Factsheet 29/12

Field Vegetables

Coriander Bacterial Blight

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This factsheet describes the symptoms of bacterial blight in coriander and its biology. A management strategy for disease control based on the results of HDC projects FV 318 and FV 403 is also presented.

Action points

- Check with seed suppliers that seed has been tested for *Pseudomonas syringae* pv. *coriandricola* and meets the minimum recommended health standard of <0.03% with a test sensitivity of ca. 900 CFU.
- Be aware of the potential for cross-infection with parsley. Inspect parsley for signs of bacterial disease - do not assume that leaf spots on parsley are caused by *Septoria*.
- Minimise the movement of machinery and people within and between crops. Wash hands and clothing when moving between crops. Do not enter crops when wet. Clean and disinfect machinery between crops and at the end of the season.
- Incorporate or destroy crop debris as soon as possible after harvesting.
- Do not grow susceptible crops in the same field more than once every two years. Clean and disinfect drilling equipment between seed lots.

Background

Coriander (*Coriandrum sativum*) is one of the major field-grown herb crops in UK. Crops are grown at high densities for fresh leaf production. Bacterial leaf spot or blight has been a recurring problem on field-grown crops. It has also been reported in protected pot-grown production.

The disease was first seen in the UK in 1967, but was not formally reported in scientific literature until 1980. It has been reported in Australia, Germany, Hungary, Mexico, Spain and the USA. The disease is described as 'umbel blight' or 'seed decay' in some of the reports.

Given that there is no formal requirement for coriander seed to be tested for bacterial blight, it is likely that the disease is more widely distributed wherever coriander is grown. There have been only a few studies on coriander bacterial blight, and these have tended to focus on crops harvested mature as a spice or seed crop. In 2007, as part of HDC project FV 318, the HDC funded work aimed at improving disease management with a focus on seed health standards. This publication, an update of Factsheet 16/10, includes findings from HDC project FV 403, in which the pathogen's host range was investigated.

1. **Typical brown necrotic leaf lesions caused by *Pseudomonas syringae* pv. *coriandricola*. Stem lesions are also visible to the left and right.**

2. **Dark water-soaked lesion on a cotyledon caused by *Pseudomonas syringae* pv. *Coriandricola***

Symptoms

Lesions may occur on all plant parts, initially appearing as dark brown or black necrotic lesions with a water-soaked margin (Figure 1). Infected seeds may fail to emerge. Early infections on seedlings and cotyledons are difficult to spot (Figure 2) and can lead to seedling death (Figure 3).

3. Seedling collapse as a result of infection by *Pseudomonas syringae* pv. *coriandricola*

Leaf spots are often angular, delimited by veins (Figure 1), and clearly visible when viewed from both sides of the leaf. As they develop, and depending on conditions, individual lesions may coalesce into larger blighted areas. Individual lesions may be surrounded by chlorosis (yellowing). Severely affected leaves also show yellowing and premature senescence. As they age, leaf spots may develop a pale tan centre with a darker margin.

4. Blue spot symptoms are only visible on the upper leaf surface.

5. Oedema symptoms are only visible on the upper leaf surface.

On plants allowed to bolt, stem lesions may result in collapse and petals may become brown and fall prematurely from infected flowers. Water-soaked lesions can develop on the green unripe fruit; these can later become dark and shrivelled.

The disease can be confused with physiological disorders such as oedema, blue spot or tip-burn, so it is important to obtain an accurate diagnosis. A characteristic feature of both 'blue spot' (Figure 4) and 'oedema' (Figure 5) is that unlike bacterial blight, the lesions are only apparent when viewed from the upper leaf surface.

Parsley can also be infected and shows similar symptoms to those seen on coriander (Figure 6). The symptoms could easily be confused with Septoria leaf spot. For more information on disease symptoms caused by other pathogens, see the online **HDC Herbs Best Practice Guide** which is available on www.hdc.org.uk/herbs.

The Pathogen

Leaf spot of coriander is caused by the bacterium *Pseudomonas syringae* pv. *coriandricola* (*Psc*) (Figure 6). Early reports of the disease did not identify the pathogen precisely, but indicated that it was a strain of *Pseudomonas* or *Pseudomonas syringae*. It was formally proposed as a distinct pathovar in Germany in 1996, with the host range limited to coriander, lovage (*Levisticum officinale*) and lady's lace (*Ammi majus*). However recent results from the USA, which have been confirmed in HDC project FV 403, indicate that it can also infect parsley and celery.

