

**Violet Root Rot (*Helicobasidium purpureum*)
on Douglas Fir (*Pseudotsuga Taxifolia*) and
Pinus Contorta.**

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IN the second week of November 1957, a complaint was received from a nursery in Co. Wicklow that something was wrong with a large plot of three year old transplants of Douglas fir, and an inspection of the nursery in question showed that many transplants both of Douglas fir and *Pinus contorta* were sickly and obviously infected with some parasite.

Aerial Symptoms.

Ten per cent. of the young trees were visibly affected. These either occurred in small groups or were scattered indiscriminately throughout the plot. The most striking feature on the Douglas fir was the wilting and down-curvature of the top two or three inches of the main stem, Fig. 1. More or less browning of the needles occurred on this wilted portion, with a tendency for the discoloration to spread downwards. In very severe cases, the cluster of dead, brown leaves on the extreme apex remained attached, but the needles immediately below the apical cluster had dropped off, leaving five or six inches of the stem bare.

Examination of the base of the stems just above soil level showed in many cases, not all, a close mat of drab cinnamon-coloured, sterile mycelium, encircling the stem to a height of a couple of inches, and spreading out to some extent over the adjacent needles, Fig. 2. The cortex underlying the mass of mycelium was found to be more or less rotten and easily detached from the stem.

Underground Symptoms.

The most obvious feature on pulling up diseased plants was the decortication of the roots. This destruction of the cortex was frequently found to be well advanced even on wilted plants which were devoid of any mycelial collar Fig. 3. Microscopical examination of the root system revealed numerous strands of purplish mycelium; and on some remaining portions of the cortex the characteristic bodies known as "corps miliaries", Fig. 4. The presence of the "corps miliaries" together with the purplish mycelium provided sufficient evidence to identify the fungus as *Helicobasidium purpureum* Pat.

With the exception of the down-curvature of the top, the disease symptoms on *Pinus contorta* were similar to those on Douglas fir, with a greater tendency for the needles to become chlorotic or yellowish.

