Forestry Commission

Tree death in poplar plantations, summer 2005

Summary

The poplar varieties Hoogvorst and Hazendans suffered from widespread death and decline at a number of sites in 2005 despite performing well in previous years. This note describes the symptoms observed, discusses possible causes and lists poplar varieties currently unaffected.

Background

1. When first released onto the commercial market the *P. Trichocarpa* x *P. deltoides* poplar varieties 'Beaupré', 'Hoogvorst' and 'Hazendans' were resistant to all known forms of the rust fungus *Melampsora larici-populina.* In 1994 a new pathotype of this fungus, known as 'E4' and able to infect Beaupré, first appeared in Europe and the UK. In 1997 a second new pathotype, later known as 'E5', able to infect 'Hoogvorst' and 'Hazendans', was discovered. Infection was initially observed in research plots of short rotation coppice growing in southern England. The very dense canopy and close spacing in short rotation coppice plantations was thought to provide ideal conditions for these pathotypes. It was thought that plantations of single-stem trees grown at wider spacing (4 m x 2 m and wider) would be less susceptible as air movement within the more open canopy would prevent very large loads of the fungus from developing.

2. *Melampsora* spp. are quite easy to identify in the field. Infected leaves are generally covered in bright orange rust pustules. During very heavy infections more than half of a tree's leaf area may be covered in these pustules. Often, leaves are more heavily infected at the bottom of the canopy than at the top. Figure 1 shows *Melampsora* spp. pustules on both sides of poplar leaves.

Figure 1 *Melampsora* spp. rust pustules on poplar leaves.

3. *Melampsora* spp. affects trees in different ways. Leaves on infected trees shrivel and fall prematurely. *Melampsora* spp. can also interfere with the frost tolerance characteristics of some host species. A combination of these effects can lead to seriously reduced increment, shoot dieback or tree death, depending on the timing and severity of the infection. Infection early on in the growing season (mid to late July) has a more pronounced effect than infection in August or September. Up until 2005, 'Hoogvorst' and 'Hazendans' have grown vigorously at many sites despite suffering rust infection late in the growing season.

Current situation

4. In summer 2005 several growers reported that large areas within blocks of 'Beaupré', 'Hoogvorst' and 'Hazendans' were dead or dying while other poplar varieties growing on the same site remained healthy and vigorous. Affected trees had either failed to flush in the spring or had flushed but had gone into decline or died soon after despite performing well in previous years. Site visits confirmed these observations. Many trees suffered extensive dieback in the canopy and also along the main stem. Digging these trees up revealed dead root systems exhibiting the blue/black coloration often associated with water-logging, despite soil conditions being relatively dry. Dead tissue extended from the root system along the lower portion of the main stem. This often resulted in a narrow band of live stem wood sandwiched between a dead canopy and dead root system. These areas of dead tissue, or lesions, were generally very sharply defined (Figure 2). Foliage, stem and root tissue samples were analysed by Forest Research pathologists. This confirmed that foliage had become infected with *Melampsora larici-populina.* Currently, only opportunistic and commonly found saprophytic species of fungus have been isolated from the root samples.

Figure 2 The sharply defined border between live and dead tissue on a young poplar in serious decline.

5. All of the circumstantial evidence collected to date suggests that the most likely cause of the symptoms observed is infection by *Melampsora larici-populina.* Why these varieties should have been so badly affected this year is unclear. It may be a cumulative effect of rust infection in previous years or it may be due to the occurrence of another more virulent pathotype. Weather conditions could have played a part although the sites affected cover a relatively large area of the country. Although the standard of management varies considerably between the sites affected, it is not thought that poor management or neglect had contributed to the scale of decline and death observed.

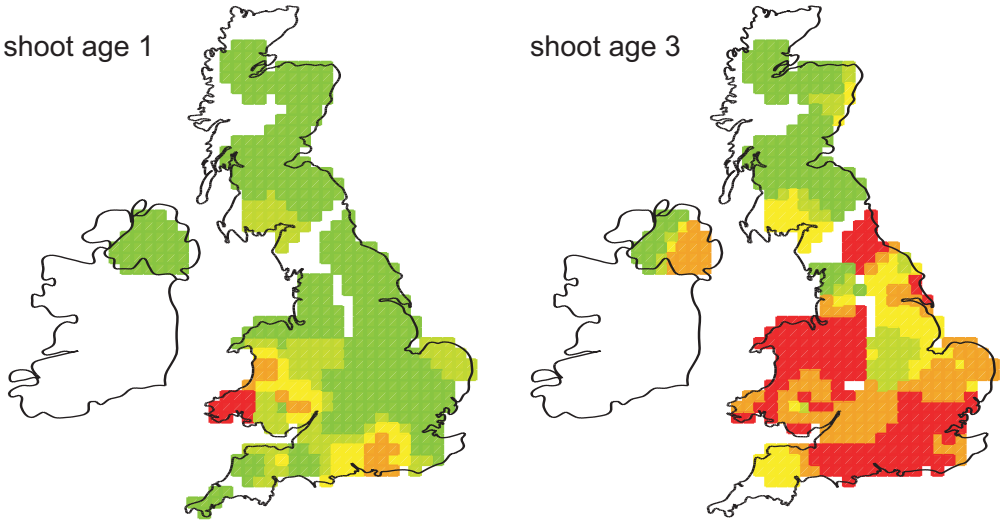
6. The rate of decline and subsequent death of the trees affected has been so rapid that growers have had little chance to take any action to reduce the number of trees lost. The plantations affected are young (up to five years old), with relatively open canopies. Consequently it is debatable whether additional pruning or the use of a wider spacing would have reduced the level of damage sustained. Pruning and thinning are important elements in the silviculture of poplar if veneer quality butts are to be produced. However, earlier guidance that such operations would also reduce vulnerability to rust is no longer on firm ground, especially when poplar varieties that have become susceptible to *Melampsora* spp. are considered.

