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2.34 Fireblight (*Erwinia amylovora*)

Summary

Fireblight is usually associated with pears but it can be significant on certain susceptible apple varieties notably **Gala** and **Egremont Russet**, and on late flowering cider apple varieties – Vilberie and Brown Snout. **Young apple trees** are particularly susceptible.

First obvious symptoms are dead blossoms *(Figure 2.34.1)* or dark brown leaves hanging from a truss or branch. These result from spring or summer infection of blossom. The bark of diseased areas or branches (cankers) is dark-green or dark brown, often water soaked and with an indistinct margin between healthy and infected tissue.

Shoot infection on apple is characteristic – initially the tips wilt and droop without browning and at this stage golden droplets of bacterial ooze are often seen on the affected stem *(Figure 2.34.2)*. Later, leaves and stem become brown. Symptoms also appear on fruit as brown irregular blotches, resembling bruises or sun scorch.

During warm humid weather, a glistening whitish/cream bacterial slime may ooze from affected shoots, branches and fruits. In dry weather, ooze becomes desiccated and appears as a silvery film on affected surfaces.

Bacteria overwinter in orchard trees and in hedgerow hawthorn and susceptible ornamentals in adjacent gardens in bark tissue along the edges of cankers formed from previous year's infections. In spring these bacteria multiply and produce ooze.

In wet weather ooze spread by wind blown rain and insects infects flowers in spring or shoot tips. *E. amylovora* can also invade via wounds (especially young shoots damaged by hail or wind) and natural openings such as nectathodes, hydathodes, lenticels, leaf scars. The bacteria then invade the tissues giving rise to typical symptoms.

Fireblight risk is greatest when temperatures exceed 18^{o}C and there is rain. Disease development occurs between 5-30^{o}C with an optimum temperature of 27^{o}C.
There are no recommended chemical control measures.

Control is dependent on understanding the disease, prevention, vigilance and rapid action when symptoms are seen.

Make routine inspections for fireblight symptoms soon after leaf fall, during winter pruning, soon after bud break, about mid-June and in late July to early August.

Inspect young trees more frequently.

Make additional inspections: if there is frost damage to blossom, following damaging storms, following warnings of fireblight, or following reports of fireblight elsewhere.

Remove and burn diseased parts of young apple trees as soon as possible. Cut through healthy wood well below diseased wood to ensure thorough removal. On mature apple trees this might not be cost effective and is less urgent.

On twigs or shoots cut out 12 ins below stain; on branches (of 1 in or more in diameter) cut out at least 18 ins below stain. Start exploratory knife cuts in healthy tissue first and move up.

Disinfect tools between cuts and between trees preferably using a recommended disinfectant (3% Hycolin, Sudol or Clearsol). Thorough removal of plant residues from the tools is essential for maximum effectiveness of disinfectants.

Disease status

Fireblight is often overlooked, particularly on apples, because of its sporadic nature in the UK. Fireblight is usually associated with pears but it can be equally important on some apple varieties such as Gala and Egremont Russet which are particularly susceptible.

In 2000 in the USA (Michigan) a fireblight epidemic was responsible for the death of 220,000 apple trees 2-5 years in age. 240 hectares of orchards were lost at a cost of $42 million. The main variety affected was Gala on M26 rootstock.

The disease, which is caused by bacteria, requires special attention because there are no recommended chemical control agents.

Hosts

Major pome fruits – pear, apple, quince; ornamentals – hawthorn, contoneaster, pyracantha, stransvaesia (Photinia), white beam, mountain ash.

High risk apple varieties – Braeburn, Gala, Egremont Russet, Fuji, Ida Red, James Grieve, Jonagold. Late flowering cider apples e.g. Vilberie, Brown Snout.

Rootstocks – M.9, M.26 – see Table 2.33.3. In some warm climates, Gala on M.9 and M.26 is particularly susceptible with rapid stem invasion reaching to the rootstock.

Young trees are particularly susceptible.

The actual risk of attack on a particular host or variety is dependent on the season's weather and on the growth stage (e.g. spring blossom, late blossom, soft shoot growth coinciding with damaging storms) as well as inherent susceptibility.

Symptoms and recognition

First obvious symptoms in the orchard are dead blossoms *(Figure 2.34.1,* above*)* or dark brown leaves hanging from a truss or branch. These result from spring or summer infection of blossom.

The bark of diseased areas or branches (cankers) is dark-green or dark brown, often water soaked and with an indistinct margin between healthy and infected tissue.

Shoot infection on apple is characteristic – initially the tips wilt and droop without browning and at this stage golden droplets of bacterial ooze are often seen on the affected stem *(Figure 2.34.2,* above*).* Later, leaves and stem become brown.

Symptoms also appear on fruit as brown irregular blotches, resembling bruises or sun scorch. Ooze present in warm, humid weather.

During warm humid weather, a glistening whitish/cream bacterial slime may ooze from affected shoots, branches and fruits.

In dry weather, ooze becomes desiccated and appears as a silvery film on affected surfaces.

