Diprion pini

Scientific Name
Diprion pini (Linnaeus), 1758

Synonyms:
Lophyrus pini var. *nigripectus* (Matsumura)
Tenthredo pini Linné, 1758
Lophyrus pini Linnaeus, 1758
Tenthredo dorsata Fabricius, 1781
Tenthredo eques (Schrank, 1782)
Tenthredo pectinata major Retzius, 1783
Tenthredo pineti Bechstein & Scharfenberg, 1805
Hylotoma nemorum Fallén, 1807
Diprion pini var. *klugi* Enslin, 1916
Diprion pini var. *nigristernis* Enslin, 1916
Diprion pini var. *nigroscutellatum* Enslin, 1916
Diprion butovitshci Hedqvist, 1967

Figure 1. Adult female of *Diprion pini* (Image courtesy of Daniel Adam, Office National des Forêts, Bugwood.org)

Common Names
Pine sawfly, Common pine sawfly, Large pine sawfly

Type of Pest
Sawfly

Taxonomic Position
Class: Insecta, **Order:** Hymenoptera, **Family:** Diprionidae

Reason for Inclusion
CAPS Target: AHP Prioritized Pest List for FY 2012 – FY2015

Pest Description
Eggs: The eggs are elongated, "somewhat kidney-shaped and are about 1.4 mm [~$^{1}/_{16}$ in] long" (Novak, 1976).

Larvae: "The light yellow to yellow-green larvae have three pairs of dark thoracic legs, seven pairs of short prolegs, which have a transitional line along the abdominal segments, and one pair of anal prolegs. The head is small and brown. The fully grown larva is 26 mm [~1 $^{1}/_{32}$ in] long" (Novak, 1976) (Fig. 2).

Pupae: "The pupae look similar to the adults; pupae are surrounded by a yellow-brown cocoon 8 to 12 mm [$^{5}/_{16}$ to ~$^{1}/_{2}$ in] in length" (Novak, 1976).

Adults: Have a strongly arched body and range from 7 to 10 mm long [~$^{1}/_{4}$ to ~$^{3}/_{8}$ in] (Novak, 1976). “The antennae have 26 segments. Sexual dimorphism is marked. The smaller male is mostly black-brown to black. It has strong comb-like (pectinate) antennae. The negligibly larger female is more robust and has saw-like antennae. The pale yellow colour prevails, with some darker patches on the thorax and on the central abdominal segments, which is ended with a saw-like ovipositor” (Novak, 1976).

Figure 2. Larva of *D. pini* on *Pinus sylvestris* (Scots pine) (image courtesy of Louis-Michel Nageleisen, Département de la Santé des Forêts, Bugwood.org).

Biology and Ecology

Females attract males through the use of sex pheromones. After adults mate, females cut grooves into pine needles in dense rows, laying 3 to 20 eggs per site (Novak, 1976). Eggs are usually laid in a cluster occupying about 10 adjacent needles (Sharov, 1993). Females then place a protective coating over the eggs (Novak, 1976). If a female fails to find a mate, she will still produce progeny, but they will all be male (Besemer, 1942). During the spring, only old needles are used, while both new and old needles are used during the summer (Novak, 1976). This could be because juvenile foliage may be toxic to early instars and can lead to high mortality, decreased rate of development, and reduction in weight and fecundity (Géri et al., 1993). Females can lay a total of 100 to 150 eggs (Novak, 1976). Eggs hatch after 14 to 21 days after being laid (Novak, 1976).

Larvae are gregarious feeders and attack the shoots as well as mine the needles from the side. Larvae may also eat the bark of the shoots and may sometimes consume the shoots completely. Larvae feeding on pine needles have been reported to completely defoliate and cause extensive damage to *P. sylvestris* in central and northern Europe (Perot et al., 2013). Older larvae are less gregarious (Novak, 1976). As the growing season continues, larvae will begin to consume needles of all age classes, not just older foliage (Långström et al., 2001). Larvae take at least 4 to 5 days to develop (Novak, 1976). Craig and Mopper (1993) state that males have 5 instars, while females have 6 instars.

