

Larch crown diseases in Trentino and South Tyrol

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ABSTRACT: Various attacks of pathogenic fungi on the larch crown were observed in Trentino/South Tyrol, Italy, over the past few years. In 1999, severe defoliation was caused by *Mycosphaerella laricina*, a rarely investigated pathogen, whose action was enhanced by high temperatures and humidity in August. In July 2000, larch woods showed crown yellowing due to *Meria laricis*. Lower temperatures and heavy precipitation were probably the predisposing factors in this case. *Hypodermella laricis* was observed in 2002 as a localised attack, while *Lachnellula wilkommii* is commonly recorded. The impact of these diseases and the environmental factors involved in their occurrence are discussed in this paper.

Keywords: *Larix decidua*; *Mycosphaerella laricina*; *Meria laricis*; *Hypodermella laricis*; *Lachnellula wilkommii*

Larix decidua Mill. is the second most common forest species in Trentino/South Tyrol, accounting for about 17% of the covered surface. This region, located in the south-eastern part of the Alps, is one of the most forested area of Italy, with about 656,000 hectares of woodland, corresponding respectively to 55% and 42% of the land areas of Trento and Bolzano provinces. The forest environment is extremely varied because of differing climatic conditions, rock origin and soil features: all the alpine tree species are present, with a net predominance of Norway spruce (*Picea abies*), although there are also some Mediterranean species that play a minor but interesting role.

In Trentino/South Tyrol, woodlands are important economically, not only for their primary production but also for their landscape-contributing characteristics. In this context, forestry is based on silvicultural naturalistic management, focused on conserving or restoring the natural characteristics of the woodland, and favouring, wherever possible, natural regeneration. By means of continuous management, carried out according to detailed Woodland Management Plans (WMPs), the targets of naturalistic silviculture are pursued; the regular revision of the WMPs (every ten years) helps the Forest Service to come to decisions on appropriate treatment. The presence of parasites and pests can play a fundamental role, influencing or modifying the evolution of the woods and nullifying the choices of the forest manager. For a better understanding of the role of diseases, the monitoring of forest health has been carried out since 1990 in both the provinces by the Forest Services and with the help

of the Forest Research Unit of the Agrarian Institute of S. Michele all'Adige (IASMA) (AMBROSI, SALVADORI 1998). Therefore, the occurrence and spread of some crown diseases on larch, as with other species, was promptly observed and reported (MARESI et al. 2001).

Larch woods range from the high altitudes to the bottoms of some valleys. The species is present both in pure stands and in mixed woods, playing an important role in both timber production and landscape characterisation.

In this paper we report on the current condition of some parasites recorded in larch woods, discussing the environmental factors involved in their occurrence and spread of the diseases.

MATERIAL AND METHODS

Field observation

The survey of pest and pathogens is carried out by the Forest Service for the province of Bolzano and by the Forest Service and Forest Unit of IASMA for the Trento woodlands. All the woodland surface is surveyed regularly and the occurrence of damage or diseases is recorded.

The monitoring method is based on five phases: observations in the forest, reporting of the problems, diagnosis, transmission and data analysis.

Forms containing information regarding about the topography of the affected area (exposition, altitude, etc.), type of damage and intensity are filled in. Field data and diagnoses are usually confirmed by the Forest Unit of IASMA. Microscopic observations and the isolation of

fungi are performed in the laboratory as standard procedures, in order to identify the pathogens involved.

All the collected data are reported to the Woodland Management Plan departments and revised every ten years. All the data are maintained in a database and relayed to a Geographic Information System (GIS).

Meteorological data

As representative of weather patterns in the region, rainfall and temperature data collected at S. Michele all'Adige were examined: total monthly rainfall and monthly mean temperature for the years 1996–2002 were compared with the means of the period 1983–1995.

RESULTS

Symptoms of disease on larch were observed over the past few years. The following pathogens were recognised and described.

