EPPO Datasheet: *Pissodes terminalis*

Last updated: 2023-02-08

IDENTITY

Preferred name: *Pissodes terminalis*
Authority: Hopping
Taxonomic position: Animalia: Arthropoda: Hexapoda: Insecta: Coleoptera: Curculionidae: Molytinae
Common names: lodgepole terminal weevil, lodgepole-pine terminal weevil
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EPPO Categorization: A1 list
view more categorizations online...
EU Categorization: A1 Quarantine pest (Annex II A)
EPPO Code: PISOTE

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Notes on taxonomy and nomenclature

Pissodes terminalis was described by Hopping (1920) and there have been no further taxonomic or nomenclature changes.

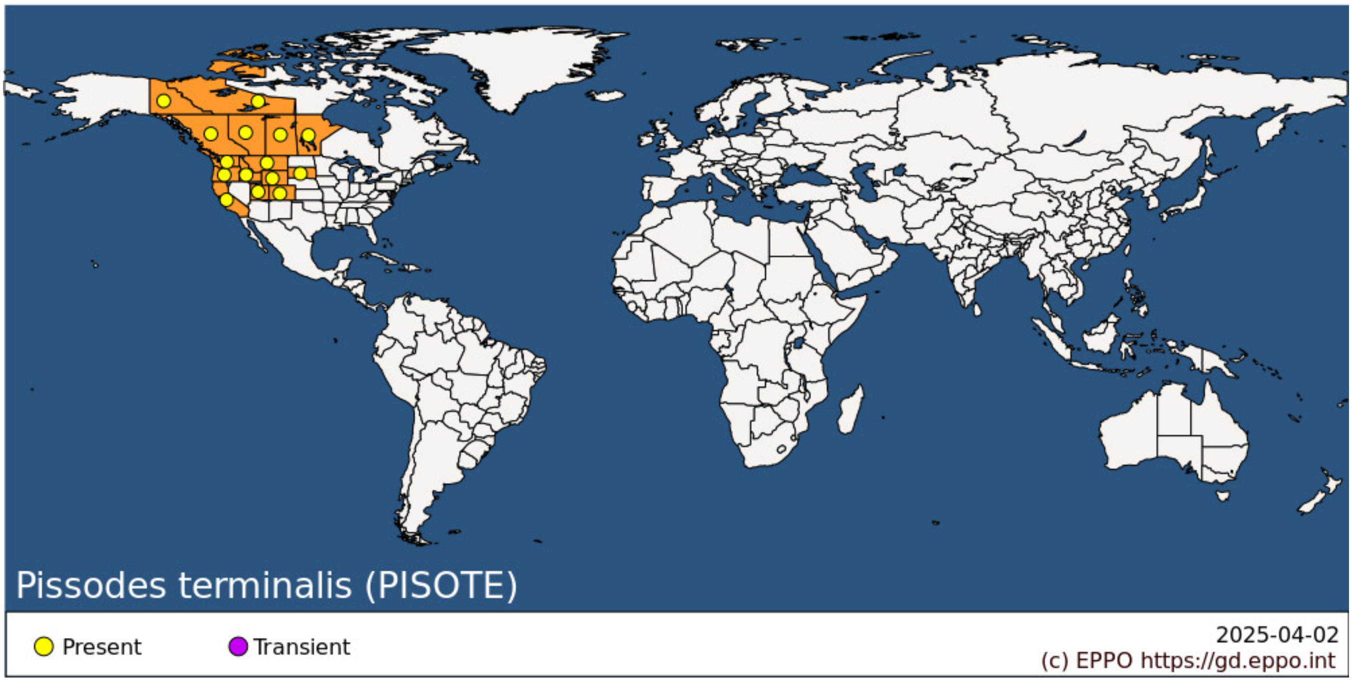
HOSTS

Pissodes terminalis breeds in coniferous trees in the genus *Pinus*, attacking mainly lodgepole pine (*Pinus contorta*) throughout most of its range and jack pine (*P. banksiana*) and jack pine x lodgepole pine hybrids in the prairie provinces of Canada. Bishop pine (*P. muricata*) and Monterey pine (*P. radiata*) are known to be occasionally attacked in California.

Host list: *Pinus banksiana*, *Pinus contorta*, *Pinus muricata*, *Pinus radiata*

GEOGRAPHICAL DISTRIBUTION

This weevil species is distributed in the western half of the United States of America and Canada, ranging from southern parts of both Yukon and the Northwest Territories in the north, to California, Utah and Colorado in the south. Its distribution follows that of lodgepole pine, but it also occurs in the boreal forest in Alberta, Saskatchewan and Manitoba where the host is jack pine and its hybrids.



