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Sveučilište u Zagrebu  
**Fakultet šumarstva  
i drvne tehnologije**

**DAN DOKTORATA BIOTEHNIČKOG PODRUČJA 2021.**

Agronomski fakultet Sveučilišta u Zagrebu, 16. do 17. rujna 2021.

# Faktori konverzije biomase mrtvog drveta za odabrane vrste šumskog drveća u Republici Hrvatskoj

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- **Projekt: Modeliranje šumskih zaliha i tokova ugljika te rizika prema budućim klimatskim scenarijima**  
(HRZZ-IP-2019-4-6325)

Početak: velj 2020.

Kraj: sij 2024.

Voditelj projekta: Hrvoje Marjanović

Projektни tim: Maša Zorana Ostrogović Sever

Elvis Paladinić

Doroteja Dimoski

Vanjski suradnici: Mislav Anić

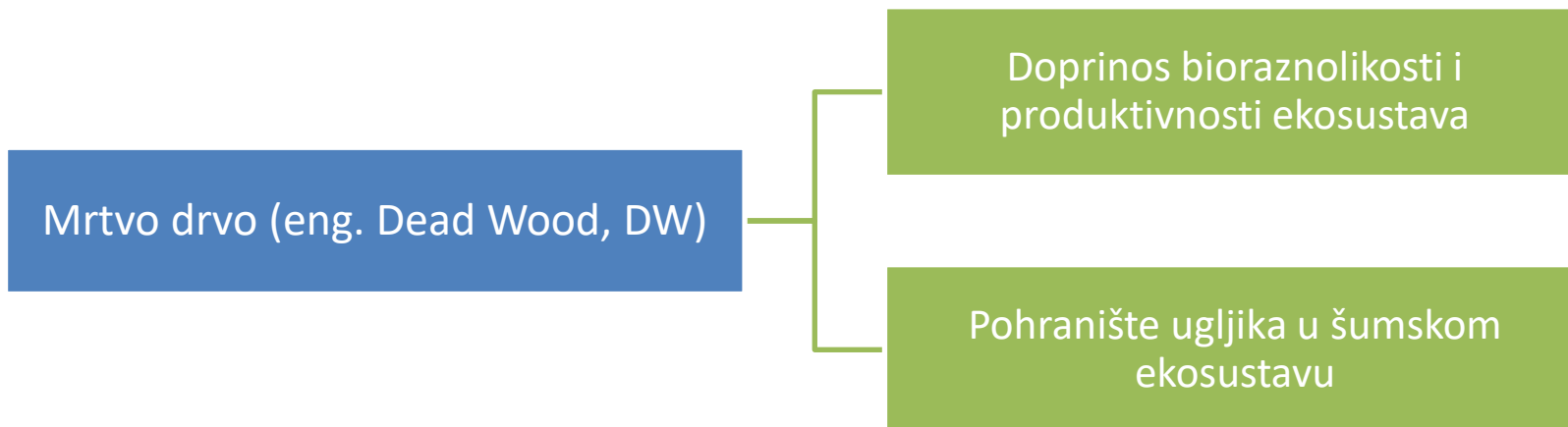
Zoltán Barcza

Dóra Hidy

Giorgio Alberti

- **Procesni model Biome-BGCMuSo**

# UVOD



- Okvirna konvencija UN-a o promjeni klime (eng. United Nations Framework – Convention on Climate Change, UNFCCC)
- Nacionalno izvješće o inventaru stakleničkih plinova (eng. National Inventory Report, NIR), sektor LULUCF (eng. Land Use, Land Use Change and Forestry)
- Faktori konverzije biomase DW – gustoća DW (eng. Basic Wood Density, BWD) i koncentracija ugljika (C) po stupnjevima raspadanja drveta
- **CILJ ISTRAŽIVANJA:** nacionalne vrijednosti navedenih faktora; moguć prijelaz na višu razinu proračuna u NIR-u

# MATERIJAL I METODE

## ❖ Područje istraživanja

Šumarija Crikvenica, G.J. Kotor Planina  
Kultura dalmatinskog crnog bora



*Pinus nigra* J.F. Arnold

NPŠO Rab  
Šuma hrasta crnike



*Quercus ilex* L.  
*Pinus pinaster* Aiton

Šumarija Jastrebarsko, G.J. Jastrebarski lugovi  
Šuma hrasta lužnjaka i velike žutilovke

