

Data Sheets on Quarantine Pests

Thaumetopoea pityocampa

IDENTITY

Name: *Thaumetopoea pityocampa* (Denis & Schiffermüller)

Taxonomic position: Insecta: Lepidoptera: Thaumetopoeidae

Common names: Pine processionary (English)
Processionnaire du pin (French)
Piniensprozessionsspinner (German)
Procesionaria del pino (Spanish)
Processionaria dei pini (Italian)

Notes on taxonomy and nomenclature: The species was described by Denis & Schiffermüller in 1776 in the genus *Bombyx*. In 1822, Hübner created the genus *Thaumetopoea* for all species now included in the family Thaumetopoeidae (raised to this category in 1990). Some authors have followed Stephens who, in 1928, included all species of Thaumetopoeidae in the genus *Cnethocampa*, which he placed in the family Notodontidae (Agenjo, 1941).

Bayer computer code: THAUPI

EU Annex designation: II/B

HOSTS

All species of *Pinus* and *Cedrus* and occasionally *Larix decidua* are attacked. Different species vary in susceptibility, partly because of physical factors such as needle morphology and dimensions, which determine suitability for oviposition (Demolin, 1969a). The following list places species in decreasing order of susceptibility:

Pinus nigra var. *austriaca*

Pinus sylvestris

Pinus pinaster

Pinus pinea

Pinus canariensis

Pinus halepensis

Cedrus atlantica

Larix decidua

The host plant also influences larval development. Survival is greater on *P. sylvestris* and *P. nigra* var. *austriaca* than on *P. pinaster* and *P. halepensis* (Montoya, personal communication). In field trials in the Thessalonika area of northern Greece, larvae developed faster on *P. radiata* than on *P. pinea* (Avtzis, 1986). Such differences must not be assumed to apply outside the regions where they were observed. For example, *P. pinaster* is not much attacked in Corsica, southern France or Spain but suffers significant damage in Les Landes (France). *Cedrus* is undamaged in the Mont Ventoux area (France), but carries high population levels in North Africa (Geri, 1980).

GEOGRAPHICAL DISTRIBUTION

EPPO region: Albania, Algeria, Austria, Bulgaria, Croatia, Cyprus, France (including Corsica), Greece (including Crete), Hungary, Israel, Italy (including Sicily and Sardinia), Lebanon, Libya, Morocco, Portugal, Spain (including Balearic Islands, but not Ibiza), Switzerland (Genève, Tessin, Valais), Syria, Tunisia, Turkey and Yugoslavia.

Asia: Cyprus, Israel, Lebanon, Syria, Turkey.

Africa: Algeria, Libya, Morocco, Tunisia.

EU: Present.

Distribution map: See CIE (1977, No. 366).

BIOLOGY

The life cycle of *T. pityocampa* is normally annual but may extend over 2 years at high altitude or in northern latitudes for part or the whole of the population. The life cycle has two phases, the adult, egg and caterpillar being aerial and the pupa hypogaeal.

Development lasts 6 months under the most favourable conditions, but the 4th and 5th instars may be prolonged in the winter. The pupal stage can be prolonged considerably by diapause which adjusts, at a given location and within certain limits, to ensure constant adult emergence dates each year. Effects of altitude and latitude are discussed by Demolin (1969b), explaining the variation in behaviour at different sites.

Daily average sunshine plays an important role in defining the northern limit of distribution. Androic (1957) proposed the isohelia of 2000 h for the northern border; this is a good approximation but varies with other climatic factors. Adult emergence dates are earlier at northern latitudes and at higher altitudes. In general, the emergence period lasts less than 1 month for vigorous populations and 1.5 months for weakened populations in regression. In most ecological conditions, the adults fly in July.

A few hours after emergence and mating, the females oviposit on the nearest pines. They can, however, fly several kilometres, and quickly extend outbreaks over large areas. The eggs are laid in cylindrical masses in a helicoid arrangement around pairs of needles. A large proportion of the egg masses are generally laid on the peripheral shoots of the crown and contain 70-300 eggs, according to the feeding conditions of the caterpillars (Geri, 1980).

After 30-45 days the young larvae bore an opening in the chorion that can be recognized easily. They aggregate in colonies and spin silken nests which enlarge until the 4th instar when the definitive winter nest is built. In general, this is situated at the branch tips in the upper part of the crown. The caterpillars change colour at each moult and at the 3th instar urticating hair patches appear (Demolin, 1963). If the autumn is warm and sunny, the caterpillar can reach the 5th instar in early winter.