Mycosphaerella laricina

At the end of summer 1999, severe defoliation was observed in many larch woods. *Mycosphaerella laricina* (Hartig) Neg. was detected on infected foliage; this is a pathogenic micro-organism common to Central

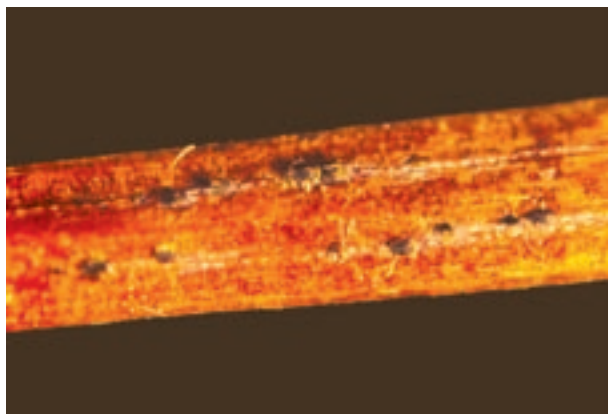


Fig. 1. Black fructification of *Mycosphaerella laricina*

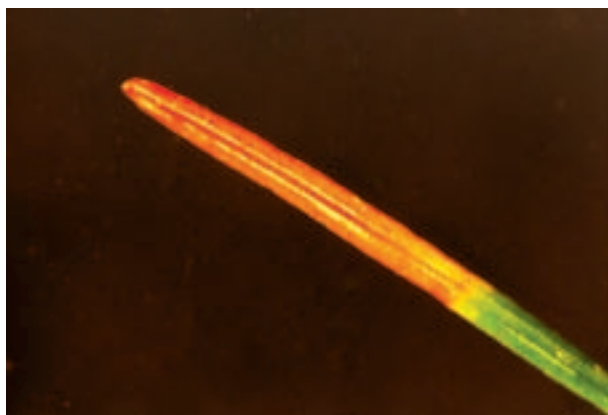


Fig. 2. Whitened tip of larch needle caused by *Meria laricis*

Europe (HARTIG 1895; BUTIN 1995), but which was not previously considered harmful in Italy, where it had never been reported (SALA 1937). Fungal attacks caused necrosis of the needles, which started in different points of the foliar surface. Black fructifications of the fungus appeared during August 1999 on the affected needles, in the browning areas (Fig. 1). Generally, the damage was observed in the lower part of the crown, but some young plants were completely affected. The defoliation of trees started at the beginning of September, almost a month before the autumn fall. Reddening of needles was more evident on the edge of infected stands.

This damage affected woods in several valleys, over almost 500 ha in Trentino. Fungal attacks were recorded mainly in mixed uneven-aged woods (97%), at around 1,000 m above sea level and on southern slopes (54%).

The climate of summer 1999, characterised by relatively high temperatures and high humidity levels, due to frequent precipitation, enhanced the attacks of the pathogen. Primary attacks started from ascospores produced on old fallen needles in spring, while the spread of infections was related to massive conidia production from pycnidia in the rainy August of 1999.

In 2000 and 2001, the presence of the fungus was observed sporadically in some moist locations, generally at a high altitude, while in 2002 reddening was recorded in some of the 1999 affected sites. No damage was noticeable as in 1999, although fruiting bodies were observed on litter needles.

Meria laricis

During July 2000, symptoms of the disease were observed in some larch forests in two valleys of Trentino. Infected plants showed a complete yellowing of the whole crown, with the tips of the needle becoming first brown then whitened (Fig. 2). On infected foliage, conidiogenous iphae and conidia of *Meria laricis* Vuill. were detected.

After the sudden occurrence of fungal attacks, the necrosis of needles and the defoliation of trees ended and no more effective damage was observed. Affected needles fell before the end of the growing season.



Fig. 3. Hysterothecia of *Hypodermella laricis*

Damage was observed to spread over about 40 ha, mostly in mixed woods with a prevalence of larch, at elevations of 800–1,300 m a.s.l., on slopes facing various directions.

Lower temperatures and heavy precipitation during July 2000 were probably the predisposing factors for the disease.

No damage was observed to natural regeneration, although it is known from the literature that this pathogen causes very real damage to seedlings in the nursery (BOUDIER 1981).

Hypodermella laricis

This ascomycete was first observed in the province of Bolzano in 1985. During summer 2002, a severe attack was reported in the Venosta valley, on the north-facing slope between 1,000 and 1,400 m a.s.l. The damage was observed in the lower part of the crown, in about 30 ha of mixed wood.

Hypodermella laricis Tubeuf was identified by the presence of the characteristic elliptical hysterothecia (Fig. 3), teardrop-shaped ascospores, and a black ring at the base of the infected needles.

Lachnellula wilkommii

Larch canker was regularly recorded during monitoring in both the provinces. Damage is not a real problem on large trees and affects mainly small branches that are easily killed. It has been observed mainly at the bottom of several alpine valleys where frost causes bark lesions that favour the spread of the fungus. The characteristic cankers caused by *Lachnellula wilkommii* (Hartig) Dennis have also been observed on older trees, but only rarely are

they related to the death of plants, although an impact on timber quality has been noted.

Meteorological data

Rainfall data (Fig. 4) suggested a different precipitation behaviour for recent years as compared to the period 1983–1995. Specifically, it is possible to highlight peaks of precipitation in spring and autumn and higher precipitation in August, both in 1999 and 2002. Tukey schematic plot graphical display (Fig. 5) confirmed the summer and autumn increase in precipitation. The temperatures show a more regular trend, although with some anomalies especially in late winter. July 2000 marked the lowest temperature due to a long period of cold weather (Fig. 6).

DISCUSSION

The pathogens reported through the monitoring of the health of forest trees over the past few years may be considered as normal components of larch wood ecosystems in Trentino/South Tyrol. Most of them seem strongly influenced by weather conditions as the agents of needle cast, and their impact relates mainly to larch stands at lower altitudes. In some areas, the defoliation caused by these fungi could be a factor limiting larch regeneration (KRAUSE, RAFFA 1992), but to date the attacks have occurred irregularly, year by year, and consequently most of the plants have been able to recover.

M. laricina can be considered a common inhabitant of larch woods. Probably it was not detected in the past due to the simultaneous presence of the crown insects *Coleophora laricella* and *Adalgas laricis*, which were regularly

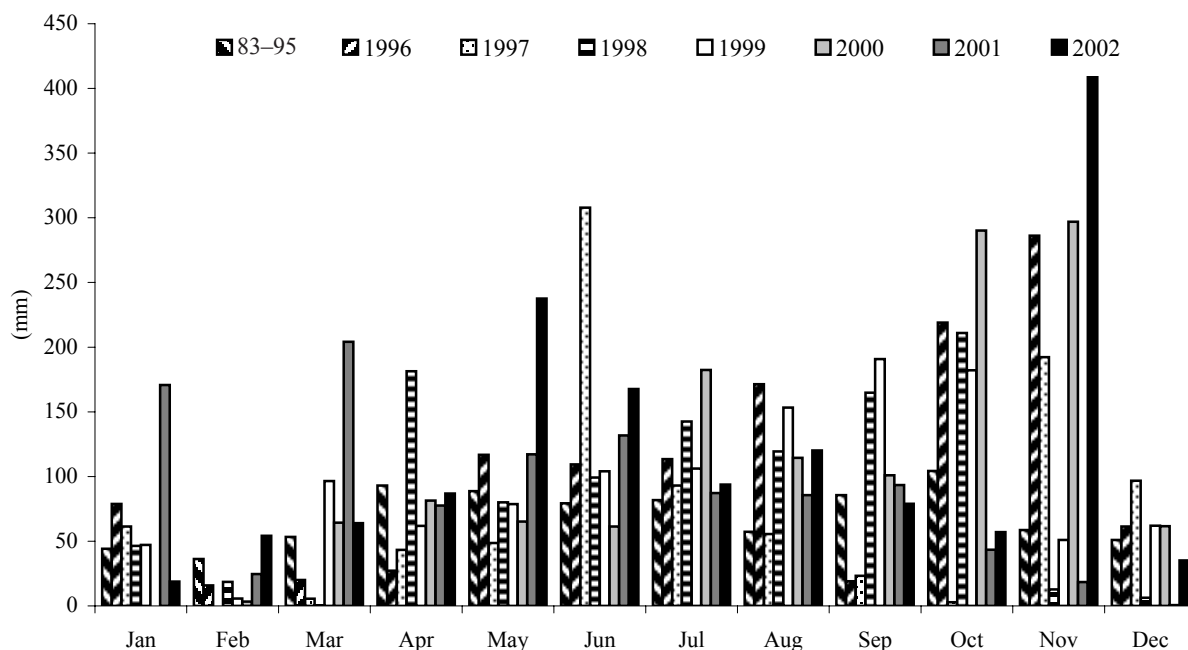


Fig. 4. Monthly rainfall at the S. Michele all'Adige meteorological station, representative of the region, during the period under consideration

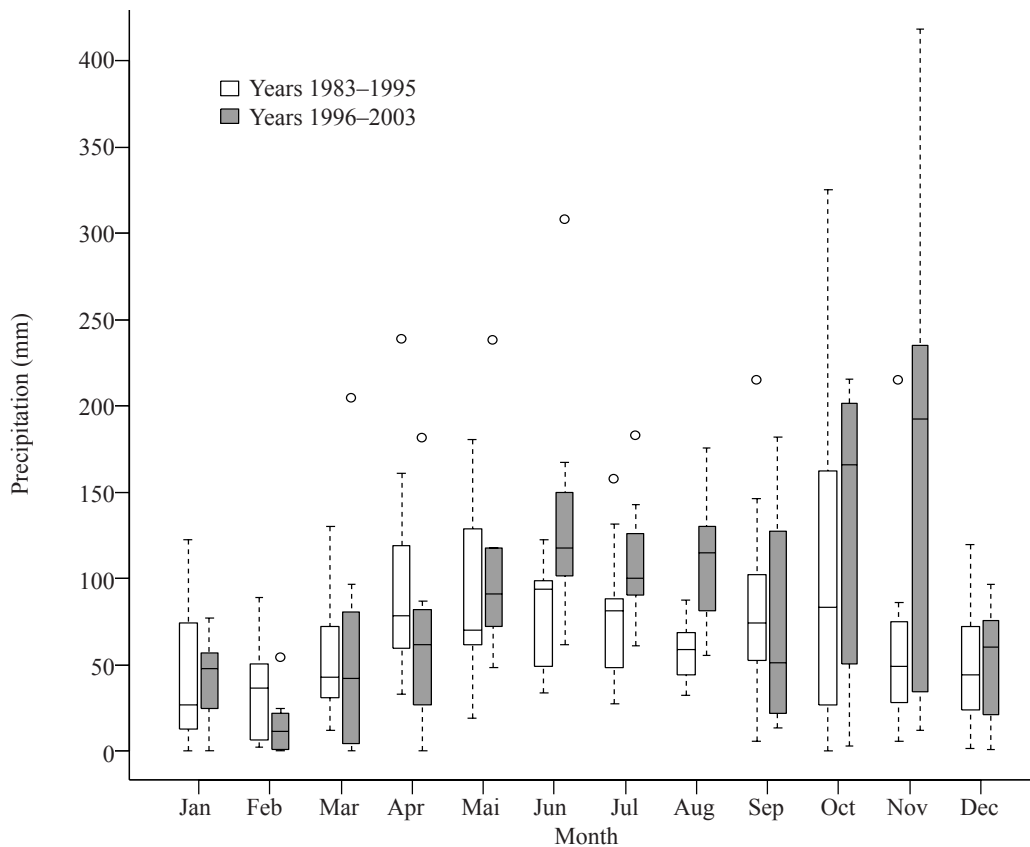


Fig. 5. Comparison of precipitation at the S. Michele all'Adige meteorological station in the two considered period (1983–1995 vs. 1996–2002) by means of Tukey schematic plot. From top to bottom: upper outlier, maximum value, 75th percentile, 50th percentile, 25th percentile, minimum value

reported in monitoring data and masked fungal damage. Attacks seem strictly related to weather conditions during summer and spring; their effects can be considered scarcely significant, because they occurred only occasionally,

mostly at the end of the growing season. No data are available on the impact on natural regeneration. The fungus is considered one of the main constraining factors affecting European larch cultivation in North America (PALMER et