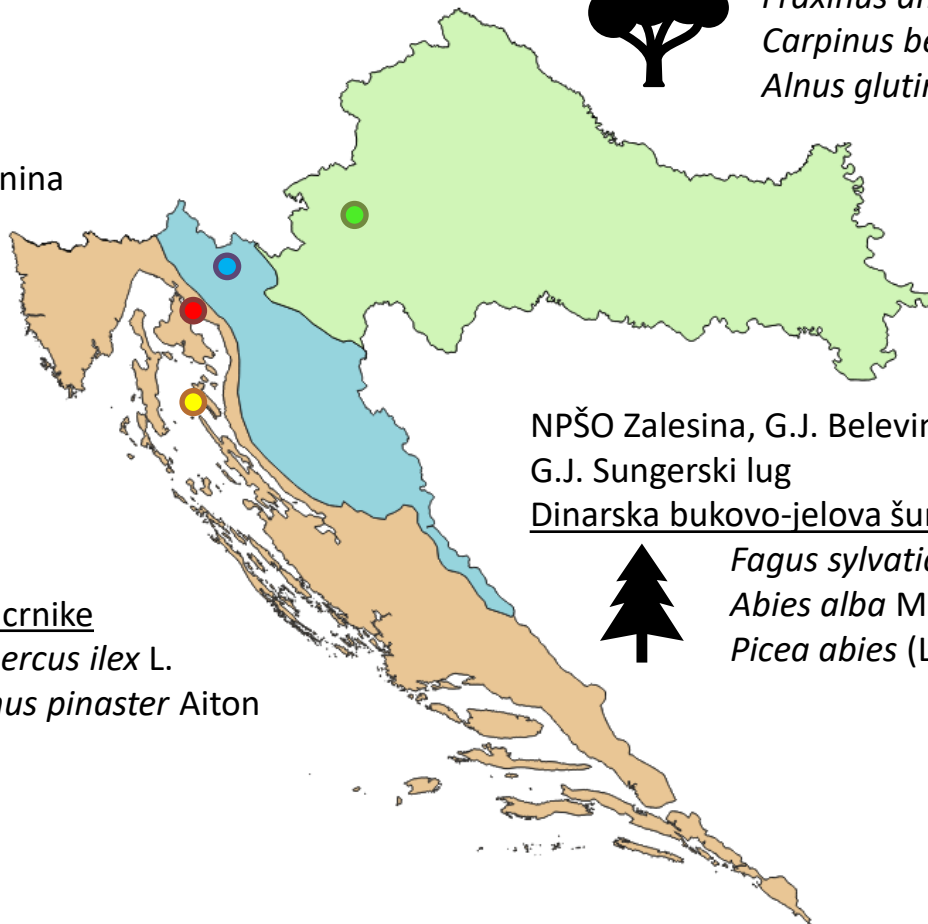


*Quercus robur* L.  
*Fraxinus angustifolia* Vahl  
*Carpinus betulus* L.  
*Alnus glutinosa* (L.) Gaertn.

NPŠO Zalesina, G.J. Belevine, G.J. Kupjački vrh,  
G.J. Sungerski lug  
Dinarska bukovo-jelova šuma



*Fagus sylvatica* L.  
*Abies alba* Mill.  
*Picea abies* (L.) Karst



Biogeografske regije (BGR)

- Kontinentalna
- Alpiska
- Mediteranska

## ❖ Terenski rad

Stupanj raspadanja	Opis	Prosjek dubina uboda odvijačem (cm)
0	Živo	0
1	Svježe mrtvo, tvrdo, s korom, s postranim granama, pravilnog oblika	< 0,5
2	Tvrdo, djelomično otpala kora, pravilnog oblika	< 2
3	Mekano, bez kore, puca pod pritiskom, nepravilnog oblika	< 5
4	Trulo, bez kore, nepravilnog oblika	> 5