The pupation 'processions', which occur in late winter and early spring, are a spectacular expression of the social behaviour. The caterpillar at the head of the procession is commonly a future female, leading the colony in a file searching for a suitable site to tunnel underground and pupate in the soil. The processions occur at temperatures of 10-22°C; at lower temperatures the colonies regroup and at higher temperatures they bury themselves wherever soil texture allows. Consequently, the cooler the soil, the more extensive is the spread of pupation sites at forest edges. At higher temperatures, the procession moves towards trunk bases in the shade of trees and may even bury itself close to the base of the original tree (Demolin, 1969c). A colony was observed to travel 37 m in 2 days in a cold mountainous area of Spain, the first 35 m being covered during the first day (Robredo, 1963).

Pupation takes place at a depth of about 10 cm and the pupae enter diapause, which always breaks 1 month before adult emergence. Some pupae or the whole colony may not

yield adults in the year of pupation, the diapause period extending until the following year or longer.

DETECTION AND IDENTIFICATION

Symptoms

In infested pine forests, it is easy to detect the presence of *T. pityocampa* by the cylindrical egg masses laid on the low branches of trees and by the early damage caused by the 1st- and 2nd-instar caterpillars. They feed on the needles of twigs close to the silken nest; these partially eaten twigs remain on the tree with their brown and yellowing needles. During the winter, defoliation increases and the white nests stand out plainly.

Morphology

Eggs

The typical cylindrical egg masses range in length from 4 to 5 cm. They are covered with the scales of the female anal tuft, which mimics the pine shoots.

Larva

The larvae develop through five instars, recognized by differences in head capsule size. The average head width of the 5th-instar caterpillar is 4.8 mm for the male and 3.4 mm for the female. The full-grown caterpillar is about 40 mm in length. The head capsule is black. The body of the 1st-instar caterpillar is dull apple-green. After the second moult, the caterpillar assumes its definitive appearance and the reddish dorsal urticating hair patches on each body segment appear arranged in pairs. The integument and hairs that clothe the body vary considerably with different provenances. In general, the integument is darker in colder areas and varies from dull bluish-grey to black. The pleural hairs vary from white to dark-yellow; the dorsal hairs range from yellow to dull orange.

Pupa

Pupation takes place in the soil in an oval, ochreous-white silken cocoon. The obdormant pupae are about 20 mm in length, oval, and of a pale brownish-yellow colour that later changes to dark reddish-brown.

Adult

The female moth has a wing-span of 36-49 mm. The wing-span of the male is 31-39 mm. The antennae are filiform in females and pectinate in males. Both have a hairy thorax. The abdomen is stout and its last segments are covered with a tuft of large scales; the abdomen of the male is brushy and sharp. The forewings are dull ashen-grey; the veins, margins and three transverse bands are darker. The hindwings are white, grey-fringed, with a characteristic dark spot in the anal region.

For further details, see also MAPA (1981).

MEANS OF MOVEMENT AND DISPERSAL

Females of *T. pityocampa* are able to fly some kilometres and the pupation processions may cover up to 37 m. Pupae may be transported with plants in attached growing medium which may be infested by buried insect pupae. Any plant cultivated near infested trees could harbour pupae.

PEST SIGNIFICANCE

Economic impact

In the Mediterranean region, *T. pityocampa* is considered one of the most important forest pests (Cadahía *et al.*, 1975) and is commonly observed in pine forests; it is also common in the cedar forests of North Africa. Defoliation damage is extremely serious in young

reforested areas where it may lead to death of trees, directly or as a consequence of attack by bark beetles or other wood-boring insects. In mature forests trees are rarely killed but significant losses occur in volume growth.

Calas (1897) estimated a 60% reduction in height growth of *Pinus nigra* trees. In young reforestation of *P. radiata*, Cadahía & Insua (1970), by controlling infestations on young trees, demonstrated losses of wood volume increment between 14 and 33% for light and high infestations, respectively. Bouchon & Toth (1971) showed by dendrochronological techniques that forests of *P. nigra* periodically subject to heavy attacks lost about 45% of their volume in 50 years. Lemoine (1977) found a reduction of 30% in circumference growth after an attack on *P. pinaster* in Les Landes (France). Defoliation of *P. nigra* subsp. *nigricans* on Mont Ventoux by *T. pityocampa* caused a missing growth ring the year after a severe attack, resulting in radial growth reductions of 35% (Laurent-Hervouet, 1986). In Corsica, radial growth losses on *P. nigra* subsp. *laricis* were 20% for the 28 years studied, but the attacks only took place every other year.

