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COLEOPTERAN PESTS INTERCEPTED ON IMPORTED FOREST PRODUCTS IN TURKEY

Vildan BOZKURT*, Ayşe ÖZDEM, Erdogan AYAN

Plant Protection Central Research Institute-Ankara/TURKEY
*(Corresponding author: vilb2002@yahoo.com)

Abstract

Five species of pests were intercepted in timbers imported to Turkey. All of them have plant quarantine importance were determined by Plant Protection Central Research Institute in Ankara. Intercepted pests were identified by an entomologists and taxonomists. These pests was identified as *Scolytus multistriatus* (Marsham, 1802) and *Scolytus ratzeburgi* (Janson, 1856) (Coleoptera: Curculionidae: Scolytinae) were intercepted from Ukrain in 2009. Another pest was identified as *Trichoferus campestris* (Faldermann) (Col.: Cerambicidae). It was intercepted on timber imported from Rusia in 2011. The other pest *Monachamus galliprovicialis* (Olivier) (Col.: Cerambicidae) was intercepted on industrial wood imported from Ukrain in 2011. The last one *Ips acuminatus* Gyllendal (Col.: Scolytidae) was imported from Ukrain in 2012. According to these results, quarantine inspectors at the checkpoints of the plants and plant products entrance gates must be careful during inspections of imported forest products in Turkey. In this study, hosts, damage, geographical distribution, pathways, pest significance and phytosanitary measures were evaluated of these pests.

Key words: Coleoptera, Forest product, Interception, Quarantine, Turkey

Introduction

In Turkey, forests cover 21.189.000 ha area and %27, 2 percent of overall country area. Forests are consist of % 60 percentage of conifers such as; Turkish pine (*Pinus brutia*) and by order of European black pine (*Pinus nigra*), Scots pine (*Pinus silvestris*), Fir (*Abies sp.),* Oriental spruce (*Picea orientalis*) and Cedar (*Cedrus libani*) and % 40 percentage of deciduous tree species such as Oak (Quercus *sp*.), Beech (*Fagus sp.),* Black alder (*Alnus glutinosa*), Chestnut (*Castanea sativa),* Musclewood (*Carpinus sp).*

Forest product includes both coniferous and nonconiferous species. *Coniferous species* contain all woods derived from trees classified botanically as Gymnospermae, for example; fir (*Abies*), parana pine (*Araucaria*), deodar (*Cedrus*), ginkgo (*Ginkgo*), larch (*Larix*), spruce (*Picea*), pine (*Pinus*), etc. These are also generally referred to as softwoods. *Non-coniferous species contain a*ll woods derived from trees classified botanically as Angiospermae, e.g. maple (*Acer*), alder (*Alnus*), ebony (*Diospyros*), beech (*Fagus*), lignum vitae (*Guaiacum*), poplar (*Populus*), oak (*Quercus*). These are generally referred to as broadleaves or hardwoods (http://www.fao.org.).

In recent years, international trade of forest products has been increased and caused introductions of foreign exotic organisms. Some of the potential organisms may not be considered as pests in their place of origin; however, they may reach pest status in a different environment. It has known that most of the pests are spread out from one country to another by the importation of raw materials of trees. In case of importation of logs, timber and woods the agricultural quarantine regulations are applied to these products which are imported into Turkey. There are also some requirements which are used for the wood packaging materials.

Quarantine pests has potential economic importance to an area which is not yet present in their country, or present but not widely distributed, and are being officially controlled. Official

visual examination of plants and forest products are made by the inspectors. All quarantine pests are regulated organisms, that is, phytosanitary action should be taken if they are intercepted. If the forestry products infested with the harmful organisms that constitute a barrier for importation and are limited and prohibited to importation. There are some Coleopteran species take places in the Regulation on Agricultural Quarantine of Turkey which contains harmful organisms importation is prohibited in case of found in some plants and plant products.

Materials and methods

This study was conducted during 2009 and 2013 in Ankara, Turkey. Aim was to identify of the wood destroying insects in an imported forest products to Turkey. Insect species such as *Scolytus multistriatus, Scolytus ratzeburgi*, *Ips acuminatus, Trichoferus campestris* and *Monachamus galliprovicialis* were assesed to as material. The other materials were timbers and industrial woods. Insect samples were taken from infested timbers and industrial woods. Infested wood samples and insect samples were sent from quarantine labarotories to Plant Protection Central Research Institute for identification. Some of the wood samples were inspected at the laboratory and placed in screen cages for insect emergence. Emerged insects were collected and identified by the taxonomists.

