EPPO Datasheet: *Pissodes nitidus*

Last updated: 2022-03-09

IDENTITY

Preferred name: *Pissodes nitidus*
Authority: Roelofs
Taxonomic position: Animalia: Arthropoda: Hexapoda: Insecta: Coleoptera: Curculionidae: Molytinae
Common names: yellow-spotted pine weevil
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EU Categorization: A1 Quarantine pest (Annex II A)
EPPO Code: PISONI

Notes on taxonomy and nomenclature

Pissodes nitidus was described in 1874 by Roelofs and there have been no taxonomic or nomenclatural changes since. Notably, this species attacks almost exclusively the 1-year-old internode of the trunk (i.e., the previous year's vertical growth) of pines in China (Jin, 1989) and on the Korean Peninsula (Park & Byun, 1988); however, in Japan it infests almost the entirety of trunks of trees and is not limited to the 1-year-old internode (Yoshikawa, 1987). This variation in colonization site in different parts of the range is very rare for species of *Pissodes*. Thus, for *P. nitidus*, this phenomenon may indicate a significant genetic difference between populations in Japan and those on the Asian mainland. An ongoing study of the taxonomy of Asian species of *Pissodes* could help resolve this.

HOSTS

In the People's Republic of China (PRC), *Pinus koraiensis* (Korean pine) is the most commonly reported host for *Pissodes nitidus* in the lesser Xingan Mountain Forest area in Heilongjiang Province, and in Jilin and Liaoning Provinces *Pinus tabuliformis* is also attacked (Jin, 1989). *Pinus densiflora, Pinus thunbergii*, and *Pinus sylvestris* var. *mongolica* have been recorded as occasional hosts in PRC. In Japan, *P. densiflora* is the only recorded native host (Yoshikawa, 1977), and although *P. koraiensis* occurs in Japan, it is uncommon and largely limited to subalpine areas (Okitsu & Momohara, 1997). In the Republic of Korea, *P. koraiensis* and *P. densiflora* are the main native hosts; however, in exotic tree plantations several North American species and hybrids (*Pinus banksiana, Pinus parviflora, Pinus rigida, Pinus rigida* × *Pinus taeda, Pinus strobus*, and *Pinus virginiana*) are attacked (Park & Byung, 1988), suggesting that this weevil species can colonize a wide variety of pines given the opportunity.

Species colonized in natural stands: *Pinus densiflora, Pinus koraiensis, Pinus tabuliformis, Pinus thunbergii, Pinus sylvestris* var. *mongolica.*
Nearctic species colonized in plantations: *Pinus banksiana, Pinus parviflora, Pinus rigida, Pinus rigida* × *Pinus taeda, Pinus strobus*, and *Pinus virginiana.*

Host list: *Pinus banksiana*, *Pinus densiflora*, *Pinus koraiensis*, *Pinus parviflora*, *Pinus rigida*, *Pinus strobus*, *Pinus sylvestris var. mongholica*, *Pinus tabuliformis*, *Pinus thunbergii*, *Pinus virginiana*

GEOGRAPHICAL DISTRIBUTION

Pissodes nitidus is an East Asian species (Alonso-Zarazaga, 2013; Anonymous, 2022; Hong *et al.*, 2011; Lu *et al.*, 2007; Wu, 1991).

EPPO Region: Russian Federation (the) (Far East)
Asia: China (Gansu, Hebei, Heilongjiang, Henan, Hubei, Jilin, Liaoning, Shaanxi), Japan (Hokkaido, Honshu, Kyushu, Shikoku), Korea, Democratic People's Republic of, Korea, Republic of

BIOLOGY

This account of the biology of *Pissodes nitidus* is compiled mainly from detailed studies in Korean pine plantations located in the Xingan Mountains, Heilongjiang province, China (Jin, 1989; Wu, 1991). The biology of this weevil in transplanted 6-year-old seedlings of *P. koraiensis* in the central part of the Korean Peninsula (Park & Byun, 1988) is very similar, except where noted, and overall the reported life cycle events in Korea occur about one month earlier than those reported in the Xingan Mountains. There is one generation per year. Upon leaving overwintering sites in litter on the forest floor in April to May, adults climb up tree trunks to sun-exposed areas for feeding, mating and oviposition. Adults feed on new growth near the tree top, boring many feeding holes (about 2 mm in diameter) which causes resin to leak out. Mating and oviposition begins in late May and peaks in early June. Females chew small holes in the bark of one-year-old shoots, lay one egg (or rarely two or three) in the hole, and plug the hole with some macerated phloem. Oviposition can occur anywhere along the stem of 6-year-old seedlings in Korea (Park & Byun, 1988).

