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MELAMPSORA RUST ON CONTAINER-GROWN WESTERN LARCH SEEDLINGS - RAINTREE NURSERY, LIBBY, MONTANA

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During production of the 1992 crop of container seedlings at the Raintree Nursery in Libby, Montana, growers discovered yellow discolorations on the foliage of young western larch (*Larix occidentalis* Nutt.) seedlings. Affected seedlings were scattered throughout one greenhouse at the nursery. Several samples were collected for laboratory examination.

Affected seedlings were approximately 6 weeks old with primary needles beginning to form; remnant cotylendons were present as well (figure 1). Yellow discoloration was due to discrete pustules concentrated on the under surface of needles (figure 1). Microscopic examinations indicated that the pustules contained aeciospores characteristic of a rust fungus. Little foliar discoloration was associated with rust pustules, although some tissue chlorosis was located above and below the pustules. Seedling mortality was not evident.

Aeciospore morphology, size, and ornamentation was indicative of *Melampsora* spp. (Ziller 1974). Several potential *Melampsora* species infect larch seedlings. The two most commonly encountered species in the Inland Northwest are *M. occidentalis* Jacks. and *M. medusae* Thuem. (Ziller 1974). Although these species often occur on the same conifer hosts, they are more selective of the *Populus* hosts they infect. *Melampsora occidentalis* occurs primarily on black cottonwood (*P. trichocarpa* Torr. & Gray) in the Pacific Northwest (Hsiang and van der Kamp 1985; Newcombe and Chastagner 1993b; Ziller 1974), whereas *M. medusae* usually infects either hybrid poplars, eastern cottonwood (*P. deltoides* Bartr.) or quaking aspen (*P. tremuloides* Michx.) (Newcombe and Chastagner 1993a; Schipper and others 1978; Ziller 1974).

The major differentiating characteristics separating these two *Melampsora* species are relative size of aeciospores and their associated echinulation (presence of superficial warts) (Ziller 1974). For *M. medusae*, warts are relatively small and not as distinct as those in *M. occidentalis*. Aeciospores of both species commonly display bilateral wall thickenings opposite each other. Microscopic examinations of aeciospores from the larch seedlings indicated that superficial warts were quite prominent and the spores were approximately 25 x 30μ. On the basis of these characteristics, it seems possible that the *Melampsora* species found on young larch seedlings at the Raintree Nursery was *M. occidentalis*.

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Figure 1--Container-grown western larch seedling with *Melampsora* aecia on the under surface of needles - Raintree Nursery, Libby, Montana.

However, this conclusion should be tempered with caution because the uredial host (*Populus* spp.) from the nursery was not identified nor examined. Recent investigations (Newcombe and Chastagner 1993b; Pinon and others 1994) indicated a new species of *Melampsora* discovered in the Pacific Northwest and California. This is a Eurasian species (*M. larici-populina* Kleb.), which was initially found causing an epidemic of leaf rust in the fall of 1991 in previously rust-free hybrid poplar plantations along the Columbia River west of the Cascades (Newcombe and Chastagner 1993b). This same species was later located in 18 counties in California; the major race of *M. larici-populina* was identified as a virulent European form (race E1) (Pinon and others 1987, 1994). Other unnamed races were also located in populations in California and the Pacific Northwest. This new introduced species can only be differentiated from native *Melampsora* species on the basis of uredospore morphology (Mlodzianowski and Siwecki 1978; Newcombe and Chastagner 1993b; Walker and others 1974). For example, uredospores of the native rust *M. occidentalis* are generally uniformly echinulate, whereas those of *M. larici-populina* have non-echinulate portions near their apices. Uredospores of *M. larici-populina* are also more clavate (Newcombe and Chastagner 1993a; Walker and others 1974). Since the uredial host of the rust at the Raintree Nursery has not yet been investigated, it is unclear if the *Melampsora* species on larch was a native species or the introduced Eurasian species. A recent evaluation indicated that *M. medusae* and *M. occidentalis* sometimes occur on western larch cones in the Northern Region (James 1988). Further investigations will be necessary to clarify *Melampsora* speciation.

