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Taxodium distichum (L.) RICH.

, 2016

**UNIVERSITY OF BELGRADE
FACULTY OF FORESTRY**

Dušan Jokanović, for.eng.

**ANATOMICAL CHARACTERISTICS OF
Taxodium distichum (L.) RICH. ON
ALLUVIAL SITES IN SERBIA**

Doctoral dissertation

Belgrade, 2016

ИНФОРМАЦИЈЕ О МЕНТОРУ И ЧЛАНОВИМА КОМИСИЈЕ

Ментор:

др Драгица Вилотић, ред. проф. Универзитета у Београду - Шумарског факултета

Чланови Комисије:

др Мирјана Шијачић-Николић, ред. проф. Универзитета у Београду - Шумарског факултета

др Милан Кнежевић, ред. проф. Универзитета у Београду - Шумарског факултета

др Владан Иветић, ванр. проф. Универзитета у Београду - Шумарског факултета

др Бранислава Лакушић, ред. проф. Универзитета у Београду – Фармацеутског факултета

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ИЗЈАВЕ ЗАХВАЛНОСТИ

Овим путем се најсрдачније захваљујем свим члановима Комисије, поштованим професорима, на издвојеном времену и спремности да ми се у сваком моменту ставе на располагање. Посебну захвалност дугујем свом ментору, проф.др Драгици Вилотић, која ми је давала неопходну подршку и драгоцене савете током целокупног научно-истраживачког рада. Хвала проф.др Мирјани Шијачић-Николић, др Владану Иветићу, ванр.проф., проф.др Милану Кнежевићу и проф.др Бранислави Лакушић, што су ми се за сваку недоумицу коју сам током писања имао моментално стављали на располагање.

Захвалност дугујем и г-дину Бобану Трмчићу, лаборанту на Катедри за Ботанику Фармацеутског факултета у Београду, на помоћи око израде анатомских препарата. Од људи са Шумарског факултета, издвојио бих следеће којима се посебно захваљујем: проф.др Љубомира Летића, проф.др Драгана Караџића, проф.др Ненада Кечу, др Ољу Кошанин, др Бранка Стајића, др Јовану Петровић, др Драгицу Станковић, Марину Нонић, дипл.инж., Николу Живановића, дипл.инж. и Јовану Деветаковић, дипл.инж.

Хвала и запосленима у ЈП „Градско зеленило“, као и ШГ „Нови Сад“- шумска управа „Бачка Паланка“, како руководству, тако и њиховим оперативцима и секачима, што су нам омогућили да оборимо стабла таксодијума како бисмо обавили неопходна истраживања.

И на крају, највеће хвала мојој породици. Mom оцу Данилу, мајци Јасмини и брату Владимиру, хвала за безграничну подршку, како у животу, тако и у научно-истраживачком раду. Хвала, јер сам увек у вама имао ослонац и потпору у својој мисији на путу којим се ређе иде.

Оне најзаслужније сам оставио за сами крај. Безгранично хвала мојој супрузи Весни, о којој не бих трошио речи. Љубав, подршка, савет, добронамерна критика, помоћ – све сам то имао у сваком моменту од моје Весне. Мојој Анастасији, јер је много трпела и за много тога остала ускраћена, како би се овај посао окончао. Mom малом анђелу, Гаги, хвала што постоји, што даје смисао свему овоме... Хвала јој, зна она већ на чему све...

КЉУЧНА ДОКУМЕНТАЦИОНА ИНФОРМАЦИЈА

UDK	
Тип документа (ТД)	Монографска публикација
Тип записа (ТЗ)	Текстуални штампани материјал
Врста рада (ВР)	Докторска дисертација
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Извод (ИЗ)	У овом раду су анализирани анатомске особине стабала <i>Taxodium distichum</i> (L.) Rich. на два различита локалитета у Србији. У том циљу су оборена по 3 стабла на оба локалитета и направљени котурови, из којих су израђени трајни анатомски препарати. Применом дескриптивне статистике одређени су сви елементи који се односе на макроскопску и микроскопску грађу дрвета.
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Abstract (AB)	In this paper, there were analyzed anatomical characteristics of <i>Taxodium distichum</i> (L.) Rich. on two different locations in Serbia. For that reason, overall 6 trunks were fallen, and after that, cuttings and permanent anatomical samples were made. All macroscopic and microscopic wood elements were determined by Descriptive Statistics.
Accepted by Scientific Board (ASB)	
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АНАТОМСКЕ ОСОБИНЕ СТАБАЛА *Taxodium distichum* (L.) RICH. НА АЛУВИЈАЛНИМ СТАНИШТИМА У СРБИЈИ

Резиме

У оквиру ове докторске дисертације, истраживане су анатомске карактеристике стабала *Taxodium distichum* (L.) Rich. на подручју Великог ратног острва и Бачке Паланке. У том циљу, вршена је макроскопска анализа дрвета и коре, као и детаљна микроскопска анализа ксилема. За детаљан опис макроскопске грађе дрвета, одређене су ширине прстенова прираста и удео позне зоне унутар прстена прираста, док је микроскопска грађа ксилема обухватала истраживање следећих елемената: висине и броја трака лигнума по mm^2 , ширине и дужине аксијалних трахеида, као и њиховог броја по mm^2 .

Како би се обавиле неопходне анализе, оборена су по три стабла на оба локалитета. Притом је било важно да су одабране јединке семеног порекла, да су задовољавајућег здравственог и физиолошког стања и да немају значајнијих техничких оштећења. Из оборених стабала су направљени котурови на 0.3 m и 1.3 m висине, из њих одговарајући исечци који обухватају блокове са ознакама од 1 до n, што значи да су обухваћени сви прстенови прираста од сржи до коре. У оквиру блокова су прављени трајни анатомски препарати на којима су обављене све неопходне анализе.

Утврђено је да су прстенови прираста у просеку шири код стабала са Великог ратног острва него у Бачкој Паланци, што се може повезати са садржајем доступне воде у земљишту. У погледу удела позне зоне унутар прстена прираста, процентуално је заступљенија позна зона код стабала са ужим (Бачка Паланка) него код стабала са ширим прстеновима прираста (Велико ратно острво). На оба локалитета је присутан тренд опадања учешћа позне зоне са висином дебла. Кора је нешто дебља и храпавија код стабала из Бачке Паланке, што се може довести у везу са старошћу.

У погледу елемената микроскопске грађе дрвета, висине трака лигнума су веће, а њихова бројност мања код стабала са локалитета Велико ратно острво. Ширина лумена трахеида у великој мери зависи од зоне унутар прстена прираста – шире су у раној зони на Великом ратном острву, а уже у позној зони у односу на Бачку Паланку. Дужина аксијалних трахеида условљена је зоном прстена прираста која се узоркује. У раној зони су аксијалне трахеиде знатно дуже код стабала са Великог ратног острва, док су у позној нешто краће у односу на стабла са локалитета Бачка Паланка. Број трахеида по mm^2 се не разликује значајније између локалитета.

На основу добијених резултата, може се констатовати да таксодијум на алувијалним стаништима у Србији има задовољавајуће морфо-анатомске особине, што може навестити да дрво има широк опсег употребе. Имајући у виду завидан репродуктивни потенцијал врсте, као и доказано висок степен адаптивности и продуктивности у условима Србије, препорука је да се таксодијум у што већем обиму уводи у нашу дендрофлору, пре свега оснивањем плантажа са овом брзорастућом врстом.

Кључне речи: *Taxodium distichum* (L.) Rich., Бачка Паланка, Велико ратно острво, ширина прстенова прираста, удео позне зоне, број трака лигнума по mm^2 , висина трака лигнума, број трахеида по mm^2 , ширина трахеида, дужина трахеида

Научна област: Шумарство

Ужа научна област: Семенарство, расадничарство и пошумљавање

ANATOMICAL CHARACTERISTICS OF *Taxodium distichum* (L.) RICH. ON ALLUVIAL SITES IN SERBIA

Summary

The scope of this doctoral dissertation was to investigate anatomical characteristics of *Taxodium distichum* (L.) Rich. in the area of Veliko ratno ostrvo and Bačka Palanka. Therefore, macroscopic analyze of wood and bark, and detailed microscopic wood analyze, as well, was performed. In order to describe detailed macroscopic wood structure, growth rings width, and proportion of late wood zone inside growth rings were determined. As for microscopic wood structure, following elements were measured: woody rays height, woody rays number per mm², width and length of tracheids, and its number per mm², as well.

In order to perform all necessary analyzes, overall six trunks (three from the first and three from the other location) were fallen. It was important that chosen trunks originated from the seed, that they were healthy and had good physiological state without some visible technical deficiencies. From the fallen trunks, there were made appropriate wood cuttings at the base (0.3 m) and at the breast height (1.3 m) of the trunk. Within these wood cuttings, there were formed blocks numbered from 1 to n, including all growth rings from the pith to the bark. Permanent anatomical samples were taken inside these blocks.

There was determined that growth rings were on average wider by trunks from Veliko ratno ostrvo than by the others from Bačka Palanka. It could be related to content of available water in the ground. As for proportion of late wood zone inside the growth rings, it was more expressed by narrower (Bačka Palanka) than by wider growth rings (Veliko ratno ostrvo). At both sites, proportion of late wood zone decreased with height of the stem. Due to the age, bark was a bit thicker by trunks of Bačka Palanka.

As for elements of microscopic wood structure, woody rays were higher, but less numerous on Veliko ratno ostrvo. Tracheids lumen width depended a lot on wood zone inside the growth rings – they were wider in a early wood zone on Veliko ratno ostrvo, but narrower in a late wood zone than in Bačka Palanka. Tracheids lengths were also dependent on sampled wood zone – tracheids were much longer in a early wood zone on Veliko ratno ostrvo, but a bit shorter in a late wood zone than in Bačka Palanka. Number of tracheids per mm² did not vary a lot between these sites.

On the base of obtained results, it could be deduced that morpho-anatomical characteristics of *Taxodium distichum* (L.) Rich. on alluvial sites in Serbia are satisfactory. It could induce a wide range of usage of this wood. Bearing on mind its big reproductive potential, and its high degree of adaptability and productivity in Serbia, as well, introduction

of *Taxodium distichum* (L.) Rich. in Serbian dendroflora could be recommended, before all by plantations establishing with these fast-growing species.

Key words: *Taxodium distichum* (L.) Rich., Bačka Palanka, Veliko ratno ostrvo, growth rings width, proportion of late wood zone, woody rays number per mm², woody rays height, number of tracheids per mm², tracheids width, tracheids length

Scientific field: Forestry

Narrow scientific field: Seed science, nursery production and afforestation

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1.

Taxodium distichum (L.) Rich. ,

Taxodiaceae F.W.Neger. (, 1987).

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Taxodium Rich. : *Taxodium*

distichum, *T.ascendens* Brogn. *T.mucronatum* Ten (, 1982).

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, *T. ascendens*

T.distichum. , ,

1640.

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(, 2010).

(, 2002).

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190-365 ,
-18°C 4 °C.

(, 2002).

: *Ulmus*

americana Planch., *Carya aquatica* Nutt., *Acer rubrum* L., *Fraxinus pensylvanica* L.,
Magnolia virginia L.,

340-600 g/cm³,

800-1000 g/cm³.

(, 2010).

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- (Brothers, 1988).

(Ewel & Odum, 1984),

2.

2.1.

Taxodium Rich.

(2005),

T.distichum

T.ascendens

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T.ascendens

Taxodium ascendens Brogn.

80

Li et al., (2010)

T.distichum *T.ascendens*

(Eclan & Pezeshki, 2002; Kozlowski & Pallardy, 2002; Pezeshki, 1991)

(De Simone et al., 2003; Jackson & Colmer 2005; Kozlowski 2002).

(Conner et al., 1997; Eclan & Pezeshki 2002; Middleton 2000; Pezeshki et al., 1999), *T.distichum*

– *T.ascendens* (Fisher & Stone 1990).

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. Crawford & Tyler (1969)

(Megonigal & Day, 1992;

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T.distichum

Na⁺ Cl⁻

(Pezeshki et al., 1987; Keddy et al., 2007),

(DeLaune et al., 1987; Desantis et al., 2007; Pezeshki et al., 1987; Williams et al., 1999).

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T.distichum

Na⁺

T.distichum

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T.distichum

(McKnight et al., 1981; Hook, 1984; Brown & Montz, 1986; Kludze et al., 1993; Keeland, 1994; Souther & Schaffer 2000; Pezeshki 2002;).

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Na⁺, Cl⁻

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T. distichum,

(Brown 1981; Nessel et al., 1982;

Lemlich & Ewel, 1984).

Ewel & Parendes (1984)

T. distichum

(Ewel & Parendes, 1984).

Taxodium Rich.,

T. distichum *T. mucronatum* .

(2012) ,
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Taxodium
T.distichum, 23.33 μm
, a 22.33
 μm , *T.mucronatum*
17.38 μm , 17.55 μm
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, *T.distichum*
1-15 , ,
T.distichum, 15-30 .
, - *T.distichum*
, *T.mucronatum* .
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2-4, .
, *T.distichum*
(1481.7 μm) *T.mucronatum* (1447.5 μm).

T.distichum

Taxodium

Taxodiaceae

(Esteban et al., 2002).

Lang (2000)

—

() () ,

(Eamus, 1999).

(Chabot & Hicks, 1982).

(Chabot & Hicks, 1982).

(Parrish et al., 1998).

2.2.

Taxodium,

Taxodiaceae. Visscher & Jagels (2003)

Taxodiaceae

Metasequoia Miki. *Glyptostrobus*

Endl.,

(Florin 1952; Momohara 1994;

Kumagai et al., 1995; Stockey et al., 2001).

()

(Henry &

McIntyre, 1926; Li, 1957; Bartholomew et al., 1983; Basinger 1991; McIntyre 1991).

Basinger (1991)

Glyptostrobus

Metasequoia.

Taxodiaceae

(Greguss 1955; Panshin &

DeZeeuw 1980). Gromyko (1982)

Visscher &

Jagels (2003)

:

Glyptostrobus pensilis Endl. – _____:

45 µm,

1-3

, 1-6

Metasequoia glyptostroboides Hu & W.C.Cheng — _____
 _____:
 _____:
 1-4
 1-5
 38
 69 μm,

Taxodiaceae.

mm² 772 *Metasequoia*, 1400
Glyptostrobus,
 (Greguss, 1955), 1300, 2200 mm² –

(Visscher & Jagels, 2003).

Glyptostrobus),

(*Metasequoia* ,

Taxodiaceae,
 Endl. *Taxodium*,
 DeZeeuw, 1980).

Sequoia
Torreya Arn.(Panshin &

Panshin & DeZeeuw (1980)

(*Sequoia* Endl.)

(*Taxus* L.).

(Liang et al., 1948; Gerry 1950; Greguss 1955; Schönfeld 1955)

Metasequoia.

(Jagels et al., 2001; Tabarsa & Chui, 2001).

Pinus densiflora

Siebold & Zucc., Yamamoto (1982)

Nakaba et al., (2008)

(Imai et al., 2005; Nobuchi & Harada, 1985).

Denn & Hale (1999),

Nothofagus nervosa Popp. & Endl.,

- .
 ()
 ,
 , *Alnus glutinosa* L. *Betula pendula*
 Roth., -
 , e .
 Jorge et al., (2000)
 () *Eucalyptus globulus* Labill.
 ,
 .
 - ,
 .
 Hudson et al., (1998)
 :
 - ;
 , ;
 , ;
 - , ;
 , ;
 , ;
 , ;

Villagra & Junent (1997)

Fabaceae - Prosopis alpataco L.

P.argentina -

P.argentina ,

. *P.alpataco*,

Cochard & Tyree (1990)

()

Quercus rubra L. *Q.alba*.

1/3

, 70 %

4 cm.

, 10 %

20 cm.

4 cm

30 %

Acer saccharum

Marsh., *Rhizophora mangle* L.
1988b; Sperry & Tyree 1988),

Cassipourea elliptica Aubl. (Sperry et al., 1988a,

2-3

Grabner et al., (2005)

Larix decidua Mill.

L.decidua. *L.decidua*
(Dix & Roffael, 1994),

L.decidua

. Kuo & Arganbright (1980)

Cote et al., (1966)

Wardrop & Dadswell (1953)

(Wimmer, 2002).

Rathgeber et al., (2006)

Pseudotsuga menziesii Britt.

1/3

μm 24 μm),

(38 μm 32 μm).

15 %

(45

(1959),

Abies pectinata DC,

:

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-

,

,

(1959)

- *Picea abies* (L.) Karst *Abies pectinata* DC -

.

:

-

,

(1959)

(*Picea abies* (L.) Karst, *Abies pectinata* DC *Pinus nigra* Arn. var.
goensis)

2.3.

Villar-Salvador et al., (1997)

Quercus coccifera L. *Q.ilex* .

(Leal et al., 2004). Garcia-Gonzales & Eckstein (2003)

(Giantomasi et al., 2009).

Martel et al., (2008)

. Riding & Little (1986)

(Zimmermann & Brown 1971;

Kozlowski & Pallardy, 1997; Vaganov et al., 2006).

(Larson, 1969; Aloni 2001)

, (Tuominen et al., 1997; Uggla et al., 1998).

, – Rossi et al., (2006b)

, Lachaud (1989)

Rathgeber et al., (2011)

, 75 % , 25 %

Nakaba et al., (2006)

Abies sachalinensis F.Schmidt

(). ,

– 1.

, 2.

, 3.

, (Fukuda 1997, 2004; Fukuda & Komamine 1980).

Nakaba et al., (2006)

10

11-

Gri ar et al., (2005)

()

(4 mm),

(1-4 mm),

(1 mm)

Abe & Nakai (1999)

Cryptomeria japonica D.Don

Cupressaceae.

(Larson 1963; Shepherd, 1964; Zahner et al., 1964; Scheriff & Whitehead, 1984).

Sheriff & Whitehead (1984)

(Klepper

et al., 1971; Molz & Klepper, 1973).

Kalliokoski et al., (2013)

P.abies. (Kukkola & Saramaki, 1983; Ingerslev et al., 2001)

(Makinen et al., 2002a; Jaakkola et al., 2005, 2007). Brix
& Mitchell (1980)

P.menziesii

(Rossi et al., 2009; Dufour & Morin, 2010; Seo et al., 2010),

(Rötzer et al., 2004; Jackson 2009; Körner & Basler 2010).

(Oribe et al., 2001; Begum et al., 2007;

Rossi et al., 2007, 2008b; Balducci et al., 2013).

Rossi et al., (2011)

Picea mariana Mill.,

(Rossi et al., 2008a; Rathgeber et al., 2011)

(Rozas et al., 2009; Vieira et al.,

2009).

(Giovannelli et al., 2007; Camarero et al., 2010).

Balducci et al., (2013)

P.mariana,

(McDowell, 2011).

Kalliokoski et al., (2012),
Deslauriers et al., 2008)

(Begum et al., 2007, 2010;

Rossi et al., (2008 b)

(Hofgaard et al., 1999; Tardif &
Conciatori, 2001; Huang et al., 2010).

(Larson, 1994).

Dufour & Morin (2012)

Dufour & Morin (2012),

88 %

12 %.

P.abies

(Mäkinen et al., 2003).

(Vownickel et al., 1975; Goulden et al., 1997; Goudiaby et al., 2011).

P.mariana (Vincent et al., 2009),

(Tang et al.,

1999).

(Dufour & Morin, 2012),

(Abe & Nakai, 1999).

(Lachaud, 1989).

()

(Larson, 1963).

(Larson, 1960).

(Jayawickrama et al., 1997)

Pinus strobus L.

(Zahner, 1963).

- Zahner (1963)

Whitmore & Zahner (1967)

Van der Burgt (1997)

(

)

4.25.

e ,

Priya & Bhat (1999)

Tectona grandis L.

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(-),

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3-4

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-

,

- Liese et al.,

(1975)

Picea abies

-

. Duenisch et al., (1996)

,

P.abies

< 1 mm.

(Eckstein et al., 1981; Aszmutat & Knigge, 1987; Nimmann & Knigge, 1989).

. Schweingruber (1980)

2.4.

Taxodium Rich.

2.4.1. *Taxodium distichum* (L.) Rich.

1-3 m, 5 m. - 30-50 m

1-2 cm 1-2 mm,

3.5 cm. 1 - 2-

5-10 mm (*Taxodiaceae*) 3-5

6-9 ().

(T.distichum

var.imbricatum),

- *T.distichum*

760 mm 1630 mm

500 m

50 m,

T.distichum

T.ascendens Brogn.

T.distichum

30

1-3

T.distichum

20-75 cm

T.distichum

60

75-100 cm

30- cm,

60

20-75 cm.

2-4

, 21 m 41.

36 m 96.

3 m 5.

200

T.distichum

1000

T.distichum

T.distichum

Stereum taxodii

marginalis Archips goyerana

Systema

T.distichum

1000

m3/ha.

Stereum taxodii

2.4.2. *Taxodium ascendens* Brogn.

T.ascendens *T.distichum*

.

T.ascendens, -

T.distichum ,

T.distichum .

T.ascendens , *T.ascendens*

T.distichum ,

,

,

T.ascendens

T.distichum. T.ascendens ,

25 m,

2.3 m.

T.ascendens

-

T.distichum

T.distichum. 30 m.

T.distichum,

,

,

,

.

T.ascendens ,

,

, *T.distichum*

,

.

T.ascendens

2.4.3. *Taxodium mucronatum* Ten.

- ().

30-45 m.

T.mucronatum

, *T.mucronatum*

().

2.5.

Taxodiaceae F.W.Neger

Taxodiaceae

(1967).

Taxodiaceae 10 : *Taxodium* Rich., *Sequoia* Endl., *Metasequoia* Miki, *Sequoiadendron* J.Buchholz., *Sciadopitys* Siebold & Zucc., *Glyptostrobus* Endl., *Cryptomeria* D.Don, *Athrotaxis* D.Don, *Taiwania* Hayata, *Cunninghamia* R.Br.

