

Tree of heaven *Ailanthus altissima* (Mill.) Swingle - the weed of urban environment

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Abstract: This paper shows the analysis of overall abundance and population structure of species *Ailanthus altissima* in the period 2000 – 2002, on the territory of Mirijevo, one of the suburbs of Belgrade. The total census of populations of *Ailanthus altissima* showed presence of 3909 individuals of this species. It was recorded that in the researched area *Ailanthus altissima* is most distributed in ruderal habitats, as well in old orchard groves and vineyards that are not exploited.

Key words: age structure of the population, *Ailanthus altissima*, distribution, Mirijevo, urban environment, weed.

Introduction

Tree of Heaven (*Ailanthus alitissima* (Mill.) Swingle) is an introduced plant species. It arrived into Europe (London) from southeastern Asia in mid 18th century, with the primary role of being food for farmed silkworms. Today, Tree of Heaven is one of the most distributed broadleaved tree species in urban biotopes throughout the Eurasian continent. This species is one of the best-adapted adventive broadleaved species to the complex ecological conditions of polluted city biotopes (Jovanović et al 1998).

Pronounced adaptability and expansive nature of Tree of Heaven in urban ecosystems throughout the world was noticed and analyzed by a number of authors (Petrović 1951, Radulović 1952, Panov 1953, Mašinski 1954, Kolesnikov 1974, Jovanović 1950, 1971, 1985, Jovanović et al 1998, Vukićević 1973, 1987, Filipović 1990 etc). Most of these authors, besides pointing out the extraordinary decorative value of planted and specially grown adult trees, also point out the biomeliorative and anti-erosive importance of this species in sanitation of flood areas.

Starting with the widely known biological and ecological characteristics of species *Ailanthus altissima*, as well as the fact that this is one of the most widely distributed and most competitive self-growing – pioneer tree species in ruderal habitats, this paper shows the total abundance and population structure in agricultural and ruderal habitats, on the example of Mirijevo, one of Belgrade suburbs.

Mirijevo is situated in the northeastern part of the city. It belongs to forest-steppe vegetation-climatic subzone, with one temperate dry period. Summers are quite warm, with medium monthly air temperature at about 23°C. Winters are mostly medium cold, although they occasionally may be very cold or somewhat warmer. Average precipitation is about 707 mm. Soil belongs to the type of eutric cambisol. The relief is a slightly wavy hill terrain at altitudes between 70 and 265 m.

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Material and Methods

Detailed research of total abundance and population structure of species *Ailanthus altissima* was performed in period 2001-2003 on the territory of Belgrade suburb Mirijevo. Within this settlement, ruderal and agricultural habitats were studied. The number of individuals was determined through total census, and for each of them the breast height was measured by standard forestry equipment. Height of trees was determined approximately by free estimate, primarily comparing them with existing objects of known height.

Results and Discussion

In the researched area, complete census of population showed that there was a total of 3909 individuals from species *Ailanthus altissima*. The distribution analysis of individual specimens showed their greater presence in ruderal habitats, as well as in old fruit plantations and vineyards which are not exploited any more. Due to objective reasons, some parts of researched area remained unavailable, so the census analysis did not include about 15% of total population of Tree of Heaven. However, the analysis of 3909 individuals of this species is still representative enough for the overall overview of present state and growth structure, and therefore also the population dynamics of this species in the studied area.

The analysis of presence of various growth classes (Tab. 1) shows that most individuals belong to younger age classes such as seedlings, juvenile individuals, shoots around the adult trees (class I) and vegetative adults (class II). This led to conclusion that in the Mirijevo area there is a pronounced expansiveness and progressiveness of population of *Ailanthus altissima*. Besides, the number of adult, reproductively able individuals (class III), number of reproductive adults and senile adults (class IV) is relatively high when compared

with younger age classes. These data point to the conclusion that *Ailanthus altissima* is successfully developing in urban conditions, that is, developing and reproducing. The correlation relationship between the adult part of population and seedlings, juveniles and vegetative adults shows that this species in urban areas finds the optimum for its development, and it can be used to explain the expansiveness of this species in urban environment.

Table 1. –Presence of ages classes in the population of the species *Ailanthus altissima*

Age class	Trunk daimeter (cm)	Number of individuals		
		2001.	2002.	2003.
I	0.5 – 2	1450	1701	2061
II	2 – 15	750	992	1187
III	15 – 30	436	440	447
IV	30 – 130	194	200	214

I –seedlings, juveniles and shoots; II –vegetatives adults
III –reproductive adults; IV –senior reproductive and senile adults

Analysis of presence of classes, as defined by height of individuals (Tab. 2), showed a great abundance of mature trees (class III). Individuals in this class produce a large number of seeds from which new individuals grow, called seedlings (class I) and their number is greatest. During the winter period, a large number of shoots dies due to low temperatures, and the surviving individuals enter the class of juvenile individuals, so the number of young trees is small when compared with shoots. Similar results were obtained by Filipović (1990) and Jovanović et al (1998).

