

**EUROPEAN AND MEDITERRANEAN PLANT PROTECTION ORGANIZATION
ORGANISATION EUROPEENNE ET MEDITERRANEENNE
POUR LA PROTECTION DES PLANTES**

20-25969 (11-16988, 11-16901)

This PRA document was modified in 2021 to clarify the phytosanitary measures recommended

Report of a Pest Risk Analysis for *Agrilus anxius*

This summary presents the main features of a pest risk analysis which has been conducted on the pest, according to EPPO Decision support scheme for quarantine pests.

Pest: *Agrilus anxius*
PRA area: EPPO region
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Date: 2010-09-13/16.
The PRA was further reviewed by the core members and the Panel on Quarantine Pests for Forestry. The risk management part was reviewed by the Panel on Phytosanitary Measures on 2011-04-07 and by the Working Party on Phytosanitary Regulations on 2011-06-23.

STAGE 1: INITIATION

Reason for doing PRA: *A. anxius* originates from North America where it is considered to be a serious pest of birch trees (*Betula* spp.) grown as amenity and forest trees. European species of birch (e.g. *Betula pendula* and *B. pubescens*) planted in North America are more susceptible than North American hosts. In the EPPO region, these birch species are widespread and important as amenity and forest trees. Concerns were raised regarding the increasing trade of wood chips from North America, which might constitute a pathway for the entry of *A. anxius* into the EPPO region.

Taxonomic position of pest: Order: Coleoptera, Family: Buprestidae

STAGE 2: PEST RISK ASSESSMENT

PROBABILITY OF INTRODUCTION

Entry

Geographical distribution:

EPPO region: absent

North America (see PRA record for references):

A. anxius is considered as present throughout the range of birch in the USA and Canada (Johnson & Lyon, 1976; Katovich *et al.*, 2005; NRC, 2010)

- **Canada:** Alberta, British Columbia, Manitoba, New Brunswick, Newfoundland, Nova Scotia, Ontario, Quebec, Saskatchewan, Prince Edward Island.

- **USA:** Alaska, Arkansas, California, Colorado, Connecticut, Delaware,

Georgia, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Montana, Nebraska, Nevada, New Jersey, New Hampshire, New York, New Mexico, North Dakota, Ohio, Oregon, Pennsylvania, South Dakota, Tennessee, Utah, Vermont, Washington, West Virginia, Wisconsin, Wyoming, Washington DC.

Major host plants or habitats:

A. anxius is known to attack many native and introduced birch species (*Betula* spp.) and their numerous crosses in North America. Susceptibility varies between birch species, with European and Asian birch species (including *B. pubescens* and *B. pendula*) being much more susceptible than North American birch species (Miller *et al.*, 1991; Nielsen *et al.*, 2011). Species reported as host: *Betula alleghaniensis* (yellow birch), *B. davurica* (black birch), *B. Jacquemontii* (white-barked Himalayan birch), *B. lenta* (sweet birch), *B. maximowicziana* (monarch birch), *B. occidentalis* (water birch), *B. papyrifera* (paper birch), *B. pendula* (silver or European birch), *B. platyphylla* (Manchurian birch), *B. populifolia* (gray birch), *B. pubescens* (downy birch), *B. utilis* (Himalayan birch).

B. albosinensis var *septentrionalis* and *B. ermanii* have been reported as rarely attacked by *A. anxius*.

Species not reported as host: *B. nigra* does not appear to be a host (Nielsen *et al.*, 2011). *B. nana* has never been documented as a host.

Which pathway(s) is the pest likely to be introduced on:

The EWG considered that the main pathways are:

• **Wood chips from Canada and the USA**

Birch might be used alone or in mixture with other species for producing wood chips. Wood chips are imported for pulpmills, energy production or fiberboard production or mulch. Wood chips are often produced from lower quality wood that might be infested. Larvae of the related species emerald ash borer *A. planipennis* have been shown to survive in wood chips under certain conditions (Mc Cullough *et al.*, 2007).

