Factsheet 15/13
(HDC Project HNS 179)

Hardy Nursery Stock

Management of bacterial canker of cherries and plums during nursery production

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Bacterial canker is a destructive disease of cherries and plums. It can be caused by two distinct pathovars of *Pseudomonas syringae*: pv. *morsprunorum* and pv. *syringae.* This factsheet describes the biology and symptoms of the disease and summarises the results of a recent HDC funded project on its control.

Action points

- Quarantine bought-in plant material and check for the appearance of symptoms.
- Replace mother-plants and stock hedges at regular intervals with tested/indexed material.
- Adopt as wide a plant spacing as economically possible.
- Use sub-, drip-or trickle-irrigation to minimise overhead watering.
- Minimise contact with plants (via machinery and people), especially when plants are wet.
- Wash/disinfect hands when moving between susceptible crops.
- Carry out all heading and pruning cuts during dry weather and when it is forecast to remain dry for a few days after the operation.
- Clean and disinfect pruning and cutting tools frequently.
- Avoid mechanical defoliation of trees in the autumn where possible.
- Remove and destroy visibly infected trees and plant debris.
- Provide adequate nutrition and ensure soil/media pH is not too low.
- Consider implementing a spray programme using copper oxychloride.
- Get the identity of the pathogen checked out for new disease outbreaks.

1. Bacterial canker and gummosis on the main stem of a young cherry tree

Introduction

Bacterial canker is one of the most important diseases of cherries and plums. In its most severe form it can kill trees and its management presents particular challenges.

Throughout the world, almost all previous work on the control of bacterial canker has been targeted at orchard fruit production. As a result of on-going problems with the disease, a three year HDC funded project (HNS 179) was commissioned examining the management of bacterial canker specifically targeting nursery production. The overall aim of the project was to identify management options which would be of benefit in the control of bacterial canker in cherries and plums. Extensive trials were undertaken at two nurseries to look at leaf and bud populations of the pathogens on cherries and plums throughout the year and to look at the effects of different spray programmes on those populations. This factsheet draws together current knowledge along with the results of project HNS 179.

Disease biology and recognition

Pathogens

In the UK, bacterial canker can be caused by two different pathovars of *Pseudomonas syringae*: *P. syringae* pv. *syringae* (*Pss*) and *P. syringae* pv. *morsprunorum* (*Psm*). *Psm* is further divided into two races. Genetic analysis suggests that the two *Psm* races and *Pss* actually represent three different 'species'. A third pathovar has also been proposed, *P. syringae* pv. *avii*, that causes disease on wild cherry in France. However, there is some doubt as to whether this can really be justified as a distinct pathovar.

The relative importance of the two pathovars differs in different parts of the world, probably a result of different climatic influences and the dominance of different host plant species. In the USA, most work has been done on *Pss;* in the UK most emphasis has traditionally been given to *Psm.*

There is also a further bacterial pathogen on *Prunus* species, *Xanthomonas arboricola* pv. *pruni* (synonymous with *X. campestris* pv. *pruni*). This bacterium is a quarantine pathogen in the EU. There have been localised reports on stone fruit subjects in Bulgaria, France, Romania, and Switzerland, and it has recently been reported on cherry laurel on nurseries in the Netherlands (2008) and Italy (2005).

Host range

Psm has a narrow host range restricted to stone fruit; strains are also host specific, so that plum strains do not infect cherry and vice versa. *Pss* on the other hand has a broad host range and can infect many plant species in many different genera; these include forsythia, lilac, pear and all *Prunus* species although there are indications that some strains may be associated with particular hosts.

Pathogen sources and spread

Both pathogens may overwinter in dormant buds and cankers. However, the importance of cankers as an inoculum source is not clear and may differ for the two pathogens. In the spring they multiply and colonise newly opening leaves and blossoms. This may result in infection, depending on the environmental conditions, but both pathogens can be present and multiply on the surfaces of apparently healthy leaves and flowers without causing disease. There are also reports of systemic spread within plants.

Several studies have suggested that populations decrease during the summer, and then rise again in the autumn, but recent work in HNS 179 indicates that this may not always be the case (at least for *Psm*). It is likely that populations fluctuate depending on the local weather conditions and the two pathogens may well differ in their responses to the environment. The presence of disease symptoms is also likely to be another factor driving population levels.

