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Data Sheets on Quarantine Pests

Dendroctonus rufipennis

IDENTITY

Name: *Dendroctonus rufipennis* (Kirby)
Synonyms: *Dendroctonus borealis* Hopkins
Dendroctonus engelmanni Hopkins
Dendroctonus piceaperda Hopkins
Dendroctonus similis LeConte
Hylurgus rufipennis Kirby
Taxonomic position: Insecta: Coleoptera: Scolytidae
Common names: Spruce beetle, Engelmann spruce beetle, red-winged pine beetle (English)
Bayer computer code: DENCRU
EPPO A1 list: No. 267
EU Annex designation: II/A1

HOSTS

D. rufipennis attacks North American *Picea* spp. generally, including in particular *P. glauca* and *P. mariana* in the north, *P. engelmannii* and *P. sitchensis* in the west, and *P. rubens* in the east.

GEOGRAPHICAL DISTRIBUTION

EPPO region: Absent.
North America: Throughout the range of *Picea*; Canada (specific records in Alberta, British Columbia, Manitoba, Northwest Territory, Saskatchewan, Yukon; presumably present also throughout the eastern provinces, where *Picea* spp.
are widespread, but specific record found only for Nova Scotia), Mexico, USA (specific records in Alaska, Arizona, Colorado, Idaho, Montana, New Mexico, Utah, Wyoming; presumably present also throughout New England and the Lake States, where *Picea* spp. are widespread, but specific record found only for New Hampshire).
EU: Absent.

BIOLOGY

The adults and larvae of *Dendroctonus* spp. are phloeophagous or bark-feeding. *D. rufipennis* mostly overwinters as adults and half-grown larvae. Adults emerge from overwintering sites between February and June. Activity is resumed when subcortical temperatures become sufficiently high, about 7-10°C. 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. rufipennis* is associated with a bluestain fungus, *Leptographium abietinum*.

D. rufipennis 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. *D. rufipennis* deposits masses of eggs in common grooves, held in position by a layer of coarse, fibrous frass that separates them from the egg gallery (Massey & Wygant, 1954). The incubation period is 3-4 weeks in *D. rufipennis* at high altitudes in Colorado, USA (Massey & Wygant, 1954).

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 but may be more than 2 years in northern Canada. The end of the larval mine is usually slightly enlarged and cleared of frass to form a pupal chamber, constructed in the inner bark. 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. Development of *D. rufipennis* requires 1 year at low elevations or 2-3 years at higher, colder sites (Wood, 1982).

For further information on the biology of *D. ponderosae*, see Schmid & Frye (1977), Linton & Safranyik (1988).

DETECTION AND IDENTIFICATION

Symptoms

Foliage does not fade until the year after attack. 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. The egg galleries of *D. rufipennis* engrave the wood more deeply than other *Dendroctonus* spp.; the thinness of spruce bark may account for this habit. They are about 13 cm long (up to 23 cm), parallel to the grain of the wood, almost straight, usually with the lower 1-2 cm next to the entrance hole hooked diagonally to either the left or the right. 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) and 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. rufipennis* is 4-7 mm long, cylindrical, dark-brown to black with reddish elytra. It resembles *D. pseudotsugae*. 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.

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. rufipennis is the most destructive of the spruce-inhabiting bark beetles (Wood, 1982). It is particularly important along the western seaboard of North America, from Alaska to Mexico, and in the Rocky Mountains. Though present where spruces occur in other parts of North America, this beetle has not attracted any particularly attention there. It is responsible for killing an estimated 0.33 to 0.50 billion board feet of standing spruce timber each year (Wood, 1982). A severe outbreak of *D. rufipennis* in 1967 in British Columbia, Canada, affected an area of 6 400 ha, largely due to a period of hot, dry weather which predisposed trees to infestation. This beetle prefers windfall, freshly cut logs and shaded slash, but may invade standing trees. Under epidemic conditions the trees selected for attack consist of windfalls or other prostrate dying green trees, or of overmature or weakened standing trees larger than about 20 cm in diameter (Wood, 1982). During an outbreak, almost any spruce tree in the stand may be selected, regardless of size or vigour. The attack usually begins on the lower third of the bole, except for the first 50-100 cm above the ground (Wood, 1982).

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. Werner *et al.* (1988) discuss management strategies for *D. rufipennis*.

Phytosanitary risk

D. rufipennis is an A1 quarantine pest for EPPO, within the category "non-European Scolytidae" (EPPO/CABI, 1992). Since it can make primary attacks on *Picea* spp., it presents a definite risk to the EPPO region, where spruces are important forest trees (both the native *P. abies* and introduced species, especially *P. sitchensis*). There appears to be no specific evidence that it will attack *P. abies*, but it does attack North American *Picea* spp. in general, so the presumption that it would attack *P. abies* is strong. *D. rufipennis* has caused extensive losses in North America, especially along the western coast, under climatic conditions which are broadly similar to those of western Europe. On the other hand, *D. rufipennis* mostly attacks weakened or windthrown trees and outbreaks are mostly linked to predisposing factors. So *D. rufipennis* is not among the most aggressive members of its genus in North America. The risk for the EPPO region can be assessed as high, but not as high as, for example, as the risk from *D. ponderosae*.

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

EPPO recommends that all countries should prohibit import of plants of *Picea* from countries where *D. rufipennis* occurs, and optionally also bark of *Picea* (OEPP/EPPO, 1990). If bark is imported, it should be heat-treated or fermented. Wood of *Picea* from such countries should be debarked, or kiln-dried, or treated (see below). An EPPO phytosanitary procedure for fermentation has been published (OEPP/EPPO, 1994a) and procedures for the other treatments are in preparation.

Infested conifer logs can be treated with chemicals on an individual basis, and fumigation of stacks with methyl bromide can provide excellent control where specialist facilities exist and temperature conditions are correct for effective treatment (White, 1971). EPPO recommends a phytosanitary procedure specifically for this fumigation (OEPP/EPPO, 1994b).

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