Larvae spin cocoons and pupation occurs on twigs, bark crevices, and undergrowth (Novak, 1976). Pupation can last two to three weeks or throughout winter depending on the time of year (Novak, 1976). Diapause occurs in the pupal stage (Novak, 1976). Some parts of the population can have a prolonged diapause which lasts more than one year (Sharov, 1993).

This species has one generation per year in northern regions of its range as well as high elevations; two generations per year can occur in its range throughout central and southern Europe (Novak, 1976). In Russia, there is a maximum of two generations a year (Sharov, 1993).

D. pini has a complex life history. Parts of the population can have prolonged diapause, which can differ in total length. There can also be differences in the number of generations per year (Knerer, 1993). Because of this, both larvae and adults may be present at the same time (Anderbrant, 1993). In areas with two generations, the first generation swarms around the end of April until the start of May (Auger, 1993, Novak, 1976). In Russia, the second generation occurs from the end of July to the beginning of August (Sharov, 1993). In the northern region of its range, adults usually emerge during June and July (Novak, 1976). Adults only live a few days and do not feed (Sharov, 1993).

Damage

D. pini populations can build up suddenly causing defoliation of large forested areas (Knerer, 1993). Outbreaks often occur after very hot and dry summers (Géri et al., 1993). *D. pini* usually attacks older pines (Géri et al., 1993) and typically causes greater damage in pure stands (Géri, 1988). Outbreaks caused by *D. pini* can lead to heavy defoliation of hosts (*Pinus* spp.) (Herz et al., 2000).

Figure 3. Damage on *Pinus sylvestris* (Scots pine) caused by *D. pini* (Image courtesy of G. Reboux, Bugwood.org).

Pest Importance

According to Sharov (1993), *D. pini* is considered one of the most serious pests of pine in Russia, Ukraine, and Belarus. In Russia, outbreaks usually occur in 3-6 year intervals after hot and dry summers (Sharov, 1993).

In Germany, mature pine forests are usually attacked (Herz et al., 2000). In the early 1990s, Lithuania had its largest outbreak of *D. pini* on *Pinus sylvestris*. These trees were located on well drained and infertile soils in the southern portion of the country (Augustaitis, 2007).

Lyytikäinen-Saarenmaa and Tomppo (2002) found that *P. sylvestris* increment and timber yield decreased due to defoliation by diprionid sawflies, including *D. pini*. During

moderate defoliation by *D. pini*, volume growth was reduced by 86% while heavy defoliation led to 94% reduced volume growth (Lyytikäinen-Saarenmaa and Tomppo, 2002). Mortality of host plants can occur during outbreaks as well. Lyytikäinen-Saarenmaa and Tomppo (2002) estimated 30% tree mortality in defoliated stands during a *D. pini* outbreak in Finland.

Geri et al. (1993) states that fecundity of *P. sylvestris* was significantly reduced when defoliated by *D. pini* the previous year.

Known Hosts

Novak (1976) states that *D. pini* is most likely to occur on 20 to 40 year old *P. sylvestris* pine forests and stands or on hosts found on poor sites in warmer areas.

Major hosts

Pinus sylvestris (Scots pine).

Minor hosts

Pinus cembra (Swiss stone pine), *P. contorta* (lodgepole pine), *P. montana* (dwarf mountain pine), *P. nigra* (black pine) (including ssp. *nigricans* var. *austriaca,* ssp. *laricio* var. *corsicana,* ssp. *clusiana* var. *cebennensis*), *P. radiata* (radiata pine), *P. strobus* (eastern white pine)*, and *P. uncinata* (mountain pine) (Barre, 2002; Liston, 1995).

*Seems to be a poor host according to Barre (2002).

Pathogens Vectored

This pest is not currently known to vector any pathogens or other associated organisms, but damage by this pest can lead to trees becoming more susceptible to secondary attack. Secondary attack may be caused by stem-boring insects like the common pine shoot beetle, *Tomicus piniperda* (Långström et al., 2001).