North America: Canada (Alberta, British Columbia, Manitoba, Northwest Territories, Saskatchewan, Yukon Territory), United States of America (California, Colorado, Idaho, Montana, Oregon, South Dakota, Utah, Washington, Wyoming)

BIOLOGY

The life cycle of this weevil species takes 1-2 years, depending on altitude and latitude. In the Cordilleran forests of Canada and at altitudes above 2000 m in Nevada and California and above 2500 m in Colorado a 2-year life cycle is common (Stevens & Knopf, 1974; Cameron & Stark, 1989; Langor *et al.*, 1991; Langor & Williams, 1998). Overwintering adults emerge from the litter before all the snow has melted and are found on terminal leaders of trees from May to July. Beetles are more likely to be found on the longest, thickest, and most sun-exposed terminals in a stand (Maher, 1982; Langor & Williams, 1998). Beetles feed for about two weeks during which the gonads mature and the fat body enlarges (Langor & Williams, 1998). During feeding, beetles chew small feeding punctures into the phloem, usually near the base of the elongating terminal, consuming the tissue. Mating and oviposition occurs by about mid-June. All eggs are laid in the developing terminal leader. The female first chews an oviposition puncture into the phloem wherein one egg (rarely two) is deposited and the puncture capped with a plug of macerated phloem. Typically, fewer than 15 eggs are laid per terminal, but females oviposit on multiple terminals. The mean fecundity is 115 eggs per female (Kovacs & McLean, 1990a). Larvae first appear in late June, and development proceeds through four larval instars. Upon hatching, young larvae feed in the phloem and move downward in the terminal for 1-2 cm before reversing direction 180° to mine upwards. Starting in early to mid-August, larvae move from the phloem into the pith of the terminal as third or fourth instars. Before entering the pith, each larva feeds around the entire circumference of the terminal, effectively girdling it, before boring into the pith. Once in the pith larvae feed upwards (70% of individuals) or downwards. Those that feed downward do not go beyond the first node. Most third instars moult before onset of winter so about 70-100% of the population overwinter as fourth instars in Western Alberta (Langor & Williams, 1998). With onset of cold temperatures, guts are voided, and development stopped. Larvae do not have an obligatory diapause. Larval development continues in May of the following year, with pupation occurring from late May to June and adults appearing by early July. Adults emerge from the terminal after several days by chewing round emergence holes of 2-4 mm diameter. Adults feed on fresh phloem of branches until autumn when they enter the litter layer to overwinter. Adults have an obligatory diapause and there are overlapping generations in the field.

In the boreal forest of Western Canada and at altitudes below 2000 m in the southern parts of its range in Nevada, California and Colorado, a 1-year life cycle is typical (Drouin *et al.*, 1963; Cameron & Stark, 1989; Langor *et al.*, 1991). With a 1-year life cycle, the entire population is synchronized (i.e., there are not overlapping generations) (Langor *et al.*, 1991). Overwintering adults emerge from the litter in May and June, and their subsequent behaviour is similar to that reported in the previous paragraph. Pupation occurs in late July in the pith, and an average of two (but up to eight) adults emerge from each terminal from mid-August to September (Drouin *et al.*, 1963; Langor *et al.*, 1991). After a brief feeding period, adults fall or crawl to the ground to overwinter.

There are variations on these two common phenologies reported in California (Stark & Wood, 1964; Cameron & Stark, 1989) and British Columbia (Maher, 1982; Kovacs & McLean, 1990a).

DETECTION AND IDENTIFICATION

Symptoms

In Alberta and Saskatchewan (Canada), adult *P. terminalis* attack trees 1.5–9.0 m tall, but typically 2.0–6.0 m tall (Langor *et al.*, 1991), and this is similar in Colorado (Stevens & Knopf, 1974). The first signs of attack are visible on the terminals of pines in late May or June when beads of resin ooze from feeding and oviposition punctures (Drouin *et al.*, 1963; Langor *et al.*, 1991; Hiratsuka *et al.*, 1995). The glistening resin is visible from up to 15 m away on sunny days. Upon close examination of terminal leaders, feeding and oviposition punctures (~1 mm diameter) are visible, particularly in the lower third of the terminal and sometimes on secondary shoots and second-year conelets. When larvae start mining the phloem, the tissue over the feeding tunnels turns magenta, contrasting with the typical green of healthy tissue. The feeding of the larvae and eventual girdling of the terminal leader ultimately causes the foliage of the leader to fade to yellow or orange-red. In jack pine in the boreal forest of Western Canada, where there is a 1-year life cycle, foliage of terminals slowly fades from yellow in June to rusty-red by late July. In addition, the terminal leader tends to droop into the shape of a shepherd's crook by July. In Cordilleran forests of Alberta and British Columbia, infested terminals of lodgepole pine usually fades in September or October, turning a brick-red colour by the following spring, but terminals do not droop to form a shepherd's crook. Dissection of discoloured terminals will reveal the presence of larvae, pupae and/or adults in the pith. This species does not make chip cocoons before pupation. After adults emerge, they create circular emergence holes of 2-4 mm diameter in the bark. Dead terminals can remain on trees for many years after beetles have emerged. Old feeding and oviposition punctures, larval galleries and adult emergence holes can be used to identify old attacks. When the terminal leader dies, the main stem usually develops a major crook or fork, but these usually straighten out after 2-3 years. It is unusual for the same tree to be attacked in successive years.

