However, this does not detect chemical damage and could over-estimate germination after pre-harvest glyphosate.

## Seed health testing

- Never sow untreated seed without testing for seed-borne diseases, particularly loose smut, leaf stripe and net blotch (where not previously present).
- Test for ergot, covered smut, and *Fusarium graminearum* if a problem is suspected.
- Test for seedling blights if seedbeds potentially cold.

Regulatory standards and advisory thresholds				Regulatory <b>S</b> Standard <b>A</b> dvisory threshold
Disease	Method	Duration	Results given as	
Loose smut <i>Ustilago nuda</i> f.sp. <i>hordei</i>	Embryo extraction	48 hours	% infection in 1000 embryos (advisory) or 2000 (certification) embryos	Maximum infection: <b>AS</b> 0.5% – minimum standard <b>S</b> 0.2% – HVS
Leaf stripe <i>Pyrenophora graminea</i>	Agar plate Molecular	7–10 days 48 hours	% infection Presence/Absence	<b>A</b> Treat if over 2% <b>A</b> Treat if present
Net blotch <i>Pyrenophora teres</i> f. sp. <i>teres</i>	Agar plate Molecular	7–10 days 48 hours	% infection % infection	<b>A</b> Treat if over 10%
Ergot <i>Claviceps purpurea</i>	Visual 500g or 1000g search	24 hours	Number of pieces in 500g or 100g	Maximum pieces: <b>AS</b> 3 pieces/500g – minimum standard <b>S</b> 1 piece/1000g – HVS
Covered smut <i>Ustilago hordei</i>	Wash	24 hours	Spores/seed	<b>A</b> Treat if present
Seedling blights <i>Microdochium nivale</i> <i>Fusarium graminearum</i> <i>Cochliobolus sativus</i>	Agar plate Agar plate Agar plate	7–10 days 7–10 days 7–10 days	% infection % infection % infection	<b>A</b> Treat if over 30% <b>A</b> Treat if over 10% <b>A</b> Treat if over 30%

### Primary samples required for given lot sizes

Lot size (tonnes)	Primary samples required
<5	Treat as not economic to test
5	10
10	20
20–30	40

# Seed-borne diseases

## Loose smut

– *Ustilago nuda*

### Symptoms

Loose smut is easily recognised as the ear is usually completely replaced by black fungal spores. Sometimes ears are partly-affected. Spores are released as the ear emerges, leaving a bare ear rachis with total grain loss. As blackened ears are so obvious the disease can appear severe, even at very low incidence.

### Importance

The disease is well controlled in certified seed stocks but relatively common in farm-saved seed. Incidence varies between seasons and cultivars. High levels are associated with increasing areas of susceptible varieties and inappropriate seed treatment choice.

### Life cycle

The fungus is present inside the seed embryo. When seed germinates, the fungus grows within the plant and infects the ear at an early development stage. Eventually spikelets are replaced with masses of fungal spores which are released at ear emergence. Spores spread by wind to nearby open flowers and infect developing grain sites on healthy plants. The fungus lies dormant within the embryo of the seed until the seeds are sown.

### Risk factors

Weather conditions during flowering influence how long florets remain open and hence susceptibility to infection. Cool, moist conditions pose a higher risk.

Most loose smut inoculum originates within diseased crops; however spread from neighbouring crops can significantly reduce seed quality.

Seed repeatedly sown without a systemic fungicide seed treatment poses a risk.

## Leaf stripe

– *Pyrenophora graminea*

### Symptoms

Successive leaves on infected plants show long narrow stripes, often pale green at first, becoming yellow and dark brown. Stripes are first seen on seedling leaves. Some leaves split along the stripes giving a shredded appearance. The first symptoms may be sudden yellowing of plants as the flag leaf emerges. Leaf stripe reduces plant efficiency by reducing green area. It can result in ear blindness, ie no harvestable grain.

### Importance

Relatively rare in the UK but potentially serious, causing yield loss and reducing grain quality. It can multiply significantly if seed is saved and re-sown without treatment.

### Life cycle

The fungus is present in the seed coat and on the seed surface. As seedlings start to grow, the fungus invades the coleoptile, penetrating to the first leaf. The fungus grows through successive leaf sheaths, producing the characteristic symptoms on each leaf until it infects the ear, which often remains in the leaf sheath.

Spores produced on infected leaves are spread by wind to developing seeds. The seed is susceptible to infection from anthesis through to soft dough.

### Risk factors

- Seed repeatedly sown without a fungicide seed treatment.
- Conditions that slow germination (eg cold, overcompacted or waterlogged seedbeds) increase seedling transmission.

## Covered smut

– *Ustilago hordei*

### Symptoms

The disease is not obvious until ear emergence when infected grains are replaced by a mass of black fungal spores. Partially affected ears are common. Infected grains appear to be covered in a thin transparent membrane which is easily broken.

### Importance

The disease is rare in UK barley but can be found in crops grown repeatedly from untreated seed. There is normally a total loss of grain from affected plants.

