

## REVIEW ARTICLE

## Effects of *Acer negundo* Invasion in Europe

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### ABSTRACT

Aim of this review is to explain why the tree *Acer negundo*, a North American native species, is not considered at the European level as a priority invasive alien species. The analyzed information refers both to American country of origin and to other countries such as China, the majority focusing on the European continent. The study refers to a single taxon, *Acer negundo*-Box elder, but other taxa are also mentioned with which it competes or have represents pests. The desk study is based on the analysis of literature for the period 1960-2022; and was focused on species description (morphological characters, biological and ecological requests, pests); invasive particularities of specie; effect on biodiversity; mitigation effects of species invasion; eradication, containment and control mechanisms. Box elder is a non-native species for Europe that has a low degree of invasibility. It penetrates only in habitats disturbed by human activities, it is more competitive compared to willow and poplar, but it can be eliminated by *Alnus incana* and *Fraxinus excelsior*. Among the three main categories of control (chemical, mechanical and biological), the most effective and selective is the one with glyphosate, but mixed options (mechanical and chemical) are also recommended. Taking into account the negative effects on the ecosystems it entered, but also the low degree of invasion and the fact that are effective methods of combating it, we concluded that this invasive foreign species is not a priority for combating, only monitoring being necessary.

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### 1. Introduction

The spread of some species from the continent of origin to other continents is a process that has its roots in human expeditions with a role in the discovery and expansion of new territories (Igamberdiev, 2025).

As a result of a pragmatic behavior, at first, they were brought as sources of food (corn, coffee, cocoa etc.), as natural fibers (cotton) or as spices, later they were brought as decorative plants or as pets. The introduction of these species was initially done with good intentions, and had the role of diversifying food sources for the human population, for fishing, forestry, hunting or ornamental.

In the 20<sup>th</sup> century, with the diversification of means of locomotion, with the increase in travel speed and the number of people moving, the process of dissemination became uncontrollable. During this period, human society in full development uses more and more natural resources, exerting increased pressure on biodiversity (FiBL & IFOAM, 2010). Numerous studies have revealed the fact that there is a decrease in biodiversity at the global level, which led the academic community to identify the causes of this decline. An important factor leading to the reduction of biodiversity is the introduction of non-native species, whose invasive behavior can have devastating effects on native species (Kleespies & Dierkes,

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2020). The current study is limited to a single invasive species, *Acer negundo* Box elder that was introduced approximately 335 years ago from the North America to Europe as an ornamental species (Porté et al., 2011). The synthesis of the information regarding the behavior of this species alien to the European continent made in this review is useful in supporting the European Commission update the lists of invasive species of EU importance in order to combat and eradicate them (Regulation (EU) 1143/2014).

## 2. Materials and Methods

The methodology consisted in the analysis of the scientific literature from the period 1960-2026. The review is a synthesis of the information related to the description of the species necessary for its correct identification and its behavior (morphological characteristics, biological and ecological demands, pests); invasive particularities of the species (the assets that give it an advantage in the competitive system with native species); effect on biodiversity (e.g. reducing the effectiveness of population of native species until their disappearance); mitigation effects of species invasion; prevent and control mechanisms. This paper is a review, based on a number of 245 papers consulted, of which 53 provided information that was relevant to the topic of the paper. Printed books consulted in the library represented approximately 10%, and the rest were bibliographic sources consulted on the internet. The main source of information was the Internet, scientific articles and older books printed on paper were consulted at the library. In the case of Internet sources, the websites of the scientific journals of forestry, biodiversity conservation, mycology, entomology and urbanism were accessed, and the search was carried out using keywords. For an effective control and eliminating the species, it is mandatory to know the behavior of the species both in the respective area of origin, North America, and in the area where it was introduced, for this reason; the literature was focused on these two geographical areas.