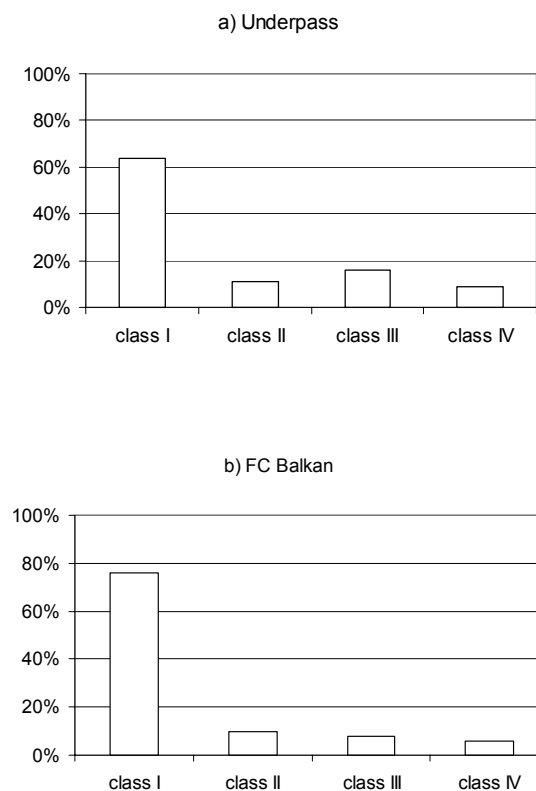
Table 2. –Presence of age classes in the species *Ailanthus altissima* (in terms of trunk height)

Age class	Trunk height (m)	Mean value (m)	Number of individuals
I	0.2 – 2	1.1	1848
II	2 – 4	3.2	689
III	4 – 14	8.2	1364

In the various microhabitats of the researched area, the population structure and stability of the species *Ailanthus altissima* showed a partial differentiation (Fig. 1). For example, populations developing in old fruit plantations and non-exploited vineyards, as well as ruderal habitats, are stable

and progressive. In these microhabitats, a relatively large number of reproductively mature adult individuals develops, and each year they produce an enormous quantity of seed, from which develops a huge quantity of seedlings and juveniles, and therefore many vegetative adults. For example, in one old unused vineyard, Tree of Heaven is represented by enormous number of individuals from classes I and II, showing the great progressiveness of the population. On the other hand, in one dark ruderal habitat (under traffic bridge in Matice Srpske St), greatest abundance is achieved by individuals from class I, while the other classes are very poorly represented. The population in this habitat is stagnating. Also in the habitats with pronounced anthropogenous influence, such as the habitat near FC "Balkan", the far greatest abundance is of individuals of class I, while the other classes are poorly represented, as the seedlings and juveniles that developed from seeds produced by individuals of classes III and IV are destroyed by humans, mechanically, physically and with fire.

Fig. 1. Histogram presence of age classes by trunk diameter on different microresidence





Tree of Heaven survives pollution very well. For example, in the streets Matice srpske, Jovanke Radaković, Vitezovi karadorđeve zvezde and Mirijevski venac, where there is the greatest pollution in Mirijevo, leaves of Tree of Heaven are completely biologically active and healthy. This shows the great resistance of this species to various types of pollution. However, in the same streets there are also other species of trees (False Acacia, Linden, Horse Chestnut etc) whose leaves are greatly influenced by phytopatological changes.

In the researched area, Tree of heaven survives, grows and develops normally, even in those places where other tree species cannot survive. Numerous young individuals were recorded in cracks in abandoned houses, concrete plateaus, sidewalk and even gutters of the city canalization system.

