

## KEITHIA DISEASE OF THUJA PLICATA

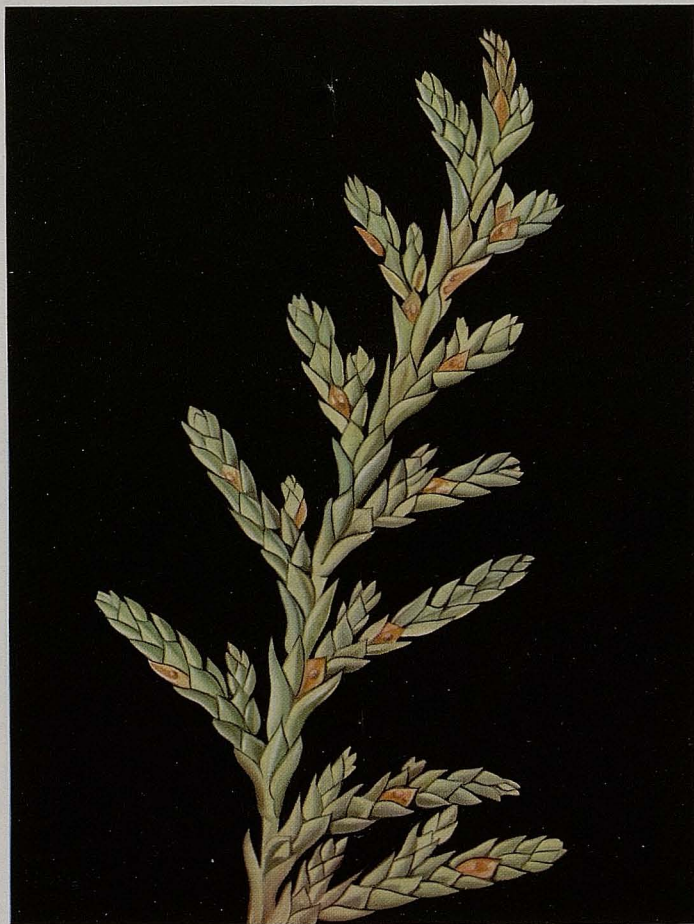


Figure 1. *Didymascella* (*Keithia*) *thujina*. Moderately light attack by the fungus on a *Thuja plicata* plant. The scattered nature of the infection is well shown.



Figure 2. *Didymascella (Keithia) thujina*. Browning on individual scale leaves of *Thuja plicata*. The immature fruit bodies of the fungus can be seen as dark brown blister-like swellings on the leaves.

The Keithia disease, caused by the fungus *Didymascella thujina* (Durand) Maire (previously called *Keithia thujina* Durand) is the most important fungal disease of the western red cedar, *Thuja plicata*. It occurs mainly in nurseries, causing great economic loss. The leaves and shoots are the parts affected and in severe cases complete beds of nursery stock are browned, or even killed.

### HISTORY OF THE DISEASE

The fungus *Didymascella thujina* is a native of America. It was first recorded in Europe in 1918 when it was discovered in Ireland, having presumably been introduced from America. Since then it has become widely distributed in Europe, including the British Isles, and now ranks as a major disease. In the United States this fungus is the most serious parasite of *Thuja* in nurseries and severe losses have also been recorded in young natural regeneration of *Thuja*.

The fungus is a member of the Ascomycetes belonging to the order Phacidiales in which the fruiting body is a typical apothecium, i.e. a disc-shaped structure containing asci from which the ascospores are released. In *Didymascella* the apothecium opens irregularly and the ascospores are distinctive in that they are very unequally two-celled.

### DESCRIPTION OF THE DISEASE

Infection is usually indicated by individual scale leaves on a shoot turning brown. In severe cases young plants may be completely overrun by the fungus and killed, but on older trees only individual branchlets are killed. The fructifications of the fungus, which are typical apothecia, appear as brown cushion-like structures visible to the naked eye or under a hand lens, usually on the upper sides of the leaves. Generally one to three fructifications appear on each leaf. At first they are covered by the epidermis, but at maturity they are exposed by the epidermis splitting and lifting above them in a flap-like manner, which is very characteristic of the disease. With age the apothecia become almost black in colour.

The surface of the fructifications is mucilaginous and able to take up water. This aids in

spore discharge which goes on during and following wet weather and also causes the fructifications to drop out of the leaf, leaving a small and easily seen cavity. This cavity is one of the most characteristic features of *Didymascella* attack. The time of spore discharge is prolonged, occurring through the spring, summer and autumn months. Ripe apothecia have been found in November. This long period of spore dispersal is probably the main factor responsible for difficulties in controlling the disease.

Attacked shoots are at first dark brown in colour but later when they drop and the apothecia have fallen out they assume an ashy grey tint in which the typical cavities can be easily seen as black spots.