**Debljinski razredi (cm)**

5-10

10-20

20-30



## ❖ Laboratorijske analize

$$\rho = \frac{m}{V}$$

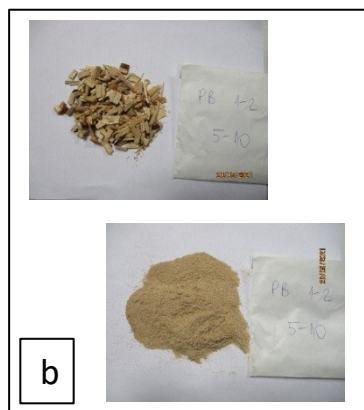
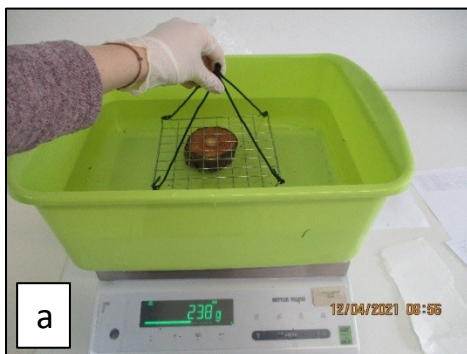
C (%)



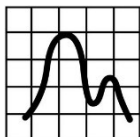
Sušenje uzoraka na 105 °C 48 h u sušioniku i odvaga prosušenih uzoraka