• **Plants for planting of *Betula* spp. from Canada and the USA**

Birch plants for planting are traded as nursery plants for forest or amenity uses. Bonsais are also considered as well as scion stems bigger than 1 cm.

• **Wood with or without bark of *Betula* spp. from Canada and the USA**

This includes round wood, wood with or without bark, and firewood. There is an increasing trade of small diameter logs for energy production; this commodity is thought to be higher risk as it will be lower quality wood.

• **Furniture and other objects made of untreated birch wood from Canada and the USA**

Fourth instars, pre-pupae and pupae may be present in untreated/air dried/bark-covered sapwood. This is often the case in rustic birch furniture where whole logs with intact bark are used to construct table legs, bed frames, etc. The risk from this pathway was considered be similar to that for wood with bark. This pathway was not studied in detail as it was in particular not possible to retrieve trade data for such commodity.

Other pathways identified but not studied further:

• **Wood packaging material containing *Betula* spp. from Canada and the USA**

Birch is used for the production of wood packaging material, including dunnage. Wood packaging material is suspected to be the source for the introduction of other *Agrilus* species into North America (including *A.*

planipennis). Since the adoption of ISPM 15 *Regulation of Wood Packaging Material in International Trade* (FAO, 2009), all wood packaging material moved in international trade should be debarked and then heat treated or fumigated with methyl bromide and stamped or branded, with a mark of compliance.

In theory, treatments applied to wood packaging material if undertaken according to ISPM 15 should destroy the pest. For this reason, the EWG did not continue the assessment of this pathway.

- **Cut branches of *Betula* spp. from Canada and the USA**

Cut branches of birch are sold in North America as decorations around Christmas time, without leaves, but no evidence of export/import was found. In any case, such cut branches are very likely to have a small diameter, and will not support the pest.

- **Natural spread**

Intercontinental spread from North America to the PRA area is very unlikely. However, this pathway would become a likely pathway of movement within the PRA area following an introduction.

- **Hitchhiking**

Adults have a high affinity with host plants and are not likely to be on non-host material. However, this pathway would become a likely pathway of movement within the PRA area following an introduction.

- **Bark and objects made of bark from Canada and the USA**

Birch bark is traditionally used for arts and handicrafts. Only larvae might be present at the interface between the bark and the wood, but if they were removed with the bark, they would dry-out and not survive.

- **Birch processed wood material and commodities made of this (plywood, etc.), wood pellets**

Processing would not allow survival of larvae or pupae in the wood.

- **Individual live insects moved by amateur entomologists**

This pathway will be covered if the pest is regulated.

Establishment

Plants at risk in the PRA area:

Betula species

Climatic similarity of present distribution with PRA area (or parts thereof):

The pest is present in North America in a wide range of climatic conditions, including lowlands and mountains, and in all areas where birch is growing. The climatic conditions are largely similar to the conditions in the EPPO region.

Characteristics (other than climatic) of the PRA area that would favour establishment:

In North America *A. anxius* is considered to attack native birch only if subject to stress (e.g. drought, high soil temperature, air pollution, ozone). Overall stress is not a factor that will influence the susceptibility of European and Asian birch trees in the PRA area because they are highly susceptible even when healthy.

Which part of the PRA area is the area of potential establishment:

All areas where birch is naturally present in the PRA area, i.e. northern Europe, from western Europe to Siberia to the East, and from Nordic countries to central France to the South. Distribution data suggests that birch is rare or not present in North Africa, Israel, Malta, Cyprus, South of Turkey; these countries are therefore not at risk.