30-100 μm , 6-24 μm .
 35-90 μm , 35-75 μm .
 1-5 μm , 5-10 μm .
 1 mm^2 – *Taxodium distichum*
 (L.) Rich. 300-500, 1000
 1 mm^2 . *Sequoia sempervirens* Endl.
 500-1150, *Cryptomeria japonica* D.Don 2000-3600,
Taiwania Hayata. 5000 mm^2 .

9 22 μm (, 1967).

(*Cryptomeria* D.Don, *Sequoiadendron* J.Buchholz),
 4 (*Taxodium distichum* (L.) Rich).

Taxodium *Sequoia*.

Sciadopitys.

Taxodium

Sequoiadendron giganteum.

(*Sequoia*)

(*Taxodium*).

– *Sequoia*

1-30, *Taxodium* 1-60

– *Sequoia* 30-40,

Taxodium 50-60 1 mm²

2.6.

Taxodium Rich.

Greguss (1955)

Taxodium.

2.6.1. *Taxodium distichum* (L.) Rich.

_____ – ().

(),

¼

_____ —
 2
 ()
 30-100 μm, 6-24 μm.
 1 mm² 200-300, 500.
 ()
), 1-20, 30
 50-60 1 mm²
 2-8

2.6.2. *Taxodium ascendens* Brogn.

_____ — ()
 (*Taxodium distichum*),
 20-
 30 %
 ()
 _____ —
 22-40 μm,

1 mm²

500.

1-12,

20-26

8-10

1 mm²

65-70.

2-4,

3.

~ ,
 :
 ~ — ,
 ~ , ,
 ~ ,
 ~ ,
 ~ (mm²,)
 ~ mm²
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5.

5.1.

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1169. 1172. km

501-362/05-XIII-01 08. 2005. (,
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72 m ,

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(,) ,
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10 m

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11/a,

0.22 ha

82 m.

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1942.

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(1970)

(1951),

, 1949.

,

6

,

(2011.), 70 . ,
1 ha,
300 , 2/3 – 111 .
1970,
80 cm,
(
, 1970).
- *Salicetum albae* Issler 1926,
myosotietosum,
(1965).
Salix alba L., *Salix fragilis* L. *Salix triandra* L.,
(
, 1970).
60-90 cm,

5.2.2.

(.2 3),
()
m) (1.3 m) (.10 a). (0.3
cm. 2
n-



.1.



.2.)



;)
(;))



;)



.3.

5.2.3.

, .

:

- 105 °C 6 8 ;

-

, ttebergu,
2-0,2 mm, 0,2-0,06 mm, 0,06-0,02 mm,
0,02-0,006 mm, 0,006-0,002 mm od 0,002 mm;

-

;

- (pH H₂O)

pH- ;

- (pH 0,01M CaCl₂)

pH- ;

- Kappen-a;

- (S $cmol*kg^{-1}$)

Kappen-a;

- (T $cmol*kg^{-1}$)

;

- (T-S $cmol*kg^{-1}$)

;

- Hissinku (%);

- Kjeldahla (%);

- (C:N) ;

- P₂O₅ K₂O (mg/100) Al-

5.3.

8 mm.

5.3.1.

5.3.2.

1 n,

8 mm,

2 cm.

„Reichert“.

15-20 μm .

(50%, 70 %, 96 % 100 %-).

„Digimizer“

400 ,

5.3.3.

120

60

60



. 4.

(400)

20

, 20

20

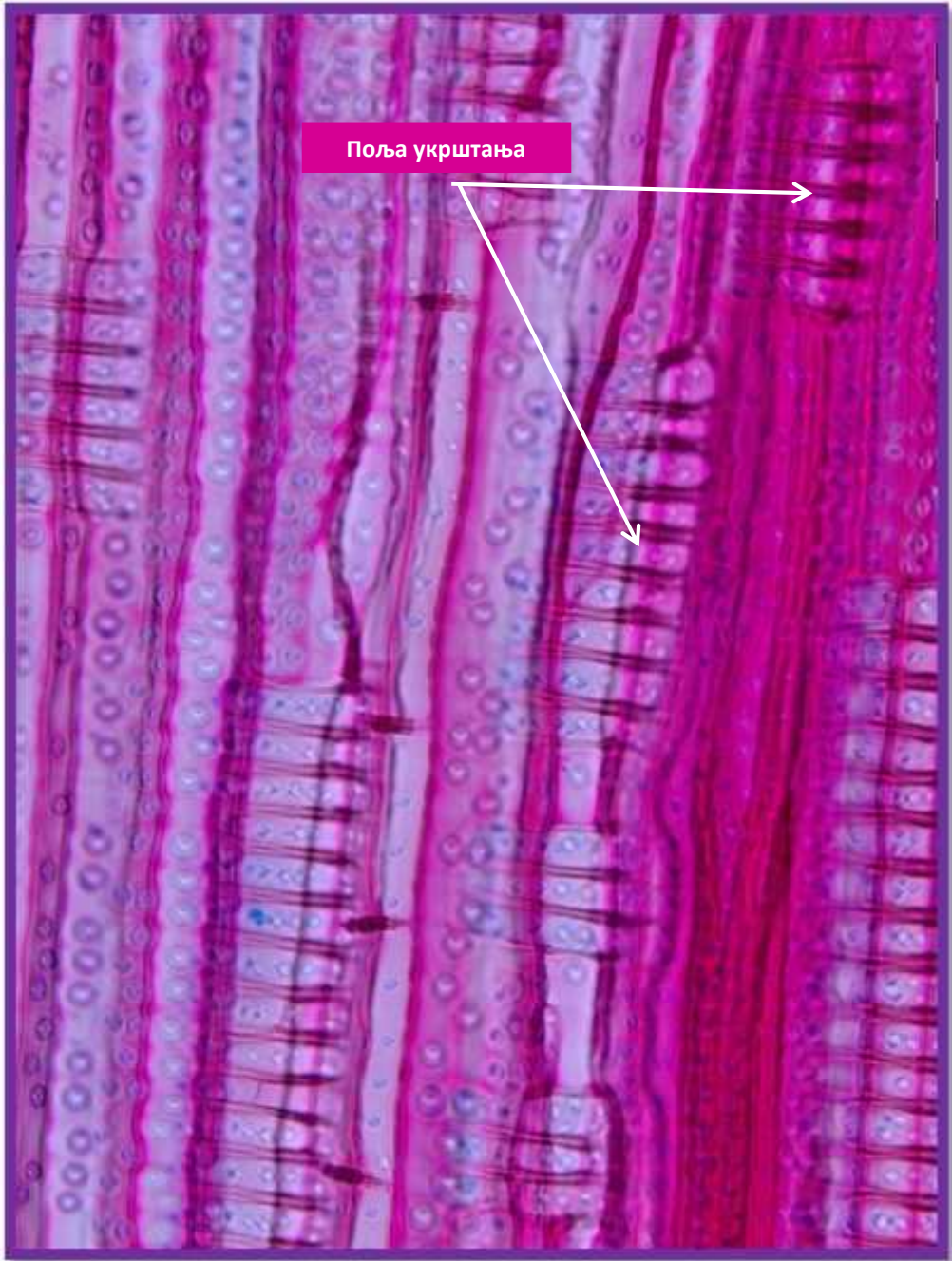
μm.

(.4).

5.3.4.

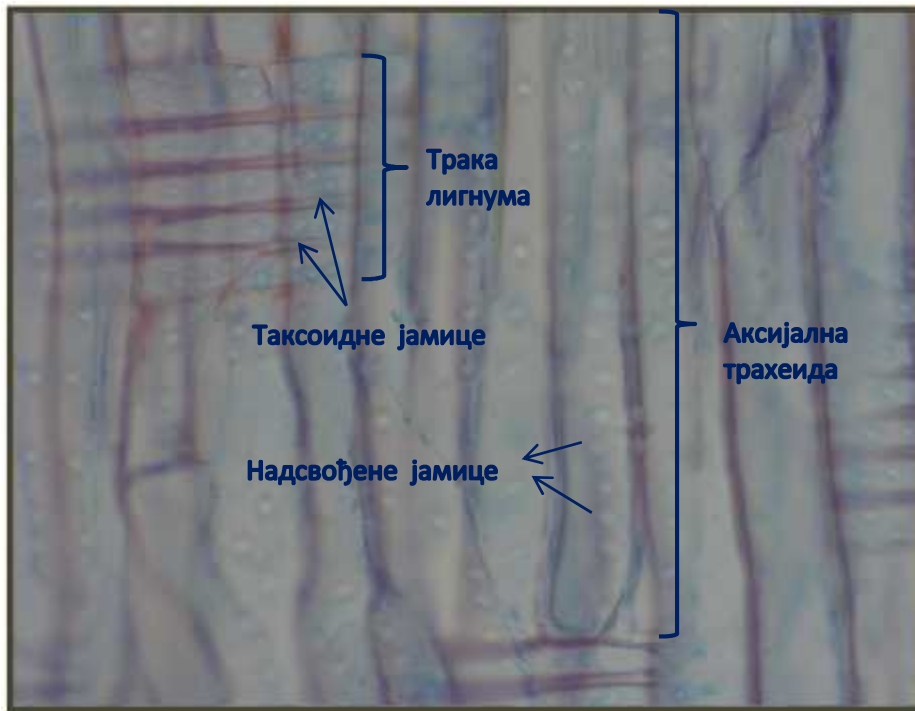
mm²

60



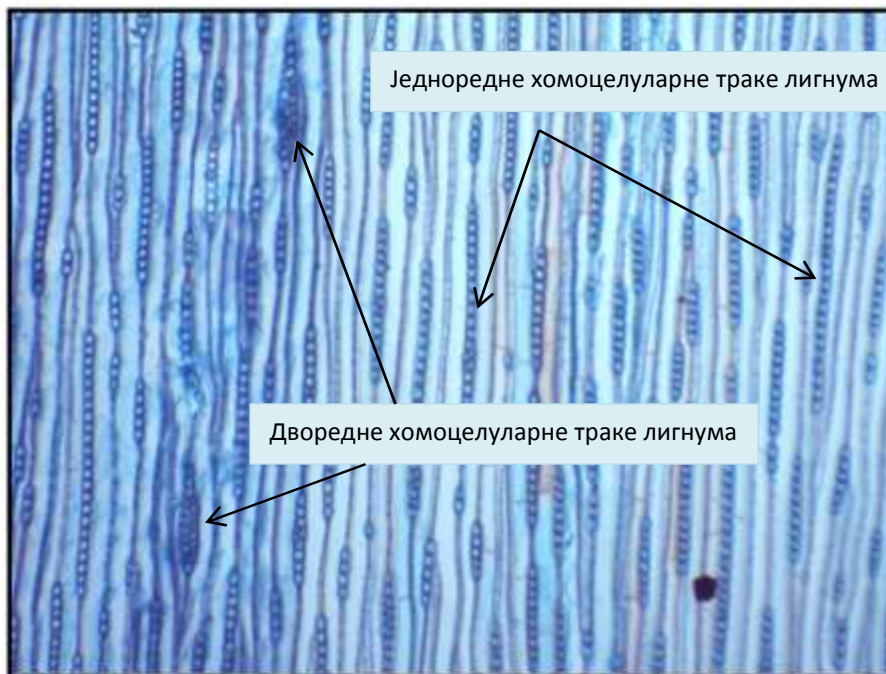
.5. ((400))

, mm² (.5, 6 7).



.6.

(400)

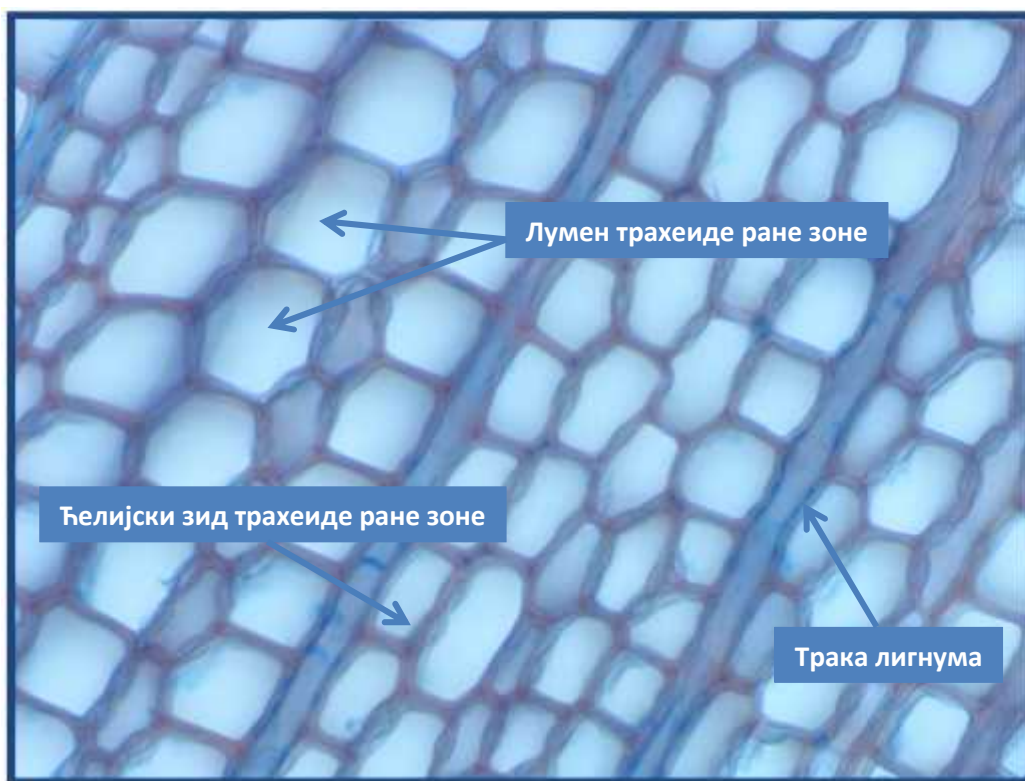


.7.

(100)

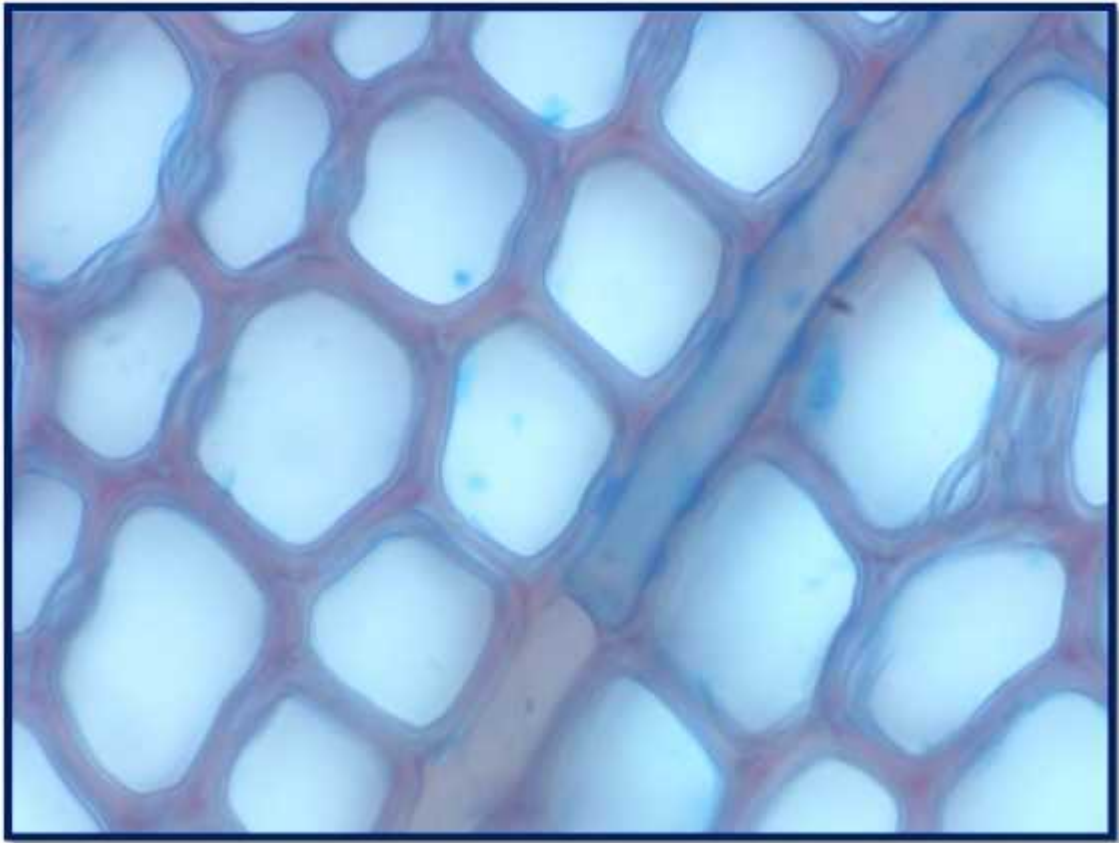
5.3.5.

— 60 60
(.8 9). μm .



.8:

(400)



.9:

(1000)

5.3.6.

mm²

1 mm² (.8 9).

6 (3),

1 mm²,

5.3.7.

.11). , (.10 , , 4 - , , ().

50 cm³

1:1.

65 °C

24 .

50 %-

()

40 .

(.14 14).

4

: 5-14, 15-24,

25-34, 35-44, 45-54,

74

55-64,

65-74.

60 ,

(. 12 13).

1-6, 7-16, 17-26 27-36, 1-4, 5-14, 15-24 25-34, 1-4, 5-14, 15-24 25-29.

1-

4

(.12 13).

5.4.

, , (,), (,), : , , . (, 2015).



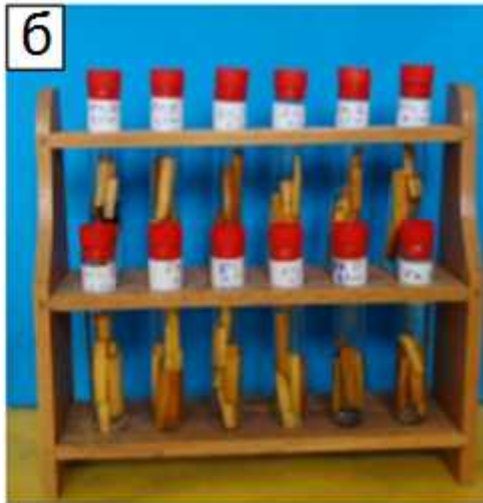
.10.) ;)

;) ;)



а

.11.)

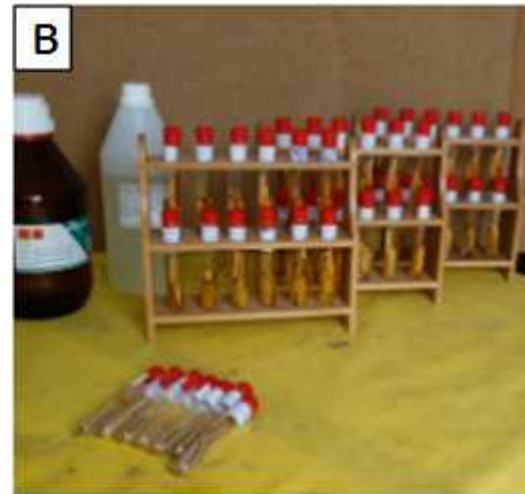


б

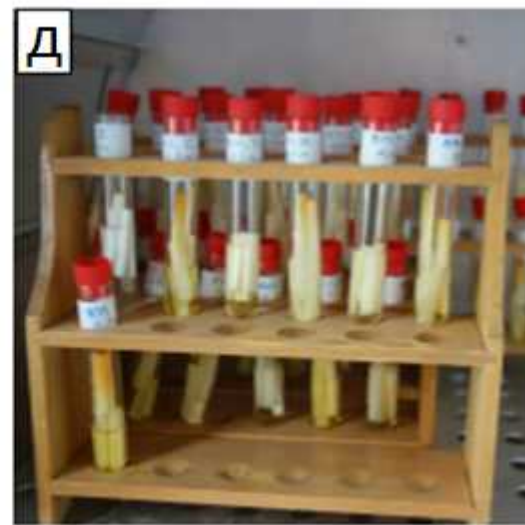


г

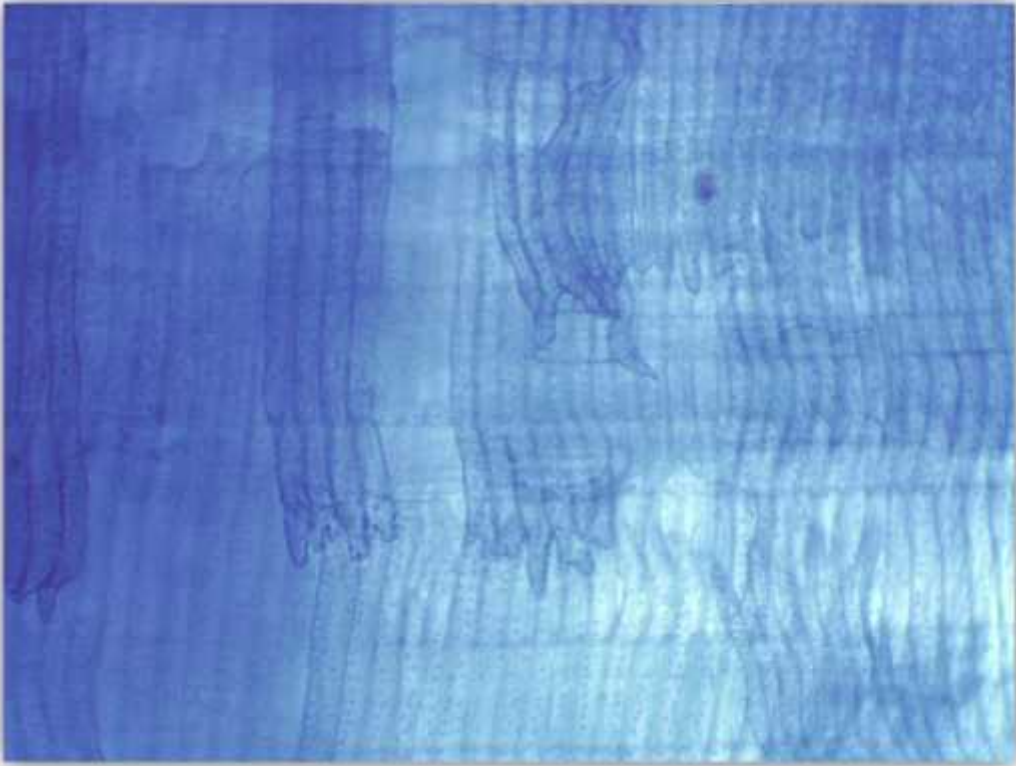
;))
;)