## 3. Results

### 3.1. Species Description and Their Range

*Acer negundo* is a species of tree in the family *Sapindaceae*, it has a self-supporting growth form, have compound, broad leaves and white flowers. The stem is crooked, bifurcated, often rotted in the middle, the bark is smooth, gray-green, which forms a slightly wrinkled rhytidome. Crown wide, irregular, interrupted, with vigorous, glabrous, shiny, reddish-green or purple stems, covered with a white hoar-frost that wipes off easily (Clinovschi, 2005). The buds are ovoid, green or brown-violet, slightly bruised, and attached to the shoot; the leaf scars join directly, at a very sharp angle. The leaves are odd-pinnate-compound with 3-7 leaflets variable in shape, ovate to ovate – separated, 5-10 cm long, acuminate, coarsely serrate, the

terminal one often trilobed. The flowers are dioecious, yellow-green, apetalous, appear before leafing, the male ones in fascicles, the female ones in pendent racemes. Immature bisamaras are light green, while mature ones are whitish gray; their wings are arranged at a sharp angle or almost parallel, and they are 2.5–3 cm long (Sofletea & Curtu, 2007). Box Elder is dioecious with imperfect flowers, although perfect flowers that appeared to be functional have been reported (Hall, 1954). The staminate flowers are fascicled; the pistillate flowers are drooping racemes and are wind pollinated (Plowman, 1915; Sargent, 1965). Flowers appear with or before the leaves from March to May, depending on the geographic location (Harlow et al., 1979). In its native range, flowers are pollinated by *Hesperiphona vespertina* (Evening Grosbeak) and *Andrena imitatrix* (The imitator miner bee) (Vines, 1960). The fruit ripening dates is August – October and the seeds dispersal period is September – March (Schopmeyer, 1974). Box Elder usually develops a shallow, fibrous root system. On deep soils it may form a short taproot with strong laterals (Green, 1934). Individuals can grow to 22.6 m height at maturity (Clinovschi, 2005). The species is short-lived, attaining an average age of 60 years but rarely 100 years. Growth during the first 15 to 20 years is very rapid and may be as much as 2.5 cm a year in Diameter at Breast Height (DBH). Poor sites in water and nutrients bring in a corresponding reduction in growth (Green, 1934). Native to North America, where it has grown extensively and vegetated as a native plant, it is considered "a weed species," especially in certain areas, such as parts of the northeastern United States ((Arno, 2020) [1977]). In 1928, Joseph Illick, chief forester for the state of Pennsylvania, wrote in *Pennsylvania Trees*, that "Box Elder" was "*rare and localized*" in this state (Illick, 2015). Lang remark also that it is originally from the Eastern and Central lands of North America. According to Overton cited by Schütt and Lang (2004), the American maple appears insular and in the west of the continent, being represented by two varieties of *arizonicum* Sarg. and *californicum* (Torr & A. Gray, 1891) Sarg. (Schütt & Lang, 2004; Sofletea & Curtu, 2007). It has a double reproductive strategy by seeds and vegetative: it produces a large number of seeds, starting at a young age, and seed germination does not require special requirements. Box Elder is capable of establishing itself on a variety of seedbeds, on flood lands, it is among the most abundant species, seeding in under willow and other soft wood species stands and invading old fields. On these sites, over story density is apparently not a factor in early germination and survival, but seedlings begin to die off after 1 or 2 years unless openings are provided. The 1- and 2-year-old Box Elder seedlings are also abundant in areas of ground vegetation ranging from light to heavy and in hardwood litter as much as 5 cm deep (Hosner & Minckler, 1960). Concerning the vegetative reproduction, it is by stump and root sprouts, being common in Box Elder from young, vigorous trees (Maeglin & Ohmann, 1973; Eyre, 1980). The propagation by cuttings indicate that best results are obtained

from cuttings taken during the period of transition from softwood to greenwood and treated with an 8,000 ppm Indole-3 Butyric Acid (IBA) -talcum mixture. European nurserymen propagate some ornamental cultivars of Box Elder using side grafting, whip and tongue grafting, or chip budding (Dirr & Heuser Jr, 1987).

