FACTSHEET

Lupin anthracnose

Figure 1. Typical symptoms of lupin anthracnose

Action points

- **Use only high quality seed and ask the supplier if any seed dressing treatments have been applied**
- **Remember that even treated seed can still have viable Colletotrichum present**
- **Monitor crops regularly for evidence of infection and dispose of affected plants promptly and carefully**
- **Reduce the risk of severe disease outbreaks by keeping the crop foliage as dry as possible**
- **Fungicides are most effective against Colletotrichum when used as a preventative programme**

Background

The fungal disease lupin anthracnose was first reported from Brazil in 1912 and is now present in most countries where lupins are grown. It is the most damaging disease of the crop, causing major problems for producers of both arable and ornamental species and cultivars. The first cases of anthracnose in the UK were found in 1989 on ornamental crops in East Anglia, and the disease remains a serious threat to production throughout the UK.

The disease is caused by the fungus Colletotrichum. Several species of Colletotrichum have been implicated in the problem over the years (in particular *C.gloeosporioides* and *C. acutatum*), but current knowledge suggests that many of these cases may have been identified incorrectly, and it is now thought that *Colletotrichum lupini* is responsible for most cases of

lupin anthracnose worldwide. As a result of the confusion over the identity of the pathogen, the precise host range of the fungus is still unclear.

Little research has been conducted into anthracnose on ornamental lupins (predominantly hybrids such as the 'Gallery' and 'Russell' series, with *L. polyphyllus* as part of their parentage). However, the disease can devastate yields of arable lupins (*L. albus*, *L. angustifolius* and *L. luteus*, grown as protein or forage crops) and there has been extensive research into the disease on arable crops, particularly in Australia, which is responsible for over two-thirds of the world's production.

Sources and spread

Much of the information provided in this section has been obtained from research into anthracnose on arable lupin crops in countries such as Australia and Germany.

The anthracnose fungus is seedborne, and infected seed is the most important source of disease outbreaks. Low levels of seed infection can lead to severe outbreaks under suitable environmental conditions (a 30% yield loss in arable lupins has been recorded from one infected seed in one thousand). Colletotrichum can remain viable on lupin seed for at least two years, possibly longer, and may be present either as an external contaminant or as a more deep-seated internal infection.

The pink or orange spore masses that develop on affected plant tissue contain large numbers of asexual spores (conidia). These are dispersed by water splash (created by rainfall or overhead irrigation) and in most cases can only spread the disease over distances of a few metres. However, spread of more than 100 metres has been documented where high winds and water splash combine to create an 'aerosol' of spore-carrying water droplets.

At least four hours of surface moisture is needed for spores to germinate and infect the plant, and longer periods of wetness are likely to lead to greater infection. Disease development is favoured by warm conditions; leaves inoculated with spores of *C. lupini* (six hours of leaf wetness provided immediately after inoculation) developed spore-producing lesions after fifteen days if maintained at 12°C but after only seven days when kept at 24°C.

In arable crops, the fungus is unable to survive on plant debris for more than a few weeks, particularly during the winter months, when a combination of high rainfall and low temperatures reduces its viability. It is not known with certainty how long it may be able to persist on plant debris on a nursery. For example, if infected plants have been grown under protection, conditions are likely to be drier and warmer than those experienced by outdoor crops, which could extend the survival period.

Information on alternative hosts is very limited, due to the confusion over the identity of the Colletotrichum species involved. There are very few records of *C. lupini* from plants other than lupin, suggesting that the pathogen is fairly host-specific. Cross-infection testing of Colletotrichum isolates derived from anthracnose-affected lupins showed that limited infection of related plants such as peas, sweet peas, trefoil and vetch was possible, together with a few unrelated plants such as Bergenia and stinging nettle.

Symptoms

Plants can show symptoms at any time from seedling emergence onwards. Seedlings may develop symptoms on the roots, cotyledons, true leaves or stems. However, severe symptoms frequently develop much later in the production process, often on mature plants that are close to marketing. Affected plants develop areas of dead tissue (necrotic lesions) on above-ground parts. On leaves, these can take the form of brown leaf spots (Figure 1) or more extensive lesions on leaf blades and/or petioles, often leading to twisting. Where petioles are affected by multiple lesions, they sometimes develop a characteristic 'corkscrew' symptom (Figure 2). If part of the petiole is completely decayed, then the area above, including the leaf blade, may be lost to leave a stump.

Figure 2. 'Corkscrewing' of petioles due to multiple lesions

Stems are also affected, with lesions often developing at the leaf nodes or at points where the stem branches out to form flower stalks. Cracking or splitting may occur at the site of infection, and severe or multiple lesions can lead to twisting of the stem or to complete stem collapse. Under wet or very humid conditions, salmon-pink or orange-coloured spore masses develop on the surface of the lesions (Figure 3). Seed pods can be attacked, leading to infection of the seeds (which sometimes shrivel or become malformed with brown lesions but are often symptomless).

Figure 3. Lesion with salmon-pink spore masses (some visible within circled area)

Disease management

Seed health

Seed health is critical, so ensure that only high-quality seed is used. Tests for Colletotrichum on lupin seed are available from seed-testing laboratories such as those of Fera (0300 100 0321) and NIAB (01233 342200). Seed companies may supply lupin seed that has been treated in some way; this often takes the form of fungicide dressings, but heat-treated seed is also available. Ensure that information about the treatment applied is obtained from the seed company used. While the treatments will reduce the risk, none of them can guarantee freedom from Colletotrichum, so the disease management measures listed below are still extremely important for the production of healthy crops.

