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THE INFLUENCE OF SUBSTRATE ON *AMBROSIA ARTEMISIIFOLIA* L. BIOMETRIC CHARACTERISTICS

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Invasion is one of the biggest global environmental problems in the world. Many scientists notify that this is an important problem which must be resolved in order to conserve biodiversity. Convention on Biological Diversity requires to eradicate or at least to control invasion species because they can endanger natural vegetation. *Ambrosia artemisiifolia* L. plants concentrate attention of agriculture specialists, biologists and medical doctors. This species is characterized as an extremely viable and can adapt to different environmental conditions. In Baltic States common ragweed has not distributed, but individual plants are found every year. At the same time *A. artemisiifolia* pollen is one of the most potent aeroallergens which can cause serious health problems. The evaluation of the European experience and the real situation in Lithuania showed that currently the main ragweed threat is the impact of pollen on human health.

Common ragweed is a pioneer that establishes easily in habitats with bare mineral soils or sparse vegetation. The texture of the soil does not seem to play an important role in its establishment, but the thickness of the organic layer is inversely related to its presence. The aim of the research was to test and evaluate effect of different types of soil on *A. artemisiifolia* biometric characteristics. Mature seeds were sown in the two types of soil: the first was peat, in the second one - equally mixed peat and sand. The results showed that *A. artemisiifolia* productivity is not significantly determined by the composition of substrate. It was found that substrate composed of peat and sand positively influences productivity of ragweed. This type of soil composition was favourable considering almost all biometric indicators of plant. Different tendency stated in 3rd level branches. On these organs number of leaves was similar in both substrate, and number of female inflorescences was slightly higher for those plants that grew in peats. This research was funded by a grant Nr. 06-26-D-08/SMT 12R-106 from the Research Council of Lithuania.

Key words: *Ambrosia artemisiifolia*, substrate, peat, sand, female inflorescences, male inflorescences

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INTRODUCTION

Plants of *Ambrosia* genus is a widespread invasion in the Eastern and Central Europe (Buttenschøn et al. 2008-2009). Genus has about 40-42 species (Peternel et al. 2006, Makra et al. 2005). *Ambrosia artemisiifolia* (common ragweed) is not widespread in Lithuania, but individual plants are found every year (Šaulienė et al. 2011). Plants grow from seeds matured not on the spot, but from the seeds, which fall accidentally during grain transit. Potentially hazardous area is the railways in the eastern part of the country with heavy transit train movement.

In Europe common ragweed is the most significant weed causing the major yield losses, especially in the sunflower, corn, sugar beet, and grain fields. These plants not only affect adversely the natural vegetation, reduces yield, but due to the large number of pollen adversely affect human health (Pinke et al. 2011). Ragweed pollen is considered to be among the strongest allergens in the world (Tokarska – Guzik et al. 2011, Staikūnienė et al. 2005, Parkhomenko et al. 2005).

Common ragweed is especially problematic in Hungary, where losses of up to 130 million euros a year are encountered (Gerber et al. 2011). In many European countries, farmers are legally obliged to prevent ragweed flowering, but in countries such as Italy, France, despite the fact that the ragweed is spread at the regional level, no legitimate credentials is valid. In Germany and Austria, control is based on the recommendations and thus is voluntary (Buttenschøn et al. 2008-2009). In the Northern Europe common ragweed is very rare, but it is believed that changing climate will transform the current situation and the north also becomes favourable for common ragweed settling (Pinke et al. 2011).

One of the factors which could control the spread of common ragweed is soil structure. In Hungary studies have been carried out, which showed that common ragweed is better sprawling in sandy soils with pH < 5. Also, this specie in the corn, sunflower fields is more entrenched in the edges than in the centre, so it avoids the intense competition with crops and thrives successfully. Common ragweed avoids salty soils. In those fields where there is a high Na, K, Mn concentration this specie is found less frequently (Pinke et al. 2011). Weeds, having allelopathic properties, adversely affect plants (Deveikytė et al. 2008). Common ragweed is characterized by high competitive power and not just overshadows the surrounding plants, but also takes a lot of nutrients. Lithuania's investigation has revealed that all the weeds accumulate chemical elements (N, P, K, Ca, Cu, Mn, Zn) more than barley, but among them *A. artemisiifolia* accumulated Cu and Zn significantly more than *Chenopodium album* L. So, ragweed absorbs some compounds accumulated in the soil better than crops (Špokienė et al. 2001). Biometric indicators of the common ragweed grown in the Lithuania's cultural soil show strong specie's invasiveness potential (Šaulienė et al. 2012), but the influence of soil structure has not been studied.