The eggs hatch in June and larvae develop through four instars before pupation. First and second instar larvae feed in the phloem and older larvae move into the xylem and pith to feed. The first three larval instars last about 15 days each in duration and the fourth instar about 20 days. The critical temperature threshold is 9.1 °C for the development of eggs and larvae, and is 9.6 °C for pupae. Pupation commences in early July and the pupa takes 10-12 days to complete development. Prior to pupation, the fourth instar larva builds a pupal chamber (about 9 mm in length) in the outer xylem at the end of larval mines. The larva lines the chamber with wood chips chewed from the xylem creating a ‘chip cocoon’ characteristic of most species of *Pissodes*. Adults start emerging in mid-July by boring a hole through the bark to exit. Newly emerged adults feed on fresh phloem in twig crotches and on upper branch tips. In late August and September, new adults can either climb down the tree trunks to overwinter on the forest floor or fly to new sites. Mating does not occur until after the overwintering period. The greatest dispersal for newly emerged adults occurs in late summer and the maximum dispersal distance measured was 1660 m. Most adults live approximately 360 days, and some adults overwinter twice. The cumulative heat sum from egg to adult is 620 degree-days above 9 °C. More than 70 species of hymenopterous parasitoids are associated with *P. nitidus*, and there are three parasitoid generations per season with the third overwintering in the portion of the upper trunk recently killed by weevils. Mortality from egg to emerged adult was calculated at 65.5% in one year, including all mortality factors; however, parasitoids cause most of the mortality. Higher weevil survival rates (>50%) are associated with stands growing in high light conditions and low relative humidity, and damage to trees is lowest (<5% of trees) on N-, NNE-

, and NNW-facing slopes. In pure Korean pine stands with canopy closure, the cooler within-stand temperature and shading slows weevil development compared to more open stands.

In Japan, *P. nitidus* readily colonize freshly cut logs (Yoshikawa, 1977) as well as the trunks of standing recently killed trees of *P. densiflora,* highlighting that the species is not constrained to breeding in the top of the trunk. In standing dead trees of 10 m height, the entire trunk was colonized but the highest emergence density was at 6-7 m above ground (Yoshikawa, 1987). These trees had bark as thick as 15 mm but the highest emergence of *P. nitidus* was from areas with thin bark of 1.0-2.5 mm. The life cycle was about the same as that reported in Korean pine in North-Eastern China. Trees were attacked in late March and April, and adults emerged about 50 days later (Yoshikawa, 1986).

DETECTION AND IDENTIFICATION

Symptoms

On the Asian mainland, where *Pissodes nitidus* attacks only the tops of pines growing in plantations, larvae feed in the phloem, sapwood and pith of 1-year-old internodes (Jin, 1989; Wu, 1991). The first signs that a tree is infested by adult weevils in the spring (April-May) are resin droplets that exude from puncture wounds caused by adults feeding on current and one-year-old shoots. Resin droplets glistening in the sun are visible from a distance of several metres on shorter trees, although this is hard to see on taller trees. Upon close inspection of shoots undergoing attack, feeding punctures (about 2 mm wide) made by adults are visible in the bark. Foliage above the attacked part of the trunk and on lateral branches attached to the infested area starts to droop as early as late April, and soon thereafter starts turning yellow and then reddish orange. The presence of chip cocoons under the bark from July onwards is also evidence that *Pissodes* are present, although chip cocoons may persist for many years after they are vacated. In plantations where there are no currently visible attacks, but where many pine trunks are branched or crooked, there is a possibility that these trees were infested by the yellow-spotted pine weevil at one time. A close examination of the stem at the point of forking or crooking often reveals stubs of old terminal growth that have discernible feeding and oviposition punctures and old chip cocoons.