### 3.2. Invasive Particularities of Species

After World War II, Box Elder's rapid growth made it a popular landscaping tree in suburban housing developments despite its poor form, vulnerability to storm damage, and tendency to attract large numbers of Box Elder bugs. Intentional cultivation has thus made the tree far more abundant than it once was. It can quickly colonize both cultivated and uncultivated areas and the range is therefore expanding both in North America and elsewhere (Uva et al., 1997). In Europe, where it was introduced in 1688 (the year of its first cultivation) as an ornamental park tree, it has spread rapidly and is now considered an invasive species in parts of Central and Eastern Europe, including Germany, the Czech Republic, Hungary, Slovenia, Romania, and Poland. In these regions, it can form dense stands in lowlands, disturbed areas, and riparian habitats on calcareous soils (Schopmeyer, 1974; Uva et al., 1997; Schütt & Lang, 2004). In Latvia and Lithuania, it was first introduced at the beginning of the 19<sup>th</sup> century. It is the most widely distributed alien maple species to be found in the parks and greeneries of Riga and Kaunas. In recent decades, the spread and invasion of this species has been observed (Straigyte et al., 2015). It has also become naturalized in eastern China (Gelderens & Gelderens, 1999). During plant species invasions, the role of adaptive processes is particularly of interest in later stages of range expansion when populations start invading habitats that initially have not been disposed to invasions (Erfmeier et al., 2011). Contrary to the resource trade-off of succession theory, *Acer* shows both high survival in shade and high growth in full light (Saccone et al., 2010a). This particular suite of traits shared with other invasive and native *Acer* species is an example of adaptive plasticity that is certainly an advantage to give it a competitive advantage over native species (Saccone et al., 2013). Box elder is invasive and is able to spread rapidly into new riparian areas (Straigyte et al., 2015). Box Elder currently invades riparian and disturbed areas in Europe, affecting both bank stability and ecosystems biodiversity. The European experts aimed at finding an eco-friendly method which would locally remove this species and help habitat restoration (Merceron et al., 2016). The invasive character of this species is the result of three characteristics of this species:

a) A species that is not demanding in terms of climate and soil, resistant to frost and negative temperatures, with eurytopic skills, it tolerates drought well, which made it also to be present in wood crops on sandy soils. But it also behaves well on moist soils in the meadow resorts. Tolerates the compact soils being

an euribiont species that adapt and grow in inappropriate conditions. Active growth and excellent vegetation condition are achieved on deep, humic acids rich soils with sufficient moisture, such as alluvial meadows. It is a species not resistant but tolerant to drought; but very resistant to frost. Prefer humid resorts, sandy-muddy, loose, fertile soils (Clinovschi, 2005). Litter decomposition and mineralization rate is increase by Box Elder leaf leachates that are characterized by higher total bacterial numbers and higher number of heterotrophic cellulose-decomposing bacteria colonies. The toxicity of *A. negundo* aqueous extracts and leachates on fungi cell are manifested at mortality and membrane depolarization levels, remove the fungus and stimulate the bacterial activities and nutrients release (Krevš et al., 2013). These mechanisms favor the processes of pedogenesis and allow the modification of some hostile environments in favorable environments for vegetation. The higher level of plasticity of the invasive species in foliage allocation in response to light and nutrient availability induced a better growth in non-limiting resource environments. Such behavior could explain the ability of *A. negundo* to outperform native tree species contributing to its spread in European resource-rich riparian forests and impedes its establishment under closed-canopy hardwood forests (Porté et al., 2011).

b) It has a double reproductive strategy by seeds and vegetative, the risk of seeds not maturing being compensated by vegetative multiplication. The individuals reach sexual maturity early in 8-11 years, longevity reaching almost 100 years. They are extremely prolific, the number of seeds being 8,200 - 20,400 cleaned seeds per pound. The seeds dormancy, in cold period, requires a mean temperature 17.7 °C and the interval is between 60-90 days (Schopmeyer, 1974; Sofletea & Curtu, 2007).

c) The trees once cultivated outside the natural range are free of natural pests, the size of the population is no longer kept under control, exploding and eliminating the native species in a competitive system. Individuals of the *A. negundo* species arriving in ecosystems different from those where the species grows natively produce a series of negative effects on the structure and functions of the ecosystem. An abundance of *A. negundo* individuals was accompanied by increased canopy cover. It is a negative relationship between canopy cover and the number of understory herbaceous species. Thus, the interception of light and the restriction of its amount for other species is a main factor supporting the negative influence of *A. negundo* on native plant communities (Veselkin et al., 2021).

