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The biotic pests of invasive and expansive woody plants in the Botanical Garden of P. J. Šafárik University in Košice

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Abstract: In the years 2000 – 2003 the resesarch into the insect pests of the selected invasive and expansive wood species in the Botanical Garden in Košice was carried. This was the continuation of the research in the years 1995 - 1999. The following invasive wood species were included into the analyses: *Robinia pseudoacacia* L., *Ailanthus altissima* MILL. SWINGLE, *Catalpa bignonioides* WALT., *Negundo aceroides* MOENCH, *Amorpha fruticosa* L., *Rhus typhina* L., *Rhus typhina* L. 'Laciniata', *Betula verrucosa* EHRH., *Fraxinus excelsior* L., *Acer campestre* L., *Acer platanoides* L., *Acer pseudoplatanus* L. and *Carpinus betulus* L.

On the basis of literature data and results of our research it can be stated that invasive and expansive woody species have a number of characters in common:

1. Low endangerment of diaspores by caprophages, in some species they have not been recorded so far (e.g. *Ailanthus altissima, Catalpa bignonioides, Negundo aceroides, Amorpha fruticosa,* and others).
2. Resistance to a complex of biotic and abiotic factors, or, as the case may be, no recorded damage so far, e.g. *Ailanthus altissima, Catalpa bignonioides, Amopha fruticosa, Negundo aceroides.*
3. From the point of view of orchard management it is the possibility of the flight of diaspores to plantations and cultures, fast growth in initial stages and owing to intensive growth the ability to outgrow and displace original wood plants in the surroundings. Together with these factors high tolerance to the synergic action of air-pollution

and climatic stress is recorded in the majority of these wood species, e.g. in urban evironment.
4. Resistance to a complex of biotic and abiotic factors, or, as the case may be, no recorded damage so far, e.g. *Ailanthus altissima, Catalpa bignonioides, Amopha fruticosa, Negundo aceroides.*
5. From the point of view of orchard management it is the possibility of the flight of diaspores to plantations and cultures, fast growth in initial stages and owing to intensive growth the ability to outgrow and displace original wood plants in the surroundings. Together with these factors high tolerance to the synergic action of air-pollution and climatic stress is recorded in the majority of these wood species, e.g. in urban evironment.
The above given characters make optimal conditions for invasion, or, as the case may be, expansion of these wood species to both surrounding and distant ecosystemes (natural or man-made ones). It enables gradual or even intensive disturbance of these ecosystems. Thus it is necessary to consider possible risks in plantations, when the above-mentioned species are used. As preventive measurements the following can be recommended: aboricides to remove undesirable regeneration (paying attention to hygienic and toxicological criteria and excluding of contraindications with nature preservation principles), mechanical removing of the wood plants before they reach the stage of fructification. Potential local mass outbreak of carpophages can be thus a positive factor for suppression of woody plant invasion.

Keywords: insect pests, invasive and expansive woody plants.

Introduction

During maintenance works in parks and other urban plant cultures can man find some woody species which can be a problem. They are able to spread spontaneously to surrounding areas and their ability to vegetative reproduction by sprouts from stumps or roots are the main obstacles in the growing of the aimed cultures. These woody species can be undesired in such circumstances and are designated as the invasive ones. ELIÁŠ (1994) defines invasive species as the non-native species able to eliminate former native species and their biocoenoses. MODRANSKÝ et al. (2002) think that during terrain monitoring even other species, not designated as invasive, can show invasive character, e.g. *Acer platanoides, Sambucus nigra, Salix caprea* and *Fraxinus excelsior*. These species are autochthonous woody plants and can be taken into account as invasive species, at least in relation to their expansion in urban areas. Such invasions can gradually deteriorate the original function of ecosystem or of artificial cultures (parks, forest parks, botanical gardens, arboreta and others). The neglection or even the absence of control measures can result to the function looses or even the total collaps of natural or artificially created ecosystems. From this viewpoint, the fructification can be a serious risk for natural ecosystems or for planed park interventions, either by the gradual or