It is possible to confuse the symptoms caused by the white pine weevil, *Pissodes strobi*, with those of *P. terminalis* as both species attack the tops of trees and cause the terminal leader to become discoloured and sometimes form a shepherd's crook. The distributions of both weevil species overlap throughout most of the range of *P. terminalis*. However, it is possible to distinguish these two species even as early as during feeding and oviposition: 1) *P. terminalis* feeds and oviposits on the current year's leader with punctures largely limited to the lower third of the terminal, whereas *P. strobi* feeds and oviposits on the previous year's terminal, i.e., the portion of the stem below the current year's elongating terminal, and punctures can occur along the entire length of the previous year's growth; 2) larvae of *P. terminalis* feed mainly upward in the leader, at least after the first two weeks following hatching, and individual larval galleries rarely coalesce, whereas the larvae of *P. strobi* feed predominantly downwards in the stem and individual galleries eventually coalesce so that there is an agglomeration of larvae around most or all of the circumference of the stem forming a so-called 'feeding ring'; and 3) *P. terminalis* pupates in the pith of current year's leader and does not form chip cocoons, whereas *P. strobi* pupates in the phloem and outer wood of the stem growth of the previous year (or even 2-4 years) and chip cocoons are formed (Hiratsuka *et al.*, 1995). The only other predominantly terminal infesting *Pissodes* in the world is *P. nitidus* from North-Eastern China, adjacent parts of Russia, the Korean Peninsula and Japan (Hokkaido) and *P. yunnanensis* from the Yunnan Province of China. Symptoms caused by these species are similar to those caused by *P. strobi* and can be discriminated from those of *P. terminalis* in similar ways.

Morphology

Eggs

Eggs are translucent, pearly white, ovoid, average 0.9 mm in length and 0.6 mm wide in California (Cameron & Stark, 1989), and look like the eggs of many species of *Pissodes*.

Larva

Larvae are legless, have milk-white bodies and light brown heads, the abdomen is slightly curved downwards, and are 10-12 mm long at maturity (Hiratsuka *et al.*, 1995). Superficially, larvae of this species look like larvae of other species of *Pissodes*. Detailed descriptions of mature larvae of *P. terminalis* and *P. strobi*, accompanied by illustrations, are provided by Williams & Langor (2002a), and detailed descriptions of the two other known terminal-infesting *Pissodes* in the world, *P. nitidus* and *P. yunnanensis,* are provided by Lee (1992) and Williams & Langor (2011), respectively.

Pupa

Pupae are about 5-9 mm in length and are milk-white, but they become darker when the adult is nearly ready to emerge (Langor *et al.*, 1991). Pupae of different *Pissodes* species cannot currently be distinguished.

Adult

Adults have a long snout, are mottled brown with variable white and yellow patches on the elytra, and 5-9 mm long. There is no easy way to discriminate between *P. terminalis* and *P. strobi* without using a morphometric approach (Williams & Langor, 2002b). Adults of *P. terminalis* are distinct from native species in the EPPO region and from *P. nitidus* and *P. yunnanensis*.

Detection and inspection methods

This species commonly attacks pine saplings ranging from 1.5-9.0 m tall and is most common on trees growing in plantations with an open canopy. Young saplings with copious resin droplets on the current year's stem growth should be investigated for signs of weevil attack such as feeding and oviposition punctures and presence of adults on the bark. Drooping of the terminal leader on some pine species and eventual discoloration of needles is also a sign of infestation. Removal of bark on current year's growth on trees suspected of being infested may reveal larval galleries in the phloem, sapwood and pith, pupae, callow adults and/or round adult emergence holes in the bark. This species does not produce chip cocoons. There are no native species of *Pissodes* in the EPPO region that specifically target the terminal leaders of pines, so detection of young pines with such damage and clear evidence of the presence of *Pissodes* is likely to signal the presence of one of four non-native terminal-infesting *Pissodes*, one of which is *P. terminalis* (others are *P. strobi*, *P. nitidus*, and *P. yunnanensis*). DNA barcodes are available for most species of *Pissodes* native to the EPPO region, as well as for all terminal-infesting species except *P. nitidus* (Langor & Sperling, 1997; Zhang *et al.*, 2007).

