

DISEASES OF FOREST AND ORNAMENTAL TREES

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slightly curved spores measuring $4.5 \times 1 \mu\text{m}$. As noted above, in Grove's opinion *L. platanoidis* was part of the life cycle of *Phyllosticta platanoidis*.

DISEASES OF THE BARK AND TRUNK

Sun scorch

Like other thin-barked trees, *Acer* spp. may be affected by sun scorch, which leads to the death of areas of bark on the south-facing sides of their trunks.

Sooty bark disease caused by *Cryptostroma corticale* (Ell. and Everh.) Gregory and Waller

The imperfect fungus *Cryptostroma corticale* has been found in the Great Lakes region in Canada and the USA, and in England, France and Germany (Anon, 1953; Plate and Schneider, 1965). In North America and in Germany it is known almost entirely as a saprophyte and as a cause of asthma (Towey *et al.*, 1932; Plate and Schneider, 1965). In Great Britain it was first noticed in 1945 in Wanstead Park in northeast London (Waller, 1952). Within a few years it appeared in many adjacent parts of Greater London, where strong circumstantial evidence suggested that it was the cause of a devastating wilt and dieback of sycamores (Gregory *et al.*, 1949). Surveys soon revealed its presence outside Greater London in Surrey, Essex and Hertfordshire, and further afield in Norfolk (Peace, 1955), and later as far north as Kettering, Northants (Pawsey, 1962). Beyond the London area, however, it was almost invariably a saprophyte on trees killed by some other agency (Peace, 1955). Not long after the discovery of the fungus in London, it was also found to be destroying sycamores in France, first in Paris, and later in Grenoble (Moreau and Moreau, 1954).

How the fungus reached Europe is unknown, though Gregory and Waller (1951) were of the opinion that it came to Great Britain in timber imported into London docks.

The causal fungus *C. corticale* has been most fully described by Gregory and Waller (1951). These authors considered it to be mainly an invader of the phloem and cambium, but it has more recently become apparent (Young, 1978) that the fungus first invades the woody tissues and then moves out to the cambium and bark at a later stage. It forms a thin, black stroma in the cambium, and one, or sometimes up to three, sporing stromata in the bark. The sporing stroma is at first a white mycelial sheet, but it splits parallel to the surface, to form a roof and a floor. These are separated by the growth of vertical columns, so that a shallow space arises, up to about 1 mm deep. Hence the affected area of bark is pushed up to form a blister. The roof, floor and the columns blacken as they mature. The floor is lined by a bluish-grey layer of conidiophores from the ends of which long fragile chains of spores are formed. These conidia are

one-celled, smooth, oval, brown when mature, and measure 4–6.5 × 3.5–4 μm. They fill the stromatic cavity in a sooty mass, and between them run sticky, unbranched capillitial threads attached to the floor. With time, the bark breaks up and falls from the affected trees, and the spores are exposed as a velvety layer that is gradually dispersed by the wind (plate 32). In France, Moreau and Moreau (1954) found the ascomycete *Eutypa acharii* associated with *C. corticale* on affected trees. In Britain, *E. acharii* has been found growing as a saprophyte on wood under the dead bark of sycamore, and may be mistaken for the cambial stroma of *C. corticale*. However, the perithecia of *E. acharii*, about 0.5 mm in diameter and embedded in the wood beneath a black layer, are very distinctive.

Symptoms of the disease Careful observation has shown that the first symptom of the disease is a wilting of the leaves of part of the crown of the tree. This wilting has been seen at varying times between May and September, and is followed by dieback of the affected branches (Gregory and Waller, 1951). The wilting leaves dry and their petioles droop, but they remain attached to the tree. The woody tissues inside a wilted branch are stained dark yellow or green. Later, at any time of the year, sporing lesions may be found, either as blisters or as open spore masses. The affected trees usually die within a few years. The disease is often first noticed only when the bark lesions are visible, and the affected tree fails to come into leaf in the spring. Inspection then shows dark vertical blisters on the trunk and branches. If the bark is then stripped off the blisters, a characteristic crackling sound may be heard as the stromatic columns break, and the brown spore mass is exposed.

On dead smooth-barked sycamores, the fungus may spread within the bark over the whole trunk, and as the bark breaks up and falls, the spores form a sooty deposit on the vegetation around (Gregory *et al.*, 1949). Sometimes, however, the sporing lesions may be high up in the crown, when they are difficult to see, and on thick-barked sycamores only small stromata a few inches across are formed (Gregory and Waller, 1951; Peace, 1955).

If a partly affected tree is cut up, a yellow or dark greenish-brown stain like that in the wilted shoots may be found in the heartwood, extending up and down the trunk, sometimes for the whole length of the stem and into the branches. Both the stain and the fungus may also be traced downward into the root system (Moreau and Moreau, 1951; Townrow, 1954). In places the stain extends into the sap wood and reaches the bark, and most of the stem blisters appear to form where the stain touches the cambium. Once the tree is dead, the stain disappears, leaving the wood a uniform grey colour (Gregory, *et al.*, 1949). 1949).

Host range *C. corticale* is known as a pathogen chiefly in Great Britain and France. There it is restricted almost entirely to sycamore, though it has also been found on field maple (*Acer campestre*), the Norway maple (*A. platanoides*) and (in France only) on the box elder (*A. negundo*) (Peace, 1955).

In North America it has occurred mainly as a saprophyte on maple logs (probably on *Acer saccharum*), though it was also recorded by Towey *et al.* (1932) on dying maples, hickories (*Carya* spp.) and basswoods (*Tilia* spp.).

Factors affecting the disease The most severe outbreaks of Sooty bark disease have occurred in and around Greater London, the warmest region in Britain, and have developed in years following particularly hot summers. Thus in the forty years up to 1980 very high summer temperatures occurred in 1947, 1948, 1955, 1959, 1975 and 1976 and disease outbreaks developed in the subsequent season or seasons. Young (1978) studied the meteorological data related to these years and concluded that the disease was likely to become acute in seasons following those where any summer month (June, July or August) had a mean daily maximum temperature of 23°C or more.

Observations by Townrow (1954) indicated that the fungus grew three times as fast in culture at 25°C as it did at 10°C and that spore germination also increased with temperature. These observations provide some evidence to support the hypothesis that this is a temperature-regulated disease.

More recent research by Dickenson and Wheeler (1980) has shown that the fungus grows more rapidly in the wood of sycamore plants held at 25°C rather than 10°C. It seems likely that high temperatures play a very important role in the rate of fungal growth in the host and therefore in the development of serious outbreaks of the disease.

In Wanstead Park when it was first found here, *C. corticale* killed between 15 and 20 per cent of the sycamores each year from 1948-1951 (Gregory and Waller, 1951). Since that time there has been a series of outbreaks, associated with hot summers, culminating in a severe outbreak in 1976 and 1977 following the hot summer of 1975 and the record temperatures in the summer of 1976. Although no formal surveys were undertaken at this time, death of sycamore occurred over many parts of southern Britain and was particularly severe in the Greater London area.

Control If the relationship between summer temperatures and the disease is maintained, the disease should largely be confined to southern Britain and Greater London in particular. Serious outbreaks are likely to occur only infrequently in seasons following hot summers. In summers with average or below average temperatures the disease is likely to remain quiescent. Unless there is a dramatic change in the summer temperatures in Britain active measures to control the disease would therefore seem to be unnecessary.

WILT DISEASES

Verticillium wilt

Acer spp. are among the trees most often and most severely affected by Verticillium wilt (plate 27), which is described in chapter 3.