### Life cycle

Spores present on seed surface or in soil infect via the coleoptile and first leaf as seedlings emerge. The mycelium develops within growing points and colonises developing ears. When the ear emerges it contains a massive amount of black spores held within a transparent membrane.

The disease cycle is completed at harvest when smutted heads are threshed releasing spores on to soil or seed. The membrane covering spores generally prevents release until harvest.

### Risk factors

- Seed repeatedly sown without a fungicide.
- Soil-borne infection.

## Seedling blights

- *Microdochium nivale*
- *Fusarium graminearum*

### Symptoms

The most common symptom of a serious attack is poor plant establishment. Other symptoms include brown lesions on stem base, leaf blotch and ear blight.

### Importance

Unlike wheat, poor seedling establishment in barley due to *Microdochium nivale* is rare. Very high infection levels may cause seedling blight when seed is sown in cold seedbeds. Losses are not as high as those seen for wheat. *Fusarium graminearum* has the potential to cause seedling losses in barley but is currently rare.

### Life cycle

Inoculum is mainly found on crop debris (*F. graminearum*), and soil (*M. nivale*) or from seed infection. The resultant seedling blight or stem-base browning releases spores which are splashed up the plant ultimately infecting the ear.

### Risk factors

- High level of seed infection.
- Untreated seed or seed without appropriate treatment.
- *M. nivale*: early sown spring barley.
- *F. graminearum*: maize in the rotation.



The barley disease management guide 2009

## Seedling blight, foot rot and leaf spot

- *Cochliobolus sativus*

### Symptoms

Early symptoms include brown roots and coleoptiles which can cause seedling blight but more usually infected plants grow to maturity. Affected plants show brown spotting on lower leaves. Severe infections can cause stem-base rotting and poorly-filled ears.

### Importance

*Cochliobolus sativus* is traditionally a disease of hotter climates than that of the UK but seedling losses and leaf spotting can occasionally occur.

The disease is rare on winter barley but is more often recorded on spring barley. Some varieties are more susceptible than others. Infections tend to be higher in organic compared to conventional systems.

### Life cycle

The soil and seed-borne fungus survives on debris and grass weeds. It sometimes causes seedling blight. More usually it infects roots but the plant survives. Leaf spotting and stem-base infections produce splash-borne spores to infect seed in ears.

### Risk factors

- Any factors that slow germination and emergence.
- Poor seedbeds.
- Extended periods of warm, moist weather.

## Net blotch

- *Pyrenophora teres f.sp.teres*
- *Pyrenophora teres f.sp.maculata* (spot form)

### Symptoms

Symptoms can be similar to leaf stripe infection in emerging crops – the first leaf has a single stripe extending the full length of the leaf. Later leaves develop more characteristic lesions.

### Importance

Seed-borne inoculum is usually much less important than infected stubble, though infected seed can start early foliar epidemics which may damage yield.

### Risk factors

- High level of seed infection.
- Varietal susceptibility.

## Ramularia leaf spot

- *Ramularia collo-cygni*

### Symptoms

Ramularia shows no visible symptoms at the seedling stage. Identification within seed and leaves requires molecular diagnostics. Symptoms occur when leaves are stressed. Square brown lesions develop on the middle or tips of leaves, surrounded by a yellow halo, on both sides of the leaf. Symptoms are similar to the spot form of net blotch, but the rectangular shape is typical of ramularia leaf spot.

### Importance

Seed-borne inoculum is considered a major disease source.

### Risk factors

- High level of seed infection.
- Varietal susceptibility.
- Wet weather at flowering.

# Rhynchosporium

## – *Rhynchosporium secalis*

### Symptoms

Rhynchosporium colonises seed tissues and can be detected by molecular and other methods. Under favourable conditions, it can be transmitted from infected seed to seedlings. Typical symptoms on leaves are pale water-soaked lesions that develop into typical brown necrotic patches with dark margins.