rapid and agressive elimination of former ecosystem elements. In many cases these woody species are being well in urban areas and they are resistent to the synergic influence of both climatic and imision stress. In comparison to the main economic woody species (e.g. spruce, fir or oaks and beech respectivelly), the fructification interval of which is to prolongate, the invasive woody plants are characteristic with the rich (sometimes every year) fruit production with a high degree of germinating seeds. The criterion for invasive woody plant species was an information from some authors, e.g. MAGIC (1997), SUPUKA (1997), BARANEC (1997), but also the reactions of certain woody species during their growing under conditions of The Botanical Garden of The P.J. Šafárik University in Košice (BG UPJŠ) were taken into account.

The aim of this work was to judge the carpophage occurence in seeds of these invasive woody plant species and to summarize up-to-date information on their vulnerability in relations to other biotic pests.

Material and methods

The sample taking was done in The Botanical Garden of The P.J. Šafárik University in Košice (BG UPJŠ) in the years 2000 – 2003, it was in the time of main seed and fruit collecting. This investigation issued from the research maintained in the years 1995 - 1999 (KELBEL 2000a).

Concise area description: BG UPJŠ was founded in 1950 formerly as Institute of Botany in The University of Agriculture and Forestry Engineering in Košice (MOCHNACKÝ 2001). BG UPJŠ is situated in the northwest of the Košice Basin, at the foot of the east headland of the Slovak Ore Mountains, in the Bankov locality, on the local part named Red Bluff. Terrain is of NE exposition, sloppy, with altitude from 218 to 370 m above sea level. Soils are shallow, they were created on geological base of pyroclastic schists and fylit rocks. An average annual temperature is 8,4 °C, an annual precipitation is 643 mm. The former natural vegetation cover of the BG UPJŠ area were forests of oaks and hornbeams (Mochnacký 2001). Following invasive woody plant species were analysed there: black locust (*Robinia pseudoacacia* L.), tree-of-heaven (*Ailanthus altissima* MILL. SWINGLE), southern catalpa (*Catalpa bignonioides* WALT.), box elder (*Negundo aceroides* MOENCH), false indigo (*Amorpha fruticosa* L.), staghorn sumac (*Rhus typhina* L.), cultivar *Rhus typhina* ' Laciniata ', white birch (Betula verrucosa EHRH.), European ash (*Fraxinus excelsior* L.), hedge maple (*Acer campestre* L:), Norway maple (*Acer platanoides* L.), sycamore maple (*Acer pseudoplatanus* L.) and European hornbeam (*Carpinus betulus* L.).

Material was taking off always from several fructificating trees. Individual seed samples from each species contained 400 seeds for every year. The samples were placed into paper sacs with datum identification. In the cases of a longer time spread between seed taking off and an entomological analyse the samples were temporarily stored in the fridge at the temperature from 0 to -2 °C. The analyse of fruit infestation were done in accordance with the methods of GUSEV

and RIMSKIJ-KORSAKOV (1961) by visual inspection and consecutive tangencial cutting. Other biotic pests were visually checked consecutively during the year.

Insect species were determined by the works of ČERMÁK (1952), GUSEV et RIMSKIJ- KORSAKOV (1953), PFEFFER et al. (1954) and KŘÍSTEK et al. (1992).

Results and discussion

The results of analyses with respective discussions are presented by individual invasive woody plant species.

Tree-of-heaven (*Ailanthus altissima* MILL. SWINGLE)

The woody plant species natural in Eastern Asia, middle China, southern part of Korean peninsula and partly in the Japan archipelago. It was introduced to Europe in 1751 (PAGAN, RANDUŠKA 1988). This species grows well on sunny places and even in poor soils. As it is one of the most widespread introduced broadleaved woody plants, it is often the subject of research, e.g. KOWARIK (1995), HEISEY (1996), JOVANOVIC et al. (1997), UDVARDY (1998), HASHIM, MARWAT (2002), MEGGARO, VILA (2002), MODRANSKÝ et al. (2002, 2003), and others.