The aim of the study analysed below was to test and evaluate effect of different types of soil on *A. artemisiifolia* plant development.

MATERIAL AND METHODS

The study was carried out in Lithuania during monitoring of common ragweed plants growth in different substrates. The first substrate: peat (1st trial version), and the second: peat in equal parts mixed with sand (2nd trial version). The main ingredient of the peat substrate was peat moss, with additives: limestone, fertilizer with microelements, water absorption promoter. Organic matter content was 92-96 per cent, acidity pH = 5.5 to 6.5. Sand texture: sand (≥ 85 per cent), dust (≤ 15 per cent), clay (≤ 10 per cent). It contains little humus, as well as is not abundant with minerals: phosphorus (0.05 per cent), potassium (1.4 per cent), calcium (2.5 per cent). Since the experimental fields were carried out under field conditions local soil composition was evaluated. Studies have shown that it is loam, which is close to neutral reaction (pH =

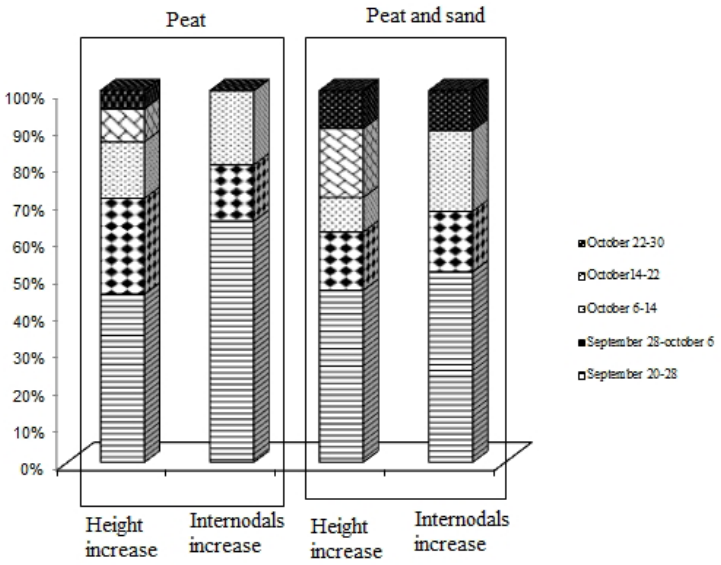


Fig1. Average of common ragweed growth rate during the investigation period.

6.71), it has very little potassium (121 mg/kg) and low nitrogen (0.09 per cent) and phosphorus (50 mg/kg).

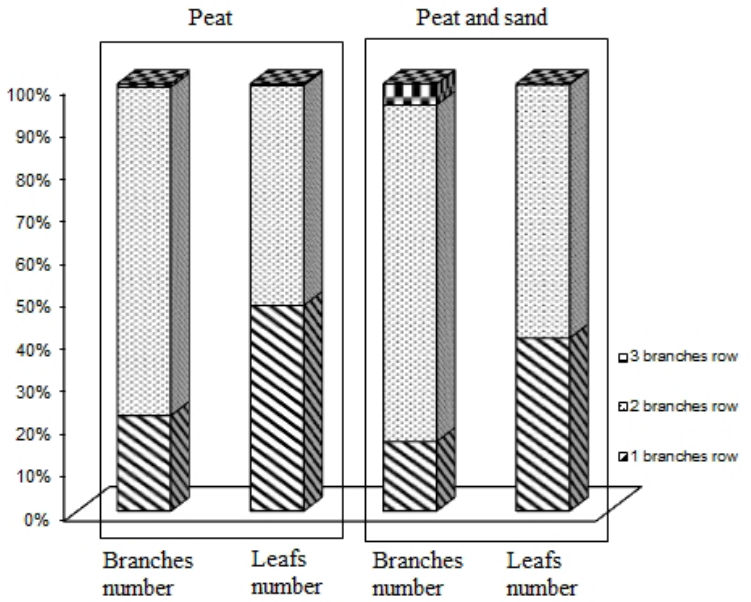
In April 2012, ragweed seeds were sown under laboratory conditions in order to ensure earlier emergence of seedlings and to protect them from frosts. After the seedlings had produced true leaves, the plants were transferred to the greenhouse. At the middle of June, ragweed seedlings were transplanted in a cultivated soil in a permanent cultivation site where environmental conditions were not controlled at any of the growth stages. Growth and development observations were carried out every 4 days in September.

