

Septoria blight of parsley

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This factsheet describes the symptoms of Septoria blight on parsley, gives information on disease biology and presents a management strategy for its control, based on results from HDC project FV 318.

Background

Parsley (*Petroselinum crispum*) is one of the major field-grown herb crops in the UK and is used for frozen and dried products as well as the fresh cut market. Septoria blight caused by the fungus *Septoria petroselini* is

a common and important disease of the crop, occurring in the UK, Europe, Asia and North America. The disease spreads rapidly under favourable environmental conditions and, when severe, can render the crop unmarketable. The disease can potentially develop

on crops under any production system, although protected crops with overhead irrigation and outdoor crops are more at risk. In field production, growers face the challenge of maintaining disease-free crops that may be in the ground throughout the year.

Symptoms

Typical early symptoms are brown leaf spots on leaves and cotyledons (Figure 1). Leaf spots are usually 1–5 mm in diameter and are variable in shape, often developing at the leaf margins. As the disease

develops, the number and size of leaf spots increases so that there can be extensive blight of the foliage. Sometimes the leaf spots have a darker margin and occasionally they may be surrounded by yellow haloes. As the leaf spots age, the centres turn tan or light grey and tiny black

fungal spore cases (pycnidia) are often visible. The presence of these pycnidia is a key diagnostic feature for this disease (Figure 2). When infection is severe, leaves may yellow then die and drop off, with pycnidia still visible in dead tissue (Figure 3).



1 Typical leaf lesions of Septoria blight caused by *Septoria petroselini* on parsley



2 Black pycnidia (spore cases) visible within leaf lesions are characteristic of Septoria blight on parsley

Downy mildew caused by fungus *Plasmopara umbelliferarum* is another common leaf disease of parsley in the UK. It is important to be able to distinguish between the two diseases so that appropriate control measures are used. Downy mildew tends to be more prevalent in cooler

weather, while Septoria blight is more common in warmer conditions. Downy mildew lesions are less well defined than those of Septoria, being paler and more variable in size and shape, and sometimes delimited by leaf veins, with associated leaf yellowing (Figure 4). There is

often white fungal growth visible, particularly on the leaf undersides, indicating spore production (Figure 5). Extensive leaf blackening may occur if the disease is severe (Figure 6). In contrast to Septoria leaf blight, there are no black pycnidia associated with this disease.



3 Black pycnidia (spore cases) of *Septoria petroselini* remain present in dead parsley leaf tissue



4 Pale angular leaf lesions of downy mildew caused by *Plasmopara umbelliferarum* on parsley



5 White spore production of downy mildew caused by *Plasmopara umbelliferarum*, on leaf undersides of parsley



6 Blackening of parsley leaves due to severe downy mildew

The pathogen

Septoria blight of parsley is caused by the fungus *Septoria petroselini*. Other species of *Septoria* affect other crops of

the Umbelliferae family (eg celery, celeriac and coriander) but the host range for each species is limited. For example, parsley is not susceptible to *S. apiicola* which causes Septoria blight on celery

and *S. petroselini* does not infect celery or celeriac. Septoria diseases also affect other herbs such as lemon balm (caused by *S. melissae*) and lavender (caused by *S. lavandulae*).

Epidemiology

Inoculum sources

Septoria blight of parsley is known to be seed-borne. Black pycnidia may be clearly visible on the seed surface (Figure 7) but they may also be more deeply embedded within seeds. Tests done as part of HDC project FV 318 confirmed the presence of *S. petroselini* in some commercial parsley seed lots, with pycnidia presence on 40% of seeds for one severely infested seed lot. Further studies demonstrated, however, that the percentage of seeds with pycnidia did not give a useful measure of pathogen viability or subsequent risk to a parsley crop. This was because in the majority of seed lots tested, spores released from pycnidia were not capable of germination or further development. It was also found that spores of *S. petroselini* could be present on seeds in the absence of pycnidia.