Results and discussion

Many important pest species are known to spread through forest trees from country to country and continents by importation. The probability of pests being with host are detected at the point of entry under present quarantine procedures. For instance, *Scolytus multistriatus, Scolytus ratzeburgi, Ips acuminatus, Trichoferus campestris* and *Monachamus galliprovicialis* were intercepted by inspectors at the border in Turkey. Inspection was made by the inspectors and sample was taken from the imported wood products which were infested with the insects.

Plants and plant products are damaged by insect species feeding on leaves, opening galleries on buds, branches and stems, sucking and feeding on roots. Among the pests in timbers of conifers such as Scolytidae and Cerambycidae species are the most common insect pests. *Scolytus* spp. and *Ips* spp. are very important pests for forests in Scolytidae family. They cause the death of trees and serious economic losses on timber which is also destroyed. Common features of bark beetles; they live phloem under the bark layer or galleries in wood. Larva creates special structural galleries. This galleries structure is significant characters for species and is used for identification of the pest.

The other species *Monochamus* spp. and *Trichoferus campestris* are belonging to the Cerambycidae family. These insects oviposit on recently dead and felled trees or trees already under stress. The feeding of the larvae produces feeding tracks on the sapwood under the bark and bore holes into the wood which may make the wood unsaleable. From the exterior, the conical oviposition scars on the bark can show that a tree has been attacked. With the bark removed, young larvae can be seen producing feeding tracks in the sapwood. The oval entry holes in the wood caused by older larvae are characteristic, although they may be hidden by an accumulation of wood borings. Grub holes are elliptical and adult exit holes are circular and their presence indicates that the insects have completed their development in the wood and have departed. *Monochamus* spp. are also the vectors for *Bursaphelenchus xylophilus*, the Pinewood Nematode. This nematode feeds on fungi innoculated into a weakened tree, but can also kill susceptible healthy pine trees, causing a condition called pine wilt disease (http://www.eppo.int/quarantine). In this study, host plants, damage, geographical distribution, pathways, pest significance and phytosanitary measures were evaluated of intercepted pests in Turkey.

1. Scolytus multistriatus (Marsham, 1802) Coleoptera: Curculionidae: Scolytinae

It is known as the Smaller Elm Bark Beetle.
Host plants: *Ulmus* spp. (Elm tree). *Zelkova carpinifolia, Populus tremula, Alnus sp., Carpinus betulus, Fagus orientalis, Prunus domestica, P. avium, Rhamnus alaternus, Quercus sp.* and *Fraxinus excelsior* (Selmi, 1998).
Damage: Beetles is vectoring *Ophiostoma (Ceratocystis) ulmi,* the causal agent of Dutch elm disease. Beetles emerged from diseased elms and fly to healty elms to feed carrying spores of the fungus. Larvae live in galleries. The foliage of diseased branches wilts, turns yellow, then brown, and finally dies. Exiting beetles leave numerous pin-sized holes in the bark.
The diagnostic key is brown streaks in infected sapwood (http://www.entomology.umn.edu).
Geographical distribution: Europe; (excl. USSR), Austria, Belgium, Britain, Bulgaria, Corsica, Czechoslovakia, France, Germany, Greece, Hungary, Italy, Netherlands, Poland, Portugal, Romania, Spain, Switzerland, Former Yugoslavia, Turkey (Selmi, 1998).
Asia; (excl. USSR), Iran, Africa; Algeria, Egypt, North America; Canada, U.S.A.
Pathways: Likely pathway is seeds, nursery stock, bark, lumber, wood packaging material including dunnage and insects.
Pest significance: It is a vektor of Dutch elm disease *Ophiostoma ulmi* (Buism.)
(http://www.entomology.umn.edu).