Morphology

Eggs: Eggs are oval, approximately 1.2 mm in length and 0.4 mm wide and are milk-white (Wu, 1991), and look like the eggs of many other species of *Pissodes*.

Larva: Larvae are typically 8-9 mm in length (but sometimes as small as 5 mm), legless, and the abdomen is slightly curved downwards. The milk-white body contrasts with the light brown head (Wu, 1991). Superficially, larvae of this species look like larvae of other species of *Pissodes*. A very detailed description of mature larvae of *P. nitidus,* accompanied by illustrations, is provided by Lee (1992), and this help distinguish *P. nitidus* from native species in the EPPO region.

Pupa: Pupae are about 7 mm in length and are milk-white for a few days (Wu, 1991), before gradually turning brown until the adult is ready to emerge. Pupae of different *Pissodes* species cannot currently be distinguished.

Adult: Adult morphology was briefly described by Roelofs (1874) based on type material from Japan. A more detailed description of adults from populations in North-Eastern China was provided by Wu (1991). Herein, key distinguishing characteristics to discriminate this species from the nine native *Pissodes* species in the EPPO region are provided based on unpublished taxonomic studies of *Pissodes* by David Langor. Adult *P. nitidus* are typically 8-9 mm long although some they may be as small as 5 mm. The base colour of the dorsal integument is reddish brown, except for the tarsi, distal half of the snout, and flagellum of the antennae, which are distinctly and contrastingly black. As well, the black to piceous ventral integument, especially that of thorax and abdomen, contrasts with the reddish-brown dorsal integument. The integument colour pattern of *P. nitidus* contrasts with all nine native species in the EPPO region. All native species have a black to brownish black (=piceous) dorsal integument that does not contrast with the ventral integument, and there is no distinct colour contrast along the length of the legs, snout and antennae. Although newly emerged (i.e., teneral) adults of native European species can resemble *P. nitidus* in integument colour, the colour contrasts within the legs, snout and antennae will not be obvious. The patterns of white and light brown to yellowish orange scales on the elytra also have high diagnostic value (e.g., number of bands, colour patterns, presence/absence of anterior band). Each elytron of *P. nitidus* has two distinct diagonal bands of lighter scales. The anterior band, which extends from interstriae four to seven, is uniformly yellowish orange or light brown. The posterior band is comprised mainly of white scales and extends from interstriae one to ten or eleven (i.e., almost the entire width of the elytron), interrupted only by a small patch of yellowish orange or light brown scales mainly on interstriae six and seven. Of the native *Pissodes* species in the EPPO region, only *P. castaneus* and some specimens of *P. validirostris* may have an elytral scale pattern somewhat resembling that of *P. nitidus*, i.e., uniformly coloured yellowish orange anterior band and bicoloured (white and yellowish orange) posterior band. However, the integument colour differs from that of *P. nitidus*, as previously described. Of these two species, only *P. castaneus* breeds in the phloem of pines, mainly on the lower parts of the trunk, whereas *P. validirostris* breeds in pine cones.

Detection and inspection methods

Pissodes nitidus commonly attacks pine seedlings and saplings ranging from three to about 30 years old and are most common on trees growing in plantations with an open canopy. Young pine seedlings and saplings with copious resin droplets on the current and previous year's growth should be investigated for signs of weevil attack such as feeding and oviposition punctures and presence of adults on the bark. Drooping of recent growth and eventual discoloration of needles is also a sign of infestation. Removal of bark on previous and current year's growth on trees suspected of being infested may reveal larval galleries in the phloem, sapwood and pith, chip cocoons, pupae, callow adults and/or round adult emergence holes in the bark. There are no native species of *Pissodes* in the EPPO region that specifically target the top of the trunks of pines so detection of young pines (or spruce) 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. nitidus* (others are *P. strobi*, *P. terminalis*, and *P. yunnanensis*).