Known Distribution

Areas of known distribution include: **Asia:** Russia; **Europe:** Albania,* Algeria, Austria, Belgium, Bosnia and Herzegovina,* Bulgaria, Croatia, Czech Republic, Denmark, Estonia,* Finland, France, Germany, Greece,* Hungary, Italy, Latvia, Liechtenstein,* Lithuania,* Luxembourg, Macedonia,* Moldova,* Monaco,* Montenegro,* the Netherlands, Norway, Poland, Portugal, Romania, Serbia*, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine, and the United Kingdom (CABI, 2008; EPPO, 2007; Géri, 1988; Liston, 1995; Novak, 1976 Tozlu, 2001).

*Geri (1988) states that *D. pini* is found throughout Europe and includes these countries in his distribution map.

Pathway

No interceptions have been recorded in the last ten years for either this species or the genus *Diprion* (AQAS, 2015; queried 5-28-2015). Neither the genus nor species is listed in the AQAS system. However, the family Diprionidae is listed as reportable. This pest may be able to travel on host plant material in international trade. Pupae of *D. pini* can be found in the bark of host plants as well as surrounding leaf litter and soil while larvae and eggs can be found on the leaves of host plants. As there are certain regulations in place when importing plant material (i.e. no soil attached to plant material) the risk associated with this pest is most likely low. This species may be moved short distances by man through silvicultural practices (CABI, 2008). Dispersal by adult sawflies may also occur.

Potential Distribution within the United States

If introduced into the United States, this species may be able to utilize other pine species not present in its native range.