2. Scolytus ratzeburgi (Janson, 1856) (Coleoptera: Curculionidae: Scolytinae)

It is known as the Birch Bark Beetle.
Host plants: The primary breeding hosts are species of oak, *Quercus,* such as *Q. petrea, Q. robur* and *Q. dalechamps*. Other tree species such as *Aesculus hippocastanum, Betula verrucosa, Carpinus betulinus, Castanea sativa, Corylus sp., Fagus sylvatica, Ostrya carpinifolia, Populus spp., Salix spp., Sorbus spp.* and *Ulmus spp.* have been cited as occasional hosts.
Damage: Pathogenic fungal diesaes as *Ceratocystis ulmi* (Buisman, 1932) transmitted by *Scolytus multistriatus* (Marsham, 1802), the agent of the blue stain wood.
Geographical distribution: In the Baltic States and Northern Europe *Scolytus ratzeburgi* can be traced in the whole region. In Belarus as well the species is known from the whole territory of the country (Lazdans 2009).
Pathways: Likely pathway is seeds, nursery stock, bark, lumber, wood packaging material.

3. Ips acuminatus Gyllendal (Coleoptera: Curculionidae: Scolytinae)

It is known as Engraver Beetle.
Host plants: Pines, *Pinus* spp. are the predominant hosts of this insect. In Europe and the Near East, Scotch pine, *Pinus sylvestris*, Austrian pine, *Pinus nigra*, Swiss stone pine, *Pinus cembra* and mugo pine, *Pinus mugo* are reported hosts. In China, Korea and Mongolia, *Pinus armandi, Pinus koraiensis, Pinus sylvestris* var. *mongolica* and *Pinus tabulaeformis* are reported hosts. In Thailand, *Pinus merkusii* and *Pinus caribaea* (exotic) are hosts. Other conifer hosts in Europe and Asia include: *Abies normanndiana* (*=A. bormuelleriana*), *Larix decidua*, *Picea obovata* and *Picea orientalis*.
Damage: The first indication of attack by bark beetles, including *Ips acuminatus*, is that infested trees fade from green to yellow to reddish brown. Killing of only the upper portion of the crown of pines is a common occurrence in some parts of this insect's natural range.
Geographical distribution: Asia: *Ips acuminatus* occurs from Turkey across Russia to China and south to Thailand. This insect is widely distributed in China.-It is also reported from Japan, Korea, Mongolia, Syria, Taiwan, Thailand, Turkey and Russia (Sakhalin Island and Siberia). Europe: Widely distributed in Europe including Austria, Belgium, Bulgaria, Czech Republic, Denmark, England, Estonia, Finland, Germany, Greece, Hungary, Italy, Latvia, Luxembourg,

Netherland, Norway, Poland, Romania, Scotland, Sweden, Spain, Switzerland, European Russia, Former Yugoslav Republics and the Republic of Georgia.
Pathways: Adult beetles are strong fliers capable of flying several km in search of suitable host material. They are also subject to dispersal by winds.
Immature stages (larvae and pupae) and adults can be transported in unprocessed logs, wood products or wooden packing material, dunnage or pallets containing bark strips.
Pest significance: *Ips acuminatus* is generally regarded as a secondary insect that attacks weakened or windthrown trees. When populations build up in weakened or down material, they can attack relatively healthy trees. In some instances, Ips accuminatus can kill large numbers of trees and cause a significant loss of commercial pine volume.

