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TRANSPIRATION OF POPLAR CLONES AS A FACTOR OF IMPROVEMENT ENVIRONMENT QUALITY

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ABSTRACT

The paper represents the results of investigation of transpiration intensity of different clones of black poplar (Section Aigeiros) in four experimental plantations with different spacing between plants. The results showed that the most intensity of transpiration had clones 618 and 457 (P. delotides) in the 4th experiment. The results lead to a conclusion that the poplar clones can be used in protect plantation because they have great potential to increase absolute and relative humidity by transpiration and improve environment quality.

1. INTRODUCTION

The modern way of life in large cities, with highly developed industry and traffic lead to the disturbance of environment and life quality. The consequences are especially evident in air composition and quality. The increased concentration of carbon dioxide, carbon monoxide, sulphur dioxide and other harmful gases, the low absolute and relative air humidity, are the main characteristics of the air in large cities. In addition, the low absolute and relative humidity, which are the consequences of the steppe climate, which characterizes Vojvodina, lead to an additional degradation of life quality. Woody species in parks, tree rows and in the country have a great role in the increase of the relative humidity. The dominant tree species in the conditions of Vojvodina are: pedunculate oak, ash and hornbeam in Srem; lime, sessile oak and beech on Mt. Fruska Gora and poplar plantations along the rivers and channels. The previous research shows that forests are a strong source of water vapour, which is generated by transpiration and evaporation. It is also known that forests affect the changes of microclimate elements in the wider surroundings. The air in forests is cooler during the day and warmer during the night compared to open spaces. The cooler air from the forest is transported to the wider environment in the form of daily winds, which decrease the temperature and increase the absolute and relative air humidity in the environment. Forests and vegetation make the climate milder and more humid [2]. According to the same author, relative

humidity in cities is lower than in forests because rainfall water runs off very fast to the drainage, so evaporation lasts for a very short time.

The literature data show that poplars are characterized by the highest photosynthetic potential [1,4,5]. Consequently, it can be expected that the high intensity of photosynthesis which releases oxygen, practically also means the release of a high quantity of water by transpiration, because these two processes are connected.

This paper presents the study results of the intensity of transpiration of several poplar clones in different planting spaces and at different localities.

2. MATERIAL AND METHOD

The first experiment was established by rooted cuttings of the clones of native black poplar - *Populus nigra* (clones N1, N2), Euramerican poplar *Populus x euramericana* (clone I-214) and Eastern cottonwood - *Populus deltoides* (clones PE 19/66 and B-17) in the nursery of the Poplar Research Institute near Novi Sad. The experiment was established in the spring 1995, spacing 0.2 x 1.50 m, and the research was performed during the autumn of the same year.

The second experiment was established at the locality "Majurska Ada" planting spaces 3 x 3 m, and 4.25 x 4.25 m. The research in this experiment was performed on 7-year-old trees. Only the clone I-214 (*Populus x euramericana*) was included in this experiment.

The third experiment was established at the locality "Spacva" in 4 planting spaces (3 x 3 m; 4.25 x 4.25 m; 5 x 5 m; 6 x 6 m and 7 x7 m). This experiment also included only the clone I-214, and the research was performed on 7-year-old trees.

The fourth experiment was established in the nursery of the Poplar Research Institute near Novi Sad with two planting spaces. This experiment dealt with the clones 618 and 457 (Eastern cottonwood - *Populus deltoides*).

Transpiration intensity was determined in the laboratory by the diurnal and nocturnal dynamics, i.e. it was monitored day and night. We applied the gravimetric (mass) method. The samples for the determination of transpiration intensity were the cut tops of plants, which were then immersed in water with paraffin oil on its surface, to prevent evaporation.

3. RESULTS

The study results of leaf area and transpiration intensity of one-year-old poplar clones are presented in Table 1. The Table shows that clone B-17 had the largest leaf area at the end of the vegetation period, and clone N2 had the smallest leaf area. This parameter affected the total transpiration during the vegetation growth period. It was assessed that the highest quantity of transpiration water during the vegetation period was released by rooted cuttings of clone N1 (native black poplar) - 36414

kg, and the lowest, by rooted cuttings of clone I-214 (Euramerican poplar) - 23572 kg.