In addition to seed-borne inoculum, *S. petroselini* can survive on parsley crop debris for at least three years and also on volunteer or overwintered plants. There is also a risk of cross-infection between neighbouring beds and crops (eg with sequential planting during the season).

Seed to seedling transmission

Transmission of *S. petroselini* from parsley seed to plants was demonstrated in HDC project FV 318 and in previous research in Germany. The seed coat attached to the cotyledon can act as a source of infection during propagation so that the fungus infects seedling leaves. The frequency of transmission from parsley seed to plants was determined in a glasshouse experiment using one seed lot. The one-hit probability of transmission was estimated within HDC project

FV 318 at between 0.00006 and 0.00009 (ie a chance of less than 1 in 10,000); this is the probability that a single spore on a single seed will be transmitted to the resulting emerged seedling(s).

Environmental conditions

The development of Septoria blight on parsley is highly dependent on the presence of water for pycnidia to swell and release spores (Figure 8), for dispersal of spores between plants and for infection to occur. Infection and symptom development can occur over a wide temperature range with optimum temperatures for disease development around 20–25°C. At 20–25°C, increasing leaf wetness duration results in greater disease severity, with symptoms most severe following 72 hours of leaf wetness. Under optimum conditions, symptoms can develop on parsley in as little as 9 days after infection.



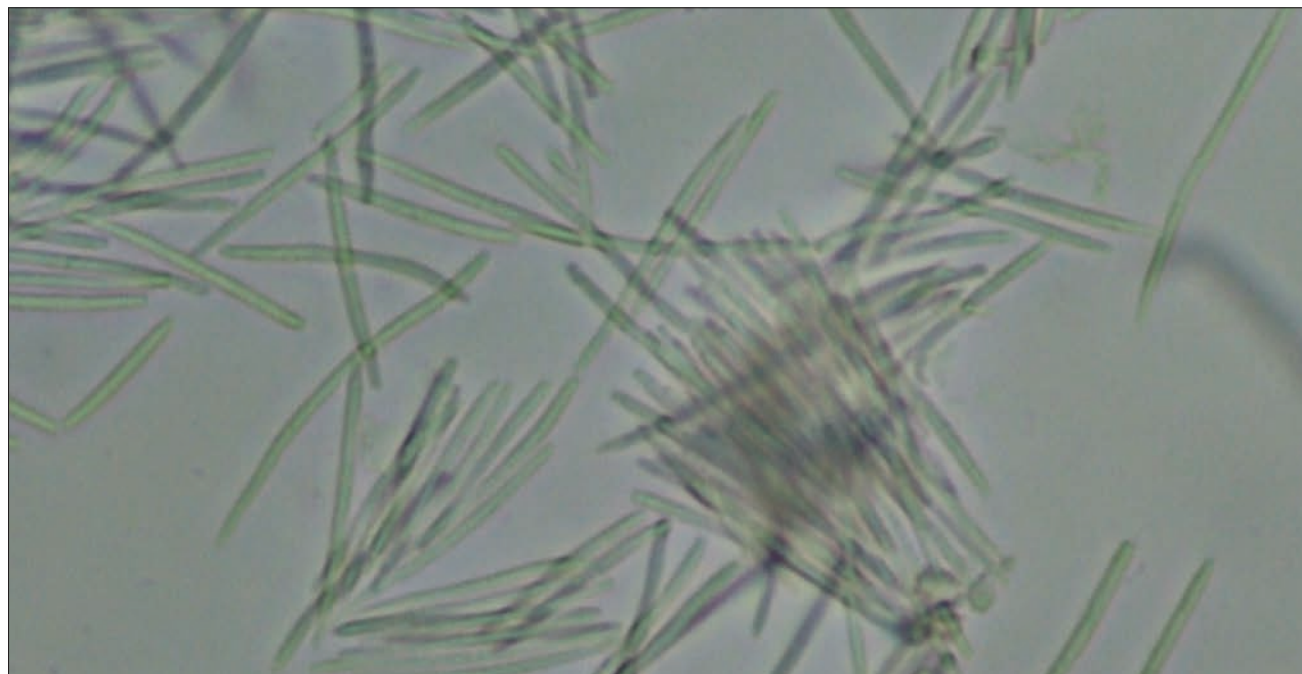
7 Pycnidia (spore cases) of *Septoria petroselini* visible on the surface of parsley seeds