в

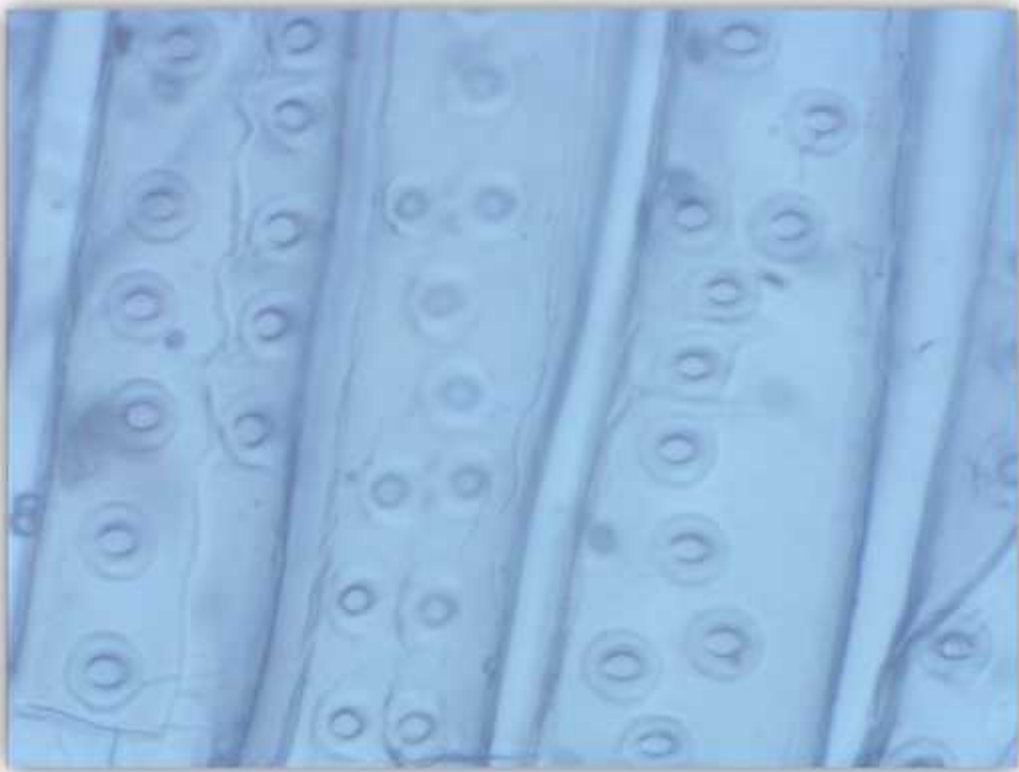


д



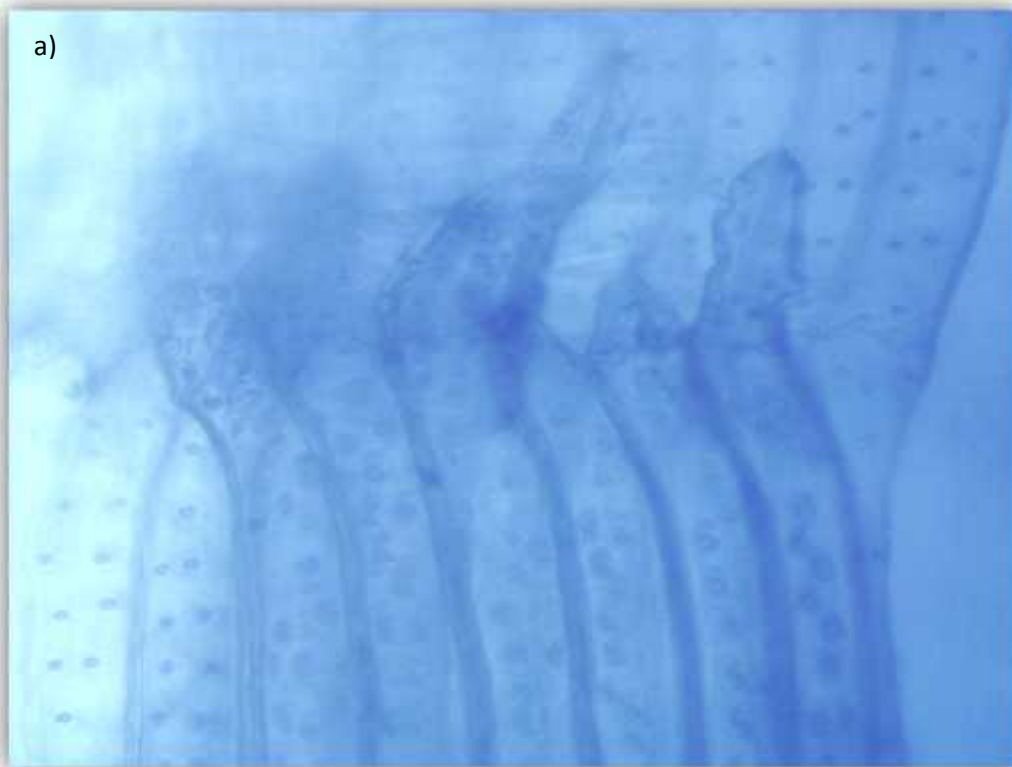
. 12:

(40)



. 13:

(400)



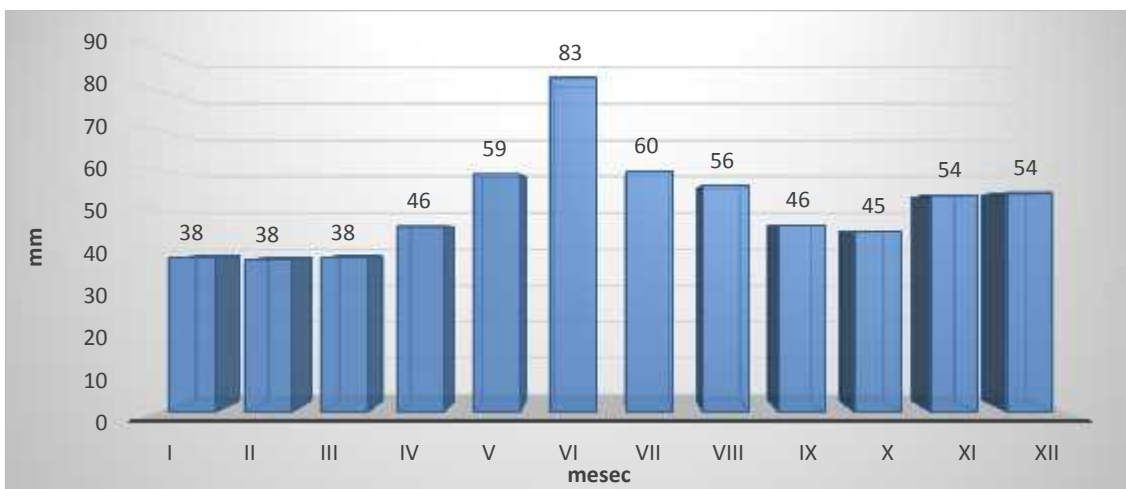
. 14: a) (100) (400)

6.

6.1.



ja a .1 e e e e e e e a e a a o o o j a . e o a (1949-2011)



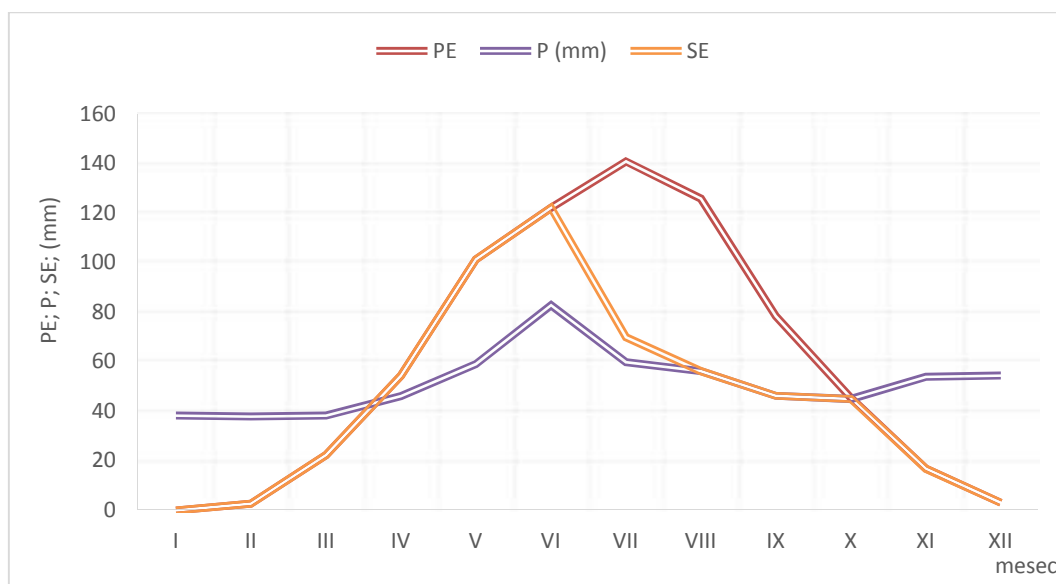
ja a .2 e a a a a o o o j a . e o a (1949-2011)

Thornthwaite-Mather

Ta e a . 1 a o Thornthwaite-Mather-u a a (1949-2011)

	T °C	PE	P (mm)	SE	M	V
I	-0,33	0,00	38,29	0,00	0,00	26,72
II	1,51	2,75	37,86	2,75	0,00	35,11
III	6,13	22,41	38,32	22,41	0,00	15,91
IV	11,71	54,41	46,10	54,41	0,00	-8,30
V	16,93	101,33	59,05	101,33	0,00	0,00
VI	20,03	122,16	82,89	122,16	0,00	0,00
VII	21,59	140,94	59,81	69,97	70,97	0,00
VIII	21,04	125,99	56,21	56,21	69,78	0,00
IX	16,73	78,51	46,34	46,34	32,17	0,00
X	11,44	45,40	45,00	45,00	0,40	0,00
XI	6,12	16,78	53,85	16,78	0,00	0,00
XII	1,62	3,08	54,45	3,08	0,00	0,00
O .	11,22	713,76	618,17	540,44	173,32	69,44
. .	18,00	623,33	350,41	450,41	172,92	-8,30

* . 1.
T (Te e a a); **PE** (o e ja a e a o a a ja); **P** (a a e);
SE (a a e a o a a ja); **M** (e o a a a e e); **V** (a a e e);



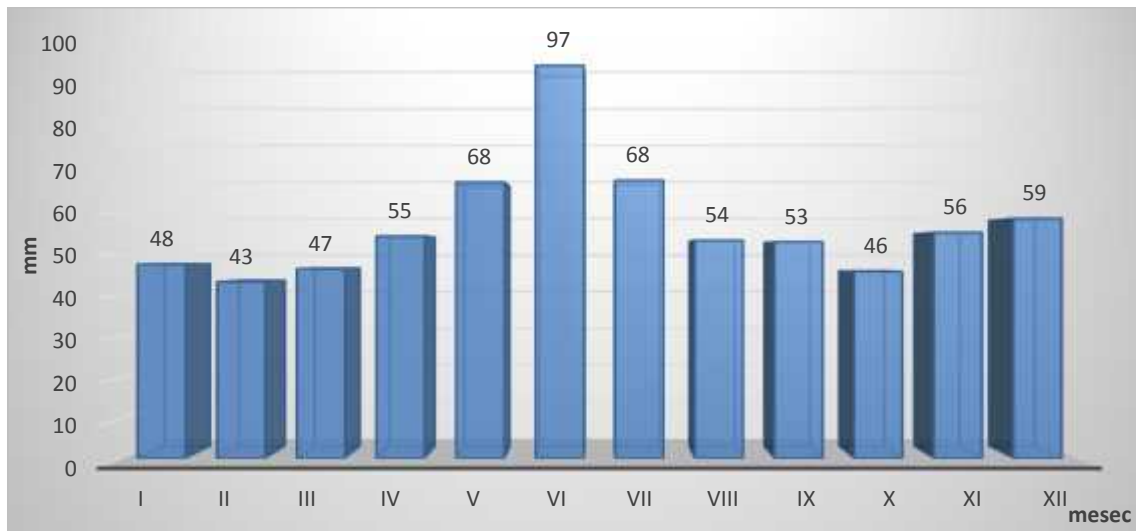
a ja a o Tornthwaite-Mather-u a a

11,2 °C,

18°C.



ja a .3 e e e e e e e a e a a o o oj a eo a
(1949-2011)



ja a .4 e e e a a a a o o oj a eo a
(1949-2011)

618,17 mm,

350.41 mm,

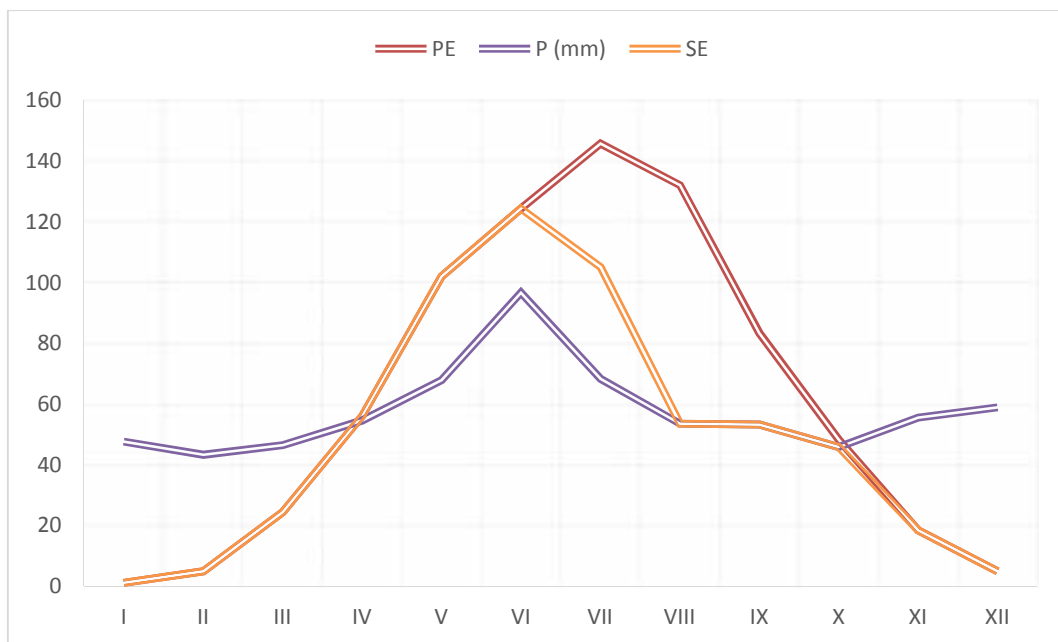
, 57 %

),
 Cl, e o 9,73, e
 a o 24,28 a e 4,84

Ta e a .2 a o Thornthwaite-Mather- a eo a (1949-2011)

	T °C	PE	P (mm)	SE	M	V
I	0,87	1,16	47,73	1,16	0,00	37,59
II	2,80	5,06	43,40	5,06	0,00	38,34
III	7,11	24,51	46,61	24,51	0,00	22,10
IV	12,56	56,11	54,70	56,11	0,00	-1,41
V	17,47	102,10	67,97	102,10	0,00	0,00
VI	20,65	124,44	96,77	124,44	0,00	0,00
VII	22,44	145,94	68,41	105,21	40,73	0,00
VIII	22,11	132,15	53,63	53,63	78,51	0,00
IX	17,99	83,47	53,28	53,28	30,19	0,00
X	12,58	48,36	45,92	45,92	2,45	0,00
XI	7,17	18,56	55,58	18,56	0,00	0,00
XII	2,74	5,05	59,05	5,05	0,00	0,00
O .	12,21	746,91	693,06	595,03	151,89	96,63
. .	18,87	644,22	394,78	494,78	149,44	-1,41

* .2.
T(Te e a a); **PE**(o e ja a e a a a ja); **P**(a a e);
SE(a a e a o a a ja); **M**(e o a a a e e); **V**(a a e e);



a ja a o Tornthwaite-Mather- a

(

),

 12.21 °C, 18.87 °C.

 693.06 mm,

 394.78 mm, 57 %

 - ,

 .

 C2, e o 12,94, e

 a o 20,34 a e 0,74.

6.2.

,

 (o et al.,

 1985). o a aj e o o e a je e o a o a e

 a ja a a e a o o a aj o a e o e.

 a e o a e e o a o a o e a e o a o a

 e o o o e a. e a o o a a a e a, o e a

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 a e a je e a a a o o a (A) - I - II - III o je

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 o o o e. o o a 4 a o ja a e a a e e o je o

 o e a o eja a. a a o o a e e e oj a oj

 a o j a o o o o aj a a o a o a a o a o e e

 o e a a a a e a. a aje a o a aj e a a e o

 o e o o , o o a a a a e a o a

 o a. O o a a o e o ja e e o o e a o .

 a a a e o a e a e je a a e o o a je o e o o a e a

 a e a a j o a e a e je.

 o a o a ja o a ja o e a-

 o a (o et al., 1985), a a o e a a o o e e a o o

a aja a o a a. a o e a e a a e o o e a o a e e o
 o o a. o 1, 2 3 a o ja a o O a a a o o
 a aj a o a o o , a je e e e o o, o a o a a.
 a o ja a e a a e (.4) a a
 o : a o a o , o eje o oj je o a a e . e a
 a o oja e o e a a a je e e. a je e je e e o , o a
 e o a, a e je e o a a a o o a a o ja e o a o
 o a.
 o o a o e e o e e e a o a e o a o
 a o e a o o a e ja a. o a o a (o : 1, 2, 3 4)
 e e a oj a a a o j a, o o o e o e oj a o
 a je o-a a o o o o 10-15 cm.
 o e a e a o j e e o o o a , o a o
 o a o e o e a a a o (a e a .3). O o a o a
 e e o a a o ja a o o a je je a e o e o a a a
 e o o o a. e a o a a o a a ja a o e a,
 j e a aj e e o 46,60-79,40%. a e a a o e e je
 a j o a e a o o a o a o e o a.
 e e oj a oj a o ja a e a a e, o o o o aj
 a a, o a o a a o a o e e o e a a a a e a.
 a aje a o a aj e a a e o o e o o ,
 o o a a a a e a o a o a. O o a a o e
 o ja e e o o e a o . e a o a o e o
 o a o o o oja e o e a o eja a a. o e o a a e e
 (o 4), a a e o oj o a , o o e e je a j
 a a o a o a e a o e o o e e o e. a aj
 e a e o e a a, a a aj e a je a o o a.

Tabela 3. Temperatura oaze a

a	a	a	a	a	a	a	Te
(cm)	%						a a a
e o a o o							
e o o o oj 1							
0-10	1.90	51.50	23.90	22.70	53.40	46.60	e o a o a a
10-40	1.40	51.70	22.20	24.70	53.10	46.90	e o a o a a
40-70	0.30	79.40	7.70	12.60	79.70	20.30	e o a o a a
e o o o oj 2							
0-10	2.70	46.60	24.20	26.50	49.30	50.70	o a a
10-40	1.90	48.40	24.80	24.90	50.30	49.70	o a a
40-70	1.20	50.50	22.50	25.80	51.70	48.30	o a a
e o o o oj 3							
0-10	2.70	47.70	23.60	26.00	50.40	49.60	o a a
10-40	1.50	48.60	22.20	27.70	50.10	49.90	o a a
40-70	1.30	49.90	22.30	26.50	51.20	48.80	o a a
a a a a a*							
e o o o oj 4							
0-15	1.50	59.80	19.30	19.40	61.30	38.70	e o a o a a
15-40	0.30	90.30	2.90	6.50	90.60	9.40	e a
40-100	0.20	84.80	7.00	8.00	85.00	15.00	o a e a
> 100	0.20	82.20	9.10	8.50	82.40	17.60	o a e a

* : , . (2014)

ea ja e o a o a o-a a o o o je
 e e o a a a, a oje a e a o ja o a a a (a e a .4).
 To je o e a a o o a o a a, j e a aj o e a a a
 o o a. o A- o o , o o e o a a
 o ja e o a o o a, a o a , o oje eo a
 a o a (a e >13 % CaCO₃). o o a oj je o e a o j
 a e a a e, o A- o o je aa o a o a a , o
 oje a o a .
 o-a a o o o e o a ja o o o
 ja o . a o e o o a a aj a ja o o a a a a
 e e a 0,41-3,47%. a aj o a o a je a a a a je
 a. O o C/N o o a a o ja e o a o o a je a

a je a o o a o a j o a e a e je. Me , o o e o
 e a a o ja a e a a e o o e a a o a je e o a o . To
 a a je o o a a e a a a o a a o a e a e je
 o e o, e a o a a e o a e a o a o , e
 o a a a je o o e e o e a . o a o a, o
 a a e e a je e a a a a e o a o a o a o e a e a o a je
 o a a a je. o a a e o o a a
 a o a o a e j o o e a o a o a. e j o a
 o a e a e je a a a a o j a, a o e je e o o a o a e a
 a a e o e a o a a o a.

