Prepared by CABI and EPPO for the EU under Contract 90/399003

Data Sheets on Quarantine Pests

Dendroctonus adjunctus

IDENTITY

Name: *Dendroctonus adjunctus* Blandford
Synonyms: *Dendroctonus convexifrons* Hopkins
Taxonomic position: Insecta: Coleoptera: Scolytidae
Common names: Round-headed pine beetle (English)
Bayer computer code: DENCAD
EPPO A1 list: No. 43
EU Annex designation: II/A1

HOSTS

D. adjunctus attacks *Pinus* spp., especially *P. montezumae* in Mexico, and *P. ponderosa* in the south-western USA. It also attacks *P. ayacahuite*, *P. hartwegii*, *P. leiophylla*, *P. maximinoi*, *P. pseudostrobus* and *P. rudis*.

GEOGRAPHICAL DISTRIBUTION

EPPO region: Absent.
North America: Mexico, USA (Arizona, Colorado, Idaho, New Mexico, Nevada, Texas, Utah).
Central America and Caribbean: Guatemala.
EU: Absent.

BIOLOGY

The adults and larvae of *Dendroctonus* are phloeophagous or bark-feeding. *D. adjunctus* usually overwinters as half-grown larvae or as 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. Flight activity falls in two main periods (May and early June, then late August to mid-October). 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.

Dendroctonus spp. are 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 the eggs are deposited individually or in small clusters in niches, or in rows in long grooves. In *D. adjunctus*, the egg niches are arranged alternately in the

phloem on the sides of the egg gallery in contact with the cambium, about 3.5 mm apart with about 40 niches per gallery. One egg is deposited in each niche, which is then filled with specially prepared frass packed to the original level or contour of the gallery. *D. adjunctus* females, in Guatemala, were reported to lay 70-125 eggs, with a maximum of 200.

The number of larval instars is four. The length of the larval period under optimum conditions is, as in other scolytids, 30 to 90 days. The larva bores into the outer bark to form the pupal cell. 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. adjunctus* may have two or more generations per year, correlated with seasonal change. However, the second generation is sometimes only partial (Hopkins, 1909; Becker, 1954). In southern New Mexico, there is only one generation, and attacks are made principally in Ocotber or November. For further information on the biology of *D. adjunctus*, see Chansler (1967).

DETECTION AND IDENTIFICATION

Symptoms

Pitch tubes on newly infested trees range in colour from dark reddish-orange to cream; they consist of resin and particles of bark expelled from the egg gallery by the beetles. 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. 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. adjunctus*, the egg galleries, in the soft inner tissues of the phloem, extend 2-5 cm horizontally from the entrance hole, then 30-35 cm vertically (up to 89 cm), sinuous and always extending upwards from the entrance hole. They cross or anastomose occasionally. 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 Thomas (1957, 1965), Peterson (1951).

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. adjunctus* is 5 mm long, cylindrical, dark-brown. 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. According to Lucht *et al.* (1974), outbreaks of *D. adjunctus* occurred from 1950 until 1980 in southern New Mexico, USA. In 1950, 16 000 pole and saw-timber-sized trees of *Pinus ponderosa* were infested on a 1000-ha site, whilst a survey in 1972 showed that 400 000 trees were affected in an area covering 60 000 ha. In Guatemala, this beetle has been reported

attacking *P. rudis*, and to a lesser extent *P. maximinoi* and *P. montezumae*, at elevations above 2700 m. According to Wood (1982), this species usually interacts with other *Dendroctonus* spp. to weaken a tree. In the absence of an epidemic of other species, *D. adjunctus* can initiate the primary attack on a tree. Trees selected for attack are weakened standing trees larger than about 25 cm in diameter (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.

Phytosanitary risk

D. adjunctus is an A1 quarantine pest for EPPO, within the category "non-European Scolytidae" (EPPO/CABI, 1992). However, this species is mainly important in Mexico on Pinus spp. which are not grown in the EPPO region. It has been responsible for losses in western USA, on *P.ponderosa* which has been quite widely planted in the EPPO region. However, even in this case, it is only a secondary species, and it is clear that *D. adjunctus* presents only a minor risk for the EPPO region, much less than certain other North American *Dendroctonus* spp.

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 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. adjunctus*, those recommended for *D. ponderosae* (EPPO/CABI, 1996), adapted specifically for *P. ponderosa*, should exclude it.

BIBLIOGRAPHY

Becker, G. (1954) Beiträge zur Kenntnis der *Dendroctonus*-Arten in Guatemala. *Zeitschrift für Angewandte Entomologie* **36**, 20-61.

Chansler, J.F. (1967) Biology and life history of *Dendroctonus adjunctus* (Coleoptera: Scolytidae). *Annals of the Entomological Society of America* **60**, 760-767.

Duncan, B. (1987) An illustrated guide to the identification and distribution of the species of *Dendroctonus* Erichson (Coleoptera: Scolytidae) in British Columbia. *Journal of the Entomological Society of British Columbia* **84**, 101-112.

EPPO/CABI (1992) Scolytidae (non-European). In: *Quarantine pests for Europe* (Ed. by Smith, I.M.; McNamara, D.G.; Scott, P.R.; Harris, K.M.). CAB International, Wallingford, UK.

EPPO/CABI (1996) *Dendroctonus ponderosae*. In: *Quarantine Pests for Europe* (2nd edition). CAB International, Wallingford, UK.

Hopkins, A.D. (1909) Contributions toward a monograph of the scolytid beetles 1. The genus *Dendroctonus*. *Technical Bulletin, United States Department of Agriculture, Bureau of Entomology* No. 17, pp. 1-164.

Lanier, G.N.; Hendrichs, J.P.; Flores, J.E. (1988) Biosystematics of the *Dendroctonus frontalis* complex. *Annals of the Entomological Society of America* **81**, 403-418.

Lucht, D.D.; Frye, R.H.; Schmid, J.M. (1974) Emergence and attack behavior of *Dendroctonus adjunctus* near Cloudcroft, New Mexico. *Annals of the Entomological Society of America* **67**, 610-612.

Peterson, A. (1951) Larvae of insects. An introduction to Nearctic species. Part II. Coleoptera, Diptera, Neuroptera, Siphonaptera, Mecoptera, Trichoptera. Privately published, Columbus, Ohio, USA.

Thomas, J.B. (1957) The use of larval anatomy in the study of bark beetles (Coleoptera: Scolytidae). *Canadian Entomologist*, Supplement 5, 3-45.

Thomas, J.B. (1965) The immature stages of Scolytidae: the genus *Dendroctonus*. *Canadian Entomologist* **97**, 374-400.

Wood, S.L. (1982) The bark and ambrosia beetles of North and Central America (Coleoptera: Scolytidae), a taxonomic monograph. *Great Basin Naturalist Memoirs* **6**, 1-1359.