Spread in the field

Spores of *S. petroselinii* are readily spread by watersplash (rain or irrigation), wind-driven rain, and also by the movement of people (eg on wet boots) and machinery. Septoria leaf blight is a polycyclic disease which means there may be many cycles of infection and disease development during a single growing season.

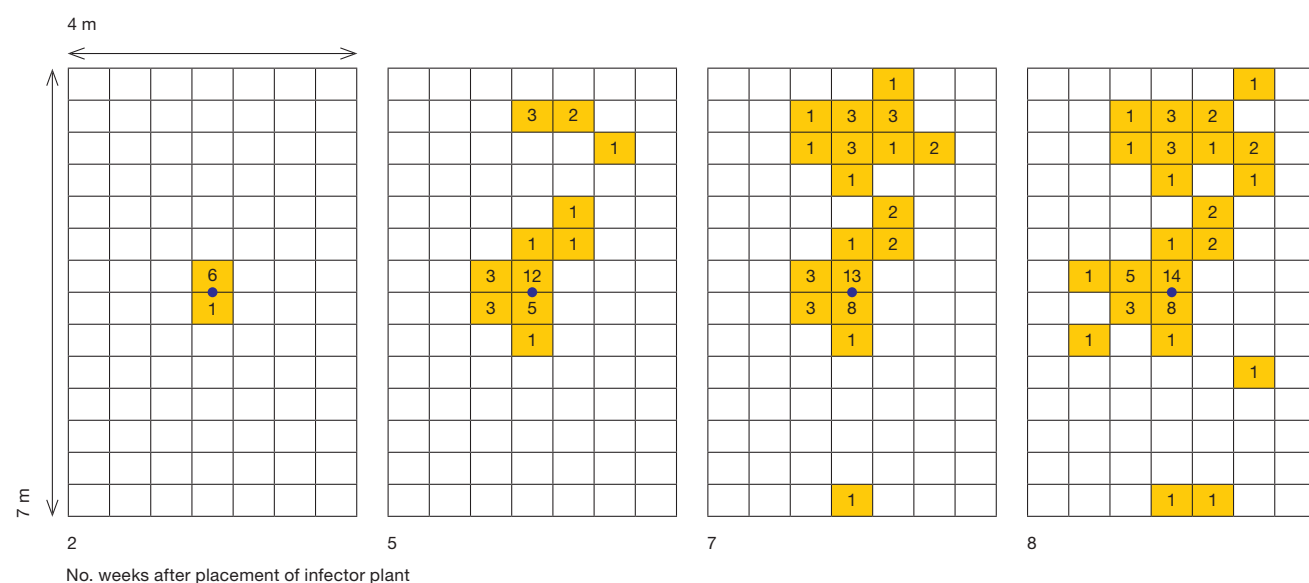
HDC project FV 318 looked at the rate of disease spread from a single focus of infection initiated immediately after foliage had been cut back to stem bases, in an overwintered plot of curly leaf parsley (in a polytunnel). Irrigation was applied daily to simulate frequent rainfall. Symptoms of Septoria were first observed after 12 days. For the first 2 weeks, disease symptoms all occurred less than 0.5 m from the infection point.

By 5 weeks, symptoms had spread up to 3 m along the length of the trial area. This had increased to spread up to 3.5 m from a point source by 7 weeks, demonstrating the extent to which Septoria can spread on parsley under environmental conditions that are high risk for disease development – see Graph 1. Spread under field conditions could potentially be even greater in the presence of wind-driven rain.



