Honey Fungus in Ornamental Plantings

Its status, biology and control

The root disease known as Honey fungus is one of the commonest causes of death in ornamental trees and shrubs in this country. However, it is far from being the only such cause and its reputation as a destroyer of gardens has been exaggerated. It is undoubtedly a serious disease, and can be quite devastating in some situations, but most commonly it kills only occasional trees and shrubs. Moreover, once identified, there are often practical measures that can be taken to limit or prevent further damage.

The disease can be caused by one of several *Armillaria* species which are known collectively as Honey fungus or *'Armillaria mellea'*. These fungi exist by decaying stumps and roots and can spread from them through the soil to infect and kill healthy roots. Honey fungus is endemic in broadleaved woodland and hence the disease is prevalent in gardens close to existing or former woods and hedgerows where old stumps or infected trees remain. It is also a common problem in long-established gardens and arboreta.

A few tree and shrub species are very resistant to the disease but most are susceptible to some degree, particularly when small, and even very large specimen trees are sometimes killed.

The fungus is particularly damaging to lilac, privet, apple, many flowering cherries,willow,birch,walnut, the true cedars (*Cedrus*), the cypresses, Western red cedar (*Thuja plicata*), Monkey puzzle and Wellingtonia among the commoner ornamental species, though it also attacks many others from time to time, especially if these are stressed by, for example, drought.

The Fungus and the Disease

Honey fungus belongs in the group of fungi whose spores are produced from fruit bodies of the mushroom kind, the *Agaricaceae* or agarics. For many years Honey fungus was considered the single variable species, *Armillaria mellea*. It is now known, however, that in Europe '*A.mellea'* consists of at least five distinct species of which the commonest found in this countryto date are *A.mellea*, *A. ostoye* and *A. gallica* (= *A. bulbosa*).

These species differ in pathogenicity and in host preference. *A. mellea* and *A, ostoyae* are highly pathogenic and can invade entirely healthy trees of many species, though *A. ostoyae* is more often found on conifers than on broadleaves. Accumulating evidence strongly suggests that *A. gallica* rarely attacks living trees and shrubs unless they are already debilitated by, for example, drought, inset defoliation or another disease - stresses which would also facilitate infection by a *A.mellea* and *A. ostoyae*. All three species are also able to colonize freshly cut stumps and other buried wood such as fence posts.

Small plants may be killed a few months after infection. Large trees may survive for many years, though the progressive death and decay of the roots renders them increasingly liable to windthrow.

In autumn, the fungi sometimes, though by no means always, produce toadstools. Those of the various *Armillaria* species are difficult to differentiate from each other but the following features, taken together, distinguish them from the toadstools of other garden fungi:

Habit: usually in clumps on or near stumps or trees

Size: 75mm-50mm tall, caps 50mm-150mm across.

Caps: yellowish-brown or brownish, often the colour of thick honey; smooth, scurfy or scaly.

Stalk: with a ragged whitish collar near the top

Gills: clearly joined to the stem and may run a little way down it,

Spores: white or cream in colour.

The spores may be visible as a whitish coating on surfaces beneath the caps, but if not their colour may be checked by cutting the cap from a fresh toadstool and placing it gills down on a dark piece of paper in still air. In a few hours, enough of the microscopic spores will be deposited for their colour to be evident. Toadstools with differently coloured spores are not Honey fungus.

While long distance spread of the disease may sometimes result from the dissemination of these airborne spores, destruction of the toadstools has no effect on local spread since this is by means of subterranean strands called rhizomorphs.

Rhizomorphs are dark reddish-brown or black, root- like structures and can indeed be very difficult to distinguish from roots. They vary from one or two to several millimeters in thickness and may be cylindrical or flattened, like shoe laces. Rhizomorphs develop mainly in the upper few inches of the soil. They may reach many feet in length but only the growing tips are infective. If a rhizomorph tip encounters and infects a living root, whitish sheets of fungal tissue form and spread in and particularly beneath the bark, killing it. At the same time, microscopic threads (hyphae) of the fungus penetrate the woody tissues of roots, and sometimes the stem base, feeding on and consequently decaying them. New rhizomorphs will eventually grow out from the infected root system and, in time, a widespread network of interconnecting rhizomorphs develops in the ground. If cut through rhizomorphs usually produce several new infective growing tips from each cut end, but any portion of the rhizomorph network detached from its woody food source will soon lose its infective ability and die.

External Disease Symptoms

Some or all of these symptoms may occur:

- Death of woody plants in ones or twos at any time of year. This may follow a reduction in number and size of leaves and a change in their colour from green to yellowish in preceding years, and branches may have died back.
- Occasional deaths over the years of plants in a small area, or the successive deaths of adjacent plants in a hedge.
- The exudation of a gummy or watery liquid from the lower stem of broadleaved trees, or resin from conifers.
- Toadstools of the fungus on or near dying or recently killed plants.