Ta e a .4. e j a o j a o a a e a

a	pH		CaCO ₃			C/N	a o a	
	H ₂ O	KCl			N		P ₂ O ₅	K ₂ O
cm			%				mg/100g	
e o a o o o								
e o o o o j 1								
0-10	7.40	6.99	7.64	13.93	0.88	9.13	38.18	25.22
10-40	8.00	7.22	13.50	1.50	0.39	3.84	11.25	10.87
40-70	8.01	7.53	13.49	0.65	0.27	2.42	5.94	5.65
e o o o o j 2								
0-10	7.42	7.01	10.06	8.61	0.96	8.96	25.07	27.47
10-40	7.85	7.32	13.38	1.55	0.38	4.12	10.48	13.68
40-70	7.96	7.30	15.47	1.12	0.29	3.91	8.64	11.90
e o o o o j 3								
0-10	7.44	7.00	8.82	10.05	1.02	9.85	38.18	31.00
10-40	7.62	7.17	12.63	3.47	0.64	5.39	25.76	21.62
40-70	7.69	7.19	14.02	2.69	0.54	5.02	20.14	18.17
a a a a a*								
e o o o o j 4								
0-15	7.91	7.54	5.62	9.76	0.40	14.22	23.43	11.54
15-40	8.83	8.38	8.43	0.41	0.01	18.41	1.04	2.68
40-100	8.83	8.31	10.68	0.41	0.01	17.87	0.00	2.02
> 100	8.66	8.00	10.24	0.48	0.01	20.40	0.00	1.70

* : , . (2014)

o o a o e a o j e o a o o a (a e a .4)
o e e e o a a a o a a j o o-a a o
o o je a a a e e, a oje a a a a e
o e e e o . e a o a a j a o-a a o o o je
o e a o o e a a je. o o a a o j a a e a a e
o e e e o a o a a j o je a a a e e (A- o o)
o a e o e e e o .

o a a a a o a o o o a o-a a o
o o , o o e o a, je a a a e o a o e
o e e e o . a o o e e e o a o a o o o a .
o o a 3 (e o a o o o), o e e e o je e o a o a e o
o o a, o je oje a o a 4 (a a a a a) a
o a e e e je aAL e o .

Ja o o e a a o a a a a o a o a o o a
o o o o e a e o e a e pH e o o o a
e oje e o a. o a a a a o a e a e je o o C/N
o o a a o aj e e a j e a aj j a a e
o o o a je, o o o e o e a e a o e a
a j o o a a a o e e a e o e.

6.3.

6.3.1.

T.distichum

.5).

.5. (mm)

			(mm)	(mm)	(mm)
	1	36	4.00	3.30	0.70
	2	34	3.85	3.18	0.67
	3	29	3.62	2.90	0.72
	1	54	7.63	6.76	0.87
	2	74	9.15	8.20	0.95
	3	74	9.35	8.68	0.67

Taxodium distichum (L.) Rich.



.15.

: 1 – 2.47 mm, 2 – 2.33 mm,
3 – 2.39 mm (.6).

, :

(. 16 17).

,

–

–

– (2010)

:

25.97 %, 24.10 %, 12.31 %, 15.89 %.

(1993)

%, 40.2 %, 36.2 42.6 %

45.8 %.

(2010) o

(),

(1993)

(2010)

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, , ,

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(, , , , P₂O₅ K₂O);

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,
(. 1-6).

Adamopoulos et al., (2009) ,

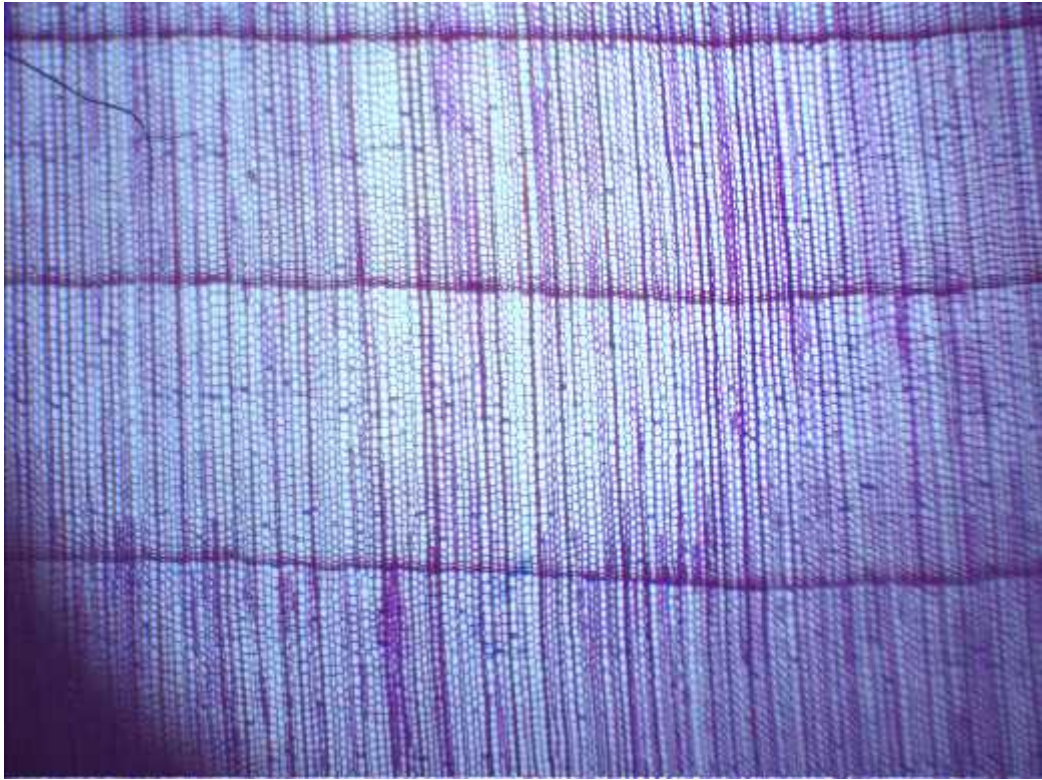
,
Pinus brutia T.,

2 m ,

,
.
,

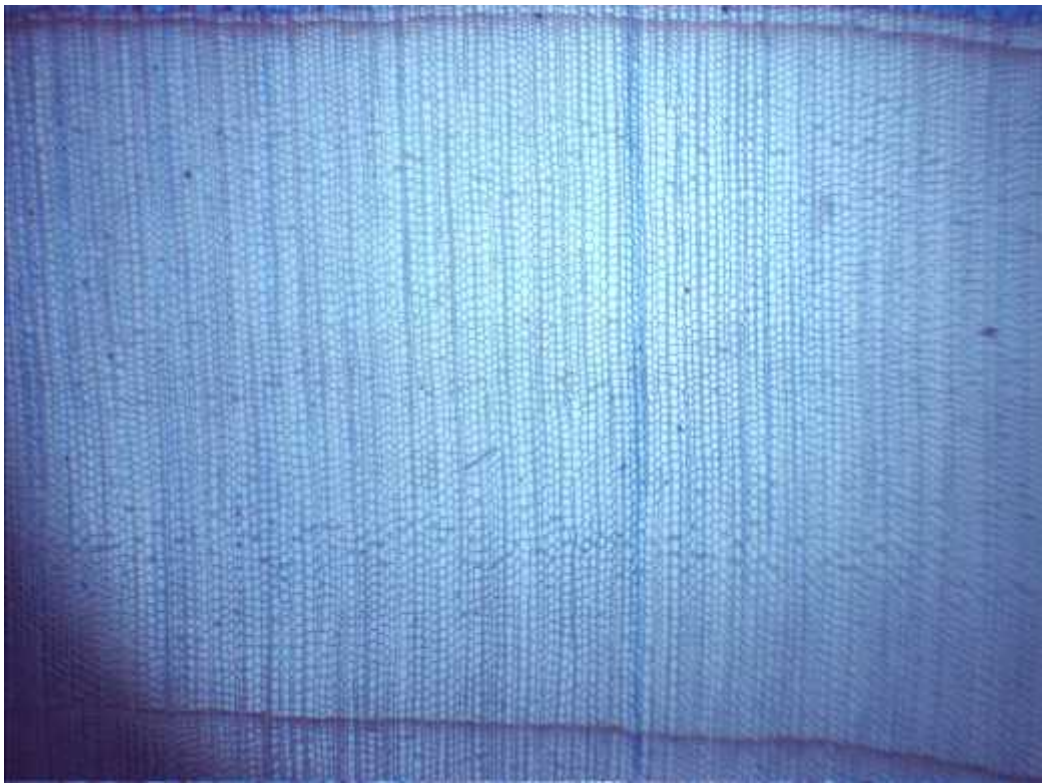
,

.



. 16.

(40)



. 17.

- (40)

- mm, 2.3 mm 5.3 mm 3.4
 - 5-9 ,
 - ,
 (Adamopoulos & Voulgaridis, 2002).
 , (Adamopoulos &
 Voulgaridis, 2002);
 Adamopoulos et al., (2009)
 ,
 (1-6),
 , 1.3 m ,
 (, Adamopoulos et al.,
 (2009)
 (-
),
 , Koga et al., (1997)
 , Megraw &
 Nearn (1972)
 , Moschler et al., (1989)
Pinus taeda L. ,
 .

Denne (Denne, 1989)

, Bannan (1967 a)

6.3.4.

(. 6).

. 6 :

		0.3 m (mm)	0.3 m (mm)	0.3 m (mm)	1.3 m (mm)	1.3 m (mm)	1.3 m (mm)
	1	3.43	1.76	5.76	3.10	1.48	5.41
	2	3.41	1.85	6.21	3.21	1.62	6.02
	3	3.29	1.99	5.08	3.11	1.86	4.95
	1	2.63	1.32	4.10	2.47	1.42	3.87
	2	2.51	1.56	3.92	2.33	1.41	3.77
	3	2.49	1.48	3.91	2.39	1.46	3.80

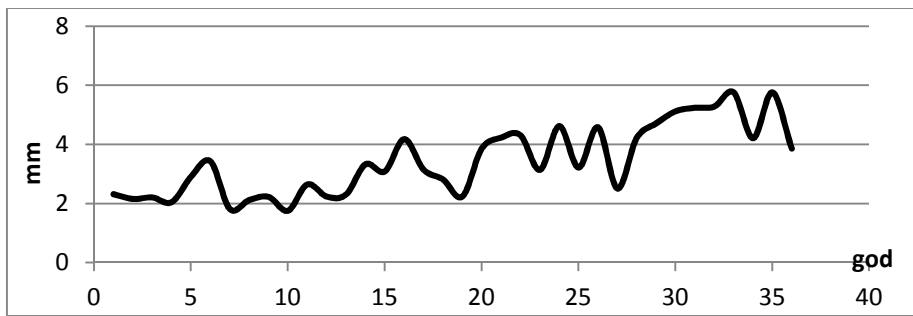
6.3.4.1.

0.3 m , 1
3.43 mm, 1.76 mm 5.76 mm.
10- , 33-
(.6).
2 0.3 m ,
3.41 mm, 1.85 mm, 6.21 mm.
7- , 34-
(.6).
3 0.3 m
3.29 mm, 1.99 mm,
5.08 mm. 10-
, , 29-
(.6).
1 1.3 m
3.10 mm, 1.48 mm, 5.41 mm.
10, 33 (.6).
2 1.3 m
1.62 mm 6.02 mm,
3.21 mm. 8- ,
, 34- (.6).
3 1.3 m ,
3.11 mm, 1.86 mm, 4.95 mm.
10,
- 29 (.6).
:

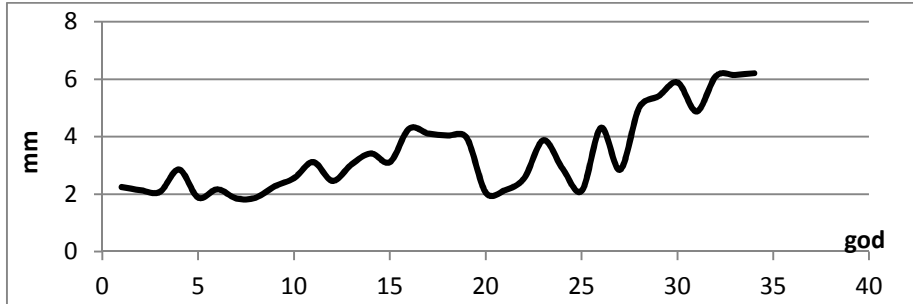
, 10- ,
 ;
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 ()
 30-
 (),
 ;
 - ()
 0.3 m 1.3 m
 , 2,

. 1-6,

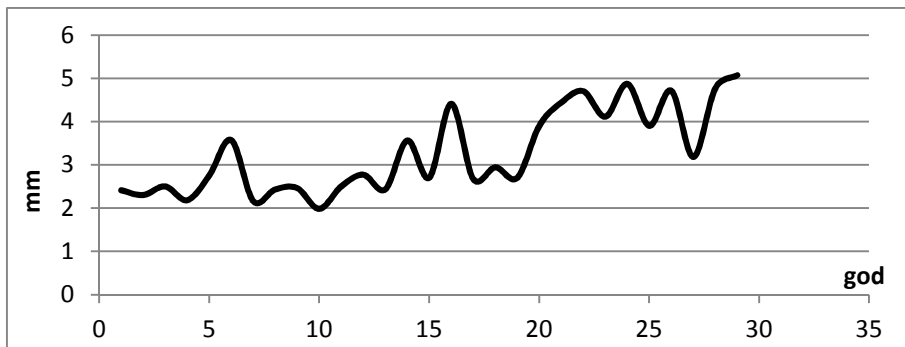
:



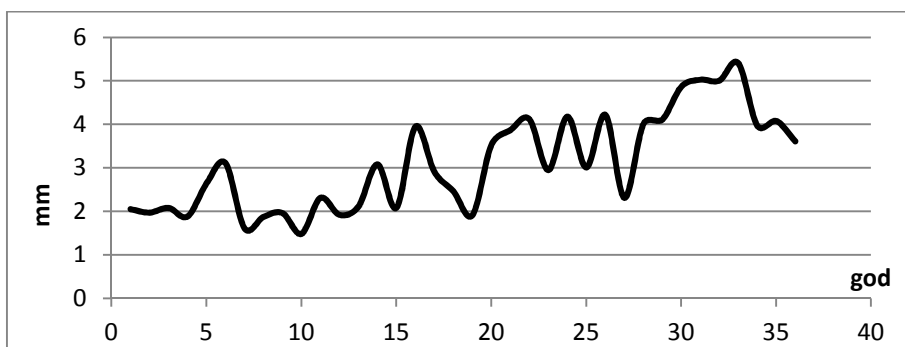
1. , .1 0.3 m



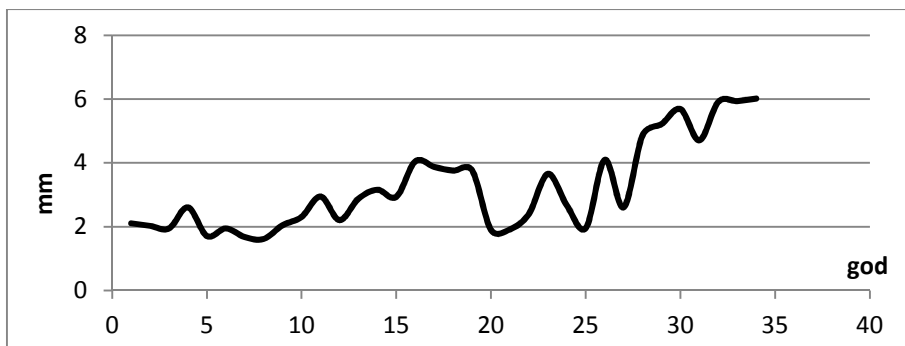
2. , .2 0.3 m



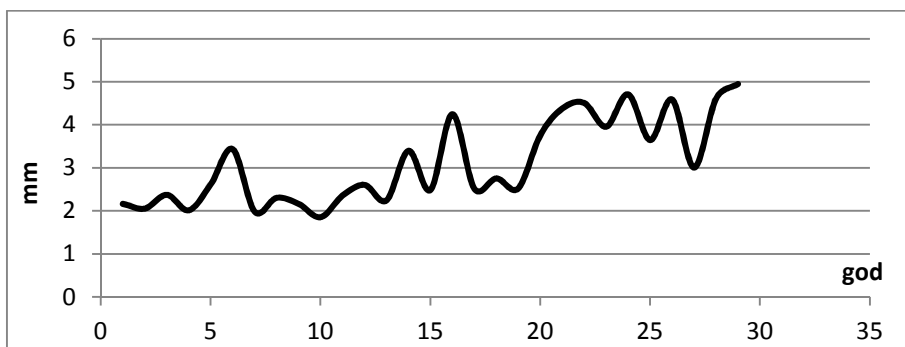
3. , .3 0.3 m



4. , .1 1.3 m



5. , .2 1.3 m



6. , .3 1.3 m

6.3.4.2.

1 0.3 m ,
2.63 mm, 1.32 mm, 4.10 mm.
4,
45 (.6).

2 0.3 m ,
2.51 mm, 1.56 mm, 3.92 mm.
, 74- ,
24- (.6).

3 0.3 m
2.49 mm, 1.48 mm, 3.91
mm. 73- ,
67 (.6).

1.3 m 1,
2.47 mm, 1.42 mm, 3.87 mm.
, 45- (.6).

2 1.3 m ,
2.33 mm, 1.41 mm, 3.77 mm.
, 74- , 24-
(.6).

3 1.3 m ,
2.39 mm, 1.46 mm, 3.8 mm.
73 , 67 -
(.6).

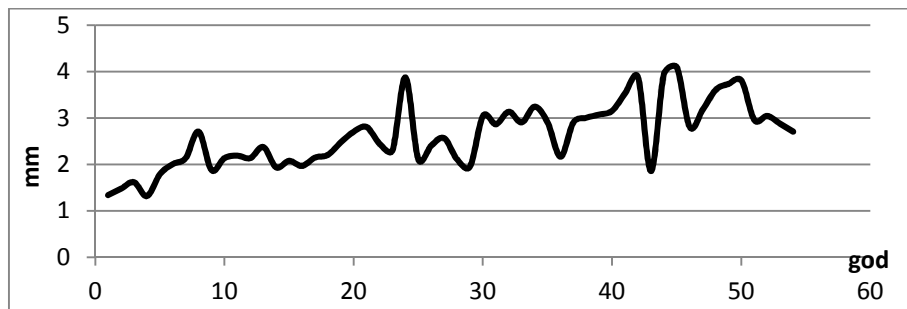
, :

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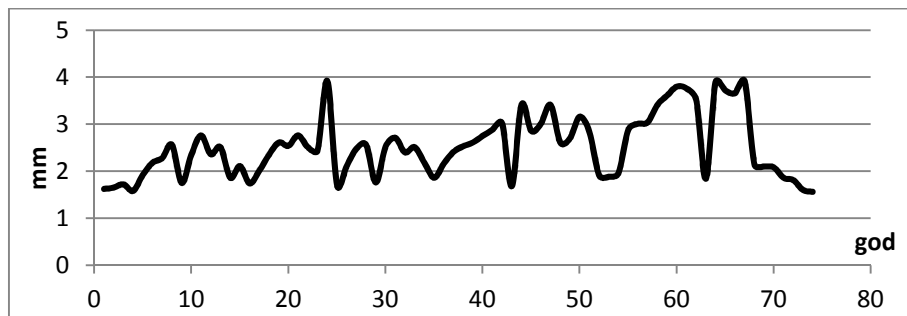
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- , , ,

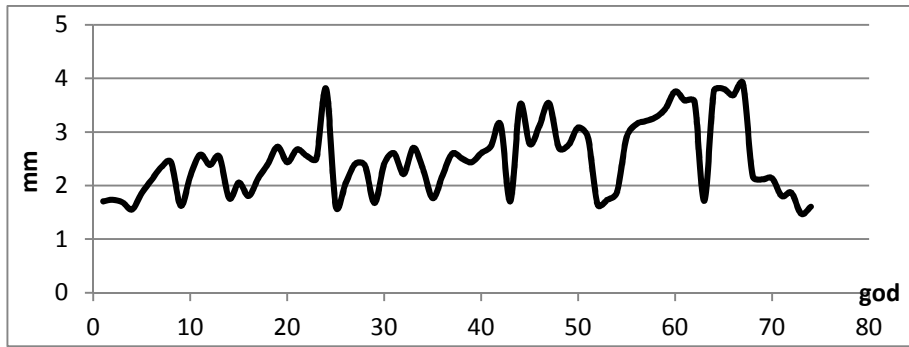
60-
(
).