During them plant height was measured, number of internodes was counted. The last measurement was carried out on 30 October. On the same day the plants were taken for detailed biometric measurements (the number of branches, number of leaves, inflorescence number and length). The data was processed by standard statistical programs.

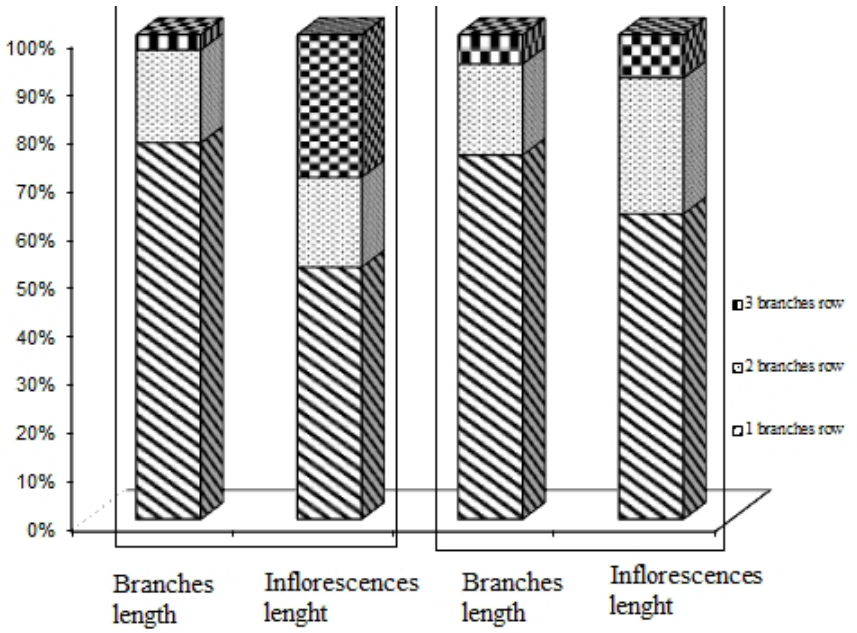
RESULTS AND DISCUSSION

Common ragweed plant growth rate evaluation

Plant growth and development are complex vital processes in plants; they are directly related to nutrition, water exchange, material movement (Sirvydas et al. 2011). In this paper, the main factor influencing growth is the soil, which, according to the hypothesis, was able to alter plant growth and development speed. Common ragweed, which is a weed, growth rate in both natural and agrarian populations is important for competition. For biodiversity conservation it is very important to have data on plant growth intensity. During the study period, minor changes (Fig. 1) are observed in measuring plant height (20-28 September). Comparative analysis of the results shows that it is slightly higher for those plants which were grown in peat substrate with sand. It was found that, in the second half on October the plant height increment in this substrate is 3 times larger than value-added of the height of the plants grown in peat.



a)



b)

Fig. 2. The influence of soil type on (a) number of branches and leafs per plant and (b) length of branches and male inflorescences.

Assumption is formed that internodal growth is slower for the plants grown in peat. The same trend is observed in the development aspect, i.e. during 14-30 October less internodal number formed (than of the plants grown in the mixed substrate). Meanwhile, in the second version of the experiment (Fig. 1) common ragweed height growth decline is observed (despite 14-22 October). However, there is no decrease in the number of internodals; on the contrary, internodal growth in number was observed during plant measurement: on 28 September to 6 October number of new internodal appearance increased less than on 6-14 October.

Statistical analysis of the results showed that along with the decrease in ragweed average gain, number of new internodals also decreases. However, concerning height, no significant difference between the specimens grown in different substratum has been identified. The observed pattern shows that substrate is not the main plant height determining factor.