POTENTIAL ECONOMIC CONSEQUENCES

How much economic impact does the pest have in its present Birch is an ecologically and economically important tree in North America (Miller *et al.*, 1991). *A. anxius* was first mentioned as a pest of ornamental

distribution:

birch in the 1890s (Slingerland, 1906), and reported as a forest pest in 1918 (Akers & Nielsen, 1984, Katovich *et al.*, 2005). Outbreaks developed during the long period of widespread birch dieback in forests in Northern USA and Canada beginning in the early 1930's (MacAloney, 1968; Jones *et al.*, 1993). The pest is also considered to be one of the major contributing factors in the decline and death of amenity birch trees in North America (Ball & Simmons, 1980). It attacks and kills trees, which die in a few years if no remedial action is taken (Appleby *et al.*, 1973). Johnson & Lyon (1976) mention it as a limiting factor to extending the range of white birch in the southern USA.

Describe damage to potential hosts in PRA area:

Damage is caused by larval feeding on the inner bark and cambium of the tree. Repeated attacks and the construction of numerous winding galleries by larvae disrupt nutrient transport that eventually kills the roots. Insect galleries can also girdle the tree branches and trunks. Initially symptoms of an infestation appear in the upper crown the tree with leaf yellowing and branch dieback. Other evidence of an infestation is the presence of 5 mm wide 'D'-shaped exit holes. Rust coloured sap oozing and staining can also be observed on the bark, along with swellings and bumps where the tree has healed inside. In many cases, tree mortality is observed within a few years after the appearance of the first symptoms. Adults feed on leaves but damage is insignificant.



Larva and galleries of *A. anxius*.
David G. Nielsen - Ohio State University (US) - Bugwood.org



Damage caused by *A. anxius* USDA Forest Service (US) - Bugwood.org

How much economic impact would the pest have in the PRA area:

The impact of the pest is likely to be high mortality of birch in the PRA area in landscapes, gardens, nurseries and forests. European and Asian birch grown in North America, especially *B. pendula*, *B. pubescens*, *B. platyphylla*, *B. maximowicziana*, (Nielsen *et al.*, 2011; Herms, 2002), *B. Jacquemontii* (Katovitch *et al.*, 2005), are highly susceptible to *A. anxius* and healthy trees are attacked and killed.

There are birch species in the PRA area that are not present in North America, and their susceptibility is not known.

CONCLUSIONS OF PEST RISK ASSESSMENT

Summarize the major factors that influence the acceptability of the risk from this pest:

If *A. anxius* entered the PRA area, the pest would have a very high probability of establishment wherever birch is present. It is adapted to a wide range of climatic conditions and would find susceptible hosts. Eradication or containment would be difficult due to the hidden life stages of the pest and the fact that it might not be detected before it has already established and caused damage. It is also very likely that the pest would spread (natural spread as it is a strong flier; human-assisted through

movement of infested birch material). Due to the higher susceptibility of European and Asian birch species, it is expected that the pest would have major economic consequences where birch is present in the PRA area. On the whole, introduction would result in high mortality of birch throughout the PRA area, and major economic impacts (including major environmental impacts).

Estimate the probability of entry:

The overall probability of entry is low-medium (with medium uncertainty), but will increase with the increasing trade of wood chips and wood for bioenergy coming from areas where the pest occurs.

- **wood chips from Canada and the USA** - probability of entry is low-medium with medium uncertainty.

Even if the likelihood of association or survival on the pathway is not high, the probability of entry would increase with the volume of the commodity traded. Only prepupae and pupae could survive on this commodity. They would first need to survive the chipping process, and then emerge after import and before the intended use (i.e. destructive processes and transfer most likely only if the commodity is stored outside). However, if wood chips are used as a mulch, transfer will be more likely.

- **plants for planting of *Betula* spp. originating from Canada and the USA** - probability of entry is low with medium uncertainty.

This pathway would most favour the successful entry (in particular transfer) of *A. anxius* to a suitable host given its biology, the intended use, and that live plants could carry most *A. anxius* life stages if the stem diameter is greater than 2 cm. If one consignment is infested, the risk of transfer to host plants would be very high. The related species *A. planipennis* is documented to have been transported long distance in nursery stock within North America (USDA-APHIS, 2009). The overall probability is low as it was considered that the total birch imports are presumed to be a very low volume of plants mainly of small diameter.