Other problems that may be confused with fireblight

Fireblight symptoms can be confused with other diseases on apple that result indeed blossoms or cankers, e.g., *Nectria* canker and blossom wilt (*Monilinia laxa f.sp. mali*) – see Tables 2.28.3 and 2.28.4. Most easily confused is blossom wilt, especially on cider apples. Usually the two are readily distinguished as blossom wilt is characterised by the striping on branches where the blossom wilt fungus is advancing from the dead blossom. However on cider apples, often the only symptom of blossom wilt is dead blossoms as the disease does not always progress into the spur. So, unless there is evidence of fungal sporulation or bacterial ooze on the blossoms, visual diagnosis is difficult. Also blossom wilt and fireblight may be present in the same cider orchard.

Disease cycle and epidemiology

Bacteria overwinter in orchard trees and in hedgerow hawthorn and susceptible ornamentals in adjacent gardens in bark tissue along the edges of cankers formed from previous year's infections. In spring these bacteria multiply and produce ooze.

In wet weather ooze spread by wind blown rain and insects infects flowers in spring or shoot tips. *E. amylovora* can also invade via wounds (especially young shoots damaged by hail or wind) and natural openings such as nectathodes, hydathodes, lenticels, leaf scars.

The bacteria then invade the tissues giving rise to typical symptoms.

Fireblight is favoured by warm moist conditions that promote rapid tree growth and high tissue water potential. Warm moist conditions favour inoculum spread, establishment of infection and rapid multiplication of bacteria in tissues. Disease risk is greatest when temperatures exceed 18^{o}C and there is rain. Disease development occurs between 5-30^{o}C with an optimum temperature of 27^{o}C. Free water on the host surface is essential for infection, but early in the season, during primary blossom, rain is not essential as dew may be sufficient to provide the surface wetness. A high level of soil moisture (rain or irrigation) is necessary to maintain high plant-tissue water potential to aid disease progression in the host.

Storms with strong winds or hail are important as they cause tissue damage and provide access points for bacteria and increase the risk of infection and rapid disease establishment.

Stem Blight (branches and trunks) usually follows blossom or shoot blight when stems are expanding rapidly in summer, especially on young trees. It is favoured by warm weather and high soil moisture and nitrogen.

Every year there will be fireblight on some trees of all hosts that is not noticed. These can be a dangerous source of inoculum in later years if they are not located and destroyed.

On hawthorns, individual trees sometimes have severe blossom blight though most trees remain disease-free. Infected trees can continue to harbour the disease in subsequent years and remain symptomless until weather conditions are favourable. Such trees can be important sources of the disease.

Factors which enhance the risk of fireblight

Inoculum – Fireblight infection not noticed or ignored in the orchard or apple or pear nursery or on nearby hawthorn or ornamental hosts especially cotoneaster and pyracantha.

Warm periods during primary apple blossom.

Late flowers or secondary blossom on apples.

Overlap of flowering between pears, apples, hawthorns or ornamental hosts.

Inoculum spread by bees and other insects visiting flowers.

Shoot and Fruit Blight – damaging storms with wind-blown rain at times of rapid shoot growth. Hail storms favour fruit blight. Inoculum spread by wind-blown rain from diseased to healthy trees.

Complacency – Ignoring fireblight as a potentially important disease of apples.

Disease monitoring and forecasting

There are no chemicals for the control of fireblight registered in the UK.

Monitoring and forecasting are therefore a vital part of fireblight prevention and control, which is based on early detection of symptoms and removal of affected tissue to prevent spread.

Because fireblight in the UK is sporadic, monitoring is best linked to weather, to identify risk periods when symptoms may be present, and field information.

Monitoring should also include nearby hawthorns and susceptible ornamentals.

Various fireblight-forecasting systems have been devised worldwide e.g., Maryblyte (USA), but the most reliable system for the UK is Billing's Integrated System 1995 or BIS95.

This system can be used manually from weather data collected daily from a reputable met. station. The BIS95 system has also been incorporated into ADEM. This is a PC-based system giving warnings of several diseases – apple scab, apple mildew and canker as well as fireblight. Weather data is recorded on a logger and downloaded to the PC
.
The BIS9 model in ADEM mainly concerns the effects of weather on infection of apple and pear by fireblight bacteria. When assessing risks, the first concern is the effects of weather on infection. However, because infection depends on other factors such as the availability and susceptibility of host tissues, inoculum level, presence of alternative hosts etc., risk days identified by ADEM are **potential** infection days, not necessarily days of actual infection.

It is therefore, vital that the BIS95 system is used in conjunction with field information and not alone. Its use is therefore quite different to that of scab and mildew models in ADEM.

When run, the model scans weather data and identifies potential infection risk days for blossom blight and shoot blight where young green tissue is infected. In this phase, the model assumes that neither host tissue susceptibility nor inoculum are limiting factors. Thus the model indicates days when weather was favourable for infection. For each potential infection day, the model also indicates the earliest date when early blight symptoms might be seen. This information is graphically displayed.