### Importance

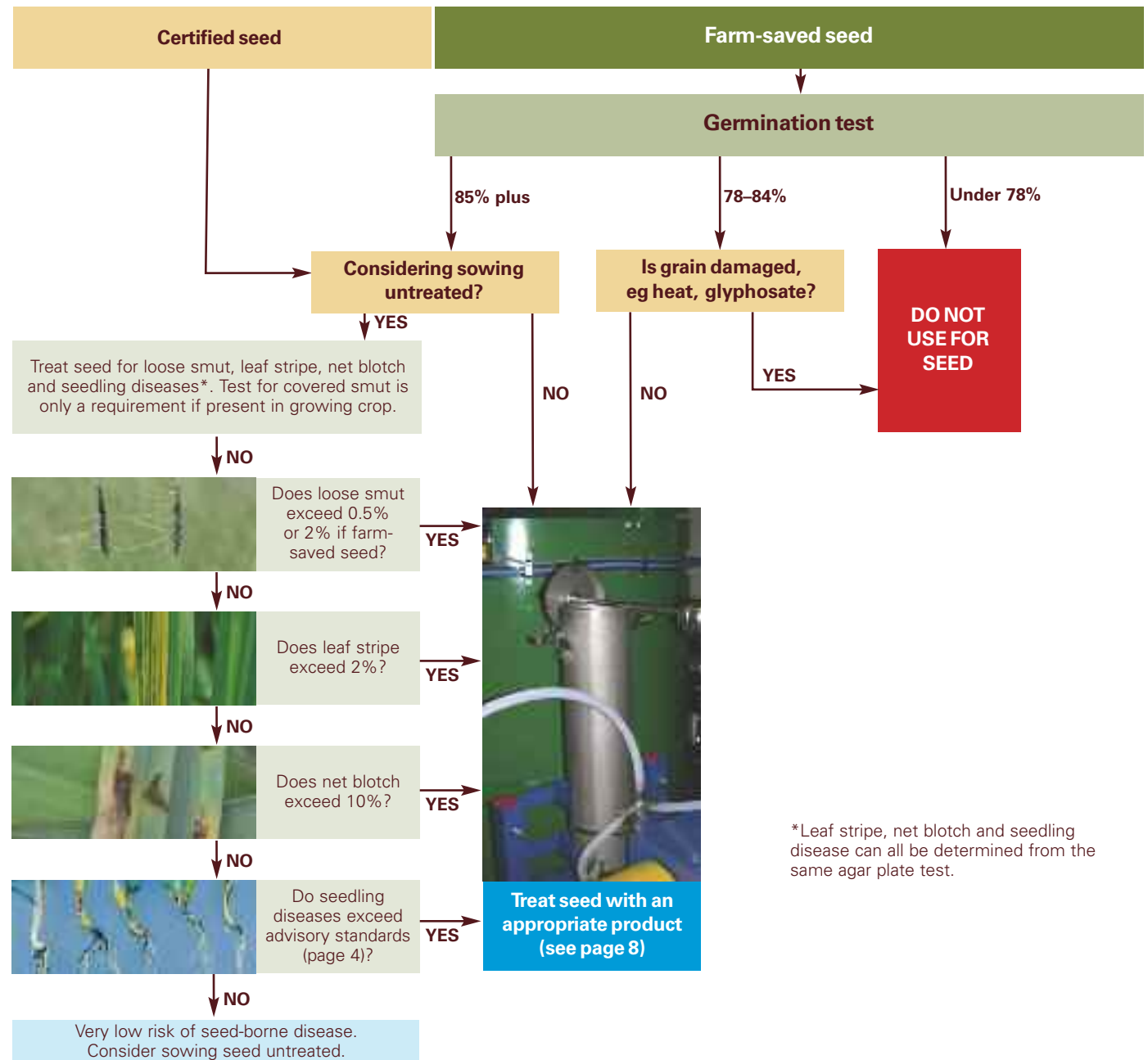
Seed-borne inoculum can contribute to the start of epidemics. Yield loss is associated with severe symptoms on upper leaves.

### Risk factors

- Varietal susceptibility.
- Wet weather from flowering onwards.
- Proximity to debris from previous barley crops.

See also page 12.

# Seed treatment – To treat or not to treat



\*Leaf stripe, net blotch and seedling disease can all be determined from the same agar plate test.

# Seed treatment – Options

Active ingredient	Product	Barley	Diseases							Pests				
			loose smut	leaf stripe	covered smut	seedling blight	net blotch	snow mould	take-all	leaf hoppers	slugs	virus vectors	wire-worm	wheat bulb fly
carboxin, thiram	Anchor Chemtura	spring	✓	✓	✓	✓	✓							
carboxin, thiram	Anchor Chemtura	winter	✓	✓	✓	✓								
clothianidin	Deter Bayer	winter								✓	✓	✓	✓	
clothianidin, prothioconazole, tebuconazole, triazoxide	Raxil Deter Bayer	winter	✓	✓	✓	✓	✓			✓	✓	✓	✓	
fludioxonil	Beret Gold Syngenta	spring winter		✓	✓	✓	✓							
fludioxonil, flutriafol	Beret Multi Syngenta	spring winter	✓	✓	✓	✓	✓	✓						
fludioxonil, tefluthrin	Austral Plus Syngenta	spring winter		✓	✓	✓	✓						✓	✓
fluquinconazole, prochloraz	Jockey BASF	winter	✓	✓		✓								
fuberidazole, triadimenol	Tripod Makhteshim Agan	spring winter	✓	✓		✓	✓							
fuberidazole, imidacloprid, triadimenol	Tripod Plus Makhteshim Agan	winter	✓	✓	✓	✓	✓							
ipconazole	Crusoe Chemtura	winter	✓	✓										
prochloraz, triticonazole	Kinto BASF	spring winter	✓	✓	✓	✓								
prothioconazole, tebuconazole, triazoxide	Raxil Pro Bayer	winter spring	✓	✓	✓	✓	✓							
silthiofam	Latitude Monsanto	winter							✓					

✓ label recommendation

✓ some known activity