As in Japan *P. nitidus* is known to attack along the full length of trunks of *Pinus densiflora* up to 10 m tall (Yoshikawa, 1987), there is a possibility that yellow-spotted pine weevils inadvertently introduced to the EPPO region from Japan may attack anywhere along the length of the trunks of pines. There are five native species of *Pissodes* that attack boles of pine trees in the EPPO region and adults and possibly larvae of *P. nitidus* can be distinguished from those species using morphological characters as described above. DNA barcodes are not yet available for *P. nitidus*.

PATHWAYS FOR MOVEMENT

Adults are capable of flight and can move at least 1660 m using a combination of walking and flying (Jin, 1989). On the Asian mainland where *P. nitidus* attacks mainly seedlings and saplings, it is possible that dispersal can be aided by human transplant of infested seedlings, young trees and foliage of susceptible pine species, especially *P. koraiensis*, *P. tabuliformis*, and *P. densiflora*. As *P. nitidus* can attack along most of the length of stems of mature *P. densiflora* in Japan, transport of logs could help dispersal of this species within the region, and long-distance transport via lumber or dunnage is possible.

PEST SIGNIFICANCE

Economic impact

In North-Eastern China, most economic impact caused by *P. nitidus* is a consequence of stand management, particularly of Korean pine (Jin, 1989). This weevil species naturally occurs throughout most of the range of its host species. In unmanaged stands, incidence and severity of damage tends to be low as the dense canopy cover keeps the temperatures in the stand relatively low, creating sub-ideal conditions for weevil development (Jin, 1989). However, when mixed stands are managed to remove competing hardwood foliage to release pines from competition and increase growth rate, this action also results in increased stand temperatures, creating ideal conditions for this weevil, and consequent rapid population increases and increased damage to tops of trunks. Similarly, when pines are grown in plantations with spacing between trees to optimize growth and control of competing vegetation, conditions ideal for *P. nitidus* development are created again (Jin, 1989). As the larvae develop in the 2-year-old leaders where eggs were laid, they chew the phloem and bore into sapwood causing damage to the tree through blocking water and nutrient movement (Wu, 1991). Thus, attacked trees lose the previous and current year's height growth which amounts to 60 to 100 cm in annual height loss (Jin, 1989). In stands where trees have been attacked two to four times, the stand volume losses are estimated to be about 20 % (Jin, 1989). In addition to causing vertical growth loss, the death of portions of the stem frequently causes a fork or crook in the stem as the highest whorl of live branches compete for dominance. Deformities (forks and major crooks) of the main stem, especially when they occur multiple times over many years, greatly decrease the value of trees for saw timber. The probability of a stem fork resulting from weevil attacks was calculated as 0.23, 0.70. 0.82, 0.90, and 1.00 after 1, 2, 3, 4, and 5+ attacks, respectively, on the same tree (Jin, 1989). As over 19 weevils can, on average, emerge from a single infested upper stem of Korean pine, damage can rapidly accrue in stands (Jin, 1989), destroying most of the commercial value.

In the central part of the Korean Peninsula damage to Korean pine by *P. nitidus* was greatest in transplanted seedlings (Park & Byun, 1988). In eight plantations receiving transplanted weevil-free seedlings ranging in age from 4-7 years, the percent of seedlings attacked within two years following transplant ranged from 0-70%, and there was a strong positive correlation of infestation with the percent of seedlings having root deformity that caused severe stress to seedlings by restricting sap movement. Young seedlings can be mined along the entire stem causing death in a large proportion of individuals. In Japan (Hokkaido), *P. nitidus* attacked 3-year-old seedlings of *Pinus strobus*, a non-native species, growing in a nursery, and the mining of larvae in stems resulted in 10% mortality of plants within three months after planting (Nishiguchi, 1961).