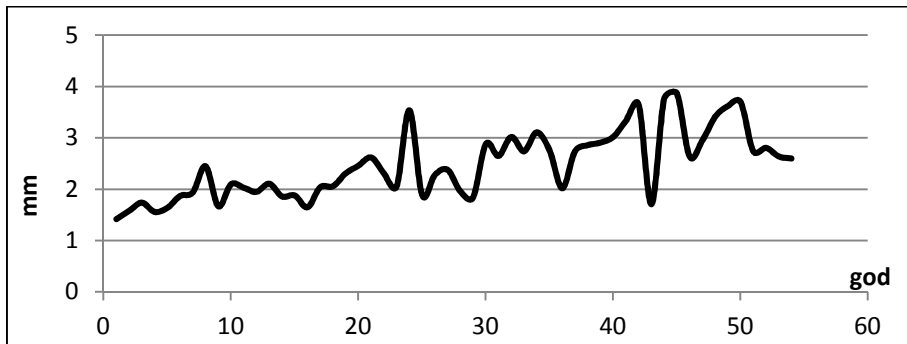
7. , .1 0.3 m



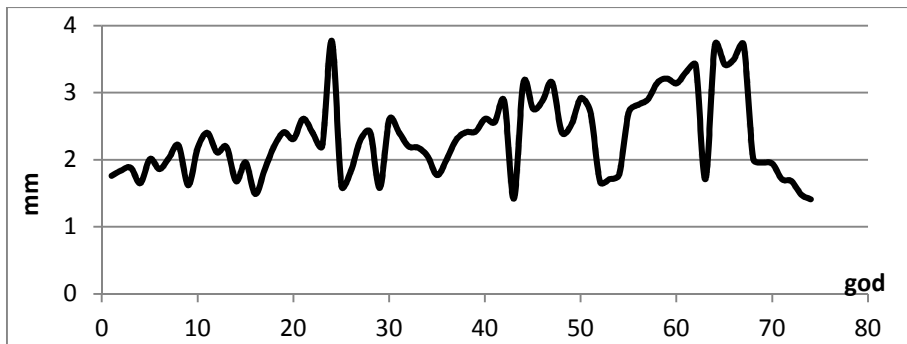
8. , .2 0.3 m



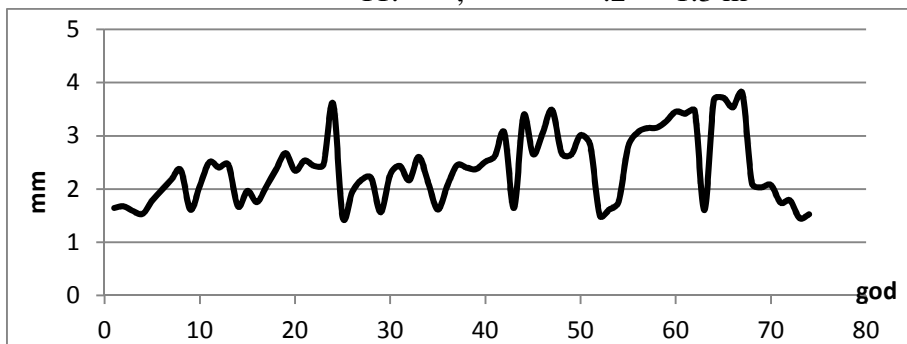
9. , .3 0.3 m



10. , .1 1.3 m



11. , .2 1.3 m



12. , .3 1.3 m

6.3.5.

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,
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- , , ;
- , , ;
- - , 0.3 m 1.3 m
,
.

6.3.5.1.

1 0.3 m ,
15.15 %,
5.18 % , 28.45 %.
, 36- (.13).
2 0.3 m
20.98 % . 4.19 % , 29.78 % .
- , 34.
(.15).
3 0.3 m
18.84 % , 3.74 % ,
28.51 % .

, ,
 , (.17).
 1 1.3 m
 11.78 %, 3.88 %, 21.32 %.

(.19).
 2 1.3 m
 13.96 %, 2.82 %, 22.27 %.

(.21).
 3 1.3 m ,
 13.36 %, 2.83 %, 21.20 %.
 -
 , . (.23).

6.3.5.2.

1 0.3 m 29.76 %, 14.75 %, 42.54 %.
 , 52. (.25).

2 0.3 m ,
 29.50 %, 12.82 %, 44.44 %.
 - (.27).

3 0.3 m
 30.31 %, 13.04 %, 45.03 %.
 - ,
 (.29).

1 1.3 m
22.22 %, 10.00 %, 35.21 %
(.31).

2 1.3 m
23.78 %, 7.09 %
36.36 % (.33).

3 1.3 m
25.90 %, 7.19 %, 36.97 % (.35).

1.3 m -

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-
,

1/3

” “,
2/3, 3/4
(, 1994; , 1988).

(, 1992);

(. 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33 35).

Adamopoulos et al., (2009)

()

- 17.6 %, 14.3 % i 12.3 %,

- 20.5 % 13.6 %.

2 m

(. 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33 35) –

Rao et al. (1997)

()

() ;

- (Gasson 1987; Lei et al., 1996)

,

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,

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(Zhang & Zhong, 1991)

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,

,

(Nepveu 1993);

- (. 14, 16, 18, 20, 22, 24, 26, 28, 30,
32, 34 36),

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- Adamopoulos et al. (2010)

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Wheeler (1987),

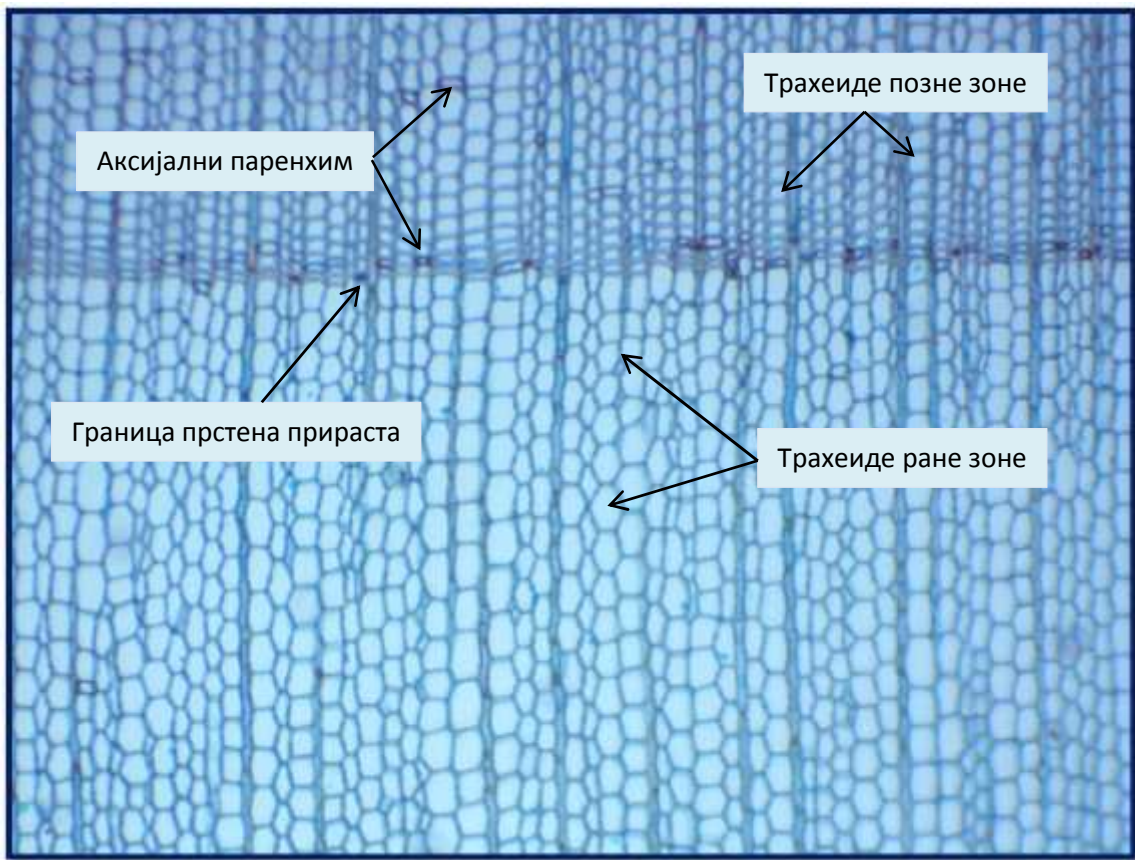
-

,

-

,

(.18).



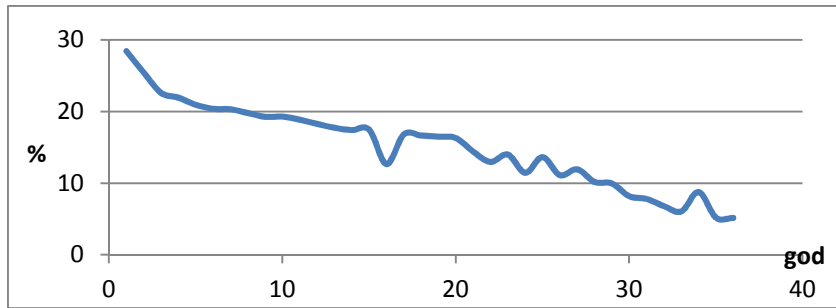
.18:

(100)

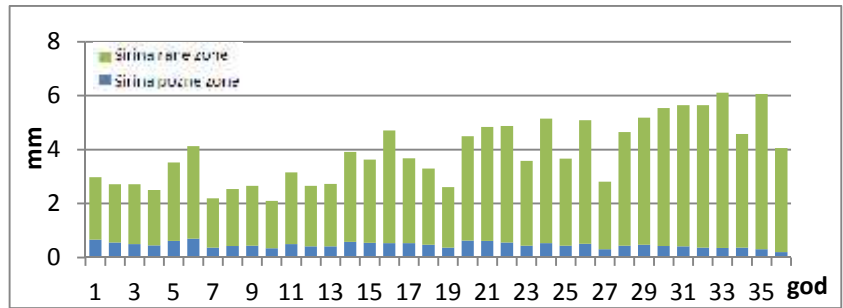
(13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33, 35),

(14, 16, 18, 20, 22, 24, 26, 28, 30,

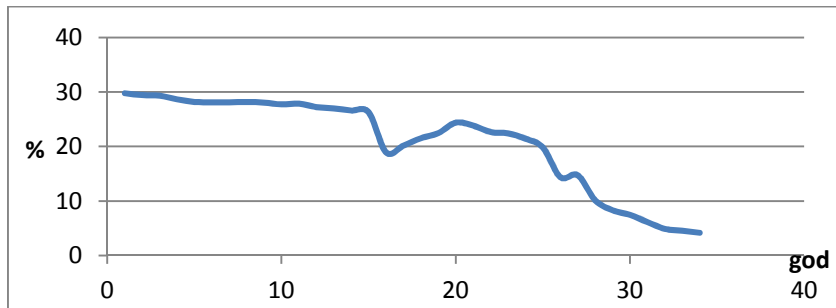
32, 34, 36).