4. Trichopferus campestris (Faldermann) (Coleoptera: Cerambycidae)

It is known as Chinese Longhorn Beetle. It is synonym with *Hesperophanes campestris.*
T. campestris was intercepted by inspectors at the border for the first time in Turkey. It was found in a timber which is imported. It is not known to occur in the Turkey and it does not exist at the plant quarantine list.
Hosts: This species can potentially attack most woody plants. About 40 genera of woody plants, both conifers and angiosperms, are known to be larval hosts for *T. campestris*. (Clarke, 2004). *Hesperophanes campestris* preferentially attacks *Malus* (apple) and *Morus* (mulberry), but has also been recorded on *Betula, Broussonetia, Gleditsia, Salix, Sorbus* and various other fruit and deciduous trees. In Japan, it is said to be highly polyphagous. According to some observations, it may attack cut wood of *Picea* and *Pinus* and even structural timbers in buildings.
Damage: The characteristic symptoms of infestation by *H. campestris* are: large entrance and emergence holes in trunks, peeling bark, waste from borings at the base of infested trees, tunnels made by large larvae. The leaves of attacked trees often show yellowing and wilting.
Geographical distribution: EPPO region: Armenia, Kazakhstan (southern), Kyrgyzstan, Russia (south-east of European part, Transbaikalia, Eastern Siberia, Far East), Uzbekistan.
Asia: Armenia, China (northern), Japan, Kazakhstan (southern), Korea (People's Republic), Kyrgyzstan, Mongolia, Russia (Transbaikalia, Eastern Siberia, Far East), Tajikistan, Uzbekistan.
EU: Absent. (Eppo Bulletin 2009). This longhorned beetle is native to Asia. Various life stages of specimens in the *Trichoferus* genus were the fourth most commonly intercepted longhorned beetles in solid wood packaging material transported to North America in 1985 and 2000. Adults were detected in Quebec Canada in 2002 and 2006. (http://extension.entm.purdue.edu/publications/WB-2.pdf).
Pathways: Natural spread of *H. campestris*, by flying adults, is rapid. Because larvae of *H. campestris* may be hidden in wood and therefore difficult to detect, they may easily be transported with bonsai plants, or wood products, of host plants moving in trade. They may in particular be carried in wood packaging because of their ability to colonize dry wood. Adults could also possibly be carried as contaminants of plants for planting (Eppo Bulletin 2009).
The larvae of *T. campestris* are found under the bark and in dry dead wood and complete their development in two or more years. Wood and solid wood-packaging materials are important as a pathway of introduction for wood-boring species. This species is often intercepted in North America from wood-packaging material of Asian origin, as well as its previous introductions into Europe and North America, it is plausible to assume that *T. campestris* has a high likelihood of becoming established in the temperate regions of the NewWorld (Grebennikov et. al. 2010).
Pest significance: *H. campestris* is an A1 quarantine pest for Canada, and also appears in the regulated pest list of New Zealand (with other *Hesperophanes* spp.). In the area of its present distribution, it is considered as a serious pest of forests and orchards, and especially of dry wood. It is most likely to establish in the southern countries of the EPPO region where climatic conditions

favour large cerambycids and a wide range of host plants is available. The main risk of entry is with wood packaging, since the pest is able to develop in dry wood. *H. campestris* is rather unlikely to be transported in small plants for planting (with the possible exception of bonsai plants), since it does not attack small branches, trunks or rootstocks. Large plants of its hosts are rarely traded (Eppo Bulletin 2009). The species is considered a quarantine pest in Europe and is included by the European and Mediterranean Plant Protection Organization (EPPO) in the EPPO A2 List of pests recommended for regulation (Anonymous 2007, 2008).

Phytosanitary measures: *T. campestris* is able to attack healthy or slightly stressed trees of many important species. It prefers to attack mature trees and, even if it does not kill them, the infestation results in significant loss of vigor, of wood marketability (because of the boreholes) and of fruit yield in the case of orchards. The pest also has the potential to damage amenity trees in cities. Nevertheless, the relative importance of *T. campestris* in damaging forest trees, trees in natural environments, orchard trees and amenity trees does not appear to have been evaluated in any detail, beyond the observation that the preferred hosts are fruit or amenity trees *(Malus* and *Morus). T. campestris* is able to develop in very dry wood, is an important technical pest of wood in the area of its present distribution. Synonym of *T. campestris* which is *H. campestris* was added in 2007 to the EPPO A2 list and endangered EPPO countries are therefore recommended to regulate it as a quarantine pest. Wood packaging should respect ISPM no. 15 (ICPM, 2003). International movement of wood of the host plants seems relatively unlikely, but measures in that case could be debarking, plus grubhole freedom, or kiln drying, or other treatment (Eppo Bulletin 2009).

5. Monachamus galliprovicialis (Olivier) (Coleoptera: Cerambycidae)

It is known as Pine Sawyer Beetles. It is in the EU Annex designation: I/A1 - as *Monochamus* spp. (non-European)

Host plants: Species of *Pinus*, *Picea*, *Abies* and Douglas-fir. The *Monochamus* spp. which are known as vectors of *B. xylophilus* mainly develop in *Pinus* spp. but other coniferous genera can sometimes also act as hosts (http://www.eppo.int/quarantine).