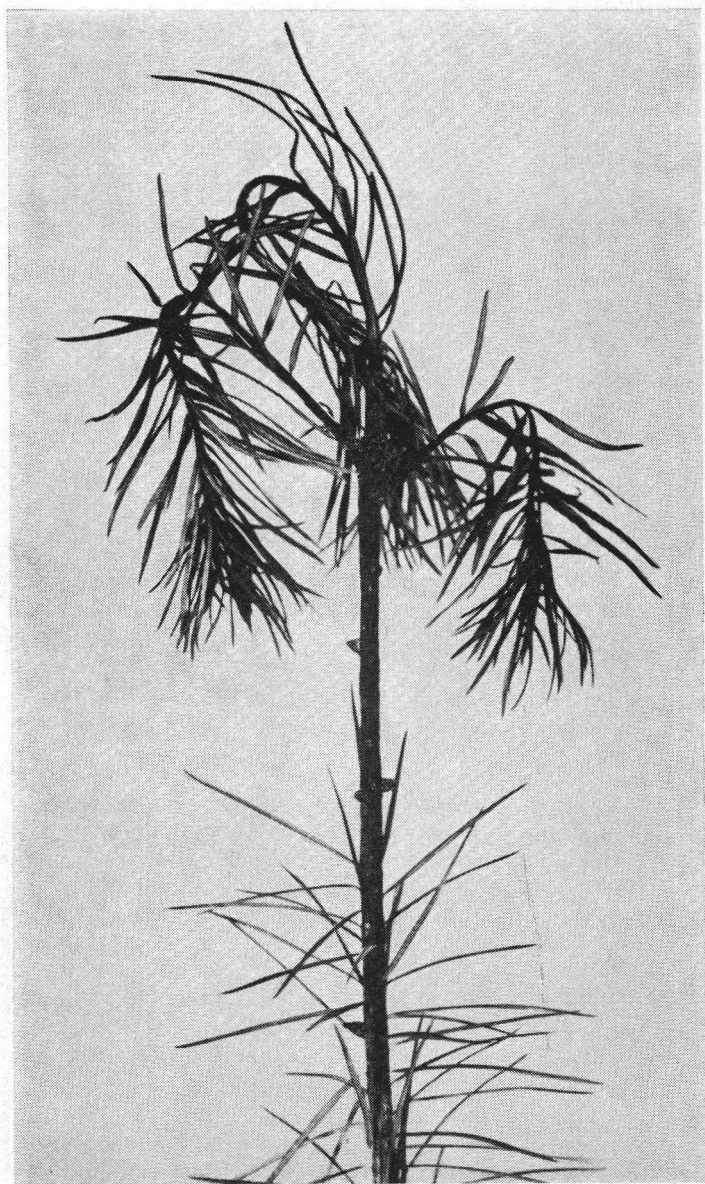


Fig. 1. Wilting of top of Douglas fir, due to attack of *Helicobasidium purpureum*. (Natural size).

Helicobasidium purpureum was also found on the following plants growing in the affected plot:—Silver weed, clover and several grasses.

The ground occupied by the nursery had been under ordinary cultivation and rotation up to four years ago, when sugar beet was grown as a cleaning crop. During the intervening years, failures of seedlings had been rather common, but these were simply attributed to ordinary damping-off.

So far as the authors are aware, this account is the first record of the Violet Root Rot fungus attacking Douglas fir and *Pinus contorta*. It has, however, been previously recorded on Sitka spruce in Scotland by Watson (5). The only point of difference between the Scotch account and the Irish one is, that in the former the violet coloured weft of mycelium was found around the collar of the plants in April, whereas in the latter account it was found in November. The chemical T.V.O. had been used in the Co. Wicklow nursery for controlling weeds, and dead weeds were in layers between the rows of transplants. The autumn of 1957 was exceptionally wet in Ireland, and these layers of weeds may have been a contributory factor to the development of so much aerial mycelium at the collar of the plants late in the season.

In the account by Watson (*ibid.*), it was suggested that severe frosts prior to the outbreak might have been a predisposing factor to the attack on Sitka spruce. Now the past 2—3 winters in Ireland have been very mild and the occurrence of frost negligible. Therefore, frost as a predisposing factor to attack can be ruled out, and in future we must consider the fungus *Helicobasidium purpureum* as a serious parasite of young conifers.

As many foresters may not be familiar with the Violet Root Rot fungus, a short outline of the history and life-cycle of the organism follows:—

Historical.

Prior to 1924 the vegetative or sterile stage of the Violet Root Rot fungus, which occurs mainly below-ground, was generally known as *Rhizoctonia crocorum* (Pers.) DC., or as *Rhizoctonia violacea* Tull. The fungus was first mentioned in 1728 as causing a destructive disease of the saffron crocus (*Crocus sativus*), but almost two hundred years were to elapse before its method of fructifying was finally explained. It is true that the sporulating stage, which occurs above ground, had been more or less familiar to botanists since 1862 under the name of *Helicobasidium purpureum* Pat. This, however, was considered to be an entirely different organism, and the connection between the aerial and subterranean stages was not realized until their relationship was demonstrated by Buddin and Wakefield (1, 2, 3).

The Violet Root Rot fungus can occur on all types of soil and under widely diverse conditions. Ducomet (4) in 1926 stated that plants belonging to twenty families containing forty-four genera and fifty-nine



Fig. 2. Dense mat of *Helicobasidium purpureum* around collar of young Douglas fir. (Natural size).

species had then been listed as susceptible to attack in addition to woody hosts. In Ireland sugar beet has been the crop most frequently attacked, but the disease has also been noted on asparagus, carrots, chicory, clover, mangolds, potatoes and seekale.

Life Cycle of *Helicobasidium purpureum*.

The fungus is mainly a soil-inhabitant and attacks the underground parts of the host.