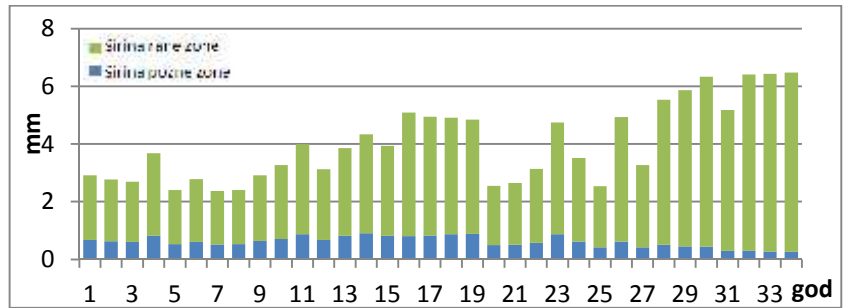
a o .13. , .1 0.3 m - % . . -



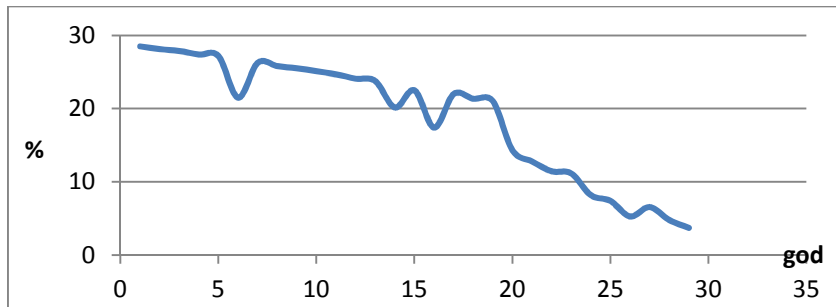
a o .14. , .1 0.3 m



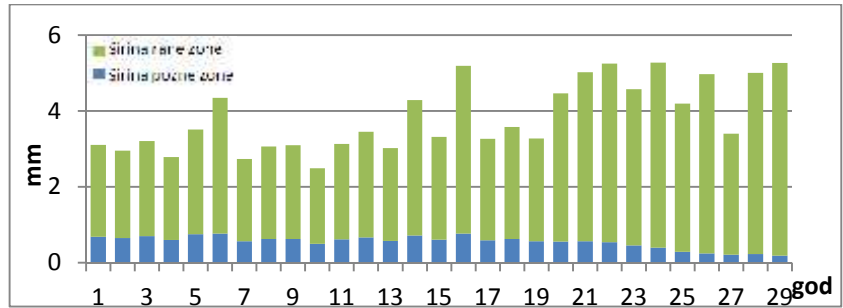
a o .15. , .2 0.3 m - % . . -



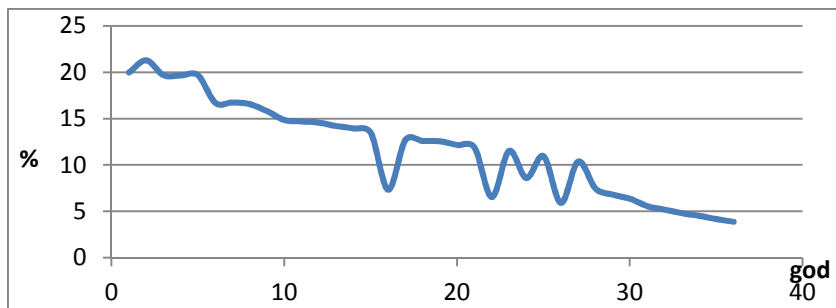
a o .16. , .2 0.3 m



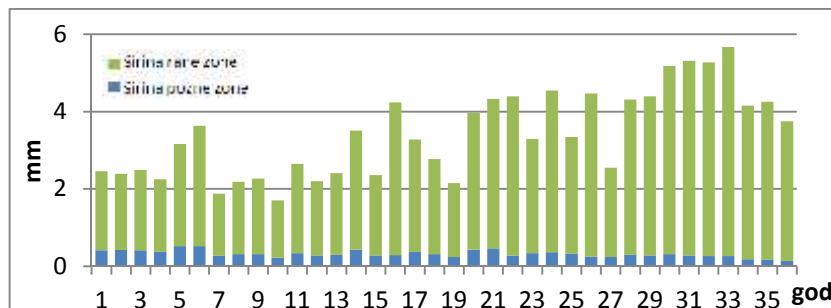
a o .17. , .3 0.3 m - % . . -



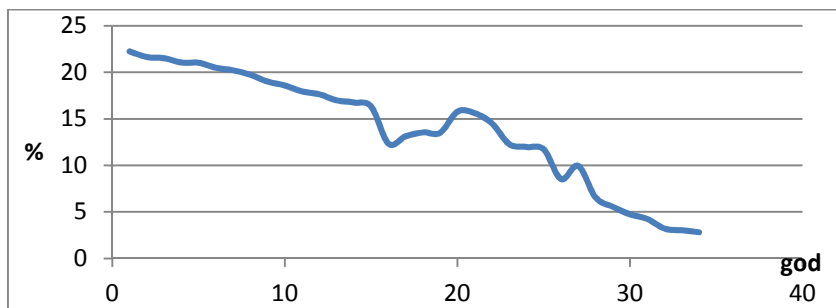
a o .18. , .3 0.3 m



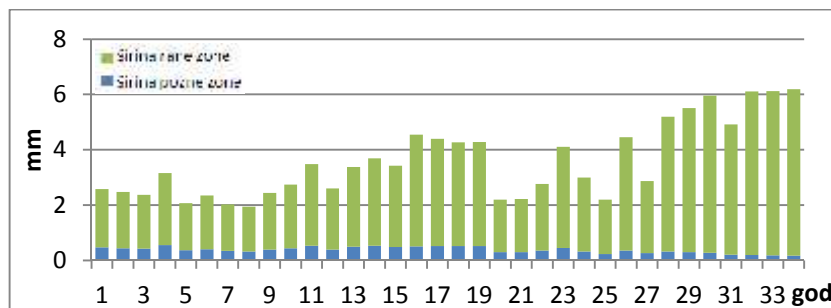
a o .19. , .1 1.3 m - % . . -



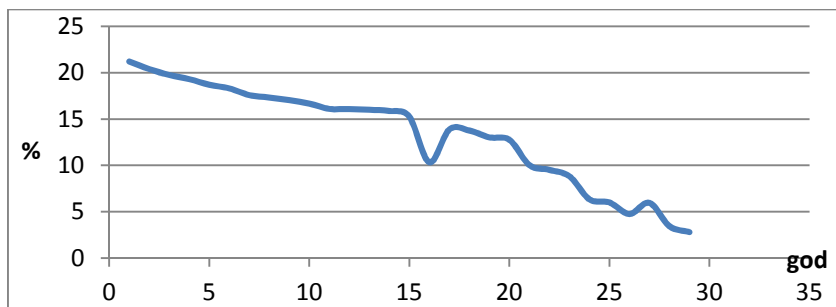
a o .20. , .1 1.3 m



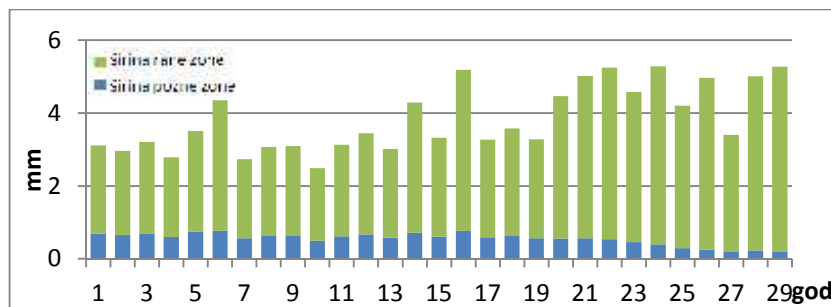
a o .21. , .2 1.3 m - % . . -



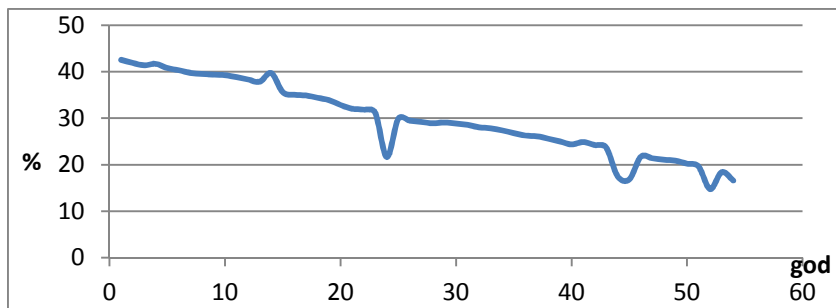
a o .22. , .2 1.3 m



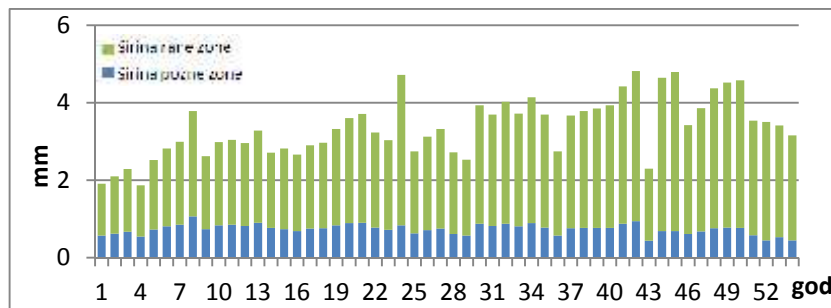
a o .23. , .3 1.3 m - % . . -



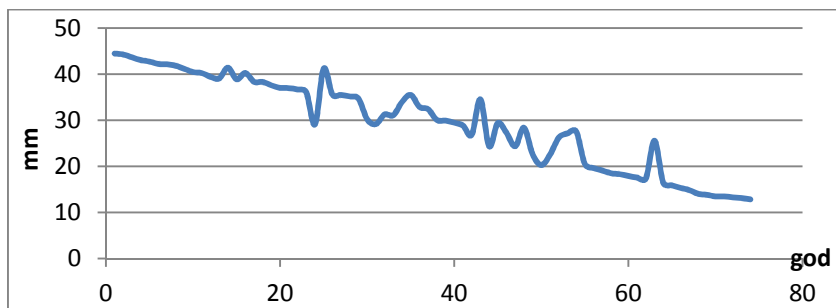
a o .24. , .3 1.3 m



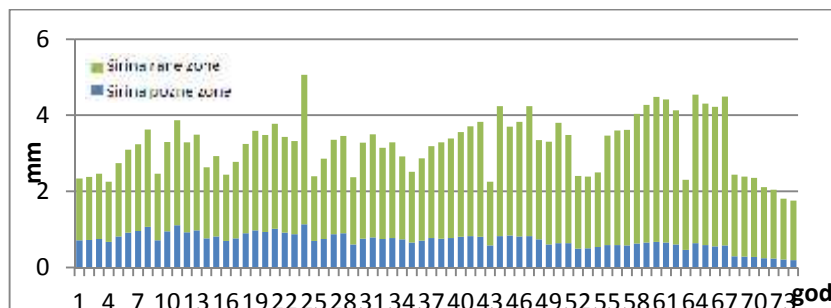
a o .25. , .1 0.3 m - % . . -



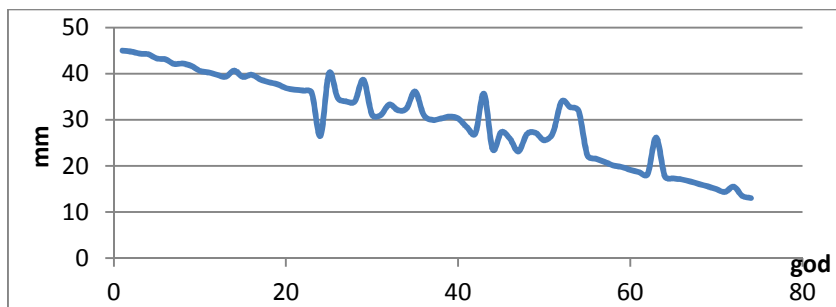
a o .26. , .1 0.3 m



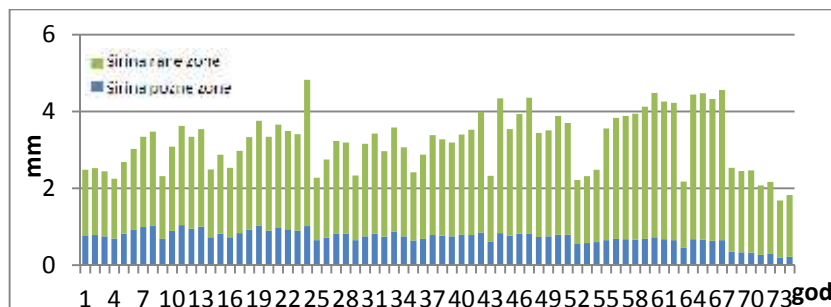
a o .27. , .2 0.3 m - % . . -



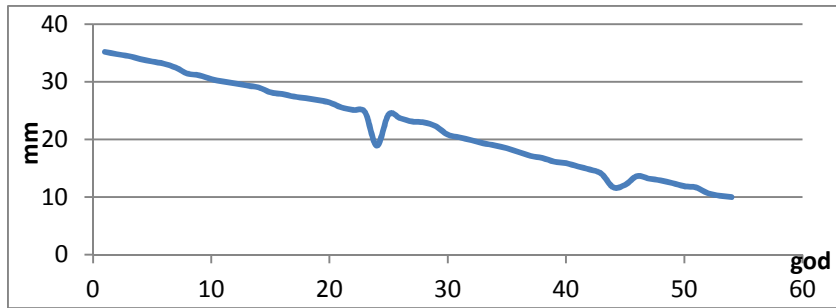
a o .28. , .2 0.3 m



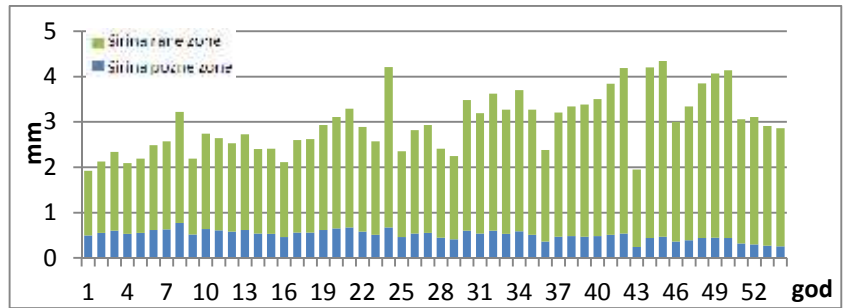
a o .29. , .3 0.3 m - % . . -



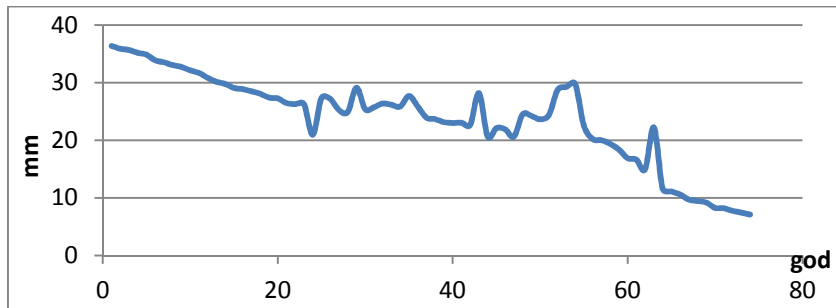
a o .30. , .3 0.3 m



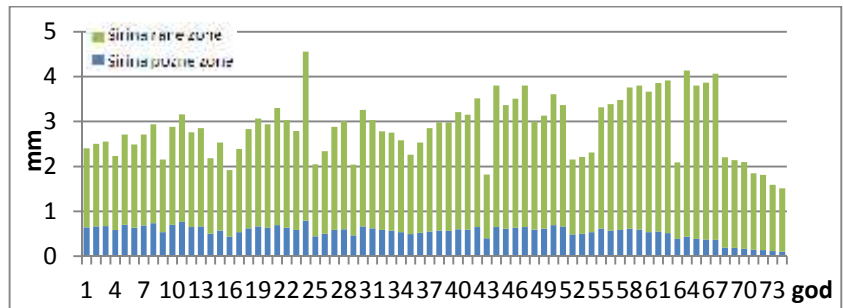
a o .31. , .1 1.3 m - % . . -



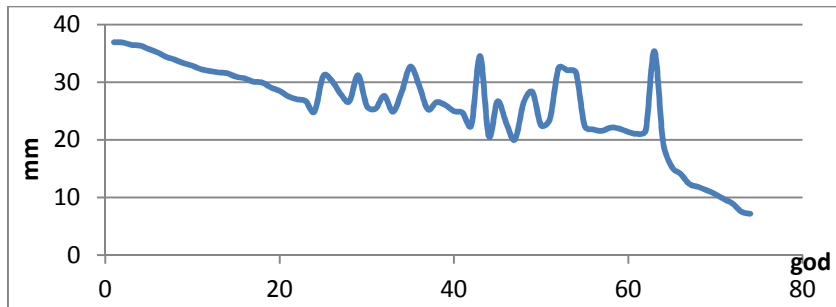
a o .32. , .1 1.3 m



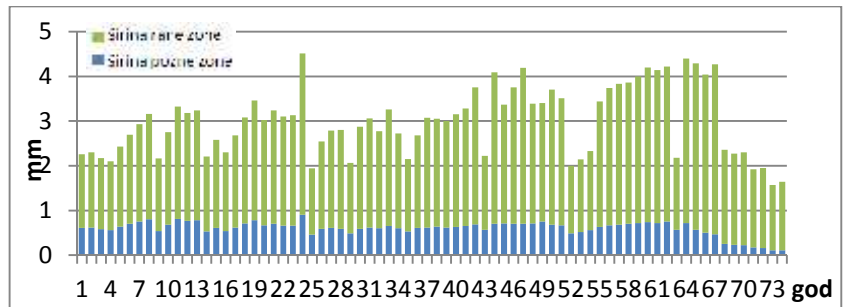
a o .33. , .2 1.3 m - % . . -



a o .34. , .2 1.3 m

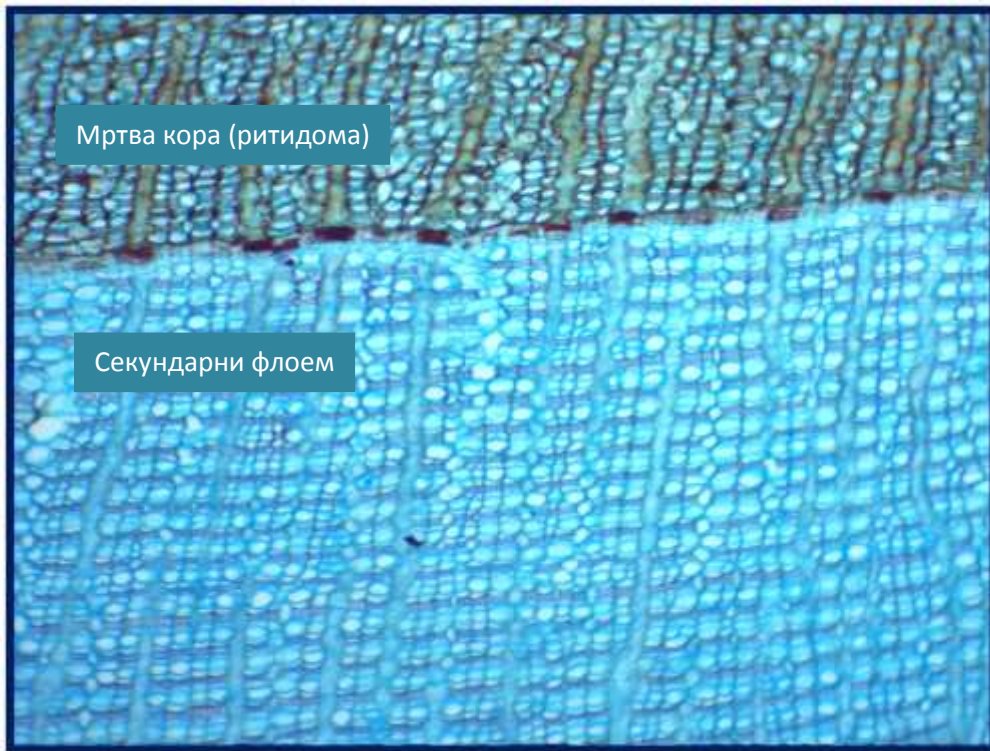


a o .35. , .3 1.3 m - % . . -



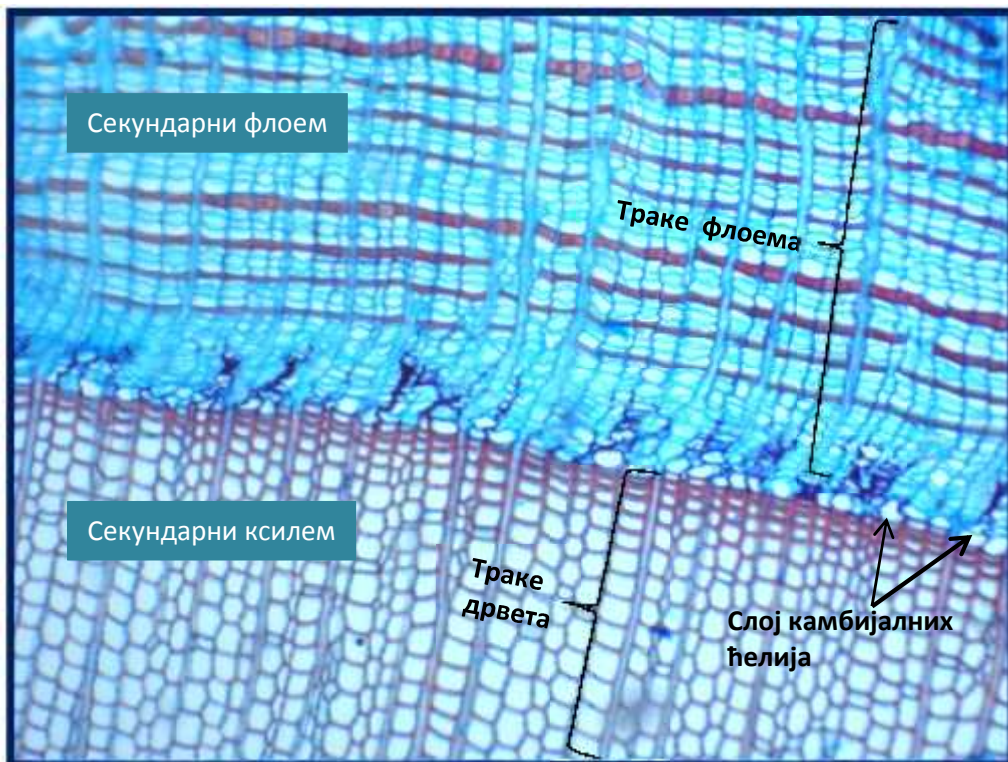
a o .36. , .3 1.3 m

6.4.



.19.

(100)



.20.

(100)

6.4.1. mm^2

6.4.1.1.

0.3 m,

K 1, 10.01,
4, 15 .
19.90, 10,
29 mm^2 . 67.49 μm ,
, 50 μm , 89 μm (.7).
2, 10.17, 4,
19 .
16.96 mm^2 7, 29
 mm^2 . 71.43 μm ,
51 μm , 98 μm (.7).
3, 10.58
, 4, 16 .
18.34, 7, 34
 mm^2 . 69.15 μm , 45 μm ,
98 μm (.7).

0.3 m,

, 7.49,
4, 14 .
9.46 mm^2 ,
4, 18 mm^2 .
4 μm , 47 μm , 22,89 μm (.7).
.7).

, 6.51
 3, 13
 7.51, 4, 15 mm².
 18.86 μm, 4 μm,
 39 μm (.7).
 , 6.81,
 3, 9
 9.83 mm², 4, 16
 mm². 22.09 μm, 4 μm,
 47 μm (.7).

3-4

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(. 37, 38, 39).
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mm² .
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, 2011; , 2015).
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mm² (. 40, 41, 42).
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1.3 m,

1, 12.44,
6, 19 .
19.04 mm², 8, 32.
89.75 μm,
71 μm, 117 μm (.7).
2, 15.23,
6, 26 .
14.32 , 5, 28 mm².
94.92 μm, 71 μm,
126 μm (.7).
3, 13.26,
6, 24 .
15.84, , 6, 26 mm².
89.82 μm, 71 μm, 114 μm
(.7).

1.3 m,

1. , 8.21,
4, 15 .
11.07, 5, 18 mm².
27.31 μm, 4 μm, 48 μm (.7).
2. , 8.79
, , 4, 15
. 10.49,
5, 18 mm². 27.52
μm, 4 μm, 47 μm (.7).
3. , 9.02,
4, 14 .
14.12, 10, 19 mm².

m)

(. 37, 38, 39, 43, 44, 45).

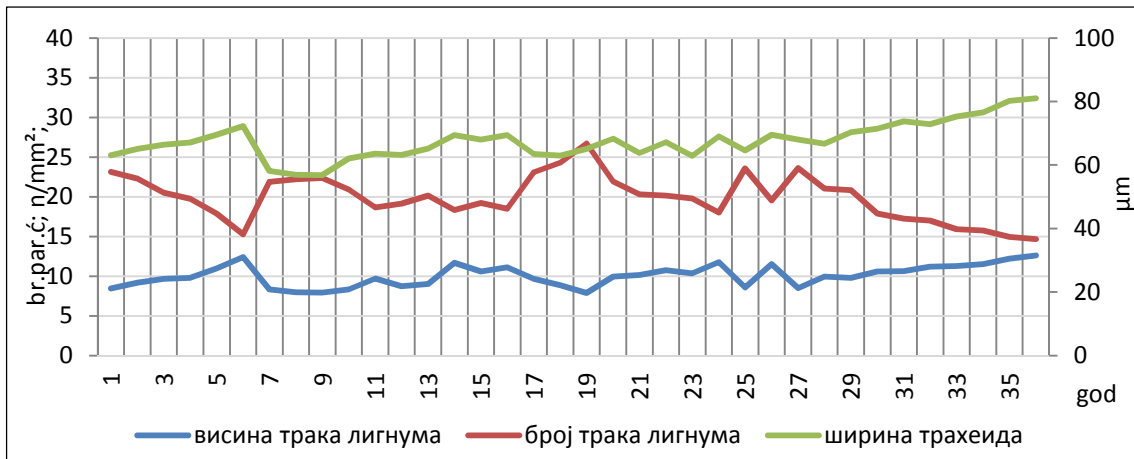
(0.3 m)