### 3.3. Pests of the Species

In native range *A. negundo* is kept under control by 47 pests. It is attacked by a wide variety of insects, including the Box Elder bug, *Leptocoris trivittatus*, which is found across most of the host's range. Others include the boxelder aphid (*Periphyllus negundinis*), and the boxelder gall midge (*Contarinia*

*negundifolia*). A number of scale insects also attack *A. negundo*. Fungi are, however, much more damaging than insects to *A. negundo*, with species of *Fomitopsis*, *Perenniporia*, *Fomes*, *Inonotus* and *Ustulina* causing significant rotting, and *Eutypella parasitica* causing a stem canker. The only pathogen which kills significant numbers of *A. negundo* trees, however, is *Verticillium albo-atrum*, which causes verticillium wilt.

**Major host of:** *Anoplophora glabripennis* (Asian longhorned beetle); *Prociophilus mexicanus*; *Pseudomonas syringae* pv. *aceris* (leaf spot); *Sawadaea bicornis* (powdery mildew on *Acer* spp.); *Thyridopteryx ephemeraeformis* (evergreen bagworm); *Tremex fuscicornis* (Tremex wasp).

**Minor host of:** *Anoplophora chinensis* (black and white citrus longhorn); *Aphelenchoides eximius*; *Candidatus Phytoplasma asteris* (yellow disease phytoplasmas); *Chaetocnema confinis* (flea beetle); *Chilecomadia valdiviana* (Chilean carpenter worm); *Chinavia hilaris* (green stink bug); *Chionaspis acer*; *Diplodia seriata* (grapevine trunk disease); *Eulecanium tiliae* (nut scale); *Euwallacea fornicatus* (polyphagous shot-hole borer); *Fomitiporia mediterranea* (esca disease); *Ganoderma lucidum* (basal stem rot: *Hevea* spp.); *Halyomorpha halys* (brown marmorated stink bug); *Lymantria dispar* (gypsy moth); *Melolontha melolontha* (white grub cockchafer); *Orgyia leucostigma* (white-marked tussock moth); *Xylella fastidiosa* (Pierce's disease of grapevines).

**Wild host of:** *Archips xylosteanus* (variegated golden tortrix); *Fomitopsis pinicola* (brown crumbly rot); *Hyphantria cunea* (fall webworm); Longidorus (longidorids); *Lymantria dispar asiatica* (Asian gypsy moth); *Peridroma saucia* (pearly underwing moth); *Pratylenchus penetrans* (nematode, northern root lesion).

**Host of (source-data mining):** *Aspidiotus hedericola*; *Boisea trivittata* (boxelder bug); *Ceroplastes japonicus* (tortoise wax scale); *Corthylus punctatissimus* (pitted ambrosia beetle); *Drepanosiphum platanoidis* (sycamore aphid); *Eutypella parasitica* (stem canker of maple); *Leptocoris trivittatus* (boxelder bug); *Longidorus attenuatus* (needle nematode); *Longidorus elongatus* (needle nematode); *Metcalfeella monogramma*; *Parthenolecanium corni* (European fruit lecanium); *Parthenolecanium persicae* (peach scale); *Periphyllus aceris*; *Phomopsis theicola*; *Pulvinaria regalis*; *Taeniothrips inconsequens* (pear thrips) (CABI, 2019).

*Exserohilum rostratum* is a fungus of the ascomycete genus *Exserohilum* has a cosmopolitan distribution, including species naturally occurring in warm, tropical, and subtropical regions.