Table 2 presents the leaf area and the quantity of transpiration water of clone I-214 (Euramerican poplar). The study results show that during one vegetation period, the trees of this clone released by transpiration, depending on planting density, between 2212 kg/ha of water (spacing 3x3 m, thinned), and 3699 kg /ha (spacing 3x3 m, unthinned). It is evident that the number of trees per hectare had a significant effect on leaf area, and in this way on the total quantity of the water released by transpiration.

The same clone in the plantation at the other locality (Table 3) released by transpiration from 1360 kg/ha (spacing 7x7m), to 1564 kg/ha (spacing 4.25 x 4.25m) during the vegetation period. It is characteristic that, in this case, the spacing had a lower influence on the total quantity of released water.

Table 1: Transpiration rate of poplar rooted cuttings in the first experiment

Clone	Leaf area per plant [cm^2]	Average daily transpiration			
		g/cm^2 h	g/h	g/day	kg/growing period
N1	2937.08	0.00492	14.450	173.400	36.414
N2	2215.60	0.00254	5.627	135.063	28.363
I-214	3771.63	0.00248	9.354	112.248	23.572
PE19/66	5610.82	0.00271	15.205	182.460	38.316
B-17	6128.07	0.00179	10.969	131.628	27.642

Table 2: Transpiration rate of poplar seven year old plants in second experiment [3]

Plant spacing	Leaf area per plant [cm^2]	No plant per ha	Leaf area [m^2/ha]	Average daily transpiration			
				kg H_2O/hour / plant	kg H_2O/hour/ hectare	kg H_2O/day/ hectare	kg/growing period per hectare
3 x 3 m	53.33	1100	59196	1.322	1468.061	17.616	3699
3 x 3 m	63.79	555	35403	1.582	877.994	10.536	2212
4.25 x 4.25 m	83.54	555	46.365	2.072	1149.852	13.798	2898
6 x 6 m	128.08	278	35606	3.176	883.029	10.595	2225

Table 3: Transpiration rate of poplar seven year old plants in the third experiment [3]

Plant spacing	Leaf area per plant [cm^2]	No. plant per ha	Leaf area [m^2/ha]	Average daily transpiration			
				kg H_2O/hour/ plant	kg H_2O/hour/ hectare	kg H_2O/day/ hectare	kg/growing period per hectare
3 x 3 m	21.00	1100	23310	0.521	578.088	6.937	1457
4.25 x 4.25 m	45.09	555	25028	1.118	620.694	7.448	1564
5 x 5 m	61.77	400	24708	1.532	612.758	7.353	1544
6 x 6 m	85.01	278	23633	2.108	586.098	7.033	1477
7 x 7 m	106.71	204	21768	2.646	539.846	6.478	1360

Table 3: Transpiration rate of poplar seven year old plants in the fourth experiment [6]

Clone	Leaf area	No. plant	Leaf area	Average daily transpiration

	per plant [cm^2]	per ha	[m^2/ha]	kg H_2O/hour/ plant	kg H_2O/hour/ hectare	kg H_2O/day/ hectare	kg/growing period per hectare
618	119.10	612	72919	3.132	1917.769	23.013	4933
457	128.03	587	75186	3.367	1977.392	23.729	4983

4. DISCUSSION

The study results show the significant variability in leaf area and transpiration intensity of the study clones of black poplars in the section *Aigeiros*. The highest quantities of transpiration water were released by the clones of Eastern cottonwood in the seven-year-old plantation. It is characteristic that the total quantity of released water during the vegetation growth period per hectare depended also on planting density, in addition to interclonal differences. This points out that during the planting, i.e. plantation establishment, both in the cities and in the country, attention should be focused to the optimal planting density, i.e. number of plants, in order to utilise fully the potential of oxygen and water release through the process of photosynthesis.

The quantity of water released by the trees of different poplar clones has an enormous significance for the increase of the absolute and relative humidity, as well as for the creation of favourable conditions for the growth of agricultural crops. Furthermore, previous investigations [4] show that the trees of different poplar clones can release up to 387 t of oxygen during the vegetation period, which points to the significance of this tree species for the improvement of air quality in towns and their surroundings. Taking into account that highly productive poplar clones, in addition to fast growth, are also generally characterised by high photosynthesis and transpiration intensities, it can be concluded that in this way the function of wood production and all beneficial functions of forests to the environment, primarily the microclimate, are united. Based on the study results, it can be concluded that highly productive poplar clones should be increasingly utilised both for the establishment of green spaces in the cities and for the establishment of protection green belts in the country.

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