8 Release of spores of *Septoria petroselinii* from pycnidia on seed

Graph 1 Map of Septoria blight spread from a single infection point in a plot of curly leaf parsley irrigated daily to simulate rain



- Position of infector plant
- 3 Area infected with Septoria, and number plants infected (out of approximately 48 plants)

Control

Seed health

As *Septoria* species can be seed-borne, use of clean seed is important for disease avoidance. Parsley seed testing positive for *S. petroselinii* can be treated using a warm-water thiram soak (not permitted for organic production). Fungicides approved for foliar applications on parsley are not permitted for use on seed. Broad spectrum disinfectants/biocides are also not permitted for use as seed treatments for parsley.

There is potential for reducing levels of *S. petroselinii* on parsley seed using physical methods. Both hot water and hot humid air treatment have been shown to be effective, but can damage seeds. The sensitivity of seeds to these treatments can vary from seed lot to seed lot. Heat treatments must therefore be optimised for individual seed lots to achieve maximum efficacy with minimal seed damage. For example, a patented technique (*Thermoseed*®, www.incotec.com) that was originally developed for cereals has now been adapted for use on vegetable seed. The technique involves treatment of seed with hot humid air and precise control of temperature, air humidity and treatment duration.

Other methods shown previously to reduce levels of *S. petroselinii* on parsley seed included use of thyme oil and particular strains of the bacteria *Pseudomonas chlororaphis* and *Bacillus subtilis*. These treatments are not currently permitted in the UK.

The viability of *S. petroselinii* on parsley seed may decline over time during storage. This should not be viewed as a reliable method of control.

Cultural practices

Although there are varietal differences in the susceptibility of parsley to *S. petroselinii* there are no varieties available that are completely resistant to the disease.

The risk of Septoria blight on parsley can be reduced during field production using the following cultural practices:

- Field crops should be planted in soil where parsley has not been grown for at least 3 years to avoid pathogen carry-over on infested crop debris.
- Where overhead irrigation is necessary, avoid watering late in the day when leaf wetness duration will be prolonged. Such conditions are conducive for disease development.
- Inspect plants regularly for early symptoms of leaf spot and rogue out infected plants.
- Where possible, isolate new/sequential plantings to avoid splash dispersal from currently or recently affected crops.
- Restrict entry into the crop, particularly when wet, use clean footwear and wash hands/clothing when moving between crops.
- Incorporate or destroy crop debris as soon as possible after harvesting.
- Clean/disinfect machinery between seed lots at drilling and between crops at harvest.

Biological control

The biological fungicide Serenade ASO (*Bacillus subtilis*) has a SOLA (0246/09) for use as a foliar fungicide on parsley. However, the efficacy of this treatment against Septoria blight on parsley foliage has not been evaluated.

Chemical control (outdoor parsley)

In FV 318, the following fungicides approved for outdoor parsley significantly reduced the incidence and severity of Septoria blight on parsley caused by *S. petroselinii*: Amistar (azoxystrobin), Signum (boscalid + pyraclostrobin) and Karamate Dry Flo Newtec (mancozeb) (Table 1). Amistar and Signum were most effective as protectants when applied 2 days before infection; Karamate Dry Flo Newtec gave

excellent control even when applied 5 days before an infection event.

Fungicide programmes for control of Septoria blight of parsley were evaluated using an 8 week crop with sprays commencing before or after an infection event: (i) Karamate Dry Flo Newtec × 3, (ii) Amistar × 2, then Karamate Dry Flo, and (iii) Signum × 2 then Karamate Dry Flo. All programmes were effective in reducing Septoria incidence and severity when programmes commenced before infection had occurred. Use of Karamate Dry Flo Newtec as the last application in a programme should be avoided because of the risk of visible spray deposits on leaves.

Applications of Amistar or Signum to parsley leaves with Septoria lesions containing mature pycnidia significantly reduced the percentage germination of *S. petroselinii* spores. This suggests that application of these strobilurin products to leaves with mature Septoria lesions could delay secondary spread of the disease by limiting germination of spores present in pycnidia.

