Managing *Pseudomonas* Bleeding Canker of Horse Chestnut

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INTRODUCTION

Over the past few years, *Pseudomonas* bleeding canker caused by the bacterial pathogen *Pseudomonas syringae* pv aesculi (*Pae*) has become a serious and widespread problem of horse chestnut trees (*Aesculus hippocastanum* L.) in the UK. Symptoms of infection include a characteristic bleeding canker where drops of orangey-red, yellow-brown or black gum exudate from lesions of bark on stems or branches of infected trees (Figure 1). With time further symptoms include a reduction in shoot growth; small leaves, thinning of the crown, twig and branch dieback, bark cracking and splitting (Figure 2).

Since our knowledge regarding biology, epidemiology and management of *Pae* is limited then information on strategies that can be employed to suppress or ideally control this problem are now required. However a key point is that on occasion infected trees have been shown to recover and survive *Pae* attack. Although the underlying reasons for this are uncertain, it may be linked to overall tree health. This indicates that horse chestnut trees have the capacity to survive *Pae* infection. This therefore indicates that two approaches may be considered for suppressing disease: (1) employment of conventional plant protection techniques that rely heavily on treating the pathogen with specific biological or chemical agents; or (2) identifying management strategies designed specifically to increase tree vitality and so provide the tree with every opportunity to recover from *Pae* infection on its own merits. The following guidelines for Pae management are therefore recommended.

SOIL DECOMPACTION

Soil compaction affects the pore space allocated for water and oxygen within the soil structure that in turn creates an environment sub-optimal for root growth. Compacted soils do not readily absorb water or allow for water drainage. There is less air to provide oxygen to the roots and carry carbon dioxide away, and there are fewer spaces for roots to grow. A bulk density ≥1.34 is associated with impeded root growth. If bulk density of a site is higher than this value then soil decompaction should be undertaken using an air-spade to cultivate the soil to a minimum depth of 15-25 cm. Ideally the whole tree rooting area below the canopy drip line should fully air-spaded and decompacted. If resources are limited the area below the canopy drip line be partitioned into eighths and four of the eight sections decompacted. In addition the area 3 x diameter at breast height should be fully air-spaded and decompacted.

FERTILISATION

Optimal nutrition is an important means with which to improve tree vitality. Trees suffering from nutrient stress in general tend to be less able to defend themselves from insect and disease attack. Based on the results of a soil analysis the correct fertiliser nutrient content should be matched to any deficient elements to ensure that only the proper nutrients at the appropriate concentration are applied to correct the deficiency. The choice of fertiliser used to remediate a nutrient deficiency however is a key point in the management of *Pae*. Potassium phosphite is **strongly** recommended as this fertiliser has been shown to stimulate tree vitality and in turn enhance resistance against a wide range of tree fungal and bacterial diseases.

DRAINAGE

Water is essential for plant growth. However, either too little or too much water can result in decline and death of plants. When soils retain too much water, or restrict water movement through them, the result can be root de-oxygenation, root disease, and eventual root death. On poorly drained sites plants may not die, but instead show chronic decline symptoms (leaf chlorosis, defoliation, marginal scorching, dwarfed foliage, crown dieback). Trees and shrubs experiencing root decline from excess water are also more susceptible to attack and invasion by diseases and insects. The site internal soil drainage should be assessed using a percolation test and drainage applied if necessary. Likewise to ensure drainage site conditions remain suitable for healthy plant growth soil moisture probes should be used to monitor the soil water status.

MULCHES

Benefits of mulches include minimising fluctuations of soil temperature and soil moisture, thus inducing root growth, weed suppression, enriching the soil with nutrients, regulation of pH, inducing soil microbial activity and improving aeration. In addition mulches can prevent mower and strimmer damage to the tree trunk and act as a buffer in preventing excess de-icing salts from percolating into the soil to around the root zone. There is also a growing body of evidence that mulches offer potential for suppressing a range of soil borne diseases such as rhizoctonia, fusarium, pythium and *Phytophthora*. Allelochemicals as a result of mulch degradation may possess fungicidal and bacterial properties. Although the impact of mulches on *Pae* canker is unknown the widespread positive benefits of mulches indicate that they should always be considered as part of a management strategy for improving tree vitality and consequently as a means of managing *Pae* infection.

CONTROL OF HORSE CHESTNUT LEAF MINER (HCLM)

HCLM can cause severe destruction of the leaves of many horse chestnut trees. Research at the University of Reading has shown that HCLM infestation has a detrimental impact on tree health and control of HCLM to as great a degree as possible will be beneficial in aiding tree recovery from *Pae*. Studies on energy loss of horse chestnut trees infested with HCLM in the UK

calculated whole tree energy loss to range between 37-41%. Likewise in a separate experiment at the Bartlett Tree Research Laboratory and Reading University bleeding canker lesions were larger in size in saplings inoculated with *Pae* where HCLM was not controlled compared to saplings where HCLM was controlled. HCLM damage can be partially reduced by removing fallen leaves during the autumn and winter and then either composting them thoroughly or burning. Bark and canopy sprays of diflubenzuron an insect growth regulator sold under the trade name Dimlin Flo can achieve 80-100% control if the whole canopy can be sprayed. Admire is a soil applied insecticide registered for the control of amenity pests to include HCLM. Mode of delivery of Admire is via a soil injection or root drench.

SUMMATION: MANAGEMENT PROGRAMME FOR THE SUPPRESSION OF *PAE* BLEEDING CANKER

The key factor regarding *Pae* management is understanding that on occasion infected trees can recover and survive. Management strategies should therefore be aimed at promoting tree vitality i.e. treat the patient and not the disease. This should be achieved by:

1. Inspecting for any external symptoms that could induce stress in trees i.e. new building construction and remediate if necessary.
2. Ensuring optimal tree nutrition. Sample soils for nutrient and pH levels based on a soil nutrient analysis and fertilise with the appropriate soil nutrients.
3. Apply a suitable product to control HCLM. HCLM attack can reduce a horse chestnut tree energy budget by 30-40% that potentially can influence the energy available for defensive metabolite production.
4. Apply organic matter such as an under composed wood mulch to a 5-10cm depth. Ideally mulches should be applied to 1m beyond the canopy drip line if possible.
5. Guard against over and under irrigation. Use soil moisture levels to ensure soil water status is optimal for tree growth.
6. Soil de-compact if soil bulk density values are ≥1.34 using an air-spade to stimulate root growth.

Fig 1. Bleeding cankers and lesions

Fig 2. Symptoms of *Pae* on trees