Evaluation of soil impact on vegetative and generative plant organs formation

Knowledge of common ragweed vegetative and generative organ development in different soils is crucial in the fight against entrenchment of these alien plants. We know that cultivated jointly with agricultural crops common ragweed is able to absorb more substances than agriculturally important plants (Špokienė & Gudžinskas 2001).

Our experiments revealed that the soil has influence for the formation of common ragweed vegetative organs. In the following is graphs shown that compared with the first and second row branch number (Fig. 2a) and length (Fig. 2b) it is slightly larger and slightly more noticeable in the third row.

In the first two rows of branches organs are twice as long in the plants grown in peat and sand. This substrate is more favourable for formation of the 3rd row branches. The research results show that the plants which grew in it formed as much as 10 times more branches and their length is twice as large as of the plants grown in peat. Estimate of the number of leaves showed that the influence of soil is obvious for number of these bodies in 2nd row branches. In our studies mixed (peat and sand) substrate gave twice as large number of leaves in 2nd row than the plants grown in peat.

In the European northern part countries development of the generative part has long been recorded as the process not characteristic for common ragweed. However, studies of recent years (Šaulienė et al. 2012) no longer let doubting that the common ragweed can form flowers and florets and produce seeds. Our studies (Fig. 2b), carried out with different types of soil showed that on the first and second row branches male inflorescences' length is slightly larger for the plants grown in the mixed substrate composed of peat and sand. Notable changes are observed in the third row, where the length of the inflorescences is 3 times as large in comparison with the plants, cultivated in the soil composed entirely of peat.

In assessing the number of inflorescences two types of trends are observed (Fig. 3), which are clearly determined not by substrate composition but by biological properties of the plant.

The first: most of the male inflorescences are produced on second row branches, although the number on one branch is less. The second pattern: the largest number of female inflorescences is formed on the first-row branches. These two facts give assumption that at least some of ragweed pollen found in the air can be of local origin, but small quantity of seeds may be the limiting factor in the spread of the plant. Comparative analysis of generative organs formation showed that female and male inflorescence number, which formed on the first and second-row branches is higher in the plants that grew in peat and sandy soil. In addition, number of female inflorescences formed on the third-row branches is larger on the common ragweed grown in the peat. The reverse reaction was observed in the male inflorescences case. The plants, which grew in the peat and sand

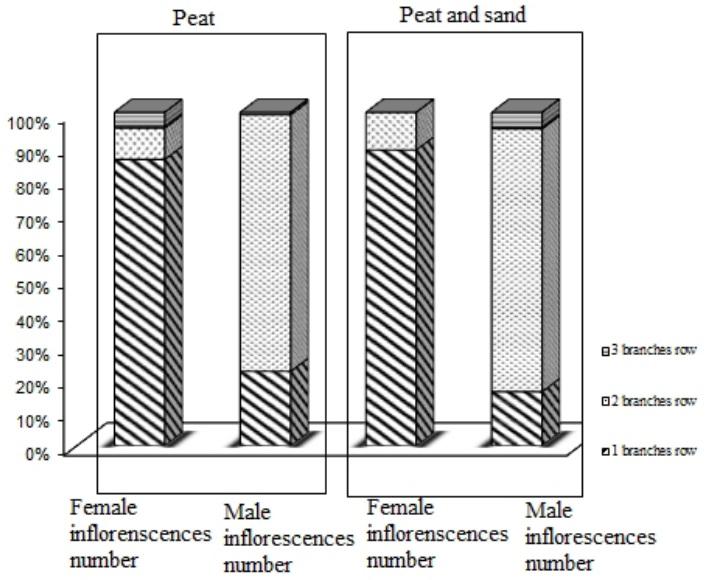


Fig. 3. Female and male inflorescence number dependence on the type of soil.

mix, formed 10 times more male inflorescences on the third row (proportional to the number of branches).

CONCLUSIONS

Systematic analysis of the above facts, showed that peat and sand substrate is more favourable environment to grow for common ragweed. In this substrate common ragweed formed more one the first, second and third row branches. Also this environment was more favourable for leaves, female florets and longer male flowers formation. This situation reaffirms the fact that both the cultural soil and soil of roadsides, neglected areas is a suitable environment to settle for common ragweed in Lithuania.

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