There are no forecasting systems that have been developed specifically for predicting the development of Septoria blight on parsley. Of models reviewed (particularly those previously developed for celery Septoria), the Tom-Cast system has advantages, requiring relatively inexpensive equipment and providing a straightforward output. The disadvantage is that the system relies on previous weather conditions rather than forecast conditions, such that fungicides with strong curative activity (not available for outdoor parsley) would be required. On a crop such as parsley, for which quality standards are high, growers would be advised to apply protectant sprays of fungicides effective against Septoria for control on parsley when high risk conditions are forecast (particularly prolonged wet periods). Spray intervals can be extended or numbers of applications reduced during dry conditions because Septoria risk is lower.

Growers using strobilurin fungicides such as Amistar or Signum should be aware of the need to use strategies to minimise the risk of selecting resistant strains.

Growers should alternate products from different chemical groups if more than one fungicide treatment is applied to a crop. Dithiocarbamate

fungicides such as mancozeb are known as 'multi-site inhibitors'; they are less likely to result in problems of fungicide resistance and are

particularly useful in preventative programmes.

Table 1 Fungicides approved for use on outdoor parsley (September 2010) with activity against Septoria blight of parsley

Active ingredient	Example products	Approval type	Mode of action
Azoxystrobin	Amistar	SOLA 1293/02	Protectant and locally systemic
Boscalid + pyraclostrobin	Signum	SOLA 2115/10	Protectant and systemic
Mancozeb	Cleancrop Mancozeb Karamate Dry Flo Newtec	SOLAs 0046/10 0028/10	Protectant

Action points

Growers

- Check with seed suppliers that seed has been tested and is free from *S. petroselinii*, or that it has been treated with thiram fungicide.
- Follow the guidelines suggested under 'cultural practices' to minimise the risk of Septoria blight developing on parsley during field production.
- Consider using a protectant fungicide programme for

management of Septoria blight on parsley, particularly when wet conditions have been forecast and the disease has been confirmed in previous or neighbouring plantings.

Seed companies/Suppliers

- Take precautions to avoid cross-contamination between seed lots via dust/debris.
- Vacuum, clean and disinfect machinery, storage areas/bins between seed lots.

- Test seed prior to cleaning/processing.
- To ensure an accurate result, it is important that samples for seed testing are obtained according to the *International Rules for Seed Testing*.
- Seed lots testing positive for viable *Septoria petroselinii* should be treated with a warm water thiram soak.
- Process/clean the cleanest seed first.

Laboratory testing

Diagnosis

For general disease diagnosis, send plant samples (packed in absorbent paper within plastic bags within a box) to a plant clinic, eg:
Fera – www.fera.defra.gov.uk
Plant Health Solutions – www.planthealth.co.uk
STC – www.stc-nyorks.co.uk

Seed health testing

There is no generally accepted or standard method for the detection of *Septoria petroselinii* in parsley seed. When sending seed samples for testing, request that diagnostic methods for Septoria disease on parsley include a check for spore viability, rather than just presence or absence of pycnidia. Seed health testing laboratories include:

Fera – www.fera.defra.gov.uk
NIAB – www.niab.com
Plant Health Solutions – www.planthealth.co.uk
SASA – www.sasa.gov.uk

Further information

More information on the work done as part of Project FV 318 can be found online in the Grower Summary at www.hdc.org.uk. A copy of the complete final report is available by contacting the HDC at hdc@hdc.org.uk. More information on diseases and

pests of herb crops can be found at www.hdc.org.uk/herbs.

Note

Regular changes occur in the approval status of pesticides arising from changes in legislation

or for other reasons. For the most up to date information, please check with your preferred supplier, BASIS registered adviser or the Communications Branch at the Chemicals Regulation Directorate (CRD), Tel. (01904) 455775, www.pesticides.gov.uk.

Acknowledgements

We are grateful to the seed companies that supplied seed for use in HDC project FV 318. All images except Figure 2 are copyright ADAS UK Ltd. Figure 2 is copyright Nigel Cattlin/FLPA.

Additional information: