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Data Sheets on Quarantine Pests

Dendroctonus pseudotsugae

IDENTITY

Name: *Dendroctonus pseudotsugae* Hopkins
Common names: Douglas fir beetle (English)
Dendroctone du sapin douglas (French)
Taxonomic position: Insecta: Coleoptera: Scolytidae
Bayer computer code: DENCPS
EPPO A1 list: No. 266
EU Annex designation: II/A1

HOSTS

The main host of *D. pseudotsugae* is *Pseudotsuga menziesii* (Douglas fir). It also occurs on the related but local and unimportant *P. macrocarpa*, and occasionally on *Larix occidentalis* and *Tsuga heterophylla*, but these are not preferred hosts.

GEOGRAPHICAL DISTRIBUTION

EPPO region: Absent.
North America: Canada (British Columbia, Yukon), Mexico (Chihuahua), USA (Alaska, Colorado, Idaho, Montana, New Mexico, Oregon, Utah, Washington).
EU: Absent.

BIOLOGY

The adults and larvae of *Dendroctonus* spp. are phloeophagous or bark-feeding. *D. pseudotsugae* mostly overwinters as immature adults. Adults emerge from overwintering sites between February and June. Activity is resumed when subcortical temperatures become sufficiently high, about 7-10°C. The insects fly individually or in small groups, during the warmth of the day in spring or near nightfall in summer (at temperatures between 20 and 45°C), and infest further trees. In *D. ponderosae*, flight activity falls in a single concentrated period (e.g. mid-July to end of August). Terpenes in the oleoresin are the primary source of attraction, guiding pioneer beetles in the selection of a new host. Pheromones are responsible for the secondary attraction of other members of the same species and are the means by which individuals communicate after colonization. Like other bark beetles, *D. pseudotsugae* is associated with bluestain fungi.

D. pseudotsugae is monogamous. The female initiates the boring of a new gallery by constructing a radial entrance tunnel through the bark into the wood. After pairing has occurred, the female is generally responsible for boring egg galleries, the formation of egg niches, and care of eggs and larvae. The male keeps the nuptial chamber and entrance tunnel clean and expels the frass from the entrance hole. Oviposition commences about 7 days after attack and, in *D. pseudotsugae*, eggs are deposited in alternating grooves about 2-4 mm deep and 1-8 cm long along the sides of the gallery, near but not necessarily

touching the cambium. The eggs are deposited in a single continuous row with the long axis perpendicular to the egg gallery and more or less parallel to the cambium. This diagnostic egg orientation is presumably associated with the fact that larvae construct independent mines. The incubation period is 8-24 days in *D. pseudotsugae*.

The number of larval instars is four. The length of the larval period under optimum conditions is, as in other scolytids, about 30 to 90 days. The end of the larval mine is usually slightly enlarged and cleared of frass to form a pupal chamber. The pupal stage, as in other scolytids, requires between 3 and 30 days, but averages 6-9 days under ideal conditions. It may be extended if pupation begins in late autumn, but is rarely an overwintering stage except in areas where the winters are very mild.

Adult *Dendroctonus* may emerge from the host tree immediately or may require a period of maturation feeding before emerging. They usually emerge through separate exit holes. After completing one gallery system it is not uncommon for the parent beetles to re-emerge and construct a second, third or fourth system of tunnels to produce an equal number of broods. A few old adults may survive the winter and participate in the production of the spring brood. However, a majority of the adults die in their tunnels after producing one brood. *D. pseudotsugae* usually has only one generation per year, but may have two or more generations, correlated with seasonal change (Furniss, 1965). For further information on the biology of *D. pseudotsugae*, see Chamberlin (1918), Bedard (1950), Humphreys (1995).

DETECTION AND IDENTIFICATION

Symptoms

The foliage of attacked trees turns yellow and finally reddish-brown. Orange to cream-coloured particles of bark and wood in crevices and at the base indicate that the tree has been infested and killed by beetles. No pitch tubes are formed.

The galleries formed by the adults and larvae are diagnostic. Within the gallery system, the entrance tunnel, mother or egg galleries and larval galleries can usually be distinguished. The entrance tunnel is usually short, more or less perpendicular to the tree axis and found at the base of simple galleries (in *Dendroctonus* spp., which are monogamous). This tunnel serves for the evacuation of frass and other debris which accumulates. The entrance hole is closed by tightly packed frass in *Dendroctonus*.

The mother or egg galleries are the same diameter along their length and sometimes possess perforations (aeration or ventilation holes) to the exterior. These galleries are constantly cleared of boring frass in most species. In *D. pseudotsugae*, the first 2-5 cm of the egg galleries angle to one side, then they run perpendicularly and nearly straight for 30 cm on average (12-90 cm), parallel with the grain of the wood. The diameter of the individual egg galleries is slightly greater than the width of a beetle.

The larval galleries commence more or less parallel to or divergent from the egg gallery, penetrating the bark or wood to varying depths and progressively widening away from it. These galleries are usually full of debris. The gallery terminates in a small chamber, where pupation occurs and the adult emerges through a hole from this chamber. In most *Dendroctonus* spp., the galleries are individual and radiate from the parental mine, or the larvae may feed in congress for part or all of their development. The mines usually extend for 1-4 cm along a straight or winding route without increasing in diameter, and then abruptly expand into an oval to irregular feeding chamber approximately 0.5-1.0 cm wide by 1 or 2 cm long.

Morphology

Eggs

Smooth, oval, white, translucent. Eggs are laid separately but packed in niches and covered with frass.

Larva

In general, *Dendroctonus* larvae are white, legless, with lightly sclerotized head; head usually as broad as long with evenly curved sides, protracted or slightly retracted. Body at most only slightly curved; abdominal segments each with two or three tergal folds; pleuron not longitudinally divided. Larvae do not change appreciably in form as they grow. Identification requires the assistance of a specialist. For generic keys to the larvae of *Dendroctonus* and other bark beetles, see Peterson (1951), Thomas (1957, 1965).

Pupa

The pupae of scolytids are less well known than the larva: exarate; usually whitish; sometimes with paired abdominal urogomphi; elytra rugose or smooth; head and thoracic tubercles sometimes prominent. See in particular Thomas (1965).

Adult

In general, *Dendroctonus* adults are relatively large bark beetles, 3-8 mm in length: *D. pseudotsugae* is 4-7 mm long, cylindrical, dark-brown to black with reddish elytra. It resembles *D. rufipennis*. Antennae geniculate, funicle five-segmented, with abrupt three-segmented club; subcircular. Head visible from above, not prolonged into distinct rostrum, narrower than pronotum, with mouthparts directed downwards. Eyes flat, usually elongate, entire. Pronotum scarcely declivous in anterior half, usually without crenulations except sometimes anterolaterally. Scutellum small and rounded or depressed. Elytra entire, concealing pygidium, with basal margin usually procurved and with crenulations. Elytra terminate in a rounded or blunt slope (the declivity) which may be fringed by a row of spines or tubercles. Tibiae unguiculate. Tarsal segment 1 not longer than 2 or 3, pseudotetramerous with third tarsal segment bilobed. For generic and specific keys to *Dendroctonus* and other genera, see Wood (1982), Duncan (1987) and Lanier *et al*. (1988).

MEANS OF MOVEMENT AND DISPERSAL

Some bark beetles are strong fliers with the ability to migrate long distances. The most common mode of introduction into new areas is unseasoned sawn wood and wooden crates with bark on them. If wood is barked, there is no possibility of introducing bark beetles. Dunnage is also a high-hazard category of material, on which most of the scolytids intercepted in the USA are found. It is particularly difficult to monitor properly. *D. pseudotsugae* has been intercepted on wood imported into China from North America (Ciesla, 1992).

PEST SIGNIFICANCE

Economic impact

Like other scolytids, *Dendroctonus* spp. periodically cause loss of wood (cut wood or standing trees) over extensive areas. Their galleries do not affect the structural properties of the wood significantly, but may render it useless for veneer or furniture making. In general, compared with other genera such as *Ips*, they tend to be more aggressive and more host-specific. They mostly breed in coniferous hosts larger than 15 cm in diameter.

D. pseutotsugae sporadically kills large quantities of mature *P. menziesii* in western Oregon and Washington, USA, particularly following blowdown from storms. Salvage of dead wood before it deteriorates beyond economic use is a major problem. Usually, the material selected for attack includes stumps, windfalls, broken logs, or other injured or

prostate trees larger than 20 cm in diameter. However, when populations are high, or when assisted by drought, healthy, vigorous standing timber may be selected. The attack on a standing tree usually begins in the upper midbole area and progresses upward and downward from that point. In prostrate material, at least when the bark is relatively thick, the beetles attack the sides and upper surfaces as well as the lower (Wood, 1982). For an annotated bibliography of *D. pseudotsugae*, see Furniss (1979).

Control

Broadly, the same control methods are available for all bark beetles. A tree that has been attacked usually cannot be saved, so preventive rather than curative control is best. Since scolytid populations are probably always present in a forest, breeding on unthrifty, injured, broken, wind-thrown or felled material, damage can be reduced or avoided by maintaining the health and vigour of the stand; especially by thinning stagnated young stands or removal of overmature trees in older stands.

Losses caused by bark beetles usually involve individual trees or irregularly distributed groups of trees. Insect surveys are made to locate and appraise infestations in their early stages. If endemic conditions prevail, natural control factors (climate, weather, predators, parasites, disease) will hold the population at a steady level at which damage is within normal limits (losses less than annual tree growth). If epidemic conditions exist, damage exceeds normal limits (losses exceed annual growth). Such surveys determine the need for direct control. The available methods have been reviewed in EPPO/CABI (1992). Treatment with insecticides is used, if at all, for logs rather than for trees.

Phytosanitary risk

D. pseudotsugae is an A1 quarantine pest for EPPO, within the category "non-European Scolytidae" (EPPO/CABI, 1992). It can make primary attacks on *Pseudotsuga menziesii*, and so presents a certain risk to the EPPO region, where this species has been introduced and planted. Climatic conditions in western Europe are broadly similar to those in the Pacific Northwest where *D. pseudotsugae* mainly occurs. However, the risk can be assessed as relatively moderate because only one host species is concerned and because *D. pseudotsugae* mainly attacks weakened or fallen and only occasionally healthy trees.

D. micans and other indigenous bark beetles (*Ips* spp.) already occur on conifers throughout most of the EPPO region, so the risk arising from introduced species is uncertain. However, those areas of the EPPO region which lack indigenous bark beetles and and protect themselves from species already present elsewhere in Europe have evident reason to protect themselves also from North American bark beetles.

PHYTOSANITARY MEASURES

If measures are needed against *D. pseudotsugae*, those recommended for *D. rufipennis* (EPPO/CABI, 1996), adapted for *Pseudotsuga menziesii*, should exclude it.

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