Marmont alley



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The research question

- Marmontova aleja is a plane tree alley near the Dubovac primary school
- Planted from 1809. to 1811.
 (Karlovac Dubovac, Grobničko
 Polje i Rijeka) during the
 construction of the Louisiana Road
 (Karlovac Rijeka)
- In Karlovac the road begins with the plane tree line, named in the honour of the Marshal Marmont (1774 - 1852) from the Napoleon Bonapartes age
- The alley is a monument of park architecture from 1968





In June 2019 the construction work had began on the national road D6 which begins with the Marmontova aleja in Karlovac and concerns the community about possible tree damage

Research questions:

What is the biological importance of Marmontova aleja for Dubovac and the City of Karlovac?

How much carbon dioxide is absorbed during the life of trees and what is the amount of carbon stored in trees?

How much oxygen does one plane tree produce in one day?

Why is it important for us to protect this tree line?





Hypotheses

 Marmontova aleja is an important biological factor in the city of Karlovac and city's district Dubovac because the plane trees have absorbed large amounts of carbon during their existence, which is especially important due to the intensive traffic and burning of fossil fuels.

• One plane tree produces significant amounts of oxygen in one day during the growing season

• The vegetation season of plane trees lasts from April to November

Research methods

Research period: March - December 2021 The total number of trees in the alley : 102



GLOBE protocols:

- biometry (for 102 plane trees)
- Iocation determination GLOBE observer
- tree height GLOBE observer application
- plant species identification the key to species identification
- circumference of wood measuring tape technology
- observation and recording of budding and greening





Tree age = tree circumference/ 1 year growth 1 year growth of the plane tree: 2,75 cm/year



fresh mass (green weight-GW) in kg $GW = 0,0346 \times d^2 * h$ (if the d> 28 cm) ili GW = 0,0577 \times d^2 * h (if the d< 28 cm)

dry mass (dry weight -DW) = GW/2

amount of absorbed carbon (Carbon storage) = DW/2

absorbed CO₂ in the lifetime of a three = Carbon storage *3,67

because $Mr(CO_2) / Ar(C) = 3,67$ chest diameter of a tree in cm = tree circumference / π

The amount of oxygen produced on one plane tree of average size

- determining the number of leaves in 1 dm³
- determining the leaf area
- 1 cm² of tree leaves produces 0.05 ml of oxygen in 1 hour at ideal temperature and pressure with optimal humidity
- Calculation of the volume of oxygen produced in 1dm³
- calculating the tree canopy volume of the average plane tree
- calculating the volume of oxygen produced for one tree in one day







RESULTS

Measured for 102 plane trees : tree height and range Measured for 102 plane tree: age, GW, DW, C, chest diameter, absorbed CO_2

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		20,71						9376,9		

Average tree height: 17,48 meters Average tree age: 67,23 years



Total mass of a living tree(GW)= 333132 kg Total dry mass (DW)= 256565 kg Total mass of stored carbon= 85097 kg Total mass of stored CO_2 = 297589 kg

Comparison of three trees of different ages and sizes with the amount of GW, DW, stored carbon and absorbed CO_2

Mark	Age of	circumf	dimet	Tree	GW(green	DW (dry	Carbon	Apsorbed
of	tree/Ye	erence/	<u>er/</u>	height/	weight)/kg	weight)	storage/	CO ₂ /kg
tree	ars	cm	cm	m		/kg	kg	
S11	37,8	104	33,1	18,67	708,64	354,32	177,16	650,18
S17	61,8	170	54,11	22,91	2323,48	1161,74	580,87	2131,8
S57	152,7	420	133,7	23,92	14807,32	7403,66	3701,83	13585

Amount of stored CO_2 for all plane trees in the street (102)



Amount of produced O_2 for one plane tree of average height



r (canopy): souces

- Number of leaves in $1 \text{ dm}^3 = 2$
- Total leaf surface of 2 leaves = 160 cm^2
- **Total volume of O_2 in 1 dm³ =** 160 cm² x 0,05 ml/1 h= 8 ml O_2 /1 h
- Volume of the tree canopy: r²π * h
 (4,71m)² * 3,14 * 14,4 m= 1003,07 m³ = 1003070 dm³
- Volume of produced O₂ in the tree canopy in 1 hour: 1003070 dm³ * 8 ml= 8024560 ml u 1 h = 8024,56 L u 1 h
 - Volume of produced O_2 in a tree canopy in 1 day: 8024,56 L * 8 h= 64196,2 L

Vegetation period on the observed plane tree





Conclusions

The hypothesis about the biological importance of the Marmontova aleja of the city Karlovac and the city's district Dubovac was confirmed by the results of the research.

- plane trees have absorbed more than 200 tons of CO₂ during their existence
- they contain more than 80 t of stored carbon thus removing that amount of carbon from the atmosphere.
- the tree-lined avenue contributes to the reduction of the greenhouse effect, especially when CO₂ absorption occurs at the site of its intensive formation
- if ideal conditions lasted 8 hours a day, one tree of average size could produce approximately more than 60,000 L of oxygen
- the vegetation period lasts from April to November

Analysis

It was not possible to use the GLOBE - TREE age calculator to calculate the age of the plane tree because there was no option to calculate the age and amount of carbon stored in the plane trees.

It is not possible to accurately calculate the amount of oxygen produced in one hour or day because photosynthesis depends on many factors, temperature, humidity, and light intensity which can change within one day or hour.

It is not possible to accurately calculate the amount of oxygen produced per cm² because the values change between each plane tree.

The following studies should measure atmospheric factors (cloud, temperature, humidity) in order to calculate the approximate amount of oxygen in ideal conditions during the growing season from April to November.

Appreciations

- to the local community, which invited the students to present the project to the residents
- to the public institution Natura Viva from Karlovac for the promotion of the project in the city of Karlovac, Croatia
- to Brian Campbell for the invitation to present the research project at the "Trees around the GLOBE" webinar, on December 8th2022.



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THANKS FOR THE ATTENTION! Dubovac Primary school, Karlovac, Croatia