7. Establishing several poplar varieties from different parent species planted in small monoclonal blocks gives some protection against total crop failure in the event of a pest or disease attacking specific varieties. This is apparent at the sites affected this year, although some varieties have died, others are growing well and remain healthy. Mixtures are likely to be most effective in the long term if the component varieties are disease tolerant rather than disease resistant ('tolerance' here implies that although the pathogen can infect the host plant only superficial damage is caused). Disease tolerance is generally controlled by many genes and is more stable than outright disease resistance, which tends to be controlled by a single gene, as is the case with the previously resistant varieties discussed here. The consequence of 'single gene resistance' is that small changes in the pathogen can overcome this defence with serious results. Currently, tolerant varieties are generally either *P. deltoides* x *P. nigra* hybrids or *P. trichocarpa* varieties. If susceptible varieties are planted, or varieties become susceptible in subsequent years, even small (~1 ha) blocks of widely-spaced trees can become heavily infected with rust. It is not therefore possible to give guidance on optimum block size or on the optimum number of varieties to include in new planting schemes. It is likely that where blocks of susceptible varieties have suffered this year more trees will be lost in subsequent years.

8. Most cases of widespread death and die back in commercial blocks of 'Hoogvorst' and 'Hazendans' have occurred in south and southwest England. Observations made in short rotation coppice trials suggest that the 'E5' pathotype is spreading east and north. The E4 pathotype, capable of infecting 'Beaupré', also spread east and north over time. This pattern is clearly seen using data collected from 49 short rotation coppice trial sites, each planted with Beaupré in the mid-1990s. Figure 3 illustrates changes in the distribution and intensity of *Melampsora* spp. rust infection in 'Beaupré' over a three-year period. Rust infection on other poplar varieties remained at consistently low levels over the same time period. Dark green areas are rust-free, light green, yellow, orange and red areas represent 'light', 'moderate', 'severe' and 'very severe' levels of rust infection respectively. This evidence strongly suggests that 'Hoogvorst' and 'Hazendans' in plantations that are currently healthy may not remain so in the future.

9. *Melampsora larici-populina* has a 'secondary host' in which it spends part of its infection cycle – this is larch. Stands of larch often harbour large populations of the pathogen which can lead to heavy infection on poplar stands planted close by. It is advisable to establish poplar plantations at least 500 m and ideally more than 2 km away from the nearest larch trees to reduce this effect. Poplar and larch should not be mixed in the same planting scheme.

Figure 3 Modelled distribution of *Melampsora* spp. rust infection in one-year-old and three-year-old Beaupré managed as short rotation coppice.



Varieties that are currently not affected, future guidance and contacts

10. As a result of our investigations this year we can no longer recommend the use of 'Beaupré', 'Hoogvorst', 'Hazendans' and 'Boelare' in either new woodlands or when gap filling ('beating up') in existing plantations. It is very likely that these varieties will not survive to form a useful final crop. The Forestry Commission no longer maintains an approved list of poplar varieties and no variety can be guaranteed to remain rust-free. However we can advise that at the time of writing, the varieties 'Ghoy', 'Gaver', 'Gibecq' (all *P. deltoides* x *P. nigra* varieties) and 'Trichobel' (a *P. trichocarpa* variety) continue to perform well and have not suffered from the problems described here. Many other poplar varieties exist but information on their performance in the UK is limited in many instances.

11. The relationship between disease-causing organisms and their host species is dynamic. The situation described here may change as information from more sites is collected. As a result further information on this subject may be issued.

12. For information on how grant schemes take into account tree losses in poplar plantations similar to those described here, contact your local Forestry Commission office. Details can be found at **www.forestry.gov.uk**. Alternatively, contact one of our national offices:

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