During seed analyses there was diagnosed no insect pest, it confirms the previous results of HRUBÍK (1975), such as our own knowledge too (KELBEL 2000a). This species has a rich seed production every year. An average rate of dry seeds in analysed samples varied in the course of investigation from 3,50 to 5,00 %. BÄRTELS (1988) presents the high degree of germination but without any quantitative data. LÖFFLER (1972) shows 70 % germination of seeds. In addition to other insect pests there is a possible occurence of the apple aphid *Aphis pomi* DE GEER., common on other woody plant species and also at the genus *Ailanthus* too (PFEFFER et al., 1954). Juhásová and HRUBÍK (1984) classified this woody species as the most resistant against pests. In BG UPJŠ there have not been registered any insect pest infestation, nor damage caused by game animals. This species shows invasive character and in relation to our up-to-date results there can be said that it is also resistant against whole complex of abiotic factors too.

Tree-of-heaven is growing well also on extreme places, e.g. ruderal ones. Bärtels (1988) emphasizes that this woody species invades in warmer climatic areas (e.g. in former Yugoslavia and Austria) very numerously, even out of gardens. MAGIC (1997) presents distribution of *A.altissima* in our countries also on the places of illegal communal waste storages where fructificated individuals occurs. It is widely distributed in Hungary where it is considered to be an aggresive woody plant species (MAGIC 1997). The sprout analysis of tree-of-heaven in BG UPJŠ revealed the maximum annual height outgrowth of 174 cm, so sprouts can outrun planted cultures in height in the cours of one yaer and in the folloving years it causes their screening and space suppression. MODRANSKÝ et al. (2003) present high invassive pressure of this species becouse according to their findings, the number of the spontaneously appeared individuals was cca

11 times higher than the number of the planted ones. From the gardening and parking viewpoint, tree-of-heaven is a very attractive woody plant, especially in respect to its habitus, shape and form of leaves and high colour variability of fruits arranged in amply ramified inflorescences. It withstands climatic stress in urban area very well but its planting must be thoroughly taken thought in respect to the mentioned risks.

Black locust (*Robinia pseudoacacia* L.)

The tree species native to the southwest of North America, introduced to Europe in 1601 (PAGAN, RANDUŠKA 1988). Modest species in respect to nutrient content, resistant to drought, appreciated by bee-keepers as important melliferous woody plant. Considering its aggressive spreading and alelopatic toxic root exudates, it can easily be troublesome woody species – it is the case also in BG UPJŠ too. LÖFFLER (1972) declares seed germinability of 55 %. A contemporary information on the insect pest infestation of black locust seeds differs: HRUBÍK (1975) presents the seed infestation caused by the species *Spermophagus sericeus* GEOFFR. (21,8 - 33,0 %), larvae of *Eurytoma caraganae* NIK. (16,2 %) and sporadicly occured pyralid moth *Etiella zinckenella* TREITSCH.. Janíček (1983) found out 10,8 % seed infestation caused by larvae of *Eurytoma caraganae*.

Our analyses revealed a finding of the beetle *Spermophagus cisti* FABR. in 11,5 % of seeds. Every seed was inhabited by one individual larva. The amount of dry seeds was 19,0 % in average (in the year 2000 it was up to 20,5 %). But diaspores are not the main problem of the invasive behaviour of black locust, this species reproduces itself predominantly by its stump and root sprout shoots which must be regularly eliminated by mechanical or chemical (arboricides) measures.

The survey of authors and their results considering a possible black locust infestation with aphids and other foliophages are reported by JUHÁSOVÁ and HRUBÍK (1984).