Defoliation damage and the presence of caterpillars are important on amenity trees in recreational and residential areas, where defoliation may also cause severe deterioration and greater maintenance costs. In addition, the caterpillars have urticating hairs from the 3rd instar onwards (Demolin, 1963), which may cause allergies resulting in conjunctivitis, respiratory congestions and asthma (Ziprkowski & Roland, 1966). These effects occur not only when the caterpillars are present, but also during the following summer because of the persistence of allergenic hairs in the remains of winter nests. This problem not only affects recreational and residential areas but also hinders silvicultural operations and grazing in forests (Marti Morera & Barri Baya, 1959).

Control

Chemical and biological control treatments are mainly applied by ULV aerial spraying with rotary atomizers at 5 litres/ha, with petroleum oil or vegetable oils as solvents. Dosages of the active ingredients are as follows (Robredo, 1980; Robredo & Obama, 1987): 45-56 g/ha of the insect growth regulator (IGR) diflubenzuron; 1.7-2.6 g/ha of the pyrethroid cypermethrin; 0.65-1.00 g/ha of the pyrethroid deltamethrin; and different formulations of *Bacillus thuringiensis* at the rate recommended by each manufacturer. All larval instars are susceptible to these treatments, but the 4th and 5th instars need the highest dosages. At this stage of development, during the winter months, the impact of pyrethroids on the beneficial insect fauna is minimized (Robredo & Obama, 1991).

In small areas or at low population density, mechanical control is also recommended, by cutting and burning of winter nests. Sex pheromone traps may be used, both for monitoring and for mass trapping (Cadahía *et al.*, 1975; Montoya, 1984; 1988).

The major parasitoids and predators of *T. pityocampa* are as follows (Biliotti, 1958; Biliotti *et al.*, 1965; Cadahía *et al.*, 1967; Demolin & Delmas, 1967; Demolin, 1969c; Du Merle, 1969).

On eggs: The parasitoids *Tetrastichus servadei* (Hymenoptera: Eulophidae), *Oencyrtus pityocampae* (Hymenoptera: Encyrtidae), *Trichogramma* sp. (Hymenoptera: Trichogrammatidae), *Anastatus bifasciatus* (Hymenoptera: Eupelmidae), and the predators *Ephippiger ephippiger* (Orthoptera: Tettigoniidae), *Barbitiste fischeri* (Orthoptera: Tettigoniidae).

On larvae: The parasitoids *Phryxe caudata* (Diptera: Larvaevoridae), *Compsilura concinnata* (Diptera: Tachinidae), *Ctenophora pavidata* (Diptera: Tachinidae), *Erigorgus femorator* (Hymenoptera: Ichneumonidae), *Meteorus versicolor* (Hymenoptera: Braconidae) and the predator *Xantandrus comtus* (Diptera: Syrphidae).

On pupae: The parasitoids *Villa brunnea* (Diptera: Bombyliidae), *V. quinquefasciata* (Diptera: Bombyliidae), *Coelichneumon rudis* (Hymenoptera: Ichneumonidae).

The most important diseases (Vago, 1958; Atger, 1964) are caused by the viruses *Borrelina* sp. and *Smithiavirus pityocampae*, the bacteria *Bacillus thuringiensis* and *Clostridium* sp., and the fungi (mainly on pupae) *Aspergillus flavus*, *Beauveria bassiana*, *Cordyceps* sp., *Metarhizium anisopliae*, *Paecilomyces farinosus*, *P. fumoso-roseus* and *Scopulariopsis* sp.

Phytosanitary risk

T. pityocampa is not listed as a quarantine pest by EPPO or by any other regional plant protection organization. Within the EPPO region it is likely to be a damaging pest only in the pine and cedar forests in the Mediterranean area. At present only a few areas are still free from the insect; for example, the Canary Islands are being protected by phytosanitary measures taken by the Spanish Department of Agriculture.

PHYTOSANITARY MEASURES

Plants for planting of the genera *Pinus* and *Cedrus* should be inspected for the presence of egg masses and caterpillar colonies of *T. pityocampa*. Likewise, nursery plants with attached growing medium should be inspected for the presence of pupae. Ideally, consignments of plants for planting, in particular those with attached growing medium, should come from an area found free, together with its immediate vicinity, from *T. pityocampa*.

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