Infection

The bacterium infects via natural openings and wounds, and can spread through the vascular system. Precise conditions for infection and disease development have not been established, but coriander bacterial blight is considered a disease of cool, wet weather.

6. Symptoms on parsley leaves, caused by *Pseudomonas syringae* pv. *coriandricola*.

Inoculum sources

Work at the National Vegetable Research Station in the 1970s showed that the disease was seed-borne. This was confirmed in later studies in Germany and Australia, so the disease is considered to be primarily seed-borne. Tests on coriander seed lots from several different seed companies, which were done as part of HDC project FV 318, confirmed the presence of *Psc* in some seed lots, with infection levels as high as 5%.

There has been no specific work to examine the survival of the pathogen in the field, in the soil or in crop debris. By analogy with seed-borne diseases of other crops caused by similar pathovars of *P. syringae* (e.g. pea bacterial blight) long-term survival in the soil is unlikely. Crop debris and residues from a previously infected crop may provide an inoculum source over the short-term, especially within a growing season, and particularly if the rate of debris breakdown is limited by dry or cold conditions.

Epiphytic survival

Again by analogy with other similar diseases caused by *P. syringae* pathovars, it is likely that *Psc* can survive and possibly multiply on leaf surfaces in the absence of symptoms. (i.e. as an epiphyte). Thus, the absence of symptoms does not necessarily mean that the pathogen is also absent; an aspect that is particularly important in the context of seed crops.

Recent studies

Studies done as part of HDC project FV 318 focussed on two aspects that are important for determining seed health standards:

- Quantifying the rate of transmission from seed to seedling.
- Quantifying the rate of spread in the field.

Seed to seedling transmission

Using dose-response data from glasshouse experiments the 'one-hit' probability of transmission is estimated as 0.00018; this is the probability that a single bacterium on a single seed will be transmitted to the resulting emerged seedling(s).

Spread in the field

In common with many other bacterial diseases, secondary spread within a crop occurs by water-splash (rain or irrigation), wind-driven rain and via the movement of people, animals, insects and machinery. HDC project FV 318 looked at the rate of disease spread from a single primary infection, initiated soon after emergence, in a series of field trials simulating crops for fresh leaf production (Figure 7).

Inevitably the rate of spread varied from trial to trial depending on the weather conditions during the trial period. In the worst case, spread resulted in disease incidence of up to 30% (in a 10m x 3m bed plot) by eight weeks after sowing (Figure 8).

7. Examining the rate of disease spread from a point source in the centre of the plot.

0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
0	0	0	0	0	0	0	0	0	0	2	1	0	0	0
0	0	0	0	0	0	0	0	0	0	2	2	1	0	0
0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
0	0	0	0	0	1	0	0	0	0	1	0	0	0	0
0	0	0	0	0	0	0	1	0	1	1	0	0	0	0
0	0	0	0	0	1	1	1	*	1	0	0	0	0	1
0	0	0	0	1	1	1	2	*	1	0	0	0	0	0
0	0	0	0	1	2	2	2	1	2	2	0	0	0	0
0	0	0	0	1	2	2	3	2	2	1	0	0	0	0
0	0	0	0	1	2	2	2	2	1	1	0	0	0	0
0	0	0	1	1	2	2	2	2	1	1	0	0	0	0
0	0	1	1	0	2	1	2	1	0	0	0	0	0	0
0	1	1	1	1	1	1	1	1	0	0	0	0	1	1
0	1	1	1	0	0	2	1	1	0	1	0	0	0	0
0	0	0	0	0	1	1	1	0	0	0	0	0	0	0
0	0	0	0	0	1	2	2	0	0	0	0	0	0	0
0	0	0	0	0	0	2	2	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	1	0	0	1	1

8. Map of disease spread in field trial. The arrow indicates primary infection. Numbers represent disease severity (0-4 scale).

Control

The most effective way to manage coriander bacterial blight is to use clean seed which has been tested and shown to meet minimum seed health standards. It is important that seed is tested, as visual inspection of seed crops is not a reliable indicator of the health of the harvested seed.