Cultural practices

Cultural measures that can be adopted on the nursery include:

- Control leaf wetness and humidity; closely spaced plants in conditions of high humidity with overhead irrigation are most at risk. To avoid this :
  - Space plants as widely as economically possible
  - Consider using sub-irrigation systems, if circumstances allow
  - Do not use overhead irrigation in the evening or at night
  - Ventilate growing structures as freely as possible
- Regularly monitor the crop so that any outbreaks are spotted and dealt with as soon as possible
- Dispose of affected plants carefully to avoid spreading contaminated debris
- Consider moving the areas of production for lupins regularly so that new crops are less likely to come into contact with debris
- Avoid overly lush, soft growth, which will be more prone to infection
- Avoid, if possible, the most susceptible cultivars
- Maintain good control of weeds, particularly leguminous species
- Have a thorough end of crop clean-up to remove all debris from standing areas; disinfect standing areas if infection occurred in the crop

Chemical control

There are currently no fungicide seed dressing treatments with activity against anthracnose approved for use on lupin seed in the UK. However, other fungicide products could potentially have been applied to seed imported from overseas. Enquire as to which treatments have been applied – it is worth taking this into account when considering the fungicides to use on the growing crop (for example, to reduce the risk of potential fungicide resistance problems).

Much of the information on fungicide efficacy against anthracnose has come from work carried out overseas (predominantly in Australia and Germany) on arable lupin crops. Several of the most effective active ingredients identified in these trials are available to UK growers of ornamental lupin crops, but it should be borne in mind that products available in the UK could be different formulations, concentrations or mixtures of the active ingredient(s) to those used and evaluated overseas. A trial carried out into the control of anthracnose on ornamental lupins in the UK as part of a BASIS project in 2012 has also provided valuable information, although the results were not statistically analysed.

Information on fungicides available to UK growers of ornamental lupin crops, containing active ingredients that have proved effective against lupin anthracnose, is presented in Table 1. In many cases, the products do not have approval or label recommendations for use on ornamental crops, but they can be used under an Extension of Authorisation for Minor Use (EAMU) or via the Long Term Arrangements for Extension of Use (LTAEU); in all cases of off-label use, treatment is at the grower's own risk. There may also be restrictions on the crop situation (for example, application to outdoor or protected crops only, use on container-grown plants only) and the number of treatments permitted per crop or year. Ensure that a range of products from different chemical groups is used whenever possible to reduce the risk of fungicide resistance. Always try the product on a small number of plants first if it has not been used previously on either lupins or on a specific lupin cultivar.

In summary, fungicides are far more effective against Colletotrichum when used as protectants; little in the way of effective eradicant activity has been demonstrated. There are some conflicting results between the various trials, but Amistar (azoxystrobin) has performed consistently well. Other active ingredients noted as being effective in one or more of the trials include: Bravo 500 (chlorothalonil), Cercobin WG (thiophanate-methyl – applied as a growing media drench or incorporation), Folicur (tebuconazole), Signum (pyraclostrobin + boscalid) and Switch (cyprodinil + fludioxonil).

Table 1. Fungicides containing active ingredients showing activity against lupin anthracnose in disease control trials*

Typical product	Active ingredient	FRAC code	Situation of use	Approval status	Maximum number of applications	Expiry / final use date
Amistar**	Azoxystrobin	11	Outdoor / protected	EAMU 3388/18	Two per year (for all outdoor production and protected soil); four per year (in container-grown, permanent protection)	30/06/2027
Amylo-X WG	*Bacillus amyloliquefaciens* D747	44	Outdoor / protected	EAMU 0428/19	Six per year	30/09/2027
Bravo 500**	Chlorothalonil	M5	Outdoor	EAMU 1130/11	One per crop	30/05/2020
Cercobin WG	Thiophanate-methyl	1	Outdoor / protected	EAMU 1655/11, EAMU 1887/11***	One per crop	30/04/2022
Folicur**	Tebuconazole	3	Outdoor	LTAEU	-	28/02/2023
Serenade ASO	*Bacillus subtilis* (strain QST 713)	44	Outdoor / protected	EAMU 2364/18	Six per year	31/10/2022
Signum	Boscalid + pyraclostrobin	7 + 11	Outdoor / protected	EAMU 2141/12	Two per year	31/07/2022
Switch	Cyprodinil + fludioxonil	9 + 12	Outdoor / protected	Label	Three per year	31/10/2022

This table has been collated using information from the Health and Safety Executive (HSE) website (pesticides.gov.uk) and from product labels and supplier technical leaflets. Important – regular changes occur in the approval status of plant protection products, arising from changes in the legislation or for other reasons. For the most up-to-date information, please check the HSE website or with a professional supplier or BASIS-qualified consultant, as information could have changed since the publication of this factsheet.

EAMU – Extension of authorisation for minor use.

LTAEU – Long term arrangements for extension of use.

Growers must hold a paper or electronic copy of an EAMU before using any product under the EAMU arrangements. Any use of a plant protection product via an EAMU is at the grower's own risk.

Always follow approved label or EAMU recommendations, including rate of use, maximum number of applications per crop or year, and where crop safety information is not available, test the product on a small number of plants to determine crop safety prior to widespread commercial use.

If in doubt about which products are permissible on ornamentals or how to use them correctly, seek advice from a BASIS-qualified consultant with expertise in ornamental plant production.

* See text of factsheet for further information.

** Other products containing this active ingredient are available.

*** EAMU 1655/11 refers to a growing media incorporation treatment. EAMU 1887/11 refers to growing media dip/drench treatments – use on plants grown in polythene tunnels is excluded.

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