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Data Sheets on Quarantine Pests

Ips calligraphus

IDENTITY

Name: *Ips calligraphus* (Germar)
Synonyms: *Bostrichus calligraphus* Germar
Ips ponderosae Swaine
Ips interstitialis (Eichhoff)
Taxonomic position: Insecta: Coleoptera: Scolytidae
Common names: Coarse writing engraver, six-spined ips, six-spined engraver beetle (English)
Notes on taxonomy and nomenclature: Lanier *et al*. (1991) have recently recognized 4 taxa within the Calligraphus species group on the basis of breeding experiments, karyology, morphology, ecology and distribution. Subsp. *calligraphus* occurs in the eastern USA and adjacent parts of Canada; subsp. *ponderosae* occurs in the range of *Pinus ponderosa* in the Black Hills, eastern Rocky Mountains and in the northern Sierra Madre Oriental in Mexico; subsp. *interstitialis* occurs in the Caribbean Archipelago. *Ips apache* Lanier *et al.* has been separated as a distinct species and occurs at lower altitudes from southeastern Arizona (USA) through Mexico. Populations south of the Isthmus of Tehuantepec on the east coast of Central America are provisionally considered to be *I. apache*.
Bayer computer code: IPSXCA
EPPO A1 list: No. 270
EU Annex designation: II/A1

HOSTS

In southeastern USA, subsp. *calligraphus* occurs mainly on the southern pines *P. elliottii* and *P. taeda*, and also on *P. echinata;* in the west, subsp. *ponderosae* occurs on *P. ponderosa*, *P. attenuata* and *P. flexilis*. In the Caribbean, subsp. *interstitialis* attacks *Pinus caribaea*, *P. cubensis*, *P. kesiya*, *P. maestrensis*, *P. massoniana*, *P. merkusii*, *P. occidentalis*, *P. oocarpa*, *P. patula*, *P. tropicalis.* In the Philippines, subsp. *interstitialis* occurs on *P. kesiya.* See also Furniss & Carolin (1977) and Wood (1982).

GEOGRAPHICAL DISTRIBUTION

EPPO region: Absent.
Asia: Philippines (Browne, 1979), subsp. *interstitialis*, probably imported with plants or seeds from Central America.
North America: Canada (subsp. *calligraphus*: Ontario, Quebec), Mexico (subsp. *ponderosae* in the north, *I. apache* throughout), USA (subsp. *calligraphus* in the east and also in California (presumably introduced), subsp. *ponderosae* in the west and also *I. apache* in Arizona; overall, Alabama, Arizona, California, Colorado, Florida, Georgia,

Louisiana, Maryland, Montana, Nebraska, New Jersey, New Mexico, New York, North Carolina, Oklahoma, South Dakota, Texas, Wyoming).
Central America and Caribbean: Cuba, Dominican Republic, Guatemala, Honduras, Jamaica, Nicaragua. The populations on the Caribbean islands are mainly if not all subsp. *interstitialis*, and the populations south of Mexico are presumed to be *I. apache.*
EU: Absent.

BIOLOGY

The adults and larvae of *Ips* spp. are phloeophagous or bark-feeding, mainly attacking declining or dead trees and freshly cut wood. They frequently carry the spores of bluestain fungi, in the case of *I. calligraphus* the fungus *Ophiostoma ips* (Yearian *et al*., 1972). They usually overwinter in the adult and larval stage with the proportion of adults to larvae varying from species to species (Wood, 1982). In California, *I. calligraphus* overwinters in all stages except the egg (Bright & Stark, 1973).

Adults emerge from overwintering sites between February and June. Activity is resumed when subcortical temperatures become sufficiently high, about 7-10°C. A temperature-dependent model of the development of *I. calligraphus* has been presented by Wagner *et al.* (1987). 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. 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.

Ips spp. are polygamous: the male excavates the entrance tunnel and nuptial chamber, and then admits two to five females. The females push their frass into the nuptial chamber. The male has the responsibility for ejecting their frass and for protecting the entrance hole. The eggs are usually deposited in individual niches, contiguous in the case of *I. calligraphus*. Up to 100 eggs may be laid per female of *I. calligraphus* (Bright, 1976). There are three larval instars (Wilkinson, 1963). The length of the larval period under optimum conditions is, as in other scolytids, 30-90 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 3-30 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.

The adult beetles may emerge from the host tree immediately, even before becoming fully coloured, or may require a period of maturation feeding before emerging. 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. There are four annual generations in *I. calligraphus* in the north of its range, but up to 9 in Florida (Haack, 1985). For further information on the biology of this species, see Lanier (1972), Wood & Stark (1968), Haack *et al*. (1987), Popp *et al.* (1989).