Concerning global climatic changes, some new insect pests become actual latterly. Out of them there can be mentioned some phytophagous species designated as invasive ones and which were dragged in our countries together with various plant material. One example is the glacillariid moth *Phyllonorycter robinielus* CLEMENS which occurence is obvious by its mining of leaves. Its overwinntering is in the stage of pupa or imago. Swarming starts in May or in the first days of July, during which time females lay eggs onto the backside of leaves along lateral veins. Little caterpillars burrow into the parenchyma tissue of the leaves and following their continual feed the so-called mines appear. The eating up of chlorophyl causes apparent blister formation on the backside of the leaves. The measures of this formation gradually increase, or it takes the almost all leaf backside and then the leaf falls down. The damage can be visible as strong tree defoliations (NOVOTNÝ, ZÚBRIK et al. 2000). This pest is registred also in BG UPJŠ from 1998, it mostly occured on the leaves of both the root and stump sprout shoots of black locust, oldre trees are lesser befallen. The

infestation was registered also at urban trees, also on the newly planted decorative, mainly globbous black locust cultivars in alleys. Here it causes physiologigal damage and deteriorates the aesthetic appearance of trees. The control of this pest can be taken into account only in the case of the plantings in parks, cities or in other specific cases (fixing of unstable soils and coombs), otherwise, in common operational conditions of forest management, black locust is considered to be an invasive and troublesome woody species, so the pest could be helpful only in the reduction of undesired black locust sprout shoots. According to HRUBÍK (2003), another potential black locust pest is the locust digitate leaf miner (*Parectopa robiniella* CLEMENS), originated from North America but registered of late years at first place in the south of Eureope and afterwards in Central Europe too. In 1989 it was found out in Moravia and in the same year in Slovakia too (KULFAN 1989). In Bohemia, its occurence was registered in 1994 but only sporadically so far and it means no problem for black locust stands. But it occurs more frequently in Slovakia and the damage especially to leaves of sprout shoots and in lower crown parts is more serious, in individual cases also at decorative cultivars of *Robinia pseudoacacia* (HRUBÍK 2003). The caterpillar of this species is light green, 3 mm long and creates conspicuous lobelike mines on the face of black locust leaflets. Such mine on a leaflet is very notable by its snowy white colour, in the course of ageing it takes dark rusted colour. The little caterpillar becomes pupa out of mine in tiny whitish cocoon. The little moth appears in August. It is univoltinous species in our conditions (HRUBÍK 2003). In BG UPJŠ this species has not been found so far.

From the vertebrates group, for black locust there can be dangerous brown hare (*Lepus europaeus*), namely by bark nibbling, especially in young plantations. The detailed survey of vertebrate pests of black locust was referred by TURČEK (1952).

Southern catalpa (*Catalpa bignonioides* WALT.)

The tree species was originally distributed in the southeast part of the North American continent, it was introduced to Europe in 1726 (PAGAN, RANDUŠKA 1988). It is half-shade demanding species requiring high soil nutrient contents. Our observations do not confirm any insect pest seed infestation, also Juhásová and HRUBÍK (1984) found out in Arboretum Mlyňany no injuries caused by biotic pests. Though this wood species is listed in the group of invasive plants, we have no information to its invasive behaviour in BG UPJŠ so far. At the same time, we can confirm no southern catalpa infestation caused by biotic pests.

Box elder (*Negundo aceroides* MOENCH)

Native to North American continent, introduced into Europe in 1688 (PAGAN, RANDUŠKA 1988). It is from half-shade to light demanding species, modest in respect to nutrient content in soil, resistant also against the atmogennous deterioration and climatic stress in urban plantings. The seed analyse recovers the occurence of no insect pest. This is in accordance to the results of HRUBÍK (1975) and KŘÍSTEK et al. (1992), and also to the results of some foreign

authors, e.g. ŽEMKOVA (1970). We also did not find out any other biotic pest infestation.