Control

Development of control methods for *P. nitidus* attacking terminal leaders of saplings is based on work in North-Eastern China (Jin, 1989; Wu, 1991). To slow invasion of new plantations by yellow-spotted pine weevil, care must be taken to reduce weevil populations in existing pine plantations within 2 km of the new plantation. Ideally this control work should be completed before the new plantation is established or certainly within three years of establishment. Control is accomplished by clipping the stem just below the currently infested portion. Infested trees are easily identifiable when the foliage at the top of the trunk starts to droop and change colour in May. As new adults start emerging in mid-July, this leaves about 2.0-2.5 months to complete the control work. Not all infested trees exhibit foliage wilting and discoloration simultaneously so it may be necessary to do stem clipping more than once in each plantation. As is the case with two terminal infesting *Pissodes* species in North America, *P. strobi* and *P. terminalis*, after the dead portion of the leader is clipped, all but one branch in the highest whorl can be clipped at the base, leaving one of the strongest branches to serve as the terminal leader. This helps the stem avoid branching and crooking thus minimizing economic impact of infestation. Ideally, clipped infested stem sections should be put in enclosures fitted with mesh lids and scattered throughout the plantation. The mesh size should be such that the robust weevils cannot escape while the more slender and smaller parasitic wasps can escape to attack weevil larvae in infested trees that were missed. The parasitic wasps associated with *P. nitidus* are diverse and some species are numerous (Jin, 1989; Hu *et al.*, 2000). Dead weevils are removed from the boxes in September, and the stem, which still have some unemerged parasitic wasps, should be placed in branches of trees throughout plantations to conserve the parasitoids to enhance parasitism of future generations of *P. nitidus*.

Phytosanitary risk

The yellow-spotted pine weevil infests several native and introduced *Pinus* species, including seedlings, saplings, mature trees and cut logs, in Eastern Asia. Its polyphagous tendencies mean it could breed in and cause significant damage to pine species in the EPPO region if it is introduced. The risk of inadvertent introduction of *P. nitidus* to the EPPO region on pine logs is likely to be very low as these materials are typically not exported from Eastern Asia to Europe but rather remain in Asia to satisfy domestic markets, especially the huge demand in China (Kramer, 2019). It would require the transportation of untreated dunnage and infested saplings, seedlings or foliage samples to allow spread of this species, and movement of these materials is subject to high levels of regulation. Although any insect may be transported as a 'hitch-hiker', it seems unlikely this could occur for *P. nitidus*. Recently, a risk assessment of bonsai trees of *Pinus thunbergii* from Japan was completed by the European Food Safety Authority at the request of the European Commission (EFSA PLH Panel, 2019). *Pissodes nitidus* infests *P. thunbergii* trees in Japan and was therefore assessed for its potential to colonize bonsai by adult dispersal from adjacent infested stands, escape detection in exporting nurseries, and be inadvertently transported to the European Union and released into the wild. This scenario was considered to be highly unlikely as the probability of bonsai remaining free of *P. nitidus* was calculated to be 99.99%.

PHYTOSANITARY MEASURES

Adherence to International Standards for Phytosanitary Measures No. 15 for solid wood packing material (**ISPM 15**) will greatly decrease the risk of introduction of bark- and wood-boring insects, including *P. nitidus*. Any seedlings, saplings, logs or foliage of *Pinus* introduced into the EPPO region should be quarantined until it is thoroughly checked for signs and symptoms of non-native species, including *P. nitidus*. Fumigation of tree material suspected of being infested with *P. nitidus* can be highly effective. Fumigation using methyl isothiocyanate applied at 20 g/m^3 for 24 h at 15 °C caused complete mortality of eggs, larvae and pupae (Naito *et al.*, 1999). Complete mortality of *P. nitidus* eggs, larvae, and pupae was achieved with fumigation using sulfuryl fluoride (30 g/m^3, 24h, 15°C) and also using methyl bromide (10 g/m^3, 24h, 15°C) (Soma *et al.*, 1999). In the EU methyl bromide can only be used in emergency quarantine situations upon receiving special permission from the European Commission. Fumigation with methyl iodide ((30 g/m^3, 24h, 15°C) caused complete mortality of eggs, larvae and pupae under bark (Naito *et al*., 2003).

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EFSA Pest survey card *on Pissodes cibriani, P. fasciatus, P. nemorensis, P. nitidus, P. punctatus, P. strobi, P. terminalis, P. yunnanensis* and *P. zitacuarense*. Available at: https://efsa.onlinelibrary.wiley.com/doi/epdf/10.2903/sp.efsa.2020.EN-1910 [Accessed 10 September 2021]

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Datasheet history

This datasheet was first published online in 2022. It is 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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