- **wood with or without bark of *Betula* spp. from Canada and the USA** - probability of entry is low-medium (wood without bark) and medium (wood with bark including firewood) with medium uncertainty.

The likelihood of entry is tempered by the seemingly relatively low volume of trade on this pathway, but this could change if trade of birch logs for large-scale energy production increased. The related species *A. planipennis* is documented to have been transported long distance in firewood within North America (Robertson & Andow, 2009, Haack *et al.*, 2010).

Estimate the probability of establishment:

The overall probability of establishment is considered as to be "very high".

Birch is widespread in the PRA area. The pest in its current distribution occupies a wide range of ecological and climatic conditions, that are also present in the PRA area. *A. anxius* would be difficult to eradicate, if introduced, it would most likely not be controlled by any natural enemies that might occur in the PRA area, nor by treatments. It is also highly pre-adapted to the hosts in the PRA area (i.e. European and Asian birch species are much more susceptible than native North American species).

Estimate the potential economic impact:

Due to the higher susceptibility of European and Asian birch species, it is expected that the pest would have major economic consequences where birch is present in the PRA area (including major environmental impacts).

Degree of uncertainty

The main uncertainties are associated with the entry (overall uncertainty: medium). If the pest does enter the PRA area, the EWG had a low uncertainty that it will establish and cause high damage.

Uncertainties to assess entry are as follows:

For all pathways: data on trade: volume, species traded, frequency and timing of import in the PRA area, distribution of the commodity throughout the PRA area after entry.

In addition:

- For wood chips: size of the chips, proportion of birch in hardwood chips imports, association of the pest with the pathway (are chips made with highly infested wood?), whether chips would be stored for some time on arrival and in which condition, end-use of the chips
- For plants for planting: management in North American nurseries
- For wood of *Betula* spp.: frequency of outbreaks in North America (the pest is most likely to be associated with wood during outbreaks), end-use of the wood.

OVERALL CONCLUSIONS

Despite the lack of detailed data, there are enough data to indicate that movement of the host (birch, *Betula* spp.) along the three pathways analyzed exists, that the pathways present a risk of introduction of *A. anxius*, and that the consequences of introduction would be devastating given the high susceptibility of European and Asian host plants and the large and wide distribution of birch in the PRA area.

The expert working group concluded that *A. anxius* posed an unacceptable risk to the EPPO region and identified phytosanitary measures which could substantially reduce the risk.

STAGE 3: PEST RISK MANAGEMENT

IDENTIFICATION OF THE PATHWAYS

Pathways studied in the pest risk management

- Wood chips from Canada and the USA
- Plants for planting of *Betula* spp. from Canada and the USA
- Wood with or without bark of *Betula* spp. from Canada and the USA
- Furniture and other objects made of untreated birch wood from Canada and the USA

IDENTIFICATION OF POSSIBLE MEASURES

Possible measures for pathways

The EWG considered that it was not possible to maintain a Pest free area for the pest in Canada or USA.

• Pathway 1: Wood chips from Canada and the USA

Measures related to consignments:

- Storage in country of export under the strict supervision of the NPPO (1 year)

A 1-year storage is sufficient for wood chips as only prepupae and pupae are likely to survive the chipping process.

- Treatment:

- heat treatment (the conditions required to destroy *A. anxius* are not clearly-defined but in New Zealand heat treatment of wood chips for at least 4 hours at a minimum core temperature of 70°C is required to destroy a range of wood boring pests including *A. sexsignatus*)
- or fumigation with sulphuryl fluoride (the conditions required to destroy *A. anxius* are not clearly-defined but in New Zealand fumigation at a dose of 80 g/m³, in separate units no larger than 2 m³, for more than 24 continuous hours at a minimum temperature of 10°C is required to destroy a range of wood boring pests including *A. sexsignatus*).