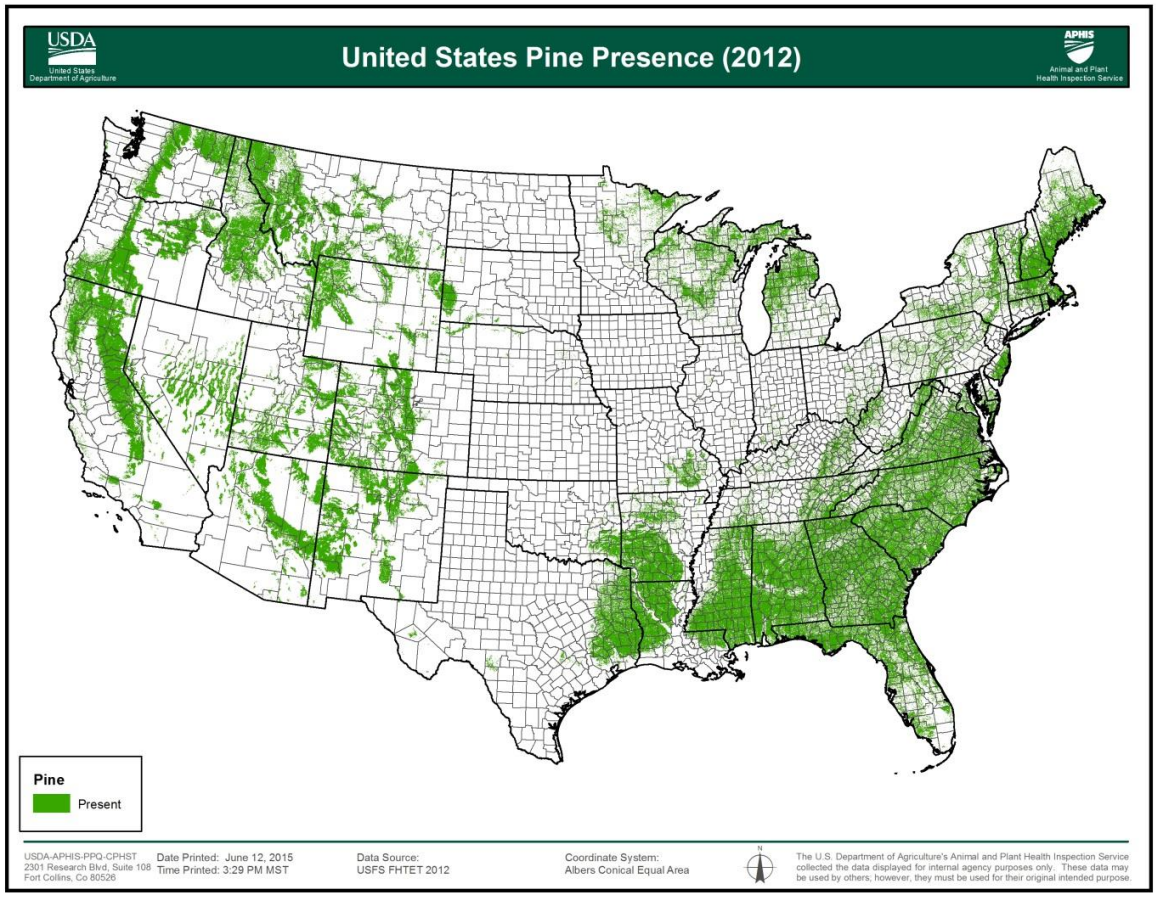

Figure 4. Tree species presence map for Pine (*Pinus* spp.) modeled in 2012 at a 240 meter resolution (USDA Forest Service, Forest Health Technology Enterprise Team). Map courtesy of USDA-APHIS-PPQ-CPHST.

In a recent host map developed by USDA-APHIS-PPQ-CPHST (Fig. 4), parts of the United States with the highest concentration of pine include: the southeastern, northeastern, western, and upper great lakes regions of the United States. Its main host, *P. sylvestris* is found throughout much of the northeastern and Midwestern portion of the United States (USDA-NRCS, 2011) (Fig. 5).

Figure 5. Distribution of *Pinus sylvestris* throughout North America (USDA-NRCS, 2011; Accessed 24 March, 2011).

Survey

Approved Methods for Pest Surveillance*: The Approved Method for this species is a trap and lure combination. The trap is the large plastic delta trap. The lure is effective for 28 days.

Any of the following Trap Product Names in the IPHIS Survey Supply Ordering System may be used for this target:

Large Plastic Delta Trap Kits, Orange,
Large Plastic Delta Trap Kits, Red, or
Large Plastic Delta Trap Kits, White

Trap color is up to the State and does not affect trap efficacy.

The Lure Product Name is "*Diprion pini* Lure."

*For the most up-to-date methods for survey and identification, see Approved Methods for Pest Surveillance on the CAPS Resource and Collaboration Site, at https://caps.ceris.purdue.edu/approved-methods.

Literature-Based Methods:

Survey site and selection

Sawflies, including *D. pini*, highly prefer pine stands on infertile and well-drained soils as well as stands that are affected by unfavorable climatic or anthropogenic factors (Augustaitis, 2007). *Pinus sylvestris* may be used in forest stands as wind breaks, timber, and Christmas tree plantations (USDA-NRCS, 2011). Traps should be placed near areas where host trees are abundant.

Time of year to survey

This species has one generation per year in northern regions of its range as well as high elevations; two generations per year can occur in its range throughout central and southern Europe (Novak, 1976). In areas with two generations, the first generation swarms around the end of April until the start of May (Novak, 1976). In the northern region of its range, adults usually emerge during June and July (Novak, 1976).

In parts of Russia where two generations occur, adults emerge from the end of April to early May and then again from the end of July to early August (Sharov, 1993).

Trap Placement

In Herz et al. (2000), traps for *D. pini* were hung on twigs of pine trees at heights of 1.8 m (6 feet). A minimum distance of 50 m (164 feet) was used between traps in the same pine stand (Herz et al., 2000).

Trapping

A sex pheromone for *D. pini* has previously been identified as the acetate or propionate ester of (2*S*,3*R*,7*R*)-3,7-dimethyl-2-tridecanol (Anderbrant et al., 2005; Bergström et al., 1995).

When surveying for *D. pini* in Germany, Herz et al. (2000) used Lund-I traps. These consisted of two horizontal cardboard sheets that were 22 x 22 cm (8.66 in); sheets were separated about 6 cm (2.36 in) from one another by wires. The upper surface of the bottom sheet is covered with insect glue and is exchangeable. Traps were hung on host plants at a height of approximately 1.8 m (5.91 ft) (Herz et al., 2000).

Visual inspection

Many countries in Europe survey for Diprionidae by either visually inspecting forest stands for damage or by sampling the egg clusters or cocoons in the soil (Herz et al., 2000).