(1.3

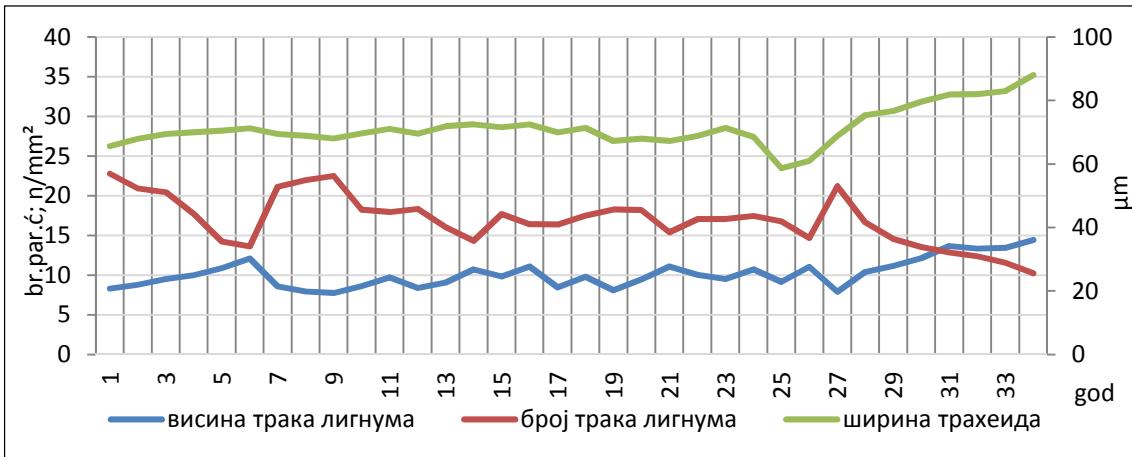
mm²

(0.3 m) (1.3 m) . 1. 0.3 m
 1.3 m ; 2. 0.3 m
 1.3 m ; 3.
 0.3 m 1.3m

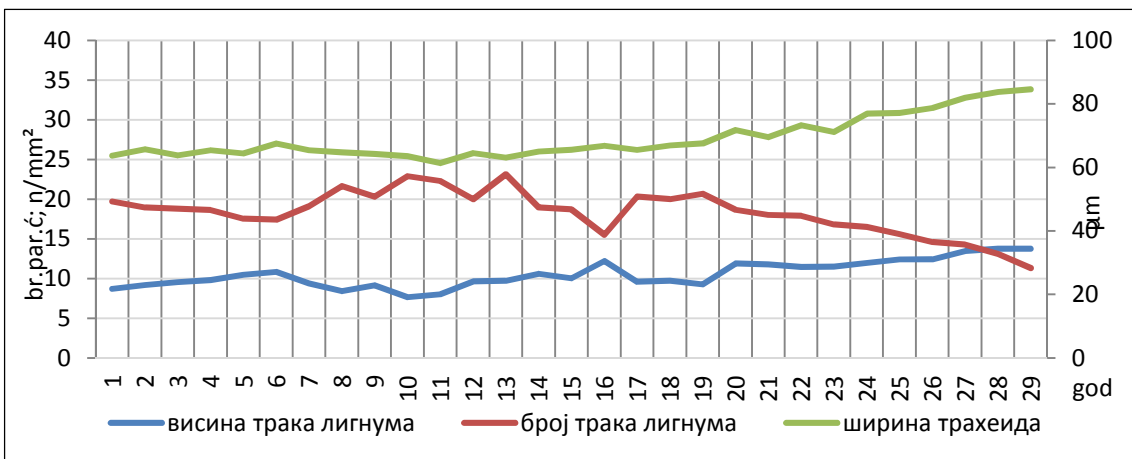
. 37-48,



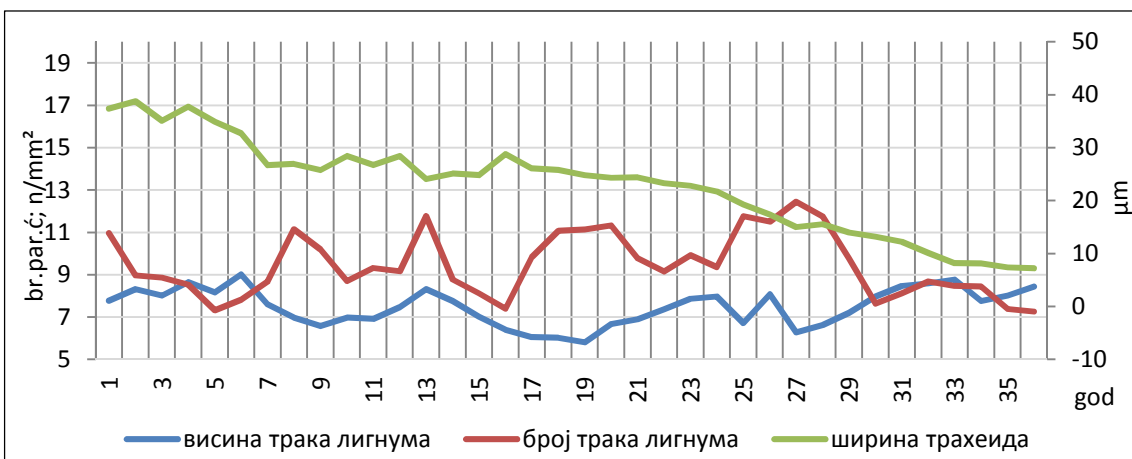
. 37. , .1 0.3 m,



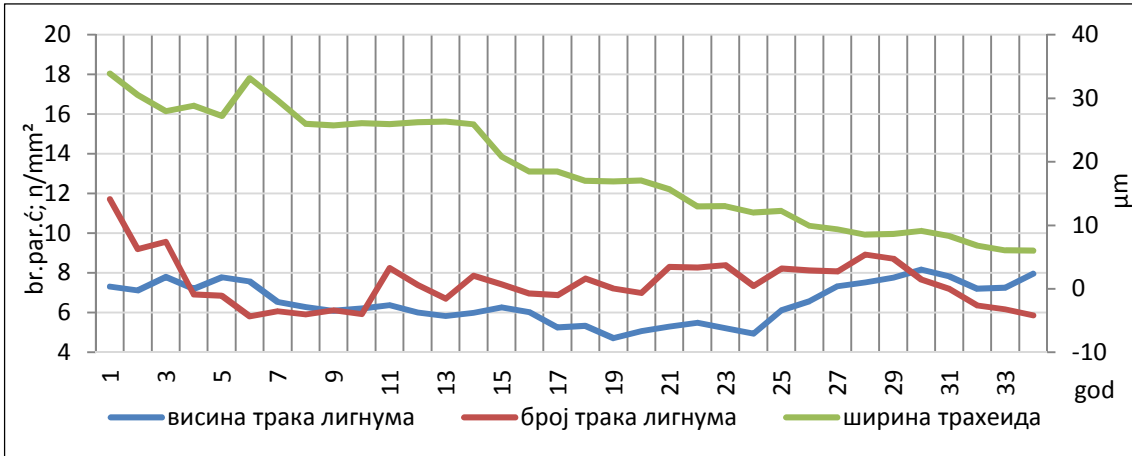
. 38. , .2 0.3 m,



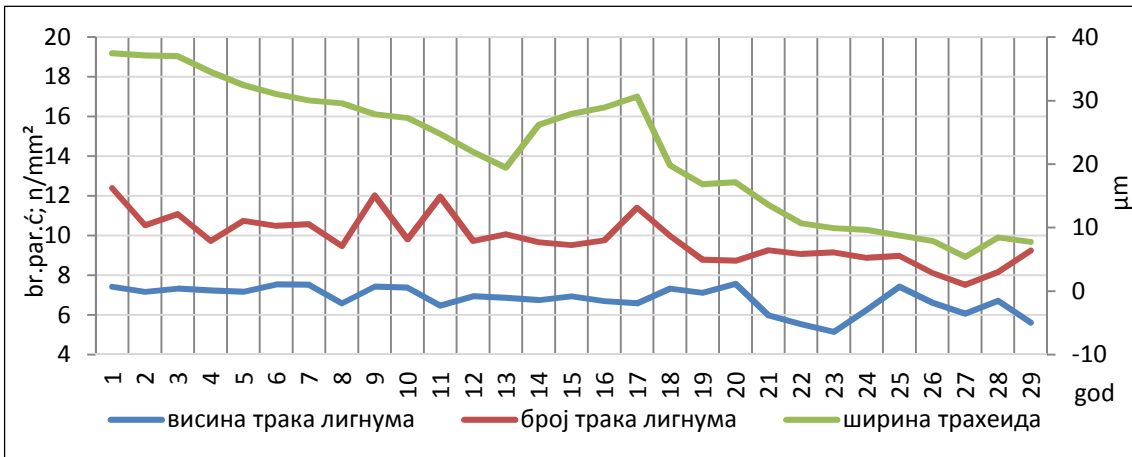
. 39. , .3 0.3 m,



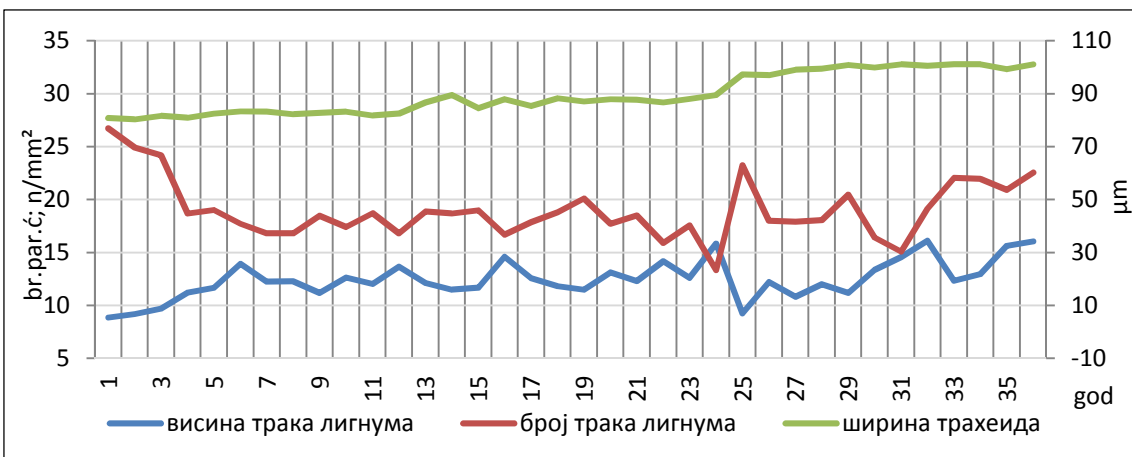
. 40. , .1 0.3 m,



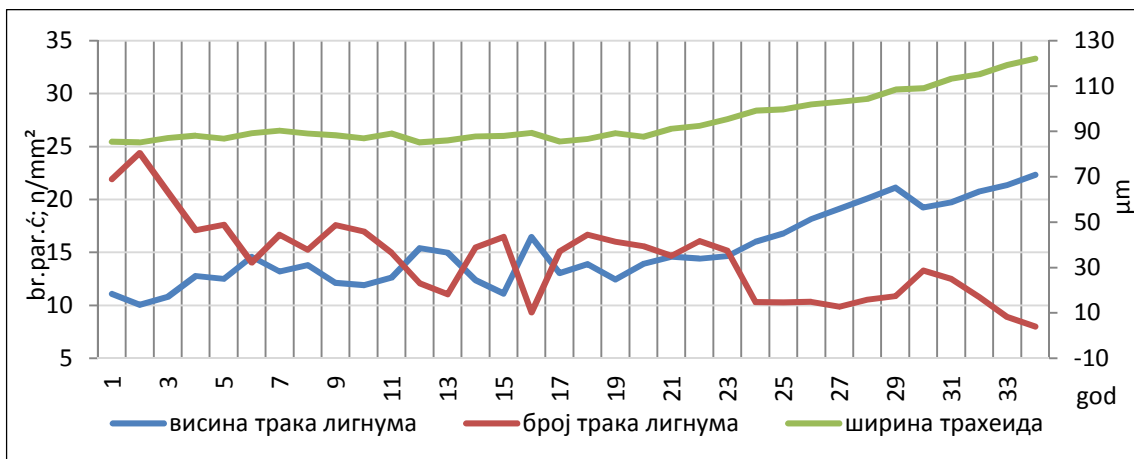
. 41. , .2 0.3 m,



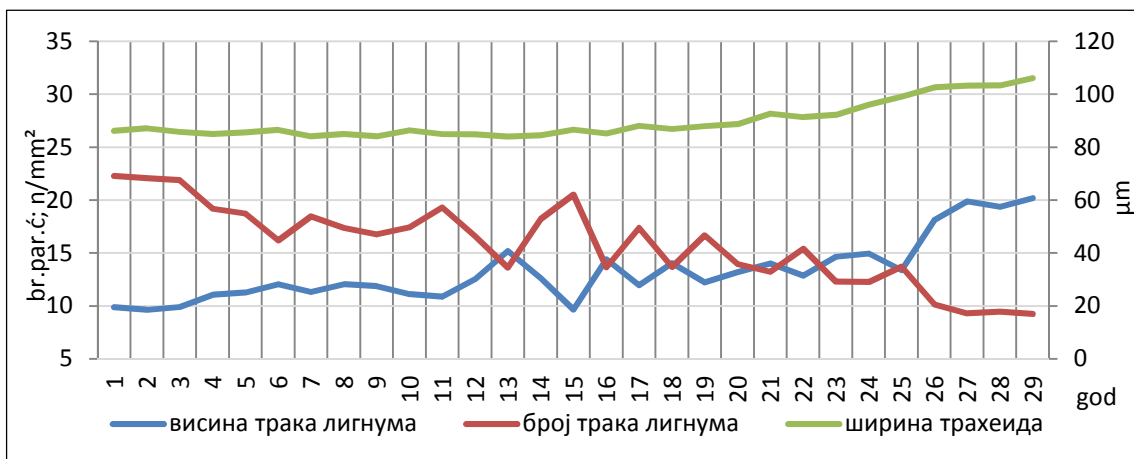
. 42. , .3 0.3 m,



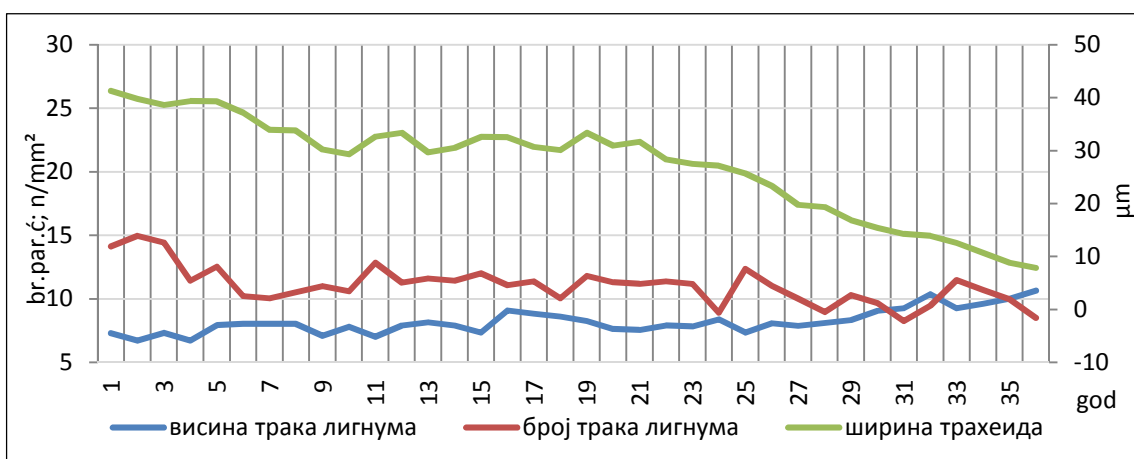
. 43. , .1 1.3 m,



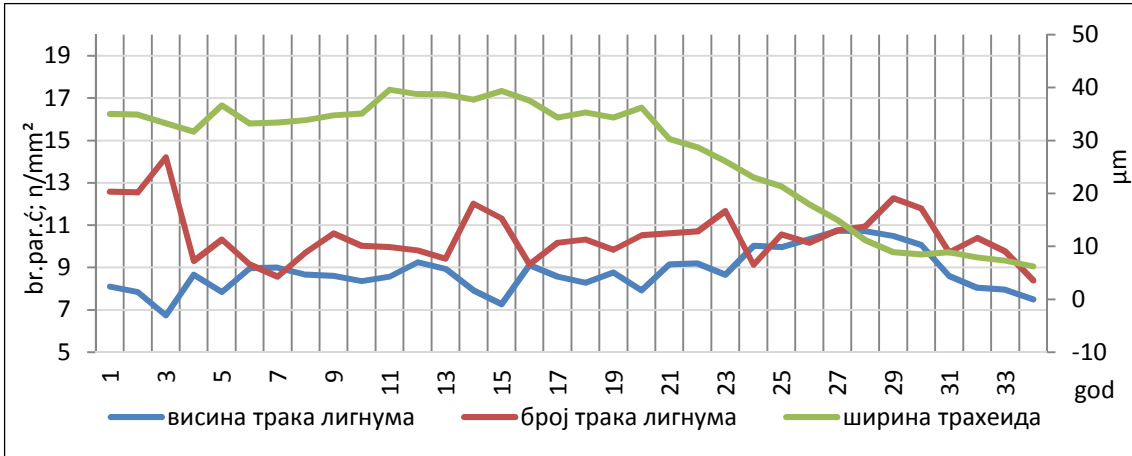
.44. , .2 1.3 m,



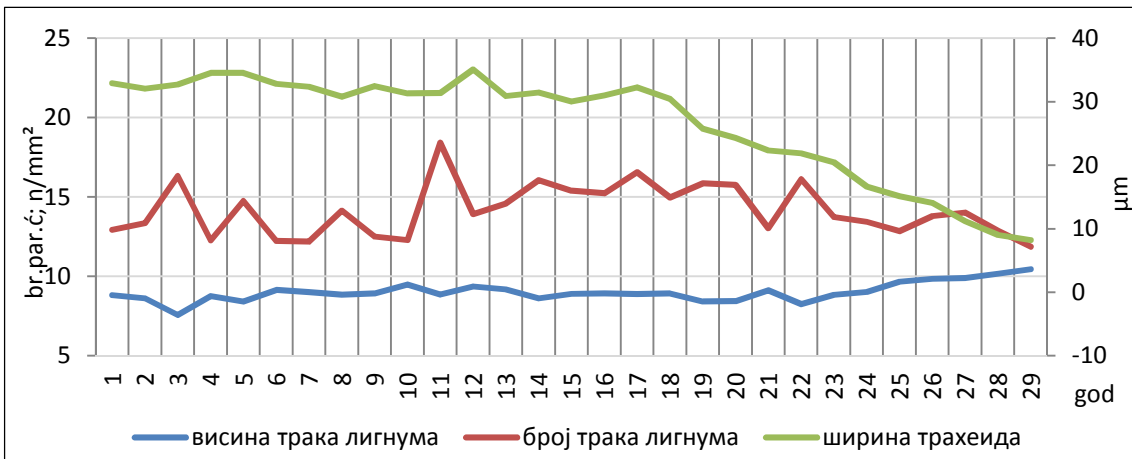
.45. , .3 1.3 m,



.46. , .1 1.3 m,



.47. , .2 1.3 m,



.48. , .3 1.3 m,

.7.

(mm²,)

.1,	(0.3 m)	(.)	10.01	4	15	2.29	11	5.24	12	10
.1,	(0.3 m)	(mm ²)	19.90	10	29	3.9	19	15.19	18	20
.1,	(0.3 m)	(μm)	67.49	50	89	7.45	39	55.53	65	65
.1,	(0.3 m)	(.)	7.49	4	14	1.95	10	3.82	8	7
.1,	(0.3 m)	(mm ²)	9.46	4	18	2.78	14	7.72	8	9
.1,	(0.3 m)	(μm)	22.89	4	47	9.28	43	86.19	25	25
.1,	(1.3 m)	(.)	12.44	6	19	3.04	13	9.22	15	12
.1,	(1.3 m)	(mm ²)	19.04	8	32	3.67	24	13.49	18	18
.1,	(1.3 m)	(μm)	89.75	71	117	8.99	46	80.84	85	88
.1,	(1.3 m)	(.)	8.21	4	15	1.91	11	3.64	8	8
.1,	(1.3 m)	(mm ²)	11.07	5	18	2.96	13	8.76	12	11
.1,	(1.3 m)	(μm)	27.31	4	48	9.97	44	99.39	32	28
.2,	(0.3 m)	(.)	10.17	4	19	2.70	15	7.31	12	10
.2,	(0.3 m)	(mm ²)	16.96	7	29	4.71	22	22.20	15	16
.2,	(0.3 m)	(μm)	71.43	51	98	9.22	47	85.05	74	74
.2,	(0.3 m)	(.)	6.51	3	13	1.84	10	3.37	5	6
.2,	(0.3 m)	(mm ²)	7.51	4	15	2.20	11	4.83	8	8
.2,	(0.3 m)	(μm)	18.86	4	39	9.23	35	85.19	25	18

.2,	(1.3 m)	(.)	15.23	6	26	4.06	20	16.45	15	15
.2,	(1.3 m)	(mm ²)	14.32	5	28	4.39	23	19.26	15	15
.2,	(1.3 m)	(μm)	94.92	71	126	11.52	55	132.61	85	92
.2,	(1.3 m)	(.)	8.79	4	15	1.91	11	3.65	8	8
.2,	(1.3 m)	(mm ²)	10.49	5	18	2.46	13	6.05	12	10
.2,	(1.3 m)	(μm)	27.52	4	47	11.79	43	139.01	35	32
.3,	(0.3 m)	(.)	10.58	4	16	2.75	12	7.56	12	10
.3,	(0.3 m)	(mm ²)	18.34	7	34	4.87	27	23.73	18	18
.3,	(0.3 m)	(μm)	69.15	45	98	10.59	53	112.19	65	68
.3,	(0.3 m)	(.)	6.81	3	9	1.59	6	2.54	8	7
.3,	(0.3 m)	(mm ²)	9.83	4	16	2.67	12	7.15	8	9
.3,	(0.3 m)	(μm)	22.09	4	47	10.71	43	114.63	28	24
.3,	(1.3 m)	(.)	13.26	6	24	3.78	18	14.26	12	14
.3,	(1.3 m)	(mm ²)	15.84	6	26	4.28	20	18.33	15	16
.3,	(1.3 m)	(μm)	89.82	71	114	8.04	43	64.57	85	88
.3,	(1.3 m)	(.)	9.02	4	14	1.77	10	3.14	8	9
.3,	(1.3 m)	(mm ²)	14.12	10	19	2.27	9	5.17	15	14
.3,	(1.3 m)	(μm)	26.50	5	39	8.73	34	76.21	32	28

6.4.1.2.

0.3 m,

2, 15, 6,61,
 22.90, 10, 63 mm².
 58.99 μm, 6 μm, 103 μm (.8).
 16, 7.87, 3,
 23.80, 10, 44 mm²
 mm². 64.94 μm, 20 μm, 99
 μm (.8).
 3, 15, 7.13,
 22.07 mm², 10, 39 mm².
 61.94 μm, 21 μm, 89 μm
 (.8).

0.3 m,

1, 9, 4.28,
 17.44, 5, 32 mm².
 35.58 μm, 12 μm, 58 μm (.8).
 2, 4.57, 1,
 9, 14.40,
 4, 32 mm².
 33.31 μm, 10 μm, 59 μm (.8)
 .8)
 3, 4.60,
 1, 12,
 13.00, 2, 28 mm²

30.99 μm , 5 μm ,
 55 μm (.8).
 (0.3 m
),
 (0.3 m
),
 (.49, 50, 51).
 54
 74
 (. 52, 53, 54).
 mm^2
 (. 49, 50, 51, 52, 53, 54).

(. 55, 56, 57, 58, 59, 60).

mm² (

).

mm² -

(.8),

49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60).

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- (, 1992),
:
60 μm , 28.5 μm
53- ,
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-
15
(.7 8). , ,
” “
(, 1994; , 1988),
·
- , (, 1992) , ,
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,

(Bannan 1937, 1954, 1965,
Gregory Romberger 1975),

mm² (Bannan 1954, Gregory
Romberger 1975)
(Lev-
Yadun 1998) (Bannan 1965)
(Larson 1994).
Pseudotsuga menziesii Britt., Gartner et al.
(2000)
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-
,
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10 ()
,
(Fahn i Arnon, 1963),

Lev-Yadun (1998)

. – *Pinus pinea* L. *Pinus halepensis* L. –
4
7-8 .

() ,

(Lev-Yadun, 1998)

Lev-Yadun (1998)

.
mm²
70 mm² 40 mm²
mm²

- Bannan (1937)

Thuja occidentalis L., *Taxodium distichum* (L.) Rich., *Abies balsamea* Mill., *Tsuga canadensis* L., *Larix laricina* Mill., *Pinus strobus* L., *Pinus banksiana* Lamb.

Bannan (1954)

Thuja occidentalis L.

Picea glauca Voss., *Pinus resinosa*

Sol. *Pinus strobus* L. (Bannan 1965),

2-4 mm,

White (1962)

Sassafras officinale Ness.

Fraxinus excelsior L. *Castanea sativa* Mill.

mm²

Bannan (1937, 1954, 1965), White (1962), White & Robards (1966)

(), Gregory
Romberger (1975), Gregory (1977), Rao (1988)

Ku era & Ku era (1967)

Gregory Romberger (1975)

(Bannan 1954, 1965, White 1962, White & Robards
1966)

Bannan (1937)

,
,
,

(Lev Yadun Aloni

1995).

Bannan (1937)

Carmi et al., (1972)

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(Fritts 1976).

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6.4.1.3.2.

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(.7 8).

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(.7 8).

(. 7 8).

67.49 μm 94.92 μm
 (.7), 58.99 μm 66.45 μm
 (.8).

1 μm ,

37.5 μm 49.8 μm 41.3

μm (, 1994).

28.5 μm , 56 μm , 41.5 μm (, 1992).

: 70-80 μm , 60 μm ,
 45 μm (, 2000).

10.49 μm 27.31 μm (.7), 30.99
 μm 56.23 μm (.8).

28.5 μm ,

19.3 μm 32 μm

(, 1994).

16.8 μm 26.2 μm ,

22 μm (,1992).

15

1-30

(, 1994),

2-20,

15

35

(, 1992),

3 51

27 31

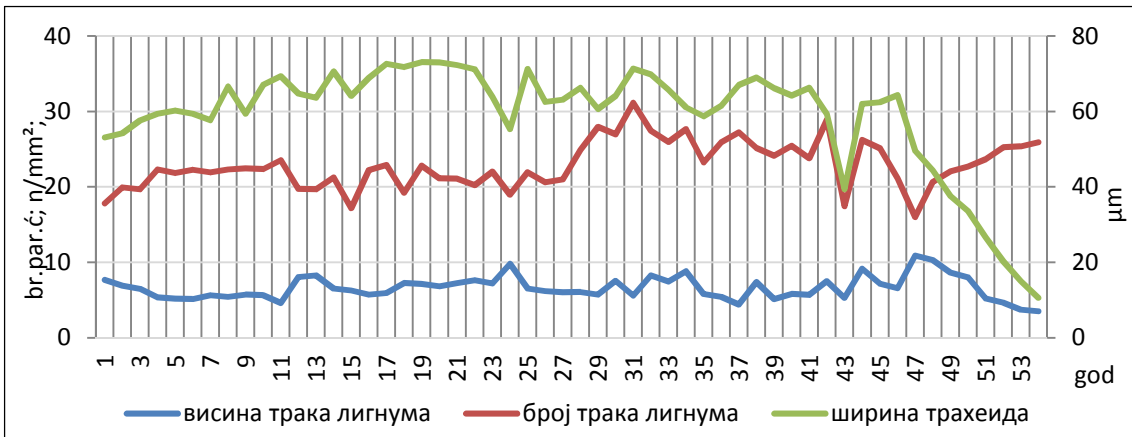
15-20,

10-20,

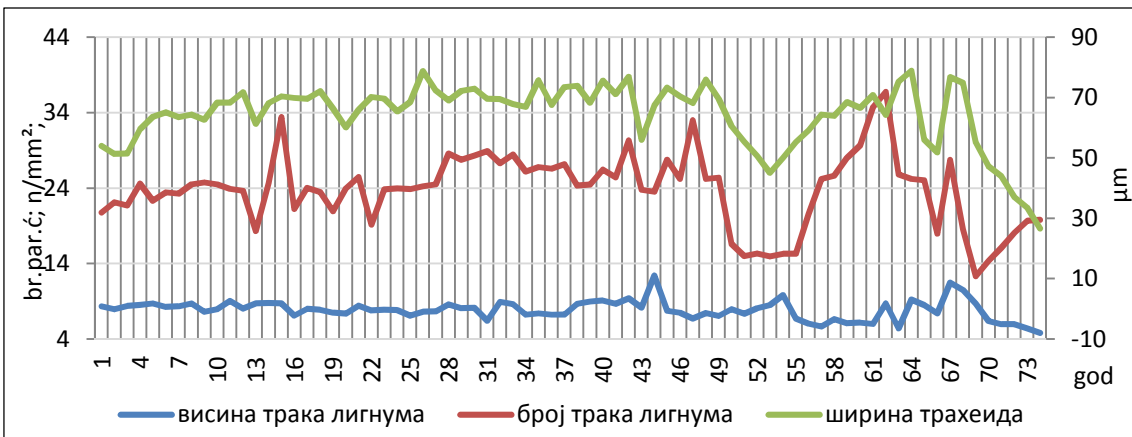
30

(, 2000).