Box elder starts to fructificate very soon, seed productions are regular and rich. Winged achenes stay on trees long time, so they are distributed to the wide surrounded area by autumnal winds and snowstorms (MAGIC 1997) by which it increases the risk of box elderd dragging in long distances. In BG UPJŠ this wood species shows invasive character only locally, the problem is more obvious in urban areas in Košice. MODRANSKÝ et al. (2003) in their research in Zvolen found out the 2–times, locally also 4 or 5-times, higher number of spontaneous individuals in relation to the planted ones. The invasive pressure was lowered in the areas where an annual low cut of woody plants in winter or spring season was realized within the frame of the keeping up outplantings.

False indigo (*Amorpha fruticosa* L.)

The shrub is native to North America, it was introduced to Europe in 1724 (PAGAN, RANDUŠKA 1988). Light loving wood plant, demanding higher soil moisture. It is cultivated in parks and hedgerows, it is also used to bind ravines and coombs. In flooded forests it can grow spontaneously (PAGAN, RANDUŠKA 1988). In BG UPJŠ conditions it becomes locally the troublesome wood species. No insect infestation was found out during seed analysis. Next to the distribution by diaspores, the invasion expresses itself also by very intensive root sprouting which can be suppressed only mechanically or chemically. We draw attention to the fact that even after the radical removing of a root system (by earthmover excavation) in BG UPJŠ condition, after a period of 3 – 4 years there was the total regeneration of roots and the sprouting ability was completely recovered. This aspect of invasive propagation into surroundings is to be considered in park and garden outplantatings.

Staghorn sumac (*Rhus typhina* L.)

***Rhus typhina* ' Laciniata '**

The shrub or up to 10 m high tree, native to the eastern areas of the North American continent. Introduced into Europe in 1622 (PAGAN, RANDUŠKA 1988). Half-shade loving wood species, unpretending to soil nutrient content. The 'Laciniata' cultivar has finely cut and differentiated leaves compared to the natural form of this species. Both shrubs were free of carpophages. JUHÁSOVÁ et HRUBÍK (1984) drew attention to the possible damage by *Melolontha melolontha* L. imagos in the years of its strong outbreak at the wood species of *Rhus verniciflua* STOKES. The damage caused by other biotic pests was not recorded in BG UPJŠ. This wood species can propagate intensively by root sprout shoots.

White birch (*Betula verrucosa* EHRH., syn. *Betula pendula* ROTH)

This species grows in Slovakia on glades, land boundaries, not maintained pasture lands and uncared meadows (PAGAN, RANDUŠKA 1987). It is light loving wood species with rapid growth, occuring in areas of continental climate.

(PAGAN, RANDUŠKA 1987). We have registered the gall-midge species *Semudobia betulae* WINN. in seeds with an average rate of 25,00 %. DRÁPALOVÁ (1979) found out the infestation caused by this pest in the years of high seed crop 1976 and 1978 within 2,5 – 5,25 %. JANÍČEK (1983) found out seed infestation caused by the gall-midge *Semudobia betulae*, there were from 1 to 35 damaged seeds per one catkin and at the same time there was registered the parasitation of this pest caused by chalcid wasps. SKUHRAVÁ (1983) presents two gall-midge species at birch, namely *Semudobia betulae* and *Semudobia skuhravae* ROSKAM. At the same time she means that in spite of the locally abundant occurence of *Semudobia betulae* in birch catkins this species can not be designated exactly as pest because from the human needs viewpoint it positively influences in the lowering density and propagation of this weed wood species. According to SKUHRAVÝ (1991), the infestation up to 30 % of seeds do not influences fertility of this species, only at higher infestation levels the reproductive potential is decreasing. ANIČKOVA (1982) described in detail the bionomy of the pest *Apion simile* KIRBY. Thist pest species can deteriorate up to 50 % of seeds, mainly at solitary individuals or trees growing in open forests with stand density under the level of 0,5.