Key Diagnostics/Identification

Approved Methods for Pest Surveillance*: Morphological. There are 13 world species in the *Diprion* genus (Smith, personal communication, 2011).
All *Diprion* are very similar in general appearance and examination of the female ovipositor and male genitalia are the most reliable means for separation of the species (Smith, personal communication, 2011).

*For the most up-to-date methods for survey and identification, see Approved Methods on the CAPS Resource and Collaboration Site at https://caps.ceris.purdue.edu/approved-methods.

Easily Confused Species

The genus *Diprion* is most similar to species of *Neodiprion* and *Gilpinia*. Species of *Gilpinia* are the most similar-looking; species of the two genera are often confused. For a key separating North American genera of Diprionidae, see Smith (1974).

Commonly Encountered Non-targets

Similar species that may show up in traps in the United States are *Diprion similis, Gilpinia hercyniae*, *Gilpinia frutetorum* and species of *Neodiprion* (Smith, personal communication, 2011).

References

Anderbrant, O. 1993. Pheromone biology of sawflies. *In* M. Wagner and K. F. Raffa (eds.) Sawfly Life History Adaptations to Woody Plants. Academic Press, Inc. San Diego, California. pp. 119-154.

Anderbrant, O., F. Östrand, G. Bergström. A. –B. Wassgren, M. –A. Auger-Rozenberg, C. Geri, E. Hedenström, H. –E. Högberg, A. Herz, and W. Heitland. 2005. Release of sex pheromone and its precursors in the pine sawfly *Diprion pini* (Hym., Diprionidae). Chemoecology 15: 147-151.

AQAS. 2015. Interception data on *Diprion pini* from 1-1-2005 to 05-28-2015. Accessed 28 May 2015 from: https://mokcs14.aphis.usda.gov/aqas/HomePageInit.do.

Auger, M., and Geri, C. 1993. Effect of the foliage of different pine species on the development and oviposition of the pine sawfly, *Diprion pini* L. (Hym., Diprionidae). Journal of Applied Entomology, 116: 494-504.

Augustaitis, A. 2007. Pine sawfly (*Diprion pini* L.)- related changes in Scots pine crown defoliation and possibilities of recovery. Polish Journal of Environmental Studies 16(3): 363-369.

Bergström, G., A. –B. Wassgren, O. Anderbrant, J. Fägerhag, H. Edlund, E. Hedenström, H. –E. Högberg, C. Geri, M. A. Auger, M. Varama, B. S. Hansson, and J. Löfqvist. 1995. Sex

pheromone of the pine sawfly *Diprion pini* (Hymenoptera: Diprionidae): chemical identification, synthesis and biological activity. Experientia 51: 370-380.

Besemer, A. F. H. 1942. The biology of the pine sawfly, *D. pini* [abstract]. Wageningen 48(6): 213-217.

CABI. 2008. *Diprion pini* (common pine sawfly) datasheet. Centre for Agriculture and Biosciences International, Crop Protection Compendium.

Craig, T. P. and S. Mopper. 1993. Sex ratio variation in sawflies. *In* M. Wagner and K. F. Raffa (eds.) Sawfly Life History Adaptations to Woody Plants. Academic Press, Inc. San Diego, California. pp. 61-92.

EPPO. 2007. PQR database (version 4.6). Paris, France: European and Mediterranean Plant Protection Organization. www.eppo.org.

Geri, C. 1988. The pine sawfly in central France. *In* A. A. Berryman (ed.) Dynamics of Forest Insect Populations. Patterns, Causes, Implications. Plenum Press, New York. pp. 377-405.

Géri, C., J.-P. Allais, and M.-A. Auger. 2003. Effects of plant chemistry and phenology on sawfly behavior and development. *In* M. Wagner and K. F. Raffa (eds.) Sawfly Life History Adaptations to Woody Plants. Academic Press, Inc. San Diego, California. pp. 173-210.

Hedenström, E., H. Edlund, A.-B. Wassgren, G. Bergström, O. Anderbrant, F. Östrand, A. Sierpinski, M.-A. Auger-Rozenberg, A. Herz, W. Heitland, and M. Varama. 2006. Sex pheromone of the pine sawfly, *Gilpinia pallida*: chemical identification, synthesis, and biological activity. Journal of Chemical Ecology 32: 2525-2541.