Recent work has also shown that immature stages of apothecia may be present on infected plants during the winter months. This may constitute an important means of overwintering by the fungus as they quickly ripen and produce ascospores with the advent of higher temperatures. By this means early spring infections may result.

No conidial or imperfect stage has been recorded in the life history of the parasite, so that infection is carried out by ascospores from the apothecia alone.

### DAMAGE

The fungus has been recorded only on western red cedar (*Thuja plicata* D. Don) and on northern white cedar (*Thuja occidentalis* L.), but it is much more important as a cause of disease on the former host. All ages of trees can be attacked. On older trees, usually only the lower branches are affected and the upper crown does not suffer appreciably. In plantations the disease is seldom important but occasional cases of serious defoliation have occurred. In all instances of such damage the affected trees were sited in sheltered, ill ventilated pockets often with heavy weed vegetation which tended to intensify the stagnant condition. In the nursery however, *Didymascella* is one of the most dangerous parasites, and in some nurseries the raising of *Thuja* plants has had to be given up because of its ravages.

In certain years very large losses are suffered,

so severe that whole beds appear to have been scorched by fire. Where the plants are not killed outright they are often so weakened and stunted as to be useless for planting. Generally speaking, four years may be taken as the age above which plants are not usually killed by the disease.

The disease is favoured by high humidity, so that densely stocked beds suffer more than lightly stocked ones. There is some evidence also that snow cover in spring encourages attack.

### CONTROL MEASURES

American reports have indicated that the disease can be controlled by several applications of standard Bordeaux mixture. In Great Britain, however, spraying has so far been unsuccessful in dealing with the disease, but further research is in progress.

Experiments have been carried out to test the possibility of raising plants from seed in nurseries which have never carried *Thuja* and which are remote from sources of infection; but this method has proved unreliable. In several cases the trial plots have become infected possibly because the spore dispersal range had been underestimated or perhaps because spores were brought into the nurseries on other plants. It has been suggested that infection may be transmitted by spores carried by the seed or on leaf debris among the seed but so far there is no evidence for this point of view.

There are occasional reports of nurseries where *Thuja* can be grown free from *Didymascella*. In these cases it is important that the nurseries be kept free from infection. No *Thuja* plants, even if thought to be free from the disease, should be brought into the nursery and the raising should be from seed only. This is a general rule which should be applied to all nurseries as movement of plants is the chief factor concerned in the spread of the disease.

The presence of *Thuja* near the nursery will constitute a threat. For this reason, *Thuja* should not be used as a hedging plant in nurseries. Judging by the results of the isolation trials, it is not possible to ensure that nurseries are sufficiently remote from sources of infection to be absolutely safe but obviously, the

farther off the source, the less the chance of infection. *Didymascella* is not important as a cause of disease in *Thuja* hedges.

When an attack has occurred, dead and badly diseased plants should be burned. The loss of foliage on the survivors may necessitate relining them and keeping them an extra year in the nursery, but survival has occurred even after considerable loss of foliage. Caution should be exercised in using diseased plants as planting stock since, because of their weakened condition, they may not survive the shock of planting. Once they are established, however, they generally recover from the disease.

It should be noted that it is common for *Thuja* plants to assume a dull brown colour after being planted out. This should not be confused with damage due to *Didymascella*. In the nursery, also, climatic influences such as cold winds may cause a bronzing of *Thuja* foliage. This also should not be confused with *Didymascella* attack, as the browning of individual leaflets and the cavities characteristic of the latter are not present.

*Thuja* foliage may also be attacked by another fungus, a species of *Pestalotia* which can cause dieback of shoots and sometimes death of individual plants. The damage is very similar to that caused by *Didymascella* but is much less frequent.

The recommended treatment of infected stock is similar to that of plants attacked by *Didymascella*. *Pestalotia* is not known to have a perfect stage so that it is classed among the *Fungi Imperfecti*, an assemblage of forms producing only asexual spores. The fructification is much less conspicuous than that of *Didymascella*, consisting of a minute saucer-shaped mass of hyphae termed an acervulus, formed beneath the epidermis of the leaf. When the acervulus is mature the epidermis is raised as a tiny blister and a white spot consisting of fungal hyphae can be seen. Later, in the white mass, there appears a black spot consisting of a mass of spores which can spread infection. Although the two fungi cause similar symptoms on *Thuja* they should not be confused, because of the characteristic appearance of the *Didymascella* fructifications.





Figure 3. *Didymascella (Keithia) thujina*. Mature fruit bodies of the fungus on scale leaves of *Thuja plicata*. The epidermis has burst above the fructifications. Note the typical epidermal flap above one of the fruit bodies.

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