In common with other bacterial pathogens, local short-distance dispersal is likely to occur via water-splash from rain or irrigation, but anything that moves between leaves or trees (including animals, people and machinery), especially if surfaces are wet, is likely to spread the bacteria. Movement over longer-distances, including between nurseries, regions and countries is most likely to occur via infected or contaminated plant material, people and equipment.

Infection and disease development

The bacteria enter plant tissues through natural openings, such as stomata, fresh leaf scars or wounds. Thus, any events causing damage to the tree, such as hail, frost, pruning, or other mechanical damage, may provide opportunities for infection. Leaf scar infection in the autumn has long been considered to be an important route for infection leading to the development of cankers. Thus premature removal of leaves before an abscission layer has formed completely (either by stormy weather or mechanical defoliation) may increase the likelihood of infection. It is also seems that leaf scar infection may be more important for *Psm* than for *Pss*.

Canker formation and development is facilitated by stress, and particularly by winter freezing, but it is likely that this differs between the two pathovars. However, given that UK winters are relatively mild, winter freezing may be less of a factor in the UK than in other parts of the world.

Symptoms

The main symptom, from which the disease gets its name, canker, is a necrotic (dead), usually sunken lesion on a stem, branch or twig. The sunken appearance results from continuing growth of the surrounding tissues. Sometimes this is associated with gummosis (production of sticky gum), but the presence of gummosis does not necessarily mean that the tree is affected by bacterial canker; gummosis is a general physiological response to stress, which could result from mechanical injury, drought, insect damage or disease caused by other pathogens. Cankers may not become obvious until six or even 18 months after infection has occurred. As well as the stem cankers that give the disease its name, other symptoms include blossom blast, bud death, leaf spots and shot-holes, death of fruiting spurs, die-back of new shoots and older stems, and spots on immature fruits.

2. The bark has been scraped away on a cherry tree to reveal the underlying canker

3. Blossom blast symptoms on cherry

4. Leaf spot and shot-hole symptoms on plum leaf

5. Shoot die-back on cherry

6. Immature cherry fruits inoculated with *Pss* (left) and *Psm* (right)

Control options

Control strategies

It is generally considered that the most effective way to control bacterial diseases is by an avoidance strategy; avoiding the introduction or carry-over of the pathogen. Such a strategy can usually be implemented effectively for seed-raised annual crops, but presents considerable challenges for vegetatively propagated perennials or where the pathogen (*Pss*) has a broad host range. It is also important to bear in mind that cankers are often the result of infections which have been initiated in the previous year, and may not always be obvious in the first year after infection. Thus the impact of any control measures taken in one growing season may not be apparent until the following season.

Avoidance

In practical terms a disease avoidance strategy for bacterial canker would mean the production of pathogen-free planting material on pathogen-free sites. Such an approach might possibly be developed through the use of micro-propagated tested/indexed rootstocks grown on isolated sites or under protection.

Results from HNS 179 suggest that both pathogens may already be widely present on nurseries, and combined with overlap in plant material at different productions stages and from different sources, it would be a challenge to maintain the health status of pathogen-free starting material. Thus a key factor in determining the success of such an approach would be the rate at which high-health starting material became contaminated.

Nursery hygiene

When moving between susceptible crops (not just cherries and plums, but any known hosts of *Pss*) hands should be washed or disinfected. The movement of machinery and staff within and between susceptible batches of plants, especially when the plants are wet, should also be avoided.

It is good practice for the control of any disease to remove and dispose of diseased/infected trees, prunings and leaf debris as quickly as possible, especially if they are potentially infected.

Pruning and grafting operations should be carried out during periods of dry weather; not just dry on the day of the operation, but forecast to be dry for a few days afterwards, until wounds have become more resistant to infection. Pruning tools, including knives and secateurs, should be disinfected as often as possible during pruning operations, and certainly when moving between different batches.

Different approaches to disinfection were examined as part of project HNS 179. Long (30 second) dips in disinfectants (0.8% Jet 5 and 0.1% available chlorine prepared from Presept™ tablets) were the most effective, but were considered impractical for field use, and cause corrosion. The use of 70% iso-propanol impregnated disinfectant wipes or spraying with 70% iso-propanol and then wiping dry, although not completely effective, were better than a quick dip in disinfectant and are probably the most practical solution for field use.