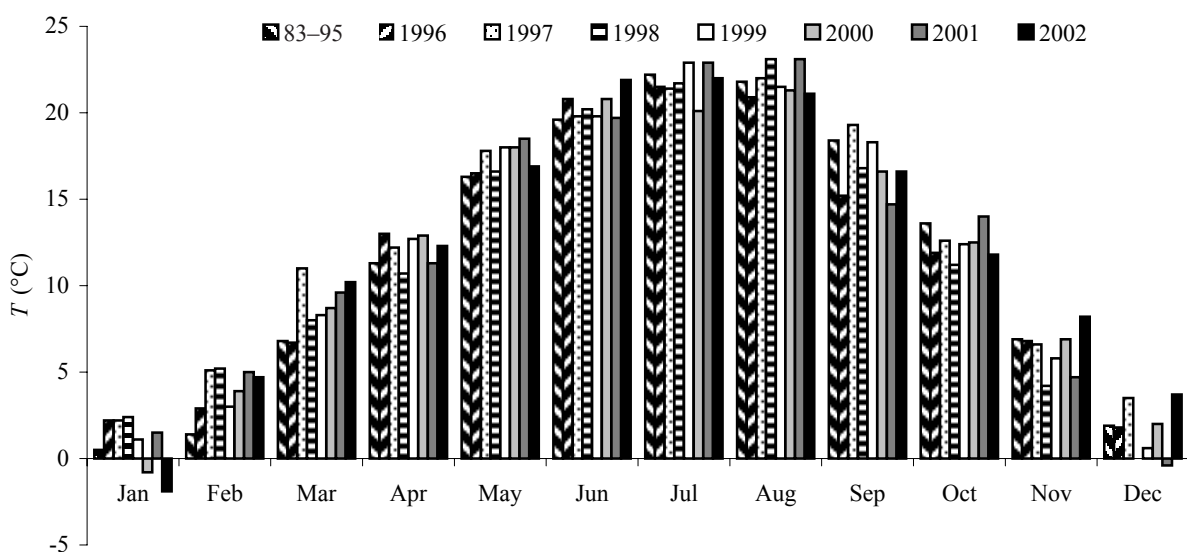


Fig. 6. Mean monthly temperature at the S. Michele all'Adige meteorological station, representative of the region, during the period under consideration

al. 1986; PATTON, SPEAR 1983), but is scarcely aggressive in Europe (BUTIN 1995), where it has been observed only sporadically.

Meria laricis was never reported in the Trentino woods in the past; it was probably present but undetected until now. It was cited by SKARMOUTSOS and MILLAR (1982) because of its ability to colonise needles affected by the trophic activities of *Adalges laricis*. *M. laricis* was not probably observed due to its scarce evidence on infected trees and because its damage could be confused with insects attacks. Its pathogenic role appears limited to this alpine context and to naturally managed woods.

Little is known about *H. laricis* in Trentino/South Tyrol. It seems more localised than the other two needle pathogens. In the literature, *H. laricis* is reported as common in the Alps and their foothills (BUTIN 1995). In Italy the fungus has not been reported as harmful to larch until now.

Occasionally the presence of infection by *L. wilkommii* on stems causes severe damage and the death of young larch trees in mixed woods. Where the disease is endemic and common, the presence of the fungus induces changes in silvicultural management, favouring different tree species, such as spruce. The impact of *L. wilkommii* can reduce larch growth at the bottom of moist, cold valleys or where frost damage is common. Timber losses, due to the disease, are generally low and tolerable.

