Phytophthora Bleeding Canker of Horse Chestnut

Joan Webber, Forest Research

ABSTRACT

Bleeding canker of horse chestnut appears to be caused by two species of *Phytophthora* – *P. cactorum* and *P. citricola*. Reports of this disease have risen greatly over the past few years although the reasons for the increased incidence are unknown. Symptoms of horse chestnut bleeding canker are described, but little is known about the epidemiology or infection process. The disease is also compared with other Phytophthora diseases including Phytophthora root rot and Sudden Oak Death caused by *Phytophthora ramorum*.

INTRODUCTION

Over the past four or five years, reports of a disease of horse chestnut trees (*Aesculus hippocastanum*) known as 'bleeding canker' have increased markedly in the UK. The disease is caused by the pathogen *Phytophthora* and was first noted in the USA in about 1930 (Caroselli, 1953). It was not observed in the UK until much later in the 1970s (Brasier and Strouts, 1976). Symptoms include visible cankers on the stem and occasionally on the scaffold branches of infected trees. If these are extensive it can lead to the death of the tree.

The reason for the increased incidence of bleeding cankers on horse chestnut is unclear, although it may be weather related. The more frequent occurrence of mild winters and wet springs could increase the likelihood of infection. Trees of all ages have been found with the disease, but the impact is probably most striking on large, mature trees. Until recently, the disease was considered to be uncommon and had only been reported from the south of England (Strouts and Winter, 2000). However, in 2003/04 more than 50 reports of the disorder were reported to the Disease Diagnosis Advisory Service of Forest Research, some in locations as far north as Lancashire and Glasgow.

Recently, diagnosing this disease on horse chestnut has been complicated by the appearance of a new pathogen known as *Phytophthora ramorum*, the cause of Sudden Oak Death in the USA. *P. ramorum* has been found mainly in nurseries in the UK and is now listed as a quarantine organism under EC plant health legislation. In a few instances, *P. ramorum* has been found to cause bleeding stem cankers on certain tree species in the UK (Brasier *et al*., 2004). Consequently, any horse chestnut with bleeding cankers is suspected of being infected by *P. ramorum*. However, bleeding canker of horse chestnut is caused by other species of *Phytophthora* although the symptoms can be very similar to those caused by *P. ramorum*.

Many tree species including horse chestnut may also suffer from Phytophthora root disease, particularly on sites which are liable to be wet. In these instances *Phytophthora* infects the roots and the root collar but the lesions may extend upwards by as much as 1-2m and be visible as bleeding areas on the tree trunk. This type of stem lesion, connected to a root infection, is distinct from the aerial lesions that can be caused by *P. cactorum* and *P. citricola.*

EXTERNAL SYMPTOMS

Trees which have been affected for some years may show crown symptoms (**Fig. 1**). However, initial symptoms are the characteristic bleeding canker. Scattered drops of rusty-red, yellow-brown or almost black gummy liquid ooze from small or large patches of bark on stems or branches of infected horse chestnut trees (**Fig. 2 and 3**).

Figure 1 Crown thinning on a mature horse chestnut suffering from bleeding canker. Other crown symptoms can include yellowing and reduction in leaf size, as well as crown dieback.

The exudate can run some way down the tree, but usually dries as dark coloured, brittle crust near the exit point in the bark. The centre of the weeping patch of bark may be cracked. In time, fruit bodies of wood-rotting fungi may also appear on the surface of the dead bark.

Figure 2 Rusty–red, yellow-brown liquid oozing from bleeding cankers in the upper part of the stem.

Over several years the fungus can gradually become extensive in the phloem and cambium of the tree and girdle the entire stem or branch. Crown symptoms become visible when the lesions are large, consisting of yellowing and thinning of the crown, and eventually crown death. In some cases, part of the crown will fail to flush, and later in the year the remaining foliage withers and dies.

INTERNAL SYMPTOMS

The inner bark (phloem) under the oozing patches is usually dead, with a watery orange-brown colour which is often clearly mottled or zoned (**Fig. 4**). The edges of the lesion margin tend to be paler with a water soaked appearance. The wood may be stained blue-black.

Sometimes white fungal mycelium can be seen under the dying bark but this is indicative of *Armillaria* (honey fungus) or other decay fungi and not *Phytophthora*. In some instances *Armillaria* is the primary pathogen, but if the bark has been invaded by *Phytophthora* it may also be colonised by *Armillaria* later on. In these instances it is rarely possible to isolate *Phytophthora* from the infected bark.