Herz, A., W. Heitland, O. Anderbrant, H. Edlund, and E. Hedenström. 2000. First use of pheromones to detect phenology patterns and density relationships of pine sawflies in German forests. Agricultural and Forest Entomology 2: 123-129.

Knerer G. 1993. Life history diversity of sawflies. *In* M. Wagner and K. F. Raffa (eds.) Sawfly Life History Adaptations to Woody Plants. Academic Press, Inc. San Diego, California. pp. 33-59.

Långström, B., E. Annila, C. Hellqvist, M. Varama, and P. Niemelä. 2001. Tree mortality, needle biomass recovery and growth losses in Scots pine following defoliation by *Diprion pini* (L.) and subsequent attack by *Tomicus piniperda* (L.). Scandinavian Journal of Forest Research 16: 342-353.

Liston, A. D. 1953. Compendium of European Sawflies. Gottfrieding, Germany. Chalastos Forestry.

Lyytikäinen-Saarenmaa, P. and E. Tomppo. 2002. Impact of sawfly defoliation on growth of Scots pine *Pinus sylvestris* (Pinaceae) and associated economic losses [abstract]. Bulletin of Entomological Research 92(2): 137-140.

Novak, V. 1976. Atlas of Insects Harmful to Forest Trees. Volume 1. Elsevier Scientific Publishing Company. Amsterdam, The Netherlands. 125 pp.

Perot, T., P. Vallet, and F. Archaux. 2013. Growth compensation in an oak-pine forest following an outbreak of pine sawfly (*Diprion pini*). Forest Ecology and Management 295: 155-161.

Ross, H. H. 1937. A generic classification of the Nearctic sawflies (Hymenoptera, Symphyta). In J. T. Buchholz, F. W. Tanner, and H. J. van Cleave (eds.) Illinois Biological Monographs. Urbana, Illinois, University of Illinois. 173 pp.

Rousselet, J., C. Géri, G. M. Hewitt, and F. Lemeunier. 1998. The chromosomes of *Diprion pini* and *D. similis* (Hymenoptera: Diprionidae): implications for karyotype evolution. Heredity 81: 573-578.

Sharov, A. A. 1993. Biology and population dynamics of the common pine sawfly, *Diprion pini* L., in Russia. *In* M. Wagner and K. F. Raffa (eds.) Sawfly Life History Adaptations to Woody Plants. Academic Press, Inc. San Diego, California. pp. 409-430.

Smith, D. R. 1974. Conifer sawflies, Diprionidae: Key to North American genera, checklist of world species, and new species from Mexico (Hymenoptera). Proceedings of the Entomological Society of Washington. 76: 409-418.

Smith, D. R. 2011. Identification methods and resources for *Diprion pini*. Personal communication to L. D. Jackson on August 1, 2011 from D. R. Smith (Systematic Entomology Laboratory, National Museum of Natural History, Smithsonian Institution).

Taeger, A., S. M. Blank, and A. D. Liston. 2010. World catalog of Symphyta (Hymenoptera). Zootaxa. 2580: 1–1064.

Tozlu, G. 2001. Studies on the pest species belonging to the families Elateridae, Buprestidae, Cerambycidae, Curculionidae (Coleoptera) and Diprionidae (Hymenoptera) in Scotch pine (*Pinus sylvestris* L.) forests of Sarikamiş (Kars), Turkey [abstract]. Türkiye Entomoloji Dergisi 25(3): 193-204.

USDA-NRCS. 2011. The PLANTS Database. National Plant Data Center, Baton Rouge, LA 70874-4490 USA. Accessed 23-24 March, 2011 from: http://plants.usda.gov.

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Draft Log

July 2015: Complete update performed. 2015 Version posted to CAPS website.
March 2013: Final datasheet posted to CAPS website.

Revisions

July 2015
1) Added new name to **Common Names** section.
2) Reviewed and updated **Biology and Ecology** section with research data.
3) Updated AQAS interception records in **Pathway** section.
2) Added updated Pine host map.
4) Conducted literature review of all sections for new information since last datasheet update.

Reviewers

June 2011

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