DETECTION AND IDENTIFICATION

Symptoms

In *Ips* spp., the gallery system is situated in the phloem-cambial region and consists of a central nuptial chamber from which elongate egg galleries fork or radiate, forming a species-diagnostic pattern. In *I. calligraphus*, there are one to six elongate, longitudinal egg galleries 14-38 cm long, which radiate from a large centrally located nuptial chamber and

deeply score the xylem, especially in thin-barked trees. The pattern is similar to that of *I. pini*, but the galleries are wider and etch the wood deeper.

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 *Ips* spp., larval mines are short to very long, straight to irregular, and always visible on peeled bark. They are moderately long in *I. calligraphus*.

Morphology

Eggs

Smooth, oval, white, translucent.

Larva

In general, *Ips* larvae are white, legless, with lightly sclerotized head; head usually as broad as long with evenly curved sides, protracted or slightly retracted; frons sometimes with pair of tubercles (some species). 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 *Ips* and other bark beetles, see Thomas (1957). For *Ips calligraphus*, see Wilkinson (1963).

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.

Adult

In general, *Ips* adults are small, 0.5-8 mm in length (4.0-6.5 mm in *I. calligraphus*), cylindrical to hemispherical in form, usually yellow, brown or black, sometimes shining and glabrous, dull and coarsely granulate, densely pubescent or covered with scales. Antennae geniculate, funicle five-segmented, with abrupt three-segmented club; subcircular to oval, strongly flattened, with sutures strongly to moderately bisinuate. Head partly concealed in dorsal view, not prolonged into distinct rostrum, narrower than pronotum, with mouthparts directed downwards. Eyes flat, usually elongate, sometimes notched, very rarely rounded or divided. Pronotum weakly to strongly declivous anteriorly and usually with many asperate crenulations in anterior half. Scutellum large and flat. Elytra entire, concealing pygidium, with basal margin straight and without crenulations. Elytra terminate in a rounded or blunt slope (the declivity) which is concavely excavated with lateral margins dentate, all teeth on summit (*I. calligraphus* is the only North American *Ips* sp. with 6 spines on the elytral declivity). Tibiae unguiculate. Tarsal segment 1 not longer than 2 or 3, distinctly five-segmented. For generic and specific keys to *Ips* and other genera, see Wood (1982).

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, *Ips* spp. periodically cause loss of wood (cut wood and sometimes 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. However, they tend to be less aggressive and less host-specific than *Dendroctonus* spp. They mostly breed in slash, or in broken, fallen or dying trees, but *I. calligraphus* can, under favourable, conditions make successful primary attacks on healthy *Pinus* stands (Wood, 1982).

I. calligraphus forms part of the so-called "southern pine bark beetle guild" (including also *Dendroctonus frontalis*, *D. terebrans*, *I. grandicollis* and *I. avulsus*; Coulson *et al*., 1986; Flamm *et al*., 1993), which attacks disturbed *Pinus* spp. in southeastern USA (e.g. disturbance by lightning strike, attacks by defoliating insects) and also causes economic problems by infesting freshly cut logs and pulpwood and introducing bluestain fungi (Wilkinson & Foltz, 1980). Published information on *I. calligraphus* as a pest relates almost exclusively to this area and to the Caribbean. It is considered only a secondary pest in California (Furniss & Carolin, 1977). Subsp. *ponderosae*, though reportedly widespread in western USA, is not considered as a pest there.

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. Such methods are recommended for *Ips* spp. in southeastern USA by Speers (1971) and Ciesla (1973). 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

I. calligraphus is an A1 quarantine pest for EPPO, within the category "non-European Scolytidae" (EPPO/CABI, 1992). Since it can make primary attacks on *Pinus* spp., it presents a certain risk to the EPPO region, where pines are important forest trees. This risk can be assessed as relatively moderate because the geographical range of this species in North America, and particularly the range in which it causes damage, is essentially southern (its subspecies extend to the Caribbean) and the *Pinus* species concerned in North America are not grown in the EPPO region. *I. calligraphus* (or rather the closely related *I. interstitialis*) has been introduced into Asia, but it may be noted that the country concerned (Philippines) is tropical.

Indigenous *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 *Ips* spp. and protect themselves from species already present elsewhere in Europe (e.g. *I. typographus*) have evident reason to protect themselves also from North American pest species of *Ips.*

PHYTOSANITARY MEASURES

If measures are needed against *I. calligraphus*, those recommended for *I. pini* (EPPO/CABI, 1996) should also exclude it.

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