It has emerged as a pathogen of Box Elder nursery sites in Tai'an, Shandong Province, China, and that the pathogen may cause serious economic losses if appropriate mitigation measures are not undertaken, this is the first report of *E. rostratum* infecting a species of *Acer*. This fungus produces

fungus disease affecting Box Elders. Diseased trees exhibit partial blackening and wilting of infected branches, and, above the necrotic area, the leaves show symptoms of leaf blight and leaf spots. The disease produced by *Exserohilum rostratum* leads to the early death of *A. negundo* individuals (Liu et al., 2021).

This fungus has not yet arrived in Europe and can be used to combat of the *A. negundo* species that is a vegetal invader of forests with native species.

### 3.4. Effect on Biodiversity

Invasive plants significantly decrease native species diversity and modify ecosystem processes within invaded communities (Vilà et al., 2011) resulting in large investments to manage and restore these ecosystems (Pimentel et al., 2005). Riparian ecosystems are highly subjected to invasions given that (i) rivers are efficient dispersal corridors for propagules over long distances (Säumel & Kowarik, 2010), and (ii) frequent disturbances increase nutrient and light availability (Hood & Naiman, 2000; Merceron et al., 2016).

Many studies demonstrated that in communities dominated by *A. negundo*, the diversity of native plants decreases (Czortek et al., 2025). Was observed a decreased taxonomic richness among vascular herbaceous plant species by 40% (inter-habitat) and 20% (intra-habitat) in areas dominated by *A. negundo*; compared to areas dominated by native tree and shrub species. An abundance of *A. negundo* was accompanied by increased of cover degree of canopy. Also, was found a negative relationship between canopy cover and the number of herbaceous species. Thus, the interception of light and the restriction of its amount for other species is a main factor supporting the negative influence of *A. negundo* on native plant communities (Veselkin et al., 2021). Active substances contained in *A. negundo* leaf litter, have a selective inhibitory effect on the germination of seeds and the growth of seedlings of monocotyledonous and dicotyledonous plants. Allelopathic substances have an inhibitory effect on seed germination and seedling growth of only dicotyledonous plants. The allelopathic effect of the fall was not a limiting factor for the germination of seeds of herbaceous plants of the above-ground cover of the studied plantation (Nikolaeva et al., 2021). Vegetating well in meadow conditions, Box Elder, mainly invades riparian areas typical of poplar and willow forests. Despite their high ecological value, the poplar and willow forests have been increasingly taken over by the invasive tree species *A. negundo*. The studies found the willow forest to be more susceptible to invasion by *A. negundo* than the poplar forest; which was revealed in significantly higher share of the maple individuals and their greater volume per unit area. Ash-leaved maples also prevailed in numbers in younger stands (<10 years) than in older ones. The presence of *A. negundo* affected biodiversity, resulting in decreased undergrowth density and biodiversity expressed in number of species (Sikorska et al., 2019). A part of the studies stressed the

importance of positive interactions for the invasion of *A. negundo* in the floodplain riparian forest, with a shift from direct to indirect facilitation through succession. The direct facilitation by the tree canopy of the native pioneer *Salix* is the main biotic process allowing the colonization of the invasive *Acer* in the floodplain. Later in the invasion process, indirect facilitation by adult con-specifics is certainly the other biotic driver of invasion allowing the establishment of a population. These positive responses and effects were for the invasive but not for the natives, likely because this species had a particular combination of traits that natives do not have. In contrast with other invasive species, the persistence through time of *Acer* cannot be explained by higher direct competitive effects than native late-successional species (Saccone et al., 2010b). In meadow forests dominated by genus *Alnus* and *Fraxinus*, without biotic interactions *A. negundo* performed similarly to native species, suggesting that the flood zones of the rivers are not protected from *Acer* invasion by a simple abiotic barrier. In contrast, this species is performing less well than *Fraxinus excelsior* and *Alnus incana* in environments with intact tree and/or herb layers. *Alnus* show the best growth rate in these conditions, indicating biotic resistance of the native plant community (Saccone et al., 2013). In context of climate changes, although other ecological and socioeconomic factors are affecting the vegetation in urban areas, many of the nonnative invasive species like *A. negundo*, found colonizing cities (or naturalizing within them) originate in warmer areas and are benefiting from the more favorable climate, in European countries where they spread (Sukopp & Wurzel, 2003).