NOVOTNÝ, ZÚBRIK et al. (2000) present the possible pests in birch trunk and branches, such as birch bark beetle (*Scolytus ratzeburgi* JANSON), in sawn or mechanically damaged tree trunks can develop technical pests such as broad-leaved ambrosia beetle (*Xyloterus domesticus* L.), ambrosia beetle (*Xyloterus signatum* E.), large timberworm (*Hylecoetus dermestoides* L.), and some other species. The same authors present that the damage to assimilatory organs can be caused by larvae of button horn sheet wasp (*Cymbex femorata* L.), poplar sawfly (*Trichiosoma lucorum* L.) and hazel sawfly (*Croesus septentrionalis* L.). On the leaves, several moth species (Lepidoptera) and hymenopterans (Hymenoptera) can occur but usually without outbreaks (NOVOTNÝ, ZÚBRIK et al. 2000). Biotic pests of white birch were studied laterly by KULA (2002), MUSATOVA (2000), VACEK, BALCAR (1999), and others.

Of late years, birch is the subject of reevaluation of its economic value, it is caused by the formation of valuable technical forms with decorative pattern of wood (budlike, fluelike, curly) which are highly valued in furniture industry (PAGAN 1997). Greater attention paid to the curly birch was the first step in receiving high-grade seed for sowing which could give rise to individuals producing quality wood sortiments (PAGANOVÁ 1993, PAGAN, PAGANOVÁ 1994, PAGANOVÁ 1994, 1997). The evaluation of birch as the undesired and weed wood species to be eliminated from forest stands within tending processes is also changing. The tolerance of birch towards air pollution and climatic stress predetermines this wood species to grow on soils of difficult aforestation but also on exposed sites in urban plantings.

European ash (*Fraxinus excelsior* L.)

The tree reaching the height of up to 40 m. It grows on deep soils rich in nutrients. (PAGAN, RANDUŠKA 1987). In the course of our research there was

found out the presence of beetle *Ligniodes enucleator* PANZ. in 32,5 % of achenes. KŘÍSTEK et al. (1992) reports that in the years 1970 and 1972 there was registered an infestation of ash seeds caused by two species of pests on 11 sites of the southern Moravia, namely *Ligniodes enucleator* which caused damage to 25,2 % seeds and the moth *Tortrix conwayana* F. with 7,0 % infestation. DRÁPALOVÁ (1979) published achene infestation caused by this pest in 1976 as 25,50 % and in 1978 as 17,35 %. ČERMÁK (1952) considers the beetle *Ligniodes enucleator* to be the most frequent ash achenes pest – from authors 300 seeds there were 113 achenes infested.

NOVOTNÝ, ZÚBRIK et al. (2000) present possible stem and branch injury caused by ash bark beetle (*Leperisinus fraxini* PANZER), larch elm bark beetle (*Leperisinus crenatus* F.), at branches of young trees there can appear *Leperisinus orni* FUCHS. The damage to leaves by sap-sucking is caused by the scales *Eulecanium corni* BOUCHE. and *Pseudochermes fraxini* KALT. These authors also reports the possible damage to assimilatory organs caused by ash weevil (*Stereonychus fraxini* DEG.) mainly in young ash stands in the south of Slovakia. The outbreak of blister beetle (*Lytta vesicatoria* L.) in the stage of imago can cause the local defoliation. In buds and leaves there can be harmful the ash bud moth (*Prays curtisellus* DON.).

The tree has high sprouting ability. In BG UPJŠ condition it is a frequent naturally seeding wood species. In respect to that it is the rapid growing wood species, it overtops other trees in outplantings. Moreover, it fructificates in the young age, PAGAN (1997) presents the fructification age in the case of solitares as 20 years and in the stands as 30 – 40 years. These facts can contribute to the invasive propagation of this wood species.

Hedge maple (*Acer campestre* L.)