Infection arises from sclerotia, and probably also from mycelium, left in the soil from a previously diseased crop. Beginning as a few strands of reddish-violet hyphae ramifying over the surface of the roots, the fungus soon forms felt-like patches of mycelium which infest the underground parts of the plant completely. As the hyphae age their colour changes to a violet brown and they become brittle.

"Corps Miliaries".

Scattered about amongst the hyphae, or more often aggregated on depressed areas of the host, numerous minute bodies occur which are about the size of a pinhead and of a deep violet or almost black colour, Fig. 4. These are the "corps miliaries" or infection cushions. By the aid of a hand lens, purple strands of hyphae may be seen radiating from these bodies over the surface of the host and extending out into the soil. The "corps miliaries" develop from fine colourless hyphae which enter the cortical tissues of the root and form compact stud-like masses of mycelium at the point of infection: internally the basal hyphae of the body diverge into the neighbouring cells, Fig. 5. By this means nutriment is transferred from the host to the external mycelium. At the same time the cortical tissues of the root are destroyed, particularly the cambium and young phloem regions. The "corps miliaries" may therefore be looked upon as feeding organs or "suckers". In advanced stages of the disease, these bodies will be found to extend considerably into the cortex.

As a result of the underground attack, occasionally there may be a slight pallor of the foliage, with or without wilting, but very often the presence of the disease is not realized until the plants are lifted. Diseased fleshy roots come up very dirty, as soil particles are held in the web of mycelium which covers the affected parts. The violet coloured hyphae are very diagnostic and cannot readily be mistaken for any other species.

Sclerotia.

At one time the "corps miliaries" were looked upon as sclerotia, but the true sclerotia are flattened or rounded bodies varying in diameter from a few millimetres to several centimetres. Sclerotia are seldom seen on fleshy roots, but in leguminous crops where the hyphae form

loose strands of mycelium along the roots of the host, sclerotia may be quite abundant. They may also be found on hyphal strands in the soil some distance from the host. The sclerotia are the chief means by which the fungus is perpetuated in the soil, and they may retain their vitality for several years in the absence of a suitable host.

Fructifications.

As already stated, the sporulating stage of *Helicobasidium purpureum* occurs above ground. The fertile condition is found only during a limited period of the year, viz. from the end of March until the latter part of May. Its ideal environment seems to be at the base of closely growing herbaceous plants, shady woods or where roots become exposed in places like rabbit burrows. The fungus grows up from the subterranean mycelium and covers the base of the plant with a dense, thick felt of beautiful Corinthian-purple mycelium. Erect branches arise from this weft, and their free ends become bent over crozier-like and develop cross walls. The curved top is the basidium,

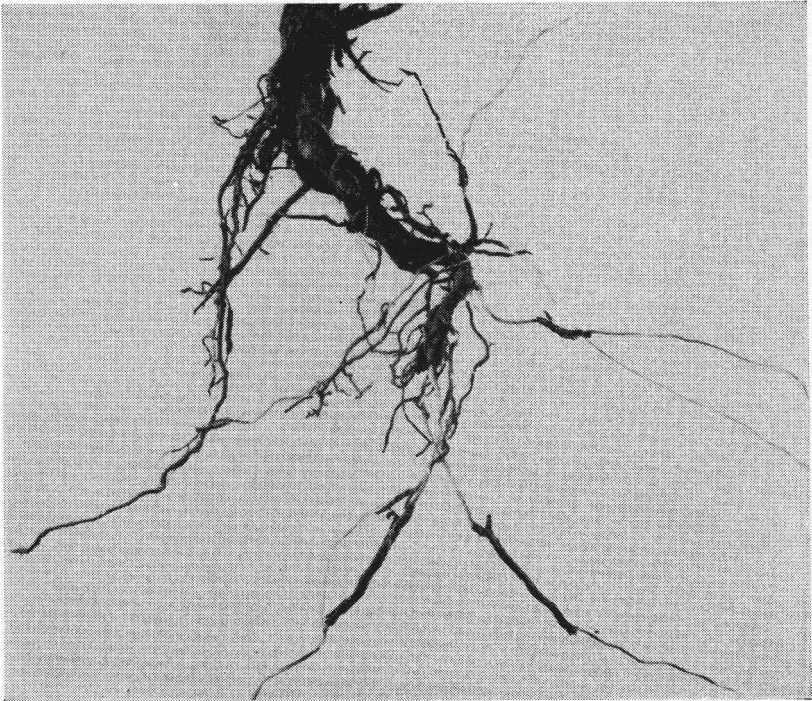


Fig. 3. Decortication of roots of Douglas fir by the violet root rot fungus.