### 3.5. Mitigation Effects of Species Invasion

Since the species was introduced in Europe in 1688, it can no longer be a question of prevention, the only solution being control and eradication.

The negative effects on biodiversity, especially on habitats of European interest such as 92A0 *Salix alba* and *Populus alba* galleries, 91E0 \* Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*) led to European level that the European Commission, to intervene with measures. The first step was the creation of a legislative framework that would support and create the premises for control and combating invasive species.

In 22 October 2014 the European Parliament and of the Council adopt the Regulation (EU) No 1143/2014 on the prevention and management of the introduction and spread of invasive alien species. This European normative act was amended and supplemented by numerous other regulations such as: Implementing Regulation (EU) 2016/145, 2016/1141, 2017/1454, 2018/968.

At the European level, there is no normative act regulating the control and combating of the *A. negundo* species. Although

it is present in the floodplain of the main rivers, it is not even on the list of priority invasive alien species of European Union concern pursuant to Regulation (EU) No. 1143/2014 of the European Parliament and of the Council; but it is present on the European red list of invasive alien species drawn up by the IUCN (IUCN, 2022). The European Union is a signatory and has ratified a series of international conventions and treaties including the Biodiversity Convention (CBD) and the Berne Convention; international normative acts that regulate the prevention, control and combating of foreign invasive species. In accordance with Article 8 letter (h) of (CBD) the signatory states, have the following obligations: prevent the introduction of invasive alien species that threaten ecosystems, habitats or species with special conservation status; achieve their control or eradication as far as possible, using means appropriate to each state.

In the 2002 Conference of the Parties (COP), the CBD adopted a decision and 11 specific guiding principles to help parties implement these requirements. Through their governments, the decision calls on parties, that the various institutions/organizations, to prioritize the development concerning invasive species chapters in national and regional strategies and action plans/to promote and implement the guiding principles of the CBD. The Bern Convention, adopted in 1979, aims to promote cooperation between signatory countries to conserve flora and fauna wildlife and their natural habitats and to protect endangered migratory species. According to Article 11.2.b of the Berne Convention (CB), to which the European Community and 38 European states are parties, it requires parties "to strictly control the introduction of non-indigenous species". The EU Biodiversity Strategy 2020-2030 contains a commitment to manage invasive alien species on the European Red List and to reduce their numbers which pose a threat to biodiversity, by 50% by 2030. The European Red List is a review of status European species according to the guidelines of the IUCN Regional Red List. It identifies those species that are threatened with extinction at European level (Pan-Europe and European Union) so that appropriate conservation measures can be taken to improve their condition. Every six years, the member states of the European Union have the obligation to report to the European Commission which are the foreign invasive species that have entered the European continent, their dispersion, the hot spots, the effects on biodiversity, and the measures to prevent, control and combat of them. Although it is not on the list of priority invasive alien species, some countries such as Romania, Poland, and Sweden have also reported the situation of the *A. negundo* species on their national territory.

### 3.6. Stopping and Control Mechanisms

Knowledge of the biological and ecological characteristics of the *A. negundo* species is the basis of strategies and mechanisms to control and combat this species, this are focused

on two aspects: eliminating mature individuals and preventing the reproduction and dispersion. The areas with the greatest dispersion are the wetlands along the rivers, respectively the meadow forests. Because they act as critical buffer zones along water courses (Correll, 1996) traditional practices of invasive plant removal, inducing soil disturbance or chemical pollution, should be avoided. One challenge is therefore to develop efficient and eco-friendly methods to constrain plant invasions and restore invaded habitats (Merceron et al., 2016) Chemical, biological, and mechanical methods largely used by managers to control invasive herbaceous plants have also been tested on invasive woody species (Holt, 2009).