Melampsora spp. cause common leaf rust of several different conifer species and *Populus* spp. (Longo and others 1985; Spiers 1975; Ziller 1974). These rusts are macrocyclic, meaning that they must colonize two separate groups of hosts to complete their life cycles. The most susceptible conifer hosts are larch, Douglas-fir, pine, fir and spruce (listed in order of relative susceptibility) (Ziller 1974). Although these fungi can infect a wide range of *Populus* spp., they appear most damaging on certain hybrid poplars (Schipper and others 1978; Widin and Schipper 1980). Little damage, other than foliar chlorosis and occasional pre-mature needle loss, occurs on conifer hosts (Schipper and others 1978).

The typical life cycle of *Melampsora* rust on larch and poplar is as follows: the fungus overwinters as dormant teliospores on fallen poplar leaves. These teliospores germinate during wet weather in the spring, at about the time larch needles first appear. Germinating teliospores produce small basidiospores which are carried by the wind and infect larch needles. Infected larch needles appear yellowish and have minute droplets on their upper surface during spring. These droplets are small, spore-producing structures called pycnia. Spores produced in pycnia do not infect plants, but fertilize other pycnia to form other spore-producing structures call aecia located on the lower surface of larch needles. Aecia are yellow to orange pustules that appear on needles 1-2 weeks after pycnia appear. Spores from aecia (aeciospores) are carried by wind to poplar leaves, cause infection, and result in production of uredial pustules. Uredia appear as yellow to orange spots on poplar leaves 1-2 weeks after aecia are found on larch needles. Uredospores are carried by wind and rain (Hamelin and others 1992) to other poplar leaves that become infected and produce more uredia. In this way, poplars over a large geographic area may become infected. This process of reinfection continues throughout the growing season. In the fall, the teliospore stage is formed on infected poplar leaves, which drop from trees to complete the life cycle (Heather and Chandrashekar 1982; Schipper and others 1978; Ziller 1974).

Within natural conifer stands, there is little need to control this disease. However, in poplar plantations and conifer nurseries control attempts may be necessary. Since the disease is most damaging in hybrid poplar plantations (Newcombe and Chastagner 1993a, 1993b; Schipper and others 1978), most efforts at reducing damage have been directed there. In most cases, locating disease resistant clones and increasing the general level of resistance in plantations is the most effective way to reduce damage (Chandrashekar and Heather 1981, 1982; Heather and Chandrashekar 1982; Widin and Schipper 1980). Such approaches are especially important when confronting introduced pathogen species such as *M. larici-populina* which may exert greater virulence on native poplar clones (Newcombe and Chastagner 1993b). Native pathogens usually cause much less damage, although individual plantations may exhibit extensive disease due to buildup of the uredial stage (Newcombe and Chastagner 1993a; Walker and others 1974).

Within nurseries, control efforts may or may not be warranted. If rust is commonly encountered, it is important to separate *Populus* spp. from conifer seedling growing areas (Schipper and others 1978; Widin and Schipper 1980; Ziller 1974). Poplars near and around greenhouses may provide a continual source of inoculum to infect larch and other conifers each spring. In most cases, fungicidal applications would not be warranted, unless extensive levels of disease were found on young conifer seedlings. Registered fungicides for this disease may not always be available (Schipper and others 1978). However, recent experience with the systemic, sterol-inhibiting fungicide triadimefon (Bayleton®) to control fusiform rust in southern pine nurseries (Kelley and Runion 1991) and *Melampsora* rust in European nurseries (Desprez-Loustau and others 1992) indicates that this chemical might be useful.

Innovative control approaches using biological agents have also been described. In greenhouse experiments, McBride (1969) dramatically decreased infection of Douglas-fir needles by *M. medusae* when certain bacteria in nutrient solutions were applied to needles. These bacteria were isolated from immature Douglas-fir needles, where they occurred naturally. Other potential biocontrol agents include species of *Cladosporium* (Sharma and Heather 1978, 1988; Heather and Sharma 1987) and *Tuberculina maxima* Rostr. (Weissenberg and Kurkela 1979). These organisms are usually hyperparasites on *Melampsora* spp. and may reduce infection and inoculum production by the rust. Unfortunately, they haven't yet been developed for commercial use to control the disease.

This is the first report of *Melampsora* rust on conifer seedlings in nurseries of the Inland Northwest. Although *Melampsora* diseases may often occur in native Northwest forests (Ziller 1974), they have not previously been reported on either container-grown or bareroot conifer seedlings in the region. These diseases should be considered in future nursery disease surveys.

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