The occurrence of crown attacks on a large scale in recent years could be related to a change in climatic conditions. More investigations into crown pathogens that affect established trees and natural regeneration are desirable. These parasites, which are undoubtedly a minor component of larch ecosystem communities, can act as bio-indicators of climatic changes highlighting forest stability and evolution.

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Choroby modřínu opadavého v Trentu v jižním Tyrolsku

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ABSTRAKT: Článek popisuje výskyt několika houbových patogenů na modřínu opadavém, sledovaný v posledních letech v oblasti Trenta (jižní Tyrolsko, Itálie) a jejich vztah k dynamice klimatu. *Mycosphaerella laricina*, druh s méně častým kalamitním výskytem, způsobil vysokou defoliaci v roce 1999, a to patrně v důsledku vyšších teplot a vlhkosti v srpnu daného roku. Nízké teploty a vysoké srážkové úhrny v červenci 2000 jsou považovány za faktory podporující přemnožení *Merie laricis*

a následně poškození modřínového jehličí patrně ze žloutnutí korun. Pozornost je dále věnována druhům *Hypodermella laricis* a *Lachnellula wilkommii*, u kterých se zjišťuje ovlivnění jejich výskytu klimatickými činiteli v roce 2000.

Klíčová slova: *Larix decidua*; *Mycosphaerella laricina*; *Meria laricis*; *Hypodermella laricis*; *Lachnellula wilkommii*

Modřín opadavý je po smrku ztepilém druhou nejrozšířenější dřevinou lesů v oblasti Trenta v jižním Tyrolsku (severní Itálie). Roste od horských hřebenů až po dna údolí v porostech čistých i smíšených a tvoří jejich významnou součást jak po stránce dřevoprodukční, tak i krajinnotvorné.

Hodnocení výskytu škůdců a patogenů a jejich následků na lesních dřevinách včetně modřínu provádějí pracovníci Forest Service of province Bolzani a Forest Service and Forest Unit IASMS for Trento v pravidelných intervalech. Monitorační metoda má pět fází: pozorování v terénu, hlášení problému, diagnóza problému, přenos dat a analýza dat. Všechny získané údaje se poskytují odboru lesního hospodářského plánování a revidují se každých 10 let, patřičná data dostává k dispozici i odbor pro geografický informační systém (GIS). Meteorologické údaje získali pracovníci klimatické oblastní stanice S. Michele all'Adige; jsou to měsíční srážkové úhrny (obr. 4) a průměrné teploty (obr. 5) v období 1997–2002 a 1983–1995.

Z výsledků šetření v období 1999–2002 lze konstatovat výraznou defoliaci modřínu koncem léta 1999, vyvolanou houbou *Mycosphaerella laricina* Hartig (kulovitka modřínová). Bylo to první poškození modřínu daným

druhem houby v Itálii. Klimatické podmínky v době výskytu poškození (léto 1999) byly charakteristické poměrně vysokými teplotami vzduchu a vysokou vzdušnou vlhkostí v důsledku častých dešťů. V následujících dvou letech (2000–2001) se houba vyskytovala pouze sporadicky, a to na vlhkých místech. Později (2002) se opět rozšířila, ale s méně výraznými symptomy poškození než v roce 1999.

Dalším houbovým patogenem byla *Meria laricis* Vuill. (merie modřínová), zjištěná ve dvou údolích v oblasti Trenta v červenci 2000. Jehličí napadených stromů zežloutlo a předčasně opadalo bez dalších patrných následků. Za příčinu kalamitního výskytu houby se považuje nízká teplota vzduchu a vysoké srážky v červenci 2000.

V práci jsou zmíněny i výskyty druhu *Hypodermella laricis* Tubeuf (sypavka), rozšířeného na severních svazích ve vyšších polohách, a *Lachnellula wilkommii* (Hartig) Denis (kustřebka modřínová), napadajícího zvláště stromy na dně alpských údolí poškozené mrazem. Závěrem se konstatuje hypotéza, že zvýšený výskyt houbových patogenů v oblasti Trenta v posledních letech souvisí s klimatickými změnami a může být i jejich indikátorem.

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