Seed health standards

Transmission and spread data obtained in HDC project FV 318 have been used in mathematical models to examine the risks of sowing seed with different infection levels in relation to the probability of detecting them. Based on the results it is recommended that seed health test protocols should be designed to achieve a tolerance standard of 0.03% (i.e. less than 1 infected seed in 3,000) and an analytical sensitivity of 900 CFU (colony forming units, a measure of bacterial numbers) with 95% probability. This means testing at least 9,000 seeds.

Seed treatment options

There are currently (08/2012) no approved chemical seed treatments for the control of coriander bacterial blight in the UK.

Results of tests done in HDC project FV 318 indicate that hot water treatment has considerable potential to reduce or even eliminate seed-borne *Psc*. Infection was reduced to undetectable levels in five out of six seed lots. A 20-fold reduction was achieved in the remaining seed lot by treatment at 53°C for 30 minutes. This temperature-time regime is at the borderline of safety for germination, and so there was a slight reduction in germination compared to untreated seed for some seed lots. In these seed lots reducing the temperature by 1°C achieved similar levels of control without loss in germination.

Other treatments were also examined in HDC project FV 318: thyme oil, Subtilex and Serenade. Although not as effective as hot water, all gave useful reductions in seed infection levels. None of these products has approval as a seed treatment in the UK. The use of general disinfectants such as peroxyacetic acid or sodium hypochlorite (bleach) as seed treatments is not permitted without a specific approval.

Foliar treatments

Research in Australia on seed / spice crops suggested that the use of copper sprays may give a reduction in disease in some circumstances, when applied at the early stages of crop development and before disease symptoms are seen, but results were variable and unlikely to be economic. In any case there are currently no approvals for the use of copper compounds on coriander.

The biological control agent Serenade ASO (based on a strain of *Bacillus subtilis*) has an extension of authorisation (EAMU) for use on herbs, and is known to have activity against bacteria, but its efficacy as a foliar spray for control of coriander bacterial blight has not been examined.

Action points for seed suppliers

- Take precautions to avoid cross-contamination between seed lots via dust and debris.
- Vacuum, clean and disinfect machinery, storage areas and bins between seed lots.
- Test seed prior to cleaning and processing.
- To ensure accuracy, it is important that samples for seed testing are obtained according to the *International Rules for Seed Testing*.
- Discard or hot-water treat seed lots with infection levels of >0.03%.
- Re-test treated seed.
- Clean and process the cleanest seed first.
- Consider applying a more stringent seed health standard for seed used for seed crops.
- Consider hot-water treatment of seed used for seed-crops regardless of health status.
- Consider testing parsley seed for *Pseudomonas syringae* pv. *coriandricola* as well as *Septoria petroselini*.

Laboratory testing

Diagnosis

For general diagnosis and confirmation of disease symptoms, send samples with a range of symptoms (wrapped in absorbent paper towel inside a polythene bag) to a plant clinic e.g.

Plant Clinic
The Food and Environment Research Agency
Sand Hutton
York
Y041 1LZ
Tel: +44 (0) 1904 462324
Email: plantclinic@fera.gsi.gov.uk
Web: www.defra.gov.uk/fera

Plant Health Solutions Ltd
Ryton Organic Gardens
Wolston Lane
Coventry CV8 3LG
Tel: +44 (0) 2476 217737
Email: clinic@planthealth.co.uk
Web: www.planthealth.co.uk

The Plant Clinic
Stockbridge Technology Centre
Cawood
Selby
North Yorkshire
YO8 3TZ
Tel: +44 (0) 1757 268275
Email: plantclinic@stc-nyorks.co.uk
Web: www.stc-nyorks.co.uk

Seed health testing

There is no accepted or published standard method for the detection of *Psc* in coriander seed. Plant Health Solutions offers a commercial testing service for the detection of Psc in coriander seed. Other laboratories e.g. Fera, NIAB, SASA may also offer this service. It is important to establish the level of validation offered by the laboratory and that the test can reliably achieve the required testing standards.

Further information

More information on work done as part of HDC projects FV 318 and FV 403 can be found online at www.hdc.org.uk. Hard copies of the reports are available - contact the HDC at hdc@hdc.org.co.uk.

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Notes

HDC is a division of the Agriculture and Horticulture Development Board (AHDB).

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