Usitnjavanje uzoraka u mlinu Rtesch ZM 200 (b)

Određivanje sadržaja ugljika elementarnim analizatorom Leco CNS 2000 (c)



## ❖ Statističke analize



Softver STATISTICA

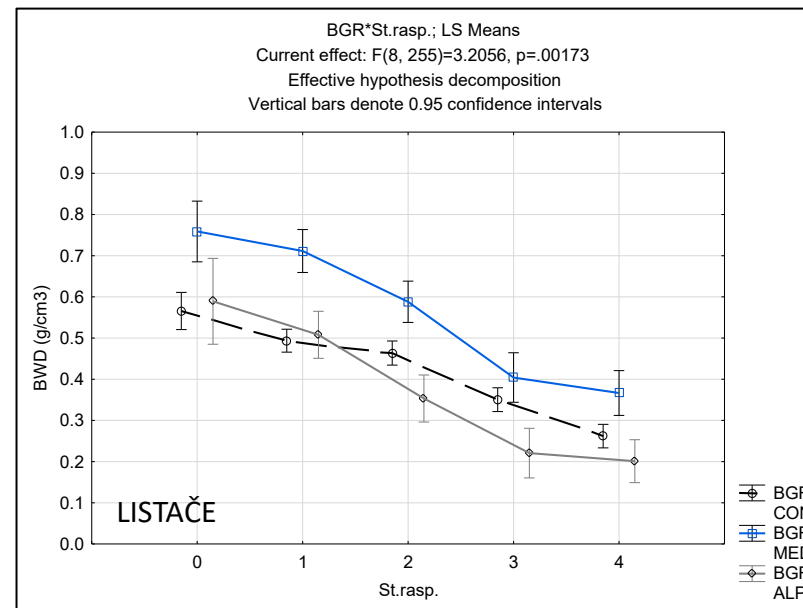
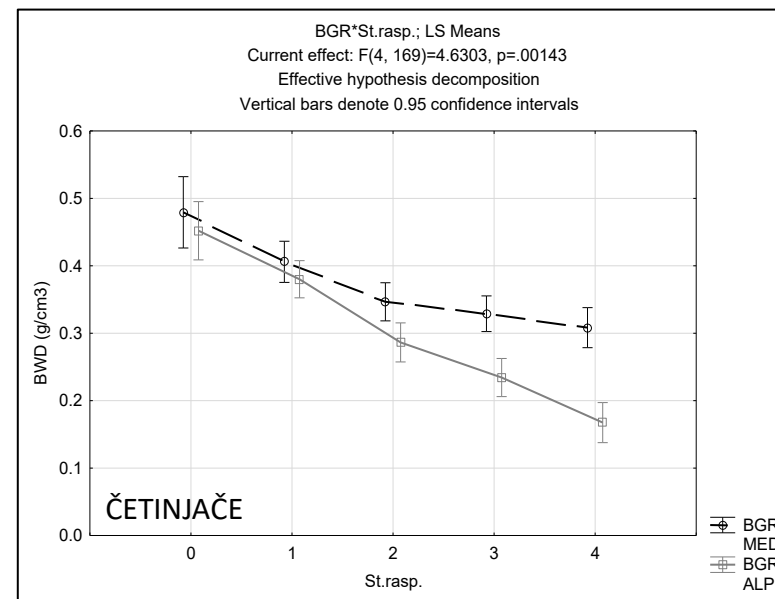
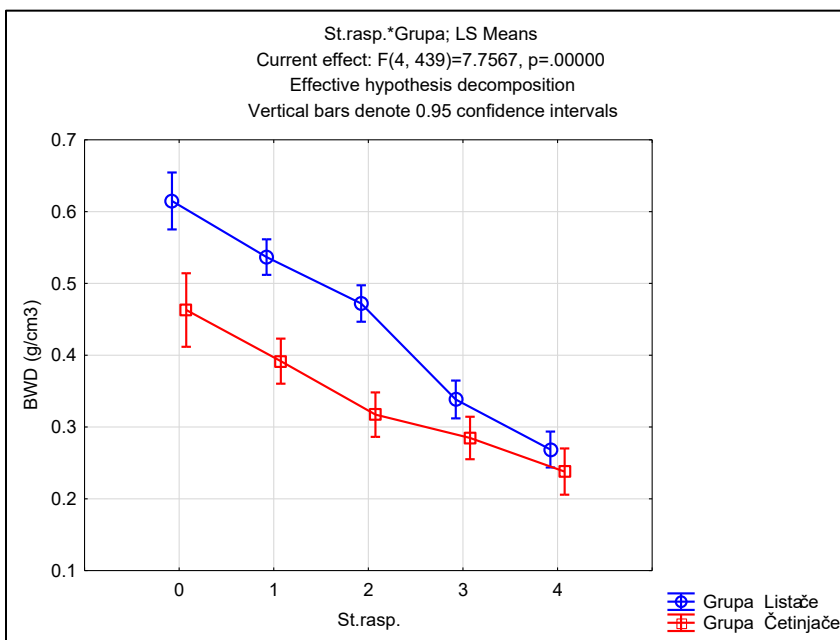
-Analiza varijance