CAUSAL AGENT

Two species of *Phytophthora* have been found to cause the bleeding cankers - *P. cactorum* and *P. citricola*. Both are widely distributed species of *Phytophthora* with a broad host range, which includes many tree genera (Erwin and Ribeiro, 1996). With horse chestnut they have been isolated from inner bark taken from the edge of bleeding cankers. However, the liquid that bleeds from the cankers does not yield any *Phytophthora*.

Figure 3 Black gummy liquid oozing from small or large patches of bark on the stem of an infected horse chestnut tree.

INFECTION PROCESS

Both *P. cactorum* and *P. citricola* can cause Phytophthora root disease and they are frequently isolated from soil and the fine roots of various tree species. However, they also can produce aerial lesions which give rise to the bleeding cankers on horse chestnut that are unconnected with root infections. This suggests that both Phytophthoras can also cause direct infection of bark, apparently in the absence of any wound or injury.

The process of disease infection and development has not been elucidated, but by analogy with other Phytophthoras it is likely that under suitably mild and wet conditions in spring, spores are produced and then spread via rainsplash and aerial misting to above ground parts of the tree. Here the spores germinate and infect the bark. In culture both species produce at least two spore types. Some spores are produced asexually – these consist of zoopores (motile, swimming spores) which tend to be short-lived and ephemeral. In addition, both species are homothallic (self fertile) and can reproduce sexually, producing spores known as oospores. These spores may allow Phytophthoras to persist for long periods in soil. However, it is probably the zoopores that initiate infections in trees.

Figure 4 Inner bark (phloem) under the bleeding patches is usually dead, with a watery orange-brown colour which is often clearly mottled or zoned.

CONTROL MEASURES

Effective control measures have not been developed, but Strouts and Winter (2000) report that if the cankers are small, it may be possible to excise the infection by cutting out all the dead and necrotic bark. They recommend that the cutting blade should be sterilised and a strip of bark at least 5cm wide from around the periphery of the canker is also removed. All excised bark should then be collected and burned.

If cankers become so extensive that the entire trunk is girdled, death is inevitable and the dead tree will have to be removed. If major branches are affected and show dieback they should be removed, because recently dead branches of horse chestnut may be susceptible to sudden fracture and drop as the wood dries out. Advice on the best time of year to prune is given in Arboriculture Note 117 (Lonsdale, 1993). However, trees with trunk infections do not pose an immediate safety risk and individuals may survive for many years with healthy crowns as disease progression can be very slow or even cease.

OTHER HOSTS

Apart from horse chestnut, bleeding canker caused by *P. cactorum and P. citricola* has also been recorded on lime (*Tilia*). Interestingly, there has not been an increase in the number of reported cases on lime in the way that there has been for horse chestnut. In the USA, the same fungi have also been found to cause bleeding cankers on *Acer* (maple), *Betula* (birch), *Liquidambar* (sweet gum), *Quercus* (oak) and *Salix* (willow) (Strouts, 1981).

PARALLELS WITH *PHYTOPHTHORA RAMORUM*

Currently, *P. ramorum* has been found causing bleeding cankers on around 10 trees at 4 different locations (http://forestry.gov.uk/pramorum). In all cases, the trees have been found close to rhododendrons which have foliage infected with *P. ramorum*; these have probably been the source of the disease for the trees (see Path News 6; http://www.forestry.gov.uk). In addition, the climate in these locations is mild, influenced by the nearby coast, with moisture laden winds that probably help to spread spores *of P. ramorum* and increase opportunities for infection. One of the affected trees is a horse chestnut, but the infected trees tend to be beech (*Fagus sylvatica*).

Unless a horse chestnut with bleeding cankers is in a location where a source of *P. ramorum* disease, such as infected rhododendrons, is nearby then the likelihood of infection by *P. ramorum* is negligible. Instead the most likely cause of the bleeding canker will be infection by *P. cactorum* or *P. citricola*. However, if it is suspected that a tree is suffering from a disease caused by a quarantine organism such as *P. ramorum* then inform the Plant Health Branch, Forestry Commission (01313146414) or plant.health@forestry.gsi.gov.uk

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FURTHER ENQUIRIES ABOUT THIS DISEASE SHOULD BE ADDRESSED TO:

Joan Webber, Forest Research
(joan.webber@forestry.gsi.gov.uk)

OR

Disease Diagnosis Advisory Service, Pathology Branch, Forest Research, Alice Holt, Farnham Surrey: ddas.ah@forestry.gsi.gov.uk

Disease Diagnosis Advisory Service, Pathology Branch, Forest Research,
Northern Research Station, Roslin, Midlothian:
ddas.nrs@forestry.gsi.gov.uk