Note: Although it is agreed that the smaller the chips, the smaller the risk, very limited research is published on the impact of chipping wood on survival on pests. Some (limited) research showed that chipping with a screen smaller than 2.5 cm destroyed *A. planipennis* in experimental conditions but other recent work also showed that some stages may be found in commercial shipment of wood chips. Therefore chipping down to a certain size is

not currently recommended as a measure for the time being. Further research should be considered to determine the safe size for wood chips in relation to *A. anxius* and how such size can be consistently obtained in commercial production of chips.

- Import permit and specified restrictions: importing at certain time (i.e. winter or when temperature is less than 5 degrees) and processing before the next flight period (i.e. before 150 degree-days have accumulated). Chips must be covered during transport from the point of entry to the process plant (but using covered truck, containers and railcars). Additionally, chips should not be stored outside. This would be possible only if use can be guaranteed and verified. ***The specifications of the requirements need to be done on a case by case basis depending on the origin and the country of destination.***

- **Pathway 2: Plants for planting of *Betula* spp. from Canada and the USA**

Measures related to consignments:

- Growing plants under specified conditions (insect-proof) with appropriate inspections (twice a year, including immediately prior to export).

This measure may be appropriate only for high value material (e.g. bonsais)

- Importing plants with stems below 2 cm diameter, or scion below 1 cm diameter.

In the USA, larvae have not been reported to colonize trees with main stems below 2 cm diameter, but have been observed to bore from larger stems and branches into branches as small as 1 cm diameter (Herms, pers. obs.; Nielsen, pers. obs.)

- **Pathway 3: Wood with or without bark of *Betula* spp. from Canada and the USA**

Measures related to consignments:

- storage for 2 years in country of export under the strict supervision of the NPPO

- treatment: heat treatment (specific conditions to be defined), irradiation.

- removal of outer sapwood

- import permit and specified restrictions: import at certain time (i.e. winter or when temperature is less than 5 degrees) and processing before the next flight period (i.e. before 150 degree-days have accumulated). This measure is not practical for firewood. ***The specifications of the requirements need to be done on a case by case basis depending on the origin and the country of destination.***

Pathway 4: Furniture and other objects made of untreated birch wood from Canada and the USA

Measures related to consignments: treatment (heat treatment, irradiation)

EVALUATION OF THE MEASURES IDENTIFIED IN RELATION TO THE RISKS PRESENTED BY THE PATHWAYS

Specific details of heat treatments that would be required to destroy *A. anxius* in wood or wood chips have not been defined and require further investigation. Measures could interfere with trade, but costs of eradication or containment attempts would be high and introduction is likely to threaten birch on a continental scale because European and Asian birch species are extremely susceptible, resulting in major economic (including environmental) impact.

Degree of uncertainty

Uncertainties in the management part are:

- Survival of the pest in wood chips depending of the size of chips
- Proportion of chips above the required size in a consignment
- Efficacy of treatments for wood
- Impact of the storage on the quality of wood
- Practical application of post-entry quarantine
- Practical implementation of the import under specific conditions

IDENTIFICATION OF POSSIBLE MEASURES

PC= Phytosanitary certificate, RC=Phytosanitary certificate of re-export

Pathway 1: Wood chips from Canada and the USA	PC and, if appropriate, RC - Treatment: heat treatment or fumigation - Storage in the country of export (1 year) - Import permit and specified restrictions: importing in winter and processing before the next flight period + covered during transport from the point of entry to the process plant + not stored outside.
Pathway 2: Plants for planting of <i>Betula</i> spp. from Canada and the USA	PC and, if appropriate, RC - Growing plants under specified conditions (insect-proof) and inspections - Importing plants with stems below 2 cm diameter, and scion below than 1 cm diameter.
Pathway 3: Wood with or without bark of <i>Betula</i> spp. from Canada and the USA	- Treatment (heat treatment, irradiation) - Removal of outer sapwood - Storage in the country of export (2 year) - Import permit and specified restrictions: import in winter and processing before the next flight period (except firewood)
Pathway 4: Furniture and other objects made of untreated birch wood from Canada and the USA	- treatment (heat treatment, irradiation)

References

For all Internet references: last accessed in January 2011.