Cultural practices

Most work on this aspect has been done in the USA on *Pss*. The general conclusion is that susceptibility is higher in poorly nourished, water-logged trees grown at low pH. Therefore it is important to ensure adequate nutrition, and that the soil or growing medium is well-drained and has a pH of around 6.4 or more.

As the pathogens are easily spread by water splash, overhead water should be minimised and sub-, drip- or trickle-irrigation systems used wherever possible. Trees should be spaced as widely as is economically feasible.

Mechanical defoliation of stock hedges prior to collection of cuttings is not recommended, as this will create fresh wounds, allowing entry of the pathogens at a time when populations may be high.

Plant resistance

There is very little reliable and consistent information on the resistance of different plant varieties and rootstocks. It is probably more correct to say that some studies have identified varieties that are more or less susceptible than others. This is further complicated by apparent differences in susceptibility to the two pathogens within a single variety. There are also conflicting claims about the influence of rootstocks on susceptibility in the scion. Nevertheless, varieties which are consistently reported as highly susceptible include the cherry varieties 'Napoleon' and 'Sweetheart' and the plum variety 'Victoria'. In the case of rootstocks there have been suggestions of lower mortality (due to *Pss*) with cherries grafted onto 'Colt' rather than 'Gisela'.

Chemical control measures

In HDC project HNS 179, although a number of alternative treatments were examined, Cuprokylt (copper oxychloride) at 3 g/L plus a wetting agent (Activator 90) at 0.25 ml/L was the most consistently effective spray treatment against bacterial canker. Two applications were made seven to 14 days apart in the spring, summer and autumn, to give a total of six sprays per season. This approach to spray timing was intended to minimise the build-up of inoculum in the spring and thus prevent leaf and shoot infections, minimise transfer of inoculum from mother-plants during budding, minimise the potential for infection during the budding process, and minimise inoculum levels in the autumn to prevent leaf-scar infections. Spray applications were also planned for days when no rain was forecast for the following 24 hours.

The biocontrol agent Serenade ASO (*Bacillus subtilis* strain QST 713) was inconsistent, and alternating with Cuprokylt gave no improvement compared to Cuprokylt alone. Tank mixing Cuprokylt with Dithane (mancozeb) and using a sticker (Nu-Film P) also gave no improvement compared to Cuprokylt plus Activator 90.

Cuprokylt should be applied as a protectant before disease symptoms are visible to reduce pathogen populations on leaves and plant surfaces. However its repeated use may select for resistant strains of the pathogen giving rise to inconsistent control.

The particular copper oxychloride product used in these trials (Cuprokylt) is formulated as a wettable powder. Other products containing copper oxychloride as the active ingredient (Cuprokylt FL and Headland Inorganic Liquid Copper) are likely to have similar efficacy, but are formulated differently. Thus the addition of a wetting agent may not be appropriate for these products. The label requirements and application rates also differ, but they can be applied in the nursery situation under the Long Term Arrangements for Extension of Use (LTAEU).

Disease diagnosis

Samples for disease diagnosis can be sent to plant clinics, including:

Fera, Sand Hutton, York YO41 1LZ. Website: www.fera.defra.gov.uk, e-mail: plantclinic@fera.gsi.gov.uk.

Plant Health Solutions Ltd., Ryton Gardens, Wolston Lane, Coventry CV8 3LG. Website: www.planthealth.co.uk, e-mail: clinic@planthealth.co.uk.

STC, Cawood, Selby, North Yorkshire YO8 3TZ. Website: www.stc-nyorks.co.uk, e-mail: enquiries@stc-nyorks.co.uk.

The Plant Clinic, East Malling Research, New Road, East Malling, Kent ME19 6BJ. Website: www.emr.ac.uk/plantclinic, e-mail: Plant.Clinic@emr.ac.uk.

Further information

HDC Factsheets and publications

HDC Factsheet 16/13. 'Bacterial diseases of herbaceous perennials'.

HDC Factsheet 04/10. 'Bacterial shot-hole of cherry laurel'.

HDC Grower summaries and reports

HDC Project HNS 179: 'Management of bacterial canker in *Prunus* species'.

HDC Project HNS 178: 'Bacterial diseases of herbaceous perennials'.

HDC Project HNS 91: 'Bacterial diseases of HNS: chemical control'.

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