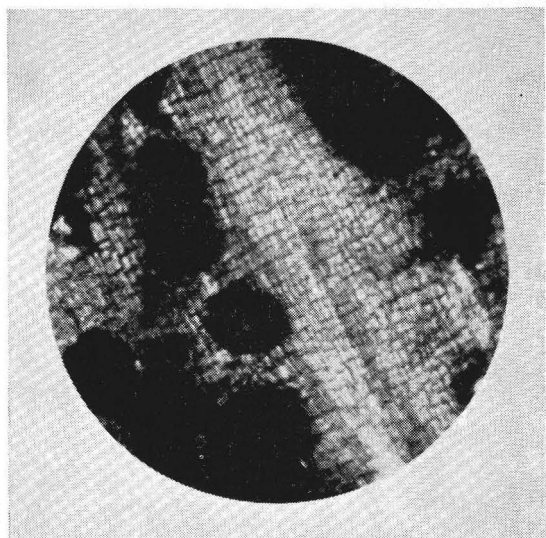


Fig. 4. Surface view of "Corps Miliaries" of *Helicobasidium purpureum*. X 36.

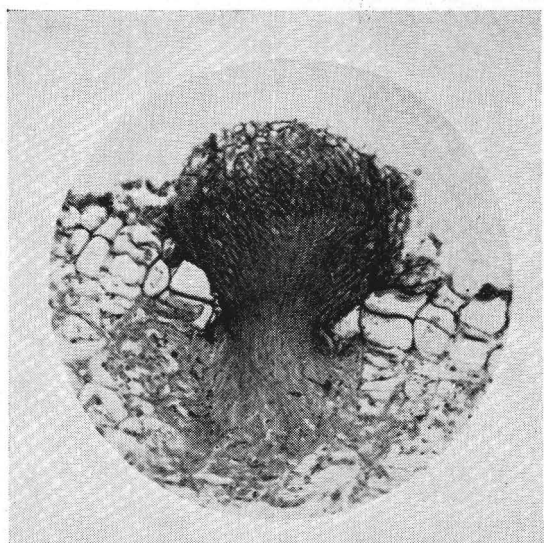


Fig. 5. Section through single infection cushion of *Helicobasidium purpureum*. X 175.

and it produces two, three or four reniform shaped spores, the basidiospores, each borne on a small stalk, the sterigma. The spores serve for the distribution of the fungus to new localities. Germination of the spore is by means of a germ-tube.

The aerial portion of the fungus is very sensitive to hot sun or hot drying winds. With age or in dry weather, the whole growth above ground loses its bright purple colour and acquires a drab-like hue.

Control.

Owing to its omnivorous habit and the fact that *Helicobasidium purpureum* is a soil fungus, its control is not an easy matter. Rotation of crops is the main method of keeping the disease in check, avoiding those crops which are most susceptible to attack on land known to be contaminated by the fungus.

In market gardens where a long rotation of crops is not possible, chemical treatment of affected areas is sometimes resorted to by growers: solutions of formaldehyde or mercuric chloride being employed to eradicate the fungus. A similar procedure might be possible in forest nurseries and would be economical if carried out in the early stages of an outbreak.

Young conifers which have their roots decorticated or partly decorticated by the fungus should not be transplanted, as they will not only contaminate fresh land, but are unlikely to survive. Plants growing in contaminated ground but free from fungus, as a precautionary measure, should have their roots up to soil level, immersed in a strong solution of copper sulphate for 20 minutes before being planted elsewhere.

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