The following symptoms usually do not indicate Honey fungus attack:

- Death of numerous shrubs, trees or herbaceous plants within a short time.
- Death or decline of trees or shrubs planted within the previous 12 months.
- Death of scattered branches on otherwise healthy plants.

Despite the impression given by some accounts, the presence of rhizomorphs in the soil or even attached to live bark does not by itself constitute evidence of an *Armillaria* attack. The most conspicuous and prolific rhizomorphs are produced by *A.gallica*, the least dangerous of the three main *Armillarias*. They are tough, elastic and often abundant enough to be removed from the soil or leaf litter in handfuls. By contrast, rhizomorphs of *A.mellea* are delicate and hard to find, while those of *A.ostoyae* lie between these two extremes.

Diagnosis

Some other agents induce similar symptoms to those described above, but if Honey fungus is the cause, the fungus itself can usually be found beneath (and perhaps permeating) the bark it has killed. If crown symptoms are well advanced, at least part of the stem base and most of the major roots will probably be infected. In order to check this, examine the stem at soil level starting near any exudates or (in larger trees) between root buttresses. Cut right through the bark to the underlying wood with a stout knife or chisel. Lever or cut pieces of bark away from the wood so that the inner bark can be examined. (Note that the outer bark normally has a dead, brown appearance and in some trees, e.g. oak, Wellingtonia, birch, this outer layer on the stem can be very thick).

(i) **If the inner bark is dead and brown**, examine it for fungal tissue (mycelium). Honey fungus mycelium characteristically forms dense, coherent, conspicuous, white or cream-coloured, paper thick sheets sandwiched between the dead bark and the underlying wood. The sheets have a strong mushroomy smell and may, at least at their edges, have a fan like appearance. If dead bark without identifiable *Armillaria* mycelium is found, another root disorder may be involved and expert advice should be sought.

(ii) **If the inner bark is alive** (white, firm, its inner smooth and moist - if in doubt compare with a healthy tree), repeat the procedure at intervals right round the tree. If you still fail to find dead bark, it is worth repeating the process of examination 50mm-150mm below soil level, including the parts of major roots close to the trunk at that level.

(iii) **If dead bark cannot be found** close to soil level or on major accessible roots, examination of deeper roots may be attempted. However, it is unusual for *Armillaria* infection to be confirmed to deep roots in trees with readily visible crown symptoms and, in such rare cases, detection can be extremely difficult. Moreover, the necessary root excavation may itself have damaged the tree unnecessarily if the above ground symptoms prove to be transitory and caused by a non-lethal agent. Consequently if dead bark cannot be readily found it may be best to seek more expert advice.

Control of Outbreaks

No alteration in soil fertility, drainage, acidity or other growing conditions is likely to have any significant effect on the progress of the disease and, despite claims to the contrary, no chemical will cure infected plants; nor has a method yet been perfected to kill the fungus in stumps and large roots though current experimental work suggests that this may eventually be feasible.

To control an outbreak there is, therefore, no entirely satisfactory alternative at present to the complete removal or destruction of infected roots or stumps. In practice, this ideal is difficult to attain but a satisfactory degree of control may be achieved by adopting the measures suggested below as far as is practicable, accepting that further losses may occur now and then.

Some chemicals will kill the fungus in the soil and in small fragments of wood, so at first sight their use after the bulk of infected material has been removed looks attractive. However, the most effective chemical, carbon disulphide, is both extremely toxic and explosive. Moreover, in practice, pieces of infected wood small enough to be effectively treated by a safe, soil- applied chemical probably only constitute a small risk of re-infection, while detached rhizomorphs are a negligible such risk. In most circumstances, therefore, chemical treatment is probably superfluous after thorough excavation and unlikely to be effective otherwise. Similarly, if planting is delayed there is no benefit to be had from replacing the soil, or from sifting out every last fragment of infected wood.

Control on woodland. No control is practicable nor is it usually necessary. Forestry Commission Bulletin No. 100, “Honey fungus” gives further information. (See last paragraph in this information note).

Control in parkland. Plant replacement trees at least 10 yards and preferably 30 yards or more away from any stump and known source of infection. If this cannot be done, proceed as below for orchards etc.

Control in orchards, gardens and the like:

(i) Stump removal and Destruction

Locate and preferably uproot all infected trees and shrubs and any old stumps in the vicinity of an outbreak. In the case of hedges and rows of closely spaced trees, remove at least one apparently healthy tree from each side of an affected individual.