The half-shade demanding wood species, relatively warm loving, growing as a shrub or a tree of up to the 15-20 m height (PAGAN, RANDUŠKA 1987). LÖFFLER (1972) presents 60% germinating capacity of its seeds. The seed analyses revealed an averaged damage to achenes of 23,5 %, out of it 16,5 % was caused by dipteran species *Megaselia giraudii* EGGER (more details in Kelbel 1998), the rest was caused by caterpillars of the moth *Pammene trauniana* D.-S.. In all that observed cases the inner content of seeds was totally eaten out. ČERMÁK (1952) was founding the moth *Pammene trauniana* in hedge maple achenes in the surroundings of Prague and the occurence of this pest was designated as not too frequent. From the gardening viewpoint this wood species easily goes to planting sites as natural seeding, where a sprout shoots production appears after its mechanical elimination. In BG UPJŠ conditions this wood species behaves as the most invasive one from our native maples.

Norway maple (*Acer platanoides* L.)

The half-shade loving wood species, resistent against frost, going well in urban environment. (PAGAN, RANDUŠKA 1987). In urban areas, it is planted in parks, such as in alleys too, it tolerates also crown cuttings (PAGAN, RANDUŠKA

1987). The analyses revealed 3 pest species, namely the dipteran *Megaselia giraudii* (the infestation degree in average of 19,5 %), the moth *Pammene trauniana* (7,00 %) and the beetle *Bradybatus kellneri* BACH (2,5 %). The overall insect infestatiom rate reached 29,00 % for years of observations and it was the highest one from the native maple species used in this research. It is in accordance with the results of KŘÍSTEK et al. (1992) from analyses done in 1972. From the gardening point of view, this wood species in BG UPJŠ looks to be invasive, it is on the second place among our native maples (behind hedge maple). After a mechanical elimination of natural seeding there stay root sprout shoots as troublesome.

Sycamore maple (*Acer pseudoplatanus* L.)

The half-shade loving tree species with high demands for both the soil and air moisture, more sensitive to air pollutants (PAGAN, RANDUŠKA 1987). From the insect pests in seeds there was found out the moth *Pammene regiana* Z., in the average rate of 9,5 %. Other pest species was not registred in achenes. Křístek et al. (1992), using their analyse results from 1972, present the damage to sycamore achenes caused by the caterpillars of *Pammene regiana* in the rate of 10,7 %. SKRZYPCZYŃSKA (1995) lists the achene pest species in the National Park Ojców in Poland: *Etainia sericopeza* Z., *Cydia inquinatana* HB. and *Pammene regiana*.

From the gardening viewpoint there is not showed the invasive behaviour of this wood species in the BG UPJŠ conditions.

NOVOTNÝ, ZÚBRIK et al. (2000) present the possible damage do tree trunks of native maple species caused by the broad-leaved ambrosia beetle (*Xyloterus domesticus* L.) and the fruit-tree pinhole borer (*Xyleborus saxesani* RATZ.). These authors consider some polyphagous moth species participating in damaging to leaves, e.g. the gypsy moth (*Lymantria dispar* L.) and the winter moth (*Operophtera brumata* L.). Relatively often damage to leaves, especially in lower altitudes, is caused by leafroller moths (Tortricidae), it is manifested by the typical rolling of leaf edges (NOVOTNÝ, ZÚBRIK et al. 2000).

European hornbeam (*Carpinus betulus* L.)

In the course of seed analysing there was not isolate any insect pest. In the second half of the vegetation period there were founded only empty hornbeam nuts which were leaved by pests. (KELBEL 2000b). On the base of analyses there was not registered any fruit decay. But the results show the high rate of dry empty fruits which was caused by the extreme manifestations of climatic factors in the time of investigations. There is not clearly determined any insect pest species of hornbeam nuts in Slovak literature. ČERMÁK (1952) drew attention to unknown pest which leaves the fruits through circular hole and such information was also appeared in the work of KŘÍSTEK et al. (1992). In this connection we want to draw attention to the paper of ČERVEŇÁK (1961) which dealed with the pests of hornbeam seed in his work in detail. In the time of the seed inspection in 1959 at the Research Station in Liptovský Hrádok there was