To date, broad-spectrum herbicide applications such as triclopyr and glyphosate are the most efficient methods to kill invasive perturbing tree species. However, these practices can have substantial ecological consequences on non-target species if sprayed or by contaminating soil and water. Infections by pathogen fungi such as *Chondrostereum purpureum* and *Fusarium* were also used with success but no homologation of these pathogens exist in Europe. Moreover, these generalist pathogens present a risk regarding native species and testing introduced ones would risk introducing a new virulent invasive species in weed management, allelopathic compounds have also been used but to our knowledge, allelopathic substances produced by native species were never tested to control invasive plants. Finally, mechanical methods (mowing, mulching, cutting, burning, uprooting, or girdling) are also largely used to eliminate invasive trees. Although it is often time consuming, methods such as girdling or cutting can be applied on targeted individuals thus avoiding environmental impacts. Girdling is a common practice in forestry (and is advised to locally eliminate invasive woody species in natural areas (Merceron et al., 2016). At present, *A. negundo* is regarded as a fast-growing species, the use of which is limited to a certain period of time and should be removed from the main plantations. However, no effective methods have been proposed for the removal of this species from the plantations. Cutting (trunk cutting) of plants is a necessary but not sufficient measure, as a large number of shoots are formed on the stump from the sleeping buds. Mechanical methods of struggle against vegetative renewal are labor-intensive and ineffective. Chemical method of treatment (application of arboricides) of shoots reduces labor costs in 5 times and the cost of work in 2.2 times. The first experiments with *A. negundo* young growth using arboricides (herbicide Tornado preparation 50%) showed the decrease of shoots growth in a month after treatment. Another herbicide used was glyphosate because it is a safety concerning other species. It was found that treatment of freshly cut stumps of *A. negundo* with glyphosate in concentration of 7.2 g/l causes death of 65% of plants. In the rest of the specimens of *A. negundo* from this option the amount of growing epicormic sprouts decreased by 5.2 times in comparison with the usual cutting (control). Besides, the

method demonstrated high ecological safety (herbicide does not get on the living ground cover, which excludes poisoning of animals); the preparation destructs quickly (2-4 weeks); low environmental impact; safe for humans; easy to use; independent from weather conditions. The results of the conducted experience allow recommending glyphosate for treatment of freshly cut stumps of *A. negundo* in specially protected areas as one of the most effective and ecologically safe ways to control this invasive species. (Nikolaeva et al., 2020).

#### 4. Discussion

*A. negundo* tree species was introduced to Europe in the 17<sup>th</sup> century, as an ornamental plant. It was introduced deliberately; at the time of introduction the population and scientists did not perceive this species as a threat to biodiversity. Although the biological peculiarities of the species allow it to invade new territories, it has not dispersed in all types of habitats, it has spread only in the flooded areas of rivers and along the access roads that cross areas with higher humidity. The negative effects of the presence of individuals of the species were observed only in the meadow forests where the *Salix* and *Populus* genera dominate, where through the competition for water, nutrients and light these genera were disadvantaged. The individuals of *A. negundo* participated in their elimination the herbaceous plants in the poplar and willow forests, both by shading, absorption of water and nutrients, and by inhibiting the germination of dicotyledonous seeds due to allelopathic substances in the litter. In the flooded meadow forests dominated by the *Alnus incana* and *Fraxinus excelsior* species, the species is kept under control, the first two that dominate showing the best growth rate in these conditions. This may be one of the explanations why *A. negundo* does not represent a major danger of invasion for natural habitats in a good state of conservation, only tree plantations and human-impacted habitats being vulnerable. In the vulnerable habitats where it has penetrated and manifests its effects, it can be combated with the help of effective selective methods that do not affect the other elements of biodiversity. Taking into account the negative effects it has on the ecosystems it entered, but also the not very high degree of invasion (it did not create hot spots in Europe), the period of over 300 years since it has been present in Europe and the fact that are effective methods of combating it, this invasive foreign species is not a priority for combating, only monitoring being necessary.

#### Conflict of Interest

The author has no conflict of interest to declare.

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