There is no simple way of removing stumps; methods which claim to burn, dissolve or rot them away are ineffective. Small stumps can be dug out by hand, but larger ones require the help of jacks, winches and excavators. It is usually far easier to uproot a tree by using its stem as a lever than to cut it down to the ground first and then to excavate the stump.

Stumps which cannot be dug out can, if access allows, be chipped or ground out with a machine designed for the purpose (see under Tree Work in the /Yellow Pages). Large unchipped pieces, particularly of the roots, often remain. These should be dug out.

The efficancy of these measures depends entirely on the thoroughness with which infected material is removed or destroyed: the larger and more numerous the remaining fragments, the greater and more prolonged the risk of reinfection. The mixture of chips and soil which remains after stump chipping probably constitutes little danger as a Honey fungus source but if it is not removed, replanting should be delayed for 12 months or until no rhizomorphs are to be found in the mixture.

If you know or suspect that larger buried segments of root remain after chipping or excavation, delay planting trees or shrubs within 30 yards of the excavation for at least 2 years, longer if possible. Annuals may be safely grown on the site meanwhile. Alternatively, replant with resistant species (see (iii) below).

If, despite the measure described above, further long-established plants die, they do not necessarily represent new infections; they may have been infected earlier but remained symptomless. These in turn should be completely removed.

(ii) Other Control Measures

Sometimes, because of their extent or location, sources of infection cannot be removed (e.g. an adjacent wood, or stump in a neighbour's garden). It may then be possible to prevent rhizomorphs from extending into planted areas by creating a physical barrier to their spread or by severing them periodically.

As far as possible, isolate the source of infection from the area to be protected by burying a sheet of heavy gauge PVC or polythene vertically between the two. It should extend from just above the ground for at least 450mm downwards, more in deep, porous soils. In siting the sheet, bear in mind that rhizomorphs radiate in all directions from infected wood, that large roots extend some distance from trees and

stumps, and that rhizomorphs may turn down and pass under the sheet if it is set at too shallow a depth.

Alternatively, to sever rhizomorphs, dig over a strip of any convenient width along a similar line as deeply as possible several times during the year; or insert a spade periodically all along the line to the requisite depth. (This procedure must continue until the stump has rotted away or the source of infection is removed.)

In some situations it may be convenient to maintain a ditch along a similar line and to dig over the bottom periodically.

(iii)
The Use of Resistant Species

On sites from which the fungus cannot be eradicated or excluded, avoid the use of particularly susceptible species (see Page1) and replant with resistant species. Observations and records indicate that the following trees and shrubs are resistant enough to the disease to make their planting in an infected area reasonably likely to succeed. Information on many other probably equally resistant species is insufficient for their inclusion here.

Abies grandis, Abies procera	Grand and Noble fir
**Acer Negundo*	Box elder
Ailanthus altissima	Tree of heaven
Arundinaria & allied genera	The bamboos
+ Buxus sempervirens	Box
Calocedrus decurrens	Incense cedar
+ Carpinus betulus	Hornbeam
Catalpa bignoniides	Indian bean tree
Cistus species	Rock roses
Clematis spp.	
Cotinus coggysria	Venetian sumach, Smoke tree
***+ Crataegus* spp	Thorns, including hawthorn
Elaeagnus spp	
Fagus sylvatica	Beech
Fraxinus excelsior	Ash
Hedera helix	Common ivy
***+ Ilex aquifolium*	Common holly
Juniperus	The junipers
* *Juglans hindsii*	Californian black walnut
Larix	Larch
Liquidambar styarciflua	Sweet gum
+Lonicera nitida	
+ Mahonia	
Nothofagus	Southern beech
Platanus x hispanica	London plane

+ *Prunus laurocerasus*	"Laurel", i.e. Cherry laurel
+ *Prunus spinosa*	Blackthorn, Sloe
Quercus spp.	Oak
Rhus typhina	Stag's-horn sumach
Robinia pseudoacacia	Locust tree, False acacia
Sorbus aria	Whitebeam
Tamarix spp	Tamarisk
+* *Taxus baccata*	Yew

+ Suitable for hedges

**Acer negundo*, *Juglans hindsii* and *Taxus baccata* seem to be virtually immune.

*** Crataegus monogyna* (Common hawthorn) and *Ilex aquifolium* have been found severely infected, but so rarely that they are worth trying except where they have already been attacked.

(iii) Where Satisfactory Control is Impossible

In these cases the area may safely be used for annual plants or lawns. As we have seen very few attacks on herbaceous perennials, these too may well be at little risk.

Prevention of Outbreaks

As it is very difficult to be sure that the fungus is absent from an apparently disease-free planted area, unwanted trees and shrubs and those killed by whatever agent should be uprooted or their stumps and roots destroyed by chipping if woody plants are to be grown within about 30 yards of them. The risk of infection from rhizomorphs at greater distances is probably very small.

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