registered the occurence of perforated hornbeam nuts. The established experiment leads to the rearing of the parasitic chalcid wasps *Eupelmus urozonus* DALM. To determine the host, the damaged seeds were analysed by cutting. In 300 analysed seeds there were found 37 dead beetles – the curculionid species *Apion holosericeum* GYLL. and in one case it was the beetle *Ptinus fur* L. from the family *Ptinidae* (the determination was done in both cases by prof. Pfeffer). This author presented also a detailed description and bionomy of both pests in his paper. In foreign literature, the pest species *Apion holosericeum* was mentioned by ZEMKOVA (1980). Apart from this species, the same author listed also other species, such as *Phyllobius piri* L. and *Ph. argentatus* L., both from the family *Curculionidae*. DMITRIJEV (1969) reports the damage to 30 % of hornbeam seeds in the Skala – Podoľskij Park caused also by the curculionid beetle *Apion holosericeum*. PRIBYLOVA - NASONOVA (1972) showed in the area of Northern Caucasus that this pest has caused the high infestation of hornbeam nuts (up to 64,4 %). The description of the damage to hornbeam nuts in our samples corresponds to the data of ČERVEŇÁK (1961). But because the rearing of pest imagos was unsuccessfull, we can not clearly say whether it was *Apion holosericeum* or not.

NOVOTNÝ, ZÚBRIK et al. (2000) present the possible damage to phloem caused by the hornbeam bark beetle (*Scolytus carpini* RATZ.). As possible pests of assimilatory organs they list some polyphagous moth species, especially the inchworms (Geometridae), e.g. the mottled umber (*Erannis defoliaria* CL.) and the winter moth (*Operophtera brumata* L.). The damage can be caused also by caterpillars of the gypsy moth *(Lymantria dispar* L.).

Considering the fact that this wood species is represented in the forest park of BG UPJŠ only with several individuals, there were not observed any manifestation of invasive behaviour. On the other hand, in the condition of the forest management, especially in the stands where the vegetative reproduction was accepted, hornbeam gains the upper of other wood species because of its high sprouting ability (PAGAN 1997).

Conclusions

From the both, literature data and our own results, there can be generalized that the invasive wood species have several common characters:

1. The wood species diaspores are at relatively low risk of carpophages attack, the seed infestation of some wood species were not registered so far (e.g. *Ailanthus altissima, Catalpa bignonioides, Negundo aceroides, Amorpha fruticosa,* and others). From the seed production point of view the determining factor is the regular (normally yaerly) rich fructification, well-known high germinating ability of seeds (e.g. BÄRTELS 1988, LÖFFLER 1972, and others) and physical properties of diaspores which are normally light, equipped with flying apparatus and having possibility of massive anemochorous propagation to nearby surroundings such as to the more remote ones.

2. The resistance against the complex of biotic and abiotic factors, some species are without any registered damage so far, e.g. *Ailanthus altissima, Catalpa bignonioides, Amopha fruticosa, Negundo aceroides.*

3. From the gardening viewpoint there is an important possibility of natural seeding into plantings and cultures, rapid initial growth and the ability to overtop and shade the surrounding natural woody plants. Together with previous factors, there is also the high tolerance towards the synergic effect of air pollution and climatic stress, e.g. in urban aglomerations.

The presented facts create optimal conditions for invasions of these wood species into the contact ecosystems, such as to the more remote ones (natural or artificially created) with their possible gradual or more intensive destruction. Therefore, it is needful to consider the possible future risks of the mentioned wood species in the time of planting. There can be recommended the liquidation of the undesired natural seedings by arboricides (with respect to the sanitary and toxicological criteria and to eliminate the possible antilogy to the nature conservation principles) or by the mechanical elimination of seedings before the beginning of the fructification stage respectively. Also any potential local outbreaks of carpophages and other biotic pests could be rather positive to control the invasive wood species from this point of view.

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