Considering the substrate, *Ailanthus altissima* is not very picky. In the Mirijevo area, no regularity in distribution of this species was recorded either, although the geological substrate is diverse. The geological structure of Mirijevo was studied in terrain on several occasions, and for the purposes of regulation plan of the settlement detailed geological studies were made, including exploratory drilling (Knežević 1997). It was known that Mirijevo is mostly covered in soil of the type of eutric cambisol. However, it is possible that the complex geological structure, together with the very pronounced modern geomorphologic and engineering-geological processes, also has a great influence

on composition of surface cover and distribution of certain weed species. A more detailed study on influence of geological substrate on diversity of certain weed species in a smaller part of Mirijevo area (alluvial sediments of Mirijevo Creek and the loess sediments of Orlovica hill) yielded some very interesting data (Nestorović, Jovanović 2003, Nestorović *et al.* 2004). Geological structure of Mirijevo is represented with Miocene and Quaternary sediments. The Miocene sediments were in most cases recorded by drilling, and are covered with Quaternary deposits. A smaller number of derivatives were recorded on steep slopes where the erosion of the soil is prominent. These are primarily the sediments of Sarmatian stratum, which are also the best represented among the Miocene sediments. The younger levels of Sarmatian have also been recorded in building sites of architectural objects (Knežević 1997). Those are marl-like clays and alevrites, followed by sands with layers of carbonate sandstones. The Quaternary sediments are represented with three types of sediments: pre-loess sediments, loess sediments and alluvial sediments. The oldest are the pre-loess sediments, recorded in drill holes. They are over 20 m thick, widely distributed and are made of pond-delluvial-proluvial formations and remains of old river terraces. The loess sediments, so-called Belgrade slope loess, cover the highest parts of Mirijevo where the loess is thickest, while toward the slopes it gradually becomes less thick. It originated by activity of wind. Within the loess, two levels were determined, separated by a horizon of earth. Pre-loess and loess deposits belong to Pleistocene (Laskarev 1922, Rakić 1977). The youngest are the alluvial sediments, recorded in the valleys of Mirijevo Creek and its tributaries, followed by proluvial, delluvial and colluvial sediments. They appeared in Holocene, under the influence of modern slope processes. This species occupies the extremely inhospitable terrains with poorly developed soil, such as sand, clay, concrete chips, habitats covered in garbage of organic or inorganic origin. In these habitats a progressive or stable growth structure of the population was recorded. Tree of Heaven forms small stands in such habitats. In these stands, another plant species are either sparse or completely absent. This may be explained by the fact that Tree of heaven develops in conditions unsuitable for other woody species.

Conclusion

In the area of Belgrade suburb Mirijevo, total census of population of species *Ailanthus altissima* in period 2001-2003 showed presence of a total of 3909 individuals. The greatest density of the population was recorded in ruderal habitats and old orchards and vineyards that are not exploited, while the smallest population density was in the urban block of this suburb.

The analysis of presence of various growth classes showed a pronounced expansiveness and progressiveness of the population of *Ailanthus altissima* in the area of Mirijevo, as most individuals belong to young age classes that include seedlings, juvenile individuals, shoots around the adult trees (class I) and vegetative adults (class II).

The analysis of presence of various growth classes showed high abundance of adult trees (class III). Individuals of this class produce a large quantity of seeds from which develop new individuals, placed into class of shoots (class I). Abundance of young trees, when compared with shoots, is small, as during the winter months low temperatures lead to dying of most young shoots. Therefore, the surviving individuals join the class of juveniles, whose abundance is small.

Ailanthus altissima survives air pollution greatly, that is, survives without any, macroscopic or microscopic, visible damage.

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KISELO DRVO (*Ailanthus altissima* (Mill.) Swingle) – KOROV URBANE SREDINE

- originalni naučni rad -

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Rezime

Na području beogradskog naselja Mirijevo totalnim prebrojavanjem (cenzusom) populacije vrste *Ailanthus altissima* u periodu 2001-2003. godine utvrđeno je prisustvo ukupno 3909 jedinki. Najveća gustina populacije je uočena na ruderalnim staništima i starim voćnjacima i vinogradima koji nisu u eksploataciji, a dok je najmanja gustina populacije bila u urbanom stambenom delu ovog naselja.

Na osnovu analize zastupljenosti različitih uzrasnih klasa utvrđeno da je izražena eksanzivnost i progresivnost populacije *Ailanthus altissima* na području Mirijeve, zato što najveći broj individua pripada mladim uzrasnim klasama koje obuhvataju klijance, juvenilne individue, izbojke oko adultnih stabala (klasa I) i vegetativne adulte (klasa II).

Analizom zastupljenosti uzrasnih klasa utvrđena je velika brojnost odraslog drveća (klasa III). Individue ove klase proizvode veliku količinu semena iz kojih se razvijaju jedinke koje se svrstavaju u klasu izbojaka (klasa I). Brojnost mladog drveća u odnosu na izbojke je mala, zato što u toku zimskih meseci usled dejstva niskih temperatura strada veći broj izbojaka. Zahvaljujući tome preživele individue ulaze u sastav klase mladih jedinki, čija je brojnost mala.

Ailanthus altissima odlično podnosi aerogađenje, tj. uspeva bez ikakvih, makroskopskih ili mikroskopskih, vidljivih oštećenja.