Damage: *Monochamus* spp. only oviposits on recently felled trees or trees already under stress. The feeding of the larvae produces feeding tracks on the sapwood under the bark and bore holes into the wood which may make the wood unsaleable. The pine wood nematode (*Bursaphelenchus xylophilus*) (Aphelenchoididae) living in coniferous wood of different tree species, a destructive pest of pine trees is very important.

Larval borings can damage freshly cut logs and reduce value of lumber. Larvae bore in wood of dead and dying trees, can cause degrade of lumber. Adults feed on needles and bark of young twigs. Larvae are often found in pine, spruce or Douglas-fir firewood (http://www.colostate.edu.)

Geographical distribution: Various species are found throughout the conifer forests of the northern hemisphere (North America, Europe and Asia).

Pest significance: Inspection of timber does not always reveal the presence of insect larvae or pupae, which can be hidden within internal galleries. *Monochamus* larvae can cause economic losses to felled logs by forming bore holes in the wood. This is normally only of significance if the logs are left for a long time in the forest after felling. Under well-managed forest conditions, *Monochamus* spp. is not generally considered to be serious pests in their own right. Thus, the only economic impact arises in countries where *Bursaphelenchus xylophilus* is present and damaging and the *Monochamus* species concerned transmit it (http://www.eppo.int/quarantine).

Phytosanitary measures:

EPPO's recommendations to prevent the introduction of *B. xylophilus* and its vectors cover plants and wood of all conifers, apart from *Thuja plicata*, from countries where the nematode occurs. It is recommended that coniferous plants should be prohibited but that countries may choose whether to prohibit wood. If not prohibited, wood must have been heat treated to a core temperature of 56°C

for 30 minutes. In the case of packing wood (crates, dunnage etc.), kiln drying could be accepted instead, whereas for particle wood, the alternative of fumigation is also acceptable.
Several quarantine treatments for wood chips have been proposed, such as steam/heat treatment or fumigation in transit with phosphine. The only known effective treatment for wood already infected with *B. xylophilus* and its vectors appears to be heat treatment, in which all parts of the wood reach a temperature of 56°C for at least 30 min; commercial kiln practices normally achieve this (http://www.eppo.int/quarantine).

Conclusion

Forest products are imported in the form of such as timber, log, chips, roundwood and sawnwood. In Turkey during quarantine inspections five species of Coleopteran pests were intercepted in timbers and industrial wood during period between 2009 to 2012 years. All of the harmful insects found in the imported forest products were identified as bark beetles (Coeloptera: Curculionidae: Scolytinae) and longhorned beetles (Coleoptera: Cerambycidae). They are known as the most common wood-destroying insects (Canakcıoglu and Mol, 1998; Toper, 2007). Intercepted pests were identified as *Scolytus multistriatus* (Marsham, 1802) and *Scolytus ratzeburgi* (Janson, 1856) *Ips acuminatus* Gyllendal (Coleoptera: Curculionidae: Scolytinae), *Trichoferus campestris* (Faldermann) and *Monachamus galliprovicialis* (Olivier) (Col.: Cerambycidae) by an insect taxonomist with the expertise of Coleoptera.

Yalınkılıc and Serez (1992) suggested that exotic pests may be introduced very easily in forest products imported into Turkey because there is a big gap between wood production and demand in Turkey. To close this gap, Turkey has to import wood products from wood exporting countries. The importation of wood from different countries, increases the possibility of the inadvertent introduction of exotic pests into Turkey. To eliminate this possibility, precautionary measures should be evaluated carefully to prevent the inadvertent introduction of exotic pests, and phytosanitary inspection at busy entry points should be performed more carefully. Plants and plant materials are inspected by the plant health inspectorate in order to satisfy plant health requirements. This inspection is conducted during the importation for imported forest products.

In conclusion, importing unprocessed logs from infested countries can have serious damages because of the introduction of forest pests. Measures must be implemented to mitigate the risk of pest introduction and establishment. Pre-border measures are intended to reduce, border measures are intended to intercept and Post-entry measures are a range of regulatory tools that can be used to prevent invasive alien species (Burgiel 2006).

Great attention is needed to make an inspection in order to prevent or reduce introduction of the pests and infestation of forests. To prevent the introduction of harmful organisms occurring from the trade of wood products sufficient phytosanitary measures should be taken at the place of origin.

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