- Akers RC & Nielsen DG (1984) Predicting *Agrilus anxius* Gory (Coleoptera: Buprestidae) adult emergence by heat unit accumulation. *Journal of economic entomology*, 77(6): 1459-1463.
- Appleby JE, Randell R & Rachesky S (1973) Chemical control of the bronze birch borer. *Journal of economic entomology* 66(1): 258-259.
- Ball JJ & Simmons GA (1980) The relationship between bronze birch borer and birch dieback. *Journal of arboriculture* 6 (12) 309-314.
- FAO (2009) ISPM 15 Regulation of Wood Packaging Material in International Trade.
https://www.ippc.int/file_uploaded/1240490152156_ISPM_15_Revised_2009_E.pdf
- Haack RA, Petrice TR, Wiedenhoef AC (2010) Incidence of bark- and wood-boring insects in firewood: a survey at Michigan's Mackinac Bridge. *Journal of Economic Entomology* 103: 1682-1692.
- Herns DA (2002) Strategies for deployment of insect resistant ornamental plants. In: M.R. Wagner, K.M. Clancy, F. Lieutier, and T.D. Paine, eds. *Mechanisms and Deployment of Resistance in Trees to Insects*, pp. 217-237. Kluwer Academic Publishing, Dordrecht, The Netherlands. 332 pp.
- Johnson WT & Lyon HH (1976) *Insects that feed on trees and shrubs*. Comstock Publishing Associates, Cornell University Press, Ithaca and London. Pp 464.
- Jones EA, Reed DD, Mroz GD, Liechty HO & Cattelino PJ (1993) Climate stress as a precursor to forest decline: paper birch in northern Michigan, 1985-1990. *Canadian Journal of Forest Research*, 23, 229-233.
- Katovich SA, Munson AS, Ball J & McCullough D (2005) Bronze birch borer. Forest Insect & Disease Leaflet 111. US Department of Agriculture and Forest Service <http://extension.usu.edu/forestry/UtahForests/Assets/FIDLs/BBB.PDF>
- MacAloney HC (1968) The bronze birch borer. Forest pest leaflet 111. US Department of Agriculture. Forest Service.
- McCullough DG, Poland TM, Cappaert D, Clark EL, Fraser I, Mastro V, Smith S & Pell C (2007) Effects of chipping, grinding, and heat on survival of emerald ash borer, *Agrilus planipennis* (Coleoptera, Buprestidae), in chips. *Forest entomology* 100(4): 1304-1315
- Miller RO, Bloese PD, Hanover JW & Haack, RA (1991) Paper Birch and European White Growth and Resistance to Bronze Birch Vary in Birch Borer. *Journal of the American Society of Horticultural Science*. 116(3): 580-584.
- Nielsen DG, Muilenburg VL, and Herns DA (2011) Interspecific variation in resistance of Asian, European, and North American birches (*Betula* spp.) to bronze birch borer (Coleoptera: Buprestidae). *Environmental Entomology* 40:648-653.
- NRC - Natural Resources Canada (2010) *Insects and diseases of forests in Canada*. Bronze birch borer. www.nrcan-nrcan.gc.ca
- Robertson DR & Andow DA (2009). Working paper: Human-mediated dispersal of emerald ash borer: Significance of the firewood pathway. (www.entomology.umn.edu/faculty/andow/EAB_Firewood.pdf)
- USDA-APHIS (2009) Emerald Ash Borer Program Manual, *Agrilus planipennis* (Fairmaire) USDA-APHIS-PPQ-Emergency and Domestic Programs-Emergency Planning, Riverdale, Maryland (US).107p.
http://www.aphis.usda.gov/import_export/plants/manuals/domestic/downloads/emerald_ash_borer_manual.pdf