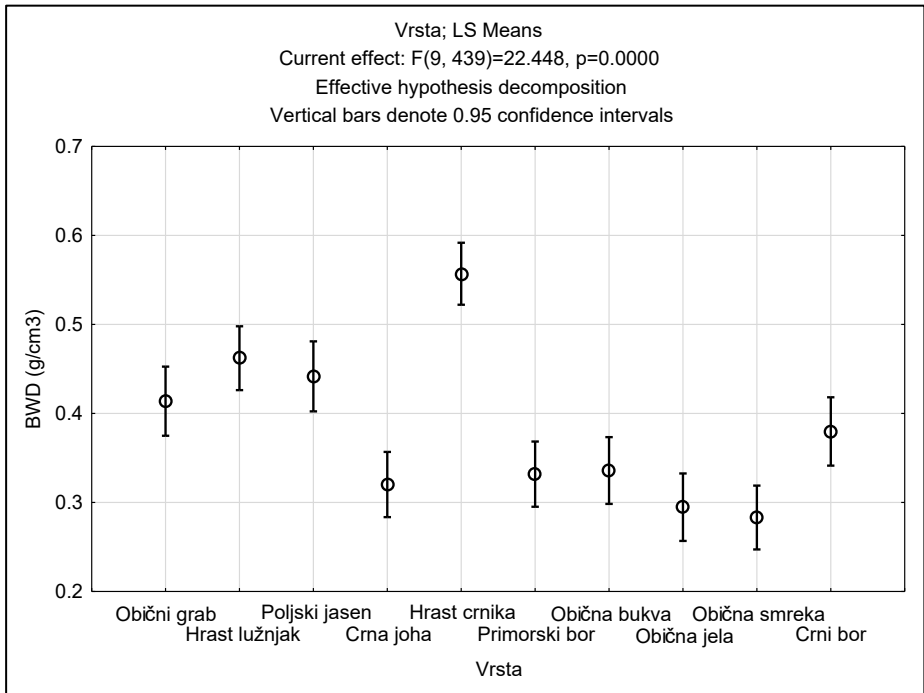
# REZULTATI I DISKUSIJA

Stupanj raspadanja	BWD (g cm <sup>-3</sup> )	BWD (g cm <sup>-3</sup> )	BWD (g cm <sup>-3</sup> )	BWD (g cm <sup>-3</sup> )	BWD (g cm <sup>-3</sup> )
	<b>Hrast lužnjak</b> (n <sub>0</sub> =6, n <sub>1</sub> =10, n <sub>2</sub> =10, n <sub>3</sub> =9, n <sub>4</sub> =10)	<b>Obični grab</b> (n <sub>0</sub> =3, n <sub>1</sub> =9, n <sub>2</sub> =19, n <sub>3</sub> =9, n <sub>4</sub> =11)	<b>Crna joha</b> (n <sub>0</sub> =3, n <sub>1</sub> =11, n <sub>2</sub> =10, n <sub>3</sub> =12, n <sub>4</sub> =10)	<b>Poljski jasen</b> (n <sub>0</sub> =4, n <sub>1</sub> =9, n <sub>2</sub> =9, n <sub>3</sub> =9, n <sub>4</sub> =9)	<b>Obična bukva</b> (n <sub>0</sub> =3, n <sub>1</sub> =10, n <sub>2</sub> =10, n <sub>3</sub> =9, n <sub>4</sub> =12)
0	0.573 ( ± 0.027)	0.597 ( ± 0.025)	0.449 ( ± 0.029)	0.618 ( ± 0.044)	0.589 ( ± 0.029)
1	0.485 ( ± 0.032)	0.558 ( ± 0.038)	0.433 ( ± 0.033)	0.546 ( ± 0.028)	0.508 ( ± 0.037)
2	0.471 ( ± 0.027)	0.540 ( ± 0.027)	0.348 ( ± 0.040)	0.507 ( ± 0.047)	0.353 ( ± 0.064)
3	0.460 ( ± 0.046)	0.298 ( ± 0.073)	0.277 ( ± 0.025)	0.392 ( ± 0.035)	0.221 ( ± 0.050)
4	0.387 ( ± 0.062)	0.237 ( ± 0.051)	0.182 ( ± 0.028)	0.243 ( ± 0.065)	0.201 ( ± 0.023)
	<b>Obična jela</b> (n <sub>0</sub> =4, n <sub>1</sub> =9, n <sub>2</sub> =9, n <sub>3</sub> =11, n <sub>4</sub> =10)	<b>Obična smreka</b> (n <sub>0</sub> =5, n <sub>1</sub> =13, n <sub>2</sub> =11, n <sub>3</sub> =10, n <sub>4</sub> =9)	<b>Crni bor</b> (n <sub>0</sub> =3, n <sub>1</sub> =9, n <sub>2</sub> =10, n <sub>3</sub> =10, n <sub>4</sub> =10)	<b>Primorski bor</b> (n <sub>0</sub> =3, n <sub>1</sub> =9, n <sub>2</sub> =11, n <sub>3</sub> =14, n <sub>4</sub> =9)	<b>Hrast crnika</b> (n <sub>0</sub> =6, n <sub>1</sub> =12, n <sub>2</sub> =13, n <sub>3</sub> =9, n <sub>4</sub> =11)
0	0.504 ( ± 0.030)	0.411 ( ± 0.068)	0.541 ( ± 0.082)	0.417 ( ± 0.015)	0.759 ( ± 0.010)
1	0.404 ( ± 0.037)	0.364 ( ± 0.017)	0.440 ( ± 0.052)	0.372 ( ± 0.029)	0.711 ( ± 0.056)
2	0.292 ( ± 0.035)	0.282 ( ± 0.025)	0.351 ( ± 0.037)	0.342 ( ± 0.043)	0.588 ( ± 0.061)
3	0.252 ( ± 0.031)	0.215 ( ± 0.036)	0.353 ( ± 0.051)	0.312 ( ± 0.066)	0.404 ( ± 0.068)
4	0.163 ( ± 0.019)	0.173 ( ± 0.036)	0.333 ( ± 0.047)	0.281 ( ± 0.066)	0.367 ( ± 0.057)