PATHWAYS FOR MOVEMENT

The natural spread of *Pissodes* spp. is determined by the flight performance of the species which is likely not more than 10 km per year based on what is known about flight capabilities of other species of *Pissodes*. International spread would most probably occur via the shipment of living pines and Christmas trees, especially lodgepole pine and jack pine. As *P. terminalis* attacks only the terminal leader, it is unlikely to be carried by wood commodities or dunnage.

PEST SIGNIFICANCE

Economic impact

The larvae of *P. terminalis* feed upward in the leader and thus can kill only one year's height growth during the year of attack. After a leader dies, one or more of the branches of the node below the terminal assumes leadership. Tree height loss caused by *P. terminalis* attack can be recovered in 2-3 years if the tree is not attacked in succeeding years (Stevenson & Petty, 1968). However, occasionally some trees may be attacked for up to four successive years (Drouin *et al.*, 1963), and repeated attacks can cause a crooked or forked stem which reduces the tree's value for lumber production (Langor *et al.*, 1991). Stem deformities can result in reduction of merchantable volume through lost height growth and degrading of lumber due to grain aberrations at the site of the crook (Maher, 1982). Thinning of young lodgepole pine and jack pine stands can increase the number of trees attacked by *P. terminalis* by 15-480%, and as many as 87% (cumulative) of pines can be attacked in thinned plantations (Langor *et al.*, 1991). The yearly incidence of attack is typically 2-5% but can be as high as 30% (Hiratsuka *et al.*, 1995).

Control

In un-thinned plantations managed for wood production, weevil control is generally not necessary. In thinned or spaced high value plantations (e.g. genetics trials, Christmas tree nurseries), control measures may be necessary. Small infestations in plantations may be controlled by pruning the infested leader just above the topmost whorl of branches as soon as damage symptoms are seen (e.g. resin flow from leaders, foliage discolouration, shepherd's crook). As weevils can survive in cut terminals, it is necessary that pruned terminals are destroyed by chipping, burning or burying (Langor *et al.*, 1991). A new leader can be encouraged by clipping all but the strongest branch of the uppermost whorl. The effectiveness of pruning is dependent upon the percent of infested leaders discovered and removed. Not all leaders show symptoms simultaneously, so it is ideal for plantations to be surveyed and pruned twice each summer, before adults begin emerging. Two or more years of pruning may be required to eradicate the population or keep it in check (Langor *et al.*, 1991). As there are several species of parasitoids that attack *P. terminalis* (Kovacs & McLean 1990b, Langor *et al.*, 1991), it may be possible to augment parasitoid populations in plantations by caging pruned infested terminals in meshed cages whereby the mesh size is sufficiently fine to trap the robust weevils but coarse enough to allow escape of the slender parasitoids (Langor & Williams, 1998). Application of insecticides to infested terminal leaders may also be an effective control strategy as this tactic is effective for another North American terminal-infesting species, *Pissodes strobi* (Langor *et al.*, 1991).

Phytosanitary risk

The main host of *P. terminalis*, lodgepole pine, is planted in the EPPO region, particularly in Northern Europe (Vacek *et al.*, 2022), as is a more uncommon host *P. radiata*, particularly in South-Western Europe (EUFORGEN, 2023), and the weevil could probably establish on these species under European conditions. In its native range, *P. terminalis* infests mainly pines in the Subsection *Contortae* and less frequently pines in the Subsection *Australes*. There are no species of these Subsections native to the EPPO Region. The potential of *P. terminalis* to spread and cause extensive damage to native European pines seems unlikely and, thus, it presents a relatively low-to-moderate risk to the EPPO region.

PHYTOSANITARY MEASURES

To prevent the introduction of life stages of *P. terminalis*, EPPO recommends that plants for planting (except seeds) and cut branches (including Christmas trees) of hosts should originate in a pest free area (EPPO, 2018). Pest free place of production is the specific requirement mentioned in the EU regulation (EU, 2022).

Because wood commodities are unlikely pathways (see Pathways for movement), phytosanitary measures are not detailed here. Measures for various wood commodities in relation to *P. terminalis* are mentioned in EPPO (2018) and EU (2022).

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Datasheet history

This datasheet was first published in the EPPO Bulletin in 1980 and revised in the two editions of 'Quarantine Pests for Europe' in 1992 and 1997, as well as in 2023. It is now maintained in an electronic format in the EPPO Global Database. The sections on 'Identity', 'Hosts', and 'Geographical distribution' are automatically updated from the database. For other sections, the date of last revision is indicated on the right.

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