The date when symptoms might be seen is used to time field searches in at risk orchards, to spot infection as soon as possible to limit spread.

In addition to standard weather data, records should also be kept of host phenology and unusual weather, i.e., storms, wind and hail, which might cause damage to young shoots etc. and increase the fireblight risk.

BIS can also be used to time sprays during blossom if treatment were available.

Prevention and control of fireblight

The procedures described are equally applicable to organic production and conventional systems.

Fireblight prevention

- Maintain good disease control in orchard and nursery.
- Replace nearby hawthorns and susceptible ornamental hosts by non-hosts.
- Keep remaining hawthorns well trimmed to prevent flowering.
- Avoid pear and apple varieties which produce late flowers (after the main blossom period) or secondary blossom in summer or autumn. Remove secondary blossom if practical.
- Do not plant cold-stored trees late, because they may subsequently flower late.
- Avoid soft shoot growth induced by excessive irrigation, poor soil drainage, or unnecessary use of nitrogen fertilizer.

Fireblight control

Learn to recognise fireblight, and distinguish it from other diseases such as *Nectria* canker (apple and pear), *Monilinia* blossom wilt (apple) and *Pseudomonas* blossom wilt (pear). (See Tables 2.28.3 and 2.28.4).
Make routine inspections at the following times:

- soon after leaf fall – fireblight-infected shoots do not drop their leaves so are easily visible after leaf fall
- during winter pruning
- soon after bud break – fireblight-infected shoots fail to leaf out
- about mid-June
- late July to early August
- Inspect young trees more frequently.
- Make additional inspections:
- if there is frost damage to blossom
- following damaging storms
- following warning of fireblight (some local warnings are issued by East Malling Research via consultants)
- following reports of fireblight elsewhere

Limit stem invasion by removing and burning diseased parts of all pear trees and young apple trees as soon as possible. Cut through healthy wood well below diseased wood to ensure thorough removal. On mature apple trees this might not be cost effective and is less urgent.

On twigs or shoots cut out 12" below stain; on branches (of 1" or more in diameter) cut out at least 18" below stain. Start exploratory knife cuts in healthy tissue first and move up.

Mark affected parts of trees with coloured plastic streamers to check the success of control measures later.

Disinfect tools between cuts and between trees preferably using a recommended disinfectant (3% Hycolin, Sudol or Clearsol).

Thorough removal of plant residues from the tools is essential for maximum effectiveness of disinfectants.

Additional Advice:

- Purchase trees from a reliable source.
- Avoid planting young trees near hawthorns.
- Remember fireblight may be difficult to spot in a hawthorn hedge as only one or a few trees may be diseased.
- Avoid overhead irrigation; it increases fireblight risk.
- Avoid pruning young or nursery trees in summer.
- Summer prune orchards only in dry weather.
- Cut out diseased parts only in dry weather.
- Pay particular attention to fireblight warnings if:
- temperatures are 21^{o}C or more during bloom
- temperatures during or shortly before bloom are –2^{o}C or less

- damaging storms occur
- Check for bark rubbing by tree ties.

Limit beehive use.

Chemical control

In other countries where fireblight is prevalent, preventative sprays of copper or antibiotics are applied during high risk periods, generally in bloom. Copper compounds are phytotoxic and none are recommended for use on apples after bud burst. The use of antibiotics is not permitted in the UK.

Biological control

There is considerable research in other countries on biological agents for control of fireblight. Four products are commercially available in the USA:
Pseudomonas fluorescens strain A506 (Blight Ban)
Pantoea agglomerans E325 (Bloomtime Biological FD)
Bacillus subtilis strain QST 713 (Serenade Max)
Bacillus pumilis strain QST 2808 (Sonata)
Usually they are applied during bloom in conjunction with blight warnings and as part of an integrated programme. They are usually not reliable enough to be used alone. Currently only Serenade is available for use on apple in the UK and recent HDC-funded trials on pears have shown that Serenade gave some control of fireblight when applied frequently starting at bud-burst.

Other chemical control

Prohexadione-calcium (Regalis) - is a growth regulator that reduces shoot growth on apples by inhibiting gibberellin biosynthesis. When used on apple to control shoot growth it also reduces the incidence and severity of fireblight shoot infection. Regalis has no direct bacterial action but increases host resistance by reducing plant vigour and also by altering phenylpropanoid biosynthesis pathways that enhance host resistance. Regalis is applied in late bloom to suppress shoot growth so its main effect is on secondary fireblight rather than on primary blossom infection.

Other host resistance-inducing chemicals – Products containing harpin (PreTect, ProAct, Messenger) have various effects on plants improving the quality of fruit. They also stimulate the defense system of the plant and increase resistance to disease. Such treatments need to be applied pre-bloom to stimulate resistance to primary blossom infection. The effects tend to be short lived so repeated applications are needed. PreTect is available in the UK and its effects on fireblight are currently under evaluation. Trial results in the USA have been promising.

Further reading

Most of the information is taken from Apple and Pear Research Council News, Issue 10 April 1996.