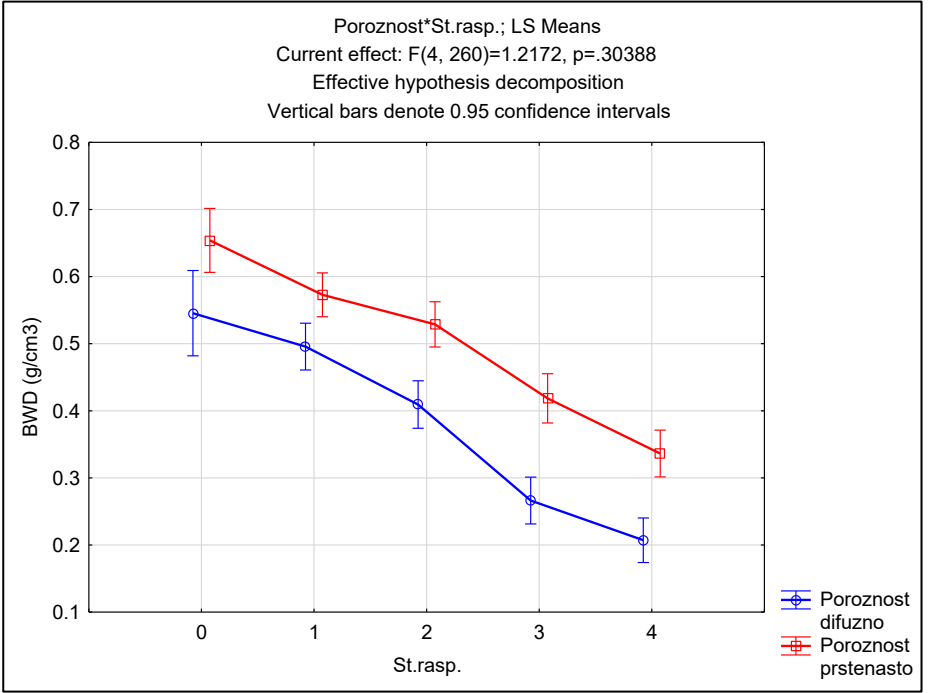
n<sub>n</sub> predstavlja broj uzoraka po stupnjevima raspadanja drva.  
1,96\*SE unutar zagrada.





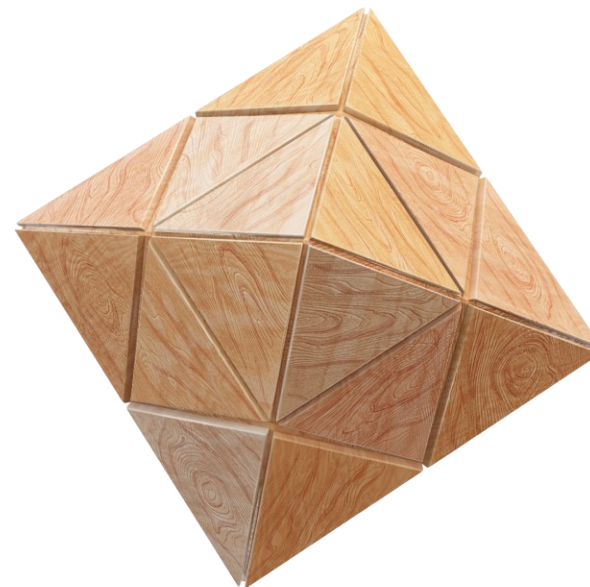


# Anatomija drva?



Stupanj raspadanja	Sadržaj C (%) <b>Hrast lužnjak</b> ( $n_1=10, n_2=9, n_3=9, n_4=19$ )	Sadržaj C (%) <b>Obični grab</b> ( $n_1=9, n_2=9, n_3=9, n_4=10$ )	Sadržaj C (%) <b>Crna joha</b> ( $n_1=10, n_2=9, n_3=9, n_4=9$ )	Sadržaj C (%) <b>Poljski jasen</b> ( $n_1=9, n_2=9, n_3=9, n_4=9$ )	Sadržaj C (%) <b>Hrast crnika</b> ( $n_1=12, n_2=13, n_3=9, n_4=11$ )
1	47.74 ( ± 0.236)	47.54 ( ± 0.127)	48.53 ( ± 0.229)	47.61 ( ± 0.339)	45.67 ( ± 0.402)
2	47.90 ( ± 0.160)	46.41 ( ± 1.579)	47.83 ( ± 0.229)	47.69 ( ± 0.360)	45.58 ( ± 0.198)
3	48.29 ( ± 0.476)	47.12 ( ± 0.421)	48.28 ( ± 0.363)	47.72 ( ± 0.375)	45.27 ( ± 1.012)
4	48.22 ( ± 0.286)	46.25 ( ± 1.500)	47.57 ( ± 0.692)	47.18 ( ± 1.177)	48.68 ( ± 2.480)

$n_n$  predstavlja broj uzoraka po stupnjevima raspadanja drva.  
1,96\*SE unutar zagrada.



**HVALA NA PAŽNJI!** 😊