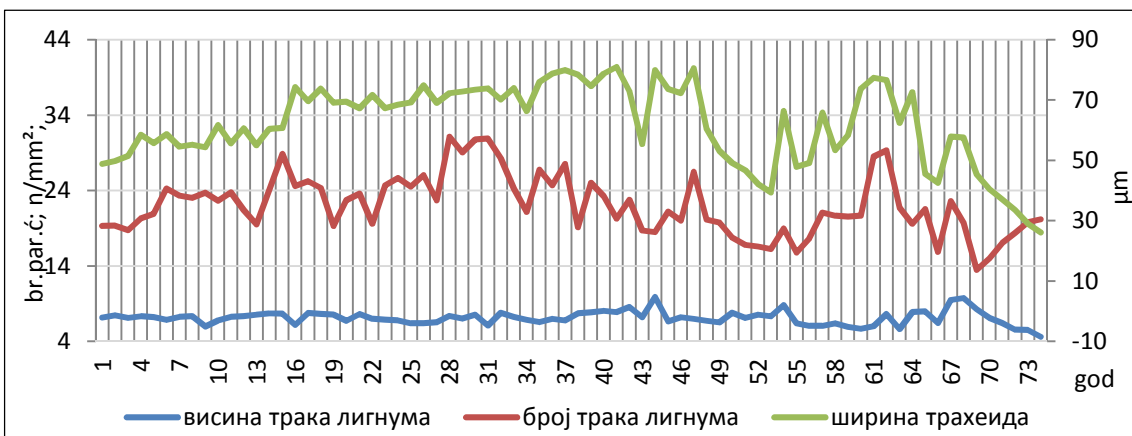
. 49-60,



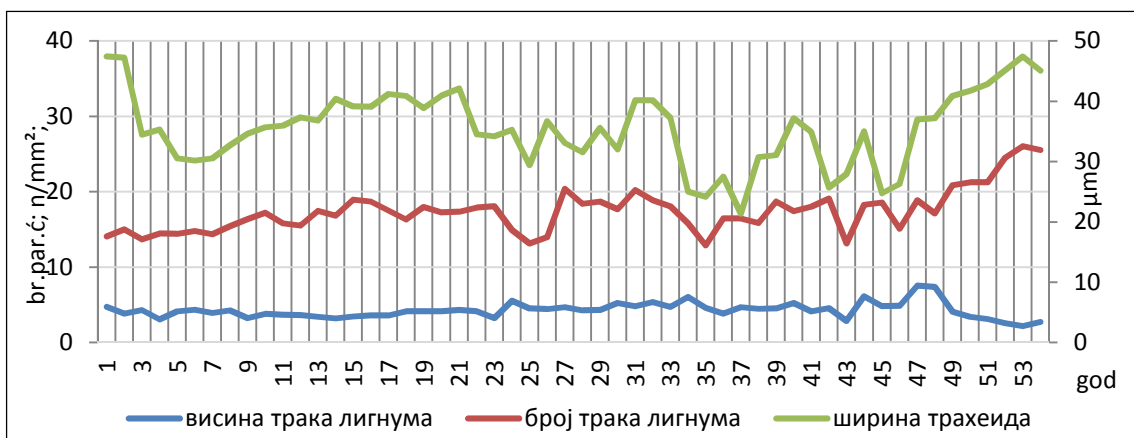
. 49. , .1 0.3 m,



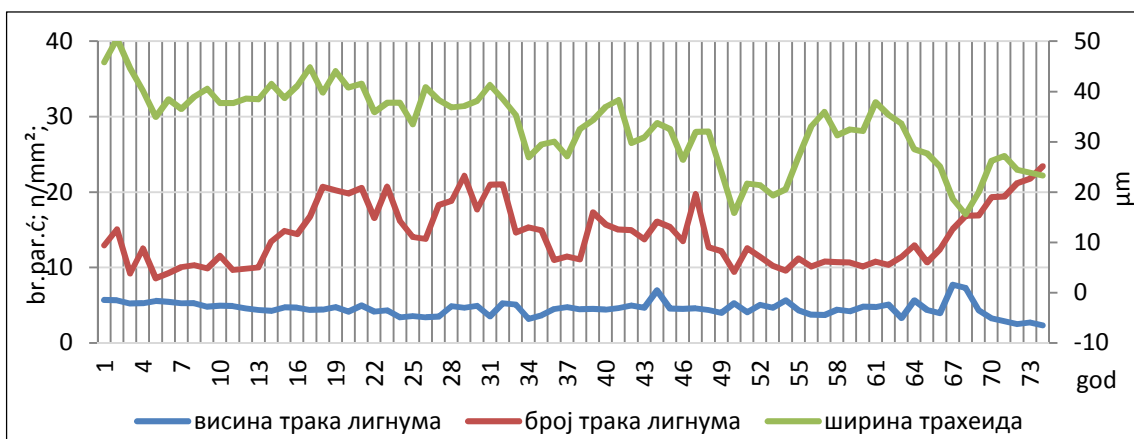
. 50. , .2 0.3 m,



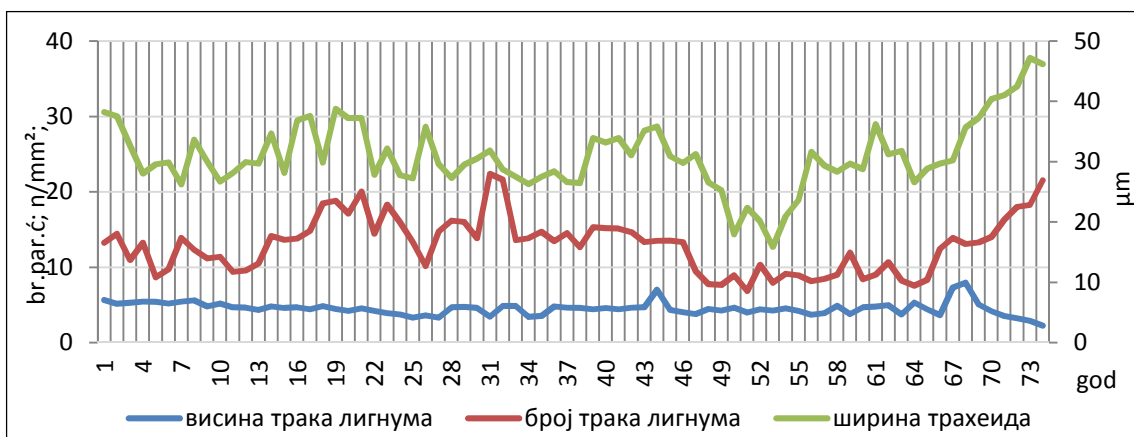
. 51. , .3 0.3 m,



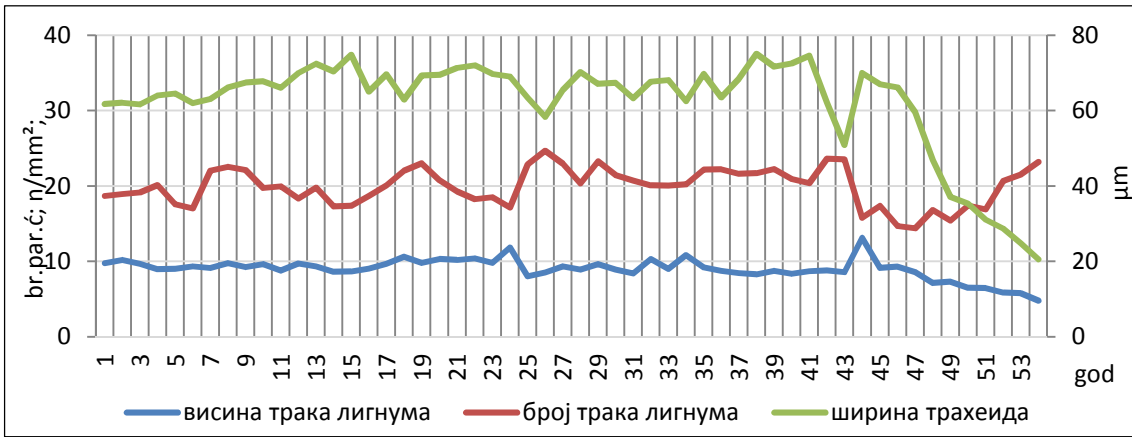
. 52. , .1 0.3 m,



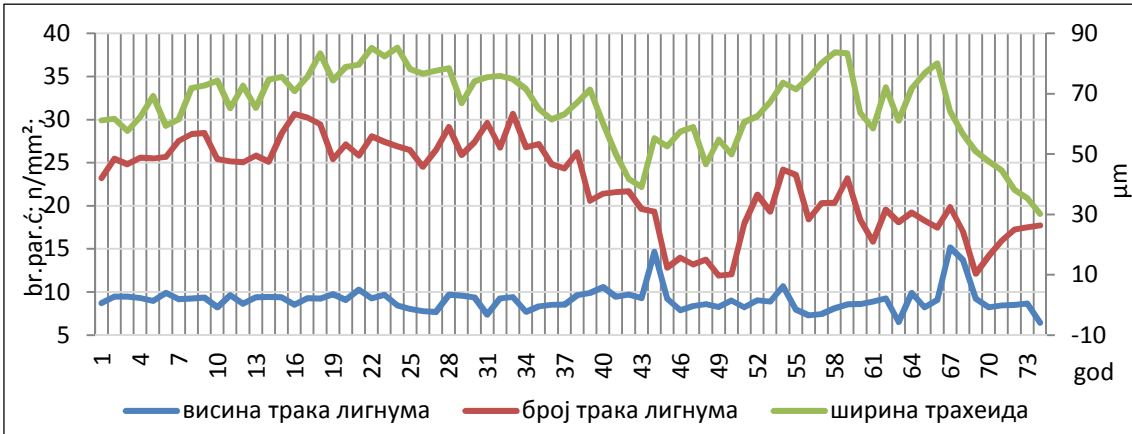
. 53. , .2 0.3 m,



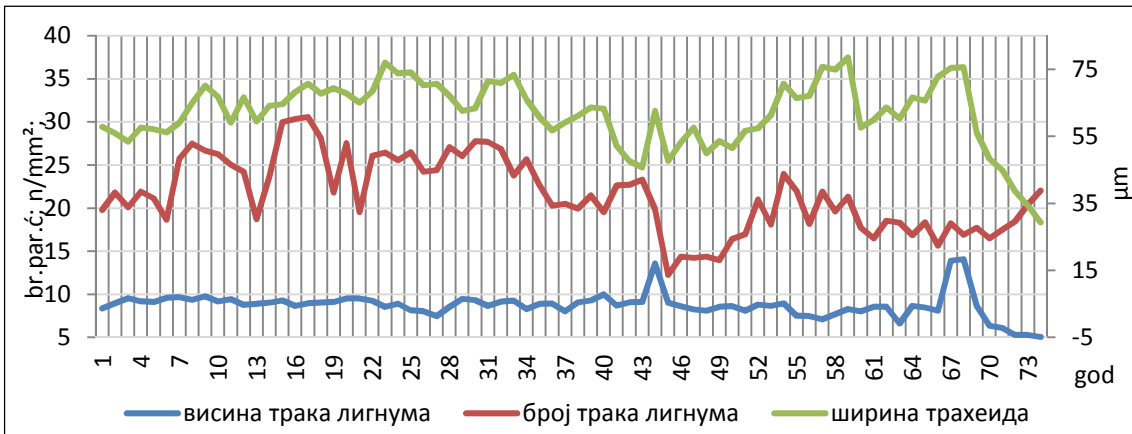
. 54. , .3 0.3 m,



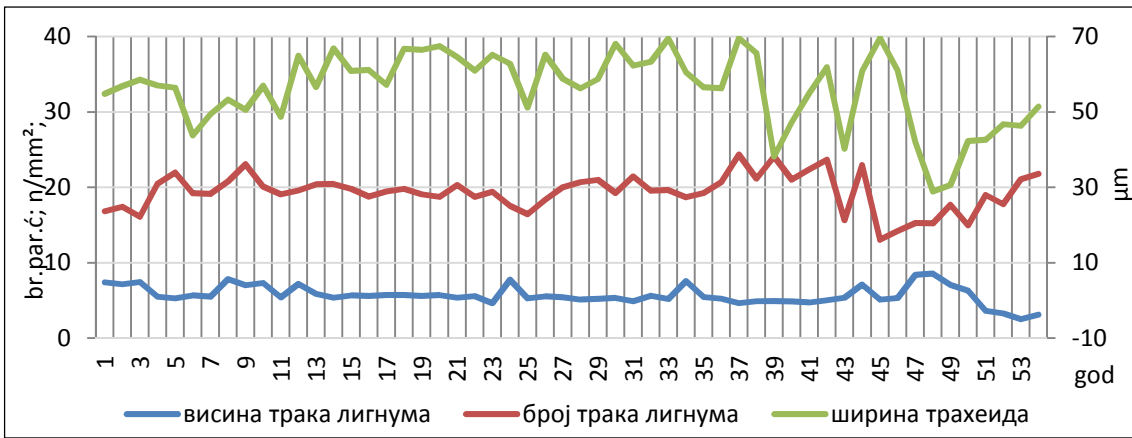
.55. , .1 1.3 m,



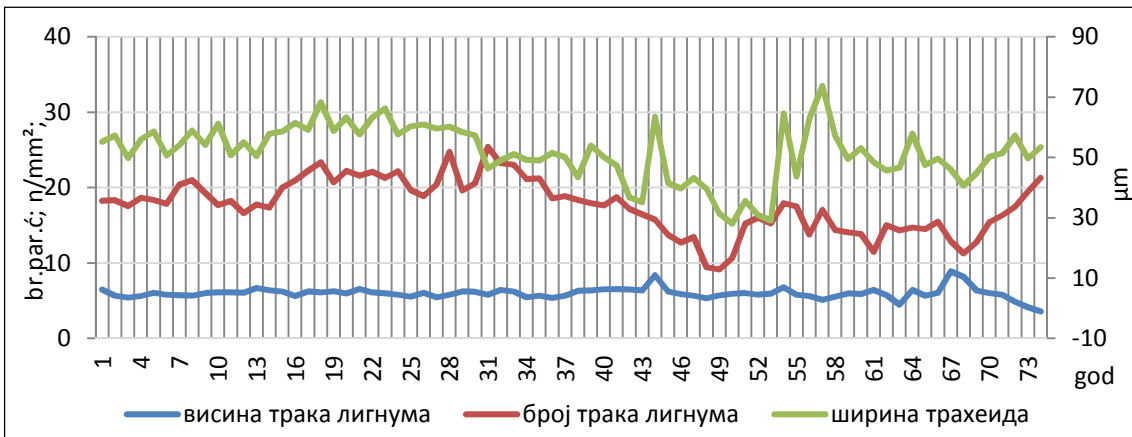
.56. , .2 1.3 m,



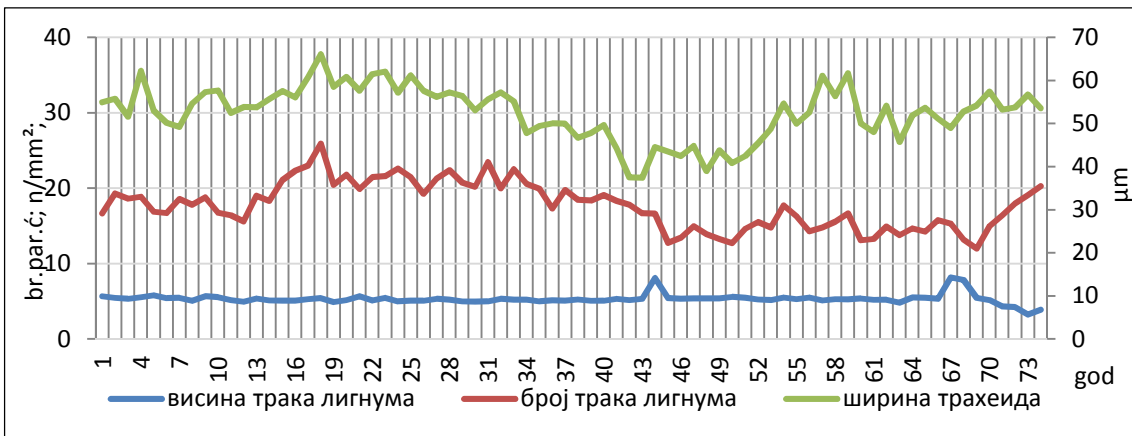
.57. , .3 1.3 m,



. 58. , .1 1.3 m,



. 59. , .2 1.3 m,



. 60. , .3 1.3 m,

.8.

(mm²,)

.1,	(0.3 m)	(.)	6.61	2	15	2.22	13	4.92	5	6
.1,	(0.3 m)	(mm ²)	22.90	10	63	6.55	53	42.87	25	25
.1,	(0.3 m)	(μm)	58.99	6	103	19.58	97	383.28	58	56
.1,	(0.3 m)	(.)	4.28	1	9	1.65	8	2.71	5	4
.1,	(0.3 m)	(mm ²)	17.44	5	32	4.98	27	24.83	15	16
.1,	(0.3 m)	(μm)	35.58	12	58	7.69	46	59.10	36	36
.1,	(1.3 m)	(.)	9.01	2	16	2.28	14	5.22	8	9
.1,	(1.3 m)	(mm ²)	19.97	5	39	8.51	34	72.41	12	20
.1,	(1.3 m)	(μm)	62.28	15	99	18.03	84	325.00	56	58
.1,	(1.3 m)	(.)	5.72	1	13	1.93	12	3.73	5	5
.1,	(1.3 m)	(mm ²)	19.40	3	36	5.84	33	34.06	25	20
.1,	(1.3 m)	(μm)	56.23	11	89	13.89	78	192.84	58	58
.2,	(0.3 m)	(.)	7.87	3	16	2.10	13	4.41	8	8
.2,	(0.3 m)	(mm ²)	23.80	10	44	5.75	34	33.11	25	24
.2,	(0.3 m)	(μm)	64.94	20	99	16.16	79	261.05	52	63
.2,	(0.3 m)	(.)	4.57	1	9	1.51	8	2.28	5	5
.2,	(0.3 m)	(mm ²)	14.40	4	32	5.27	28	27.73	15	14
.2,	(0.3 m)	(μm)	33.31	10	59	9.42	49	88.74	35	35

.2,	(1.3 m)	(.)	9.10	4	18	2.37	14	5.63	8	9
.2,	(1.3 m)	(mm ²)	22.53	4	39	6.10	35	37.15	25	24
.2,	(1.3 m)	(mm ²)	66.45	24	99	14.39	75	207.17	65	66
.2,	(1.3 m)	(.)	6.01	2	12	1.60	10	2.55	5	6
.2,	(1.3 m)	(mm ²)	17.69	1	33	4.87	32	23.72	15	17
.2,	(1.3 m)	(μm)	51.80	20	86	11.50	66	132.16	58	52
.3,	(0.3 m)	(.)	7.13	3	15	1.55	12	2.41	8	7
.3,	(0.3 m)	(mm ²)	22.07	10	39	5.32	29	28.33	25	23
.3,	(0.3 m)	(μm)	61.94	21	89	14.39	68	206.98	78	63
.3,	(0.3 m)	(.)	4.60	1	12	1.45	11	2.11	5	5
.3,	(0.3 m)	(mm ²)	13.00	2	28	4.70	26	22.11	12	14
.3,	(0.3 m)	(μm)	30.99	5	55	7.50	50	56.26	25	30
.3,	(1.3 m)	(.)	8.74	3	18	2.20	15	4.83	8	8
.3,	(1.3 m)	(mm ²)	21.62	6	39	6.07	33	36.79	25	23
.3,	(1.3 m)	(μm)	61.84	24	89	11.78	65	138.79	58	62
.3,	(1.3 m)	(.)	5.33	2	12	1.31	10	1.71	5	5
.3,	(1.3 m)	(mm ²)	17.75	7	32	4.59	25	21.07	15	17
.3,	(1.3 m)	(μm)	52.40	24	82	10.50	58	110.18	58	52

6.4.2. mm²

6.4.2.1.

0.3 m,

, 2.74 mm,
1.92 mm, 3.83 mm,
mm² 269.25, 213, 335.33
(.9 9a).
, 2.32 mm,
1.28 mm, 4.04 mm,
mm² 211.75, 151.67, 294.33 (.9 9a).
,
: 2.66 mm, 1.56 mm 4.01 mm,
mm² : 210.09, 169.33,
285.33 (.9 9a).

0.3 m,

1, 1.16 mm,
0.78 mm, 1.71 mm, mm² 63.39,
21.33, 93.33 (.9 9a).
2, 1.18 mm, 0.82
mm, 1.77 mm,
mm²: 70.21, 30.33 95.00 (.9 9a).
3, 0.95 mm, 0.61
mm, 1.55 mm, mm²
34.00, 96.33, 73.32 (.9 9a).

1.3 m,

, 2.89 mm, 2.04
mm, 4.02 mm, ,
mm²: 275.42, 217.67 340.33 (.9 9 a).

, 2.75 mm,
2.04 mm, 3.91 mm, mm²,
221.45, 159.67, 297.00 (
.9 9 a).

, ,
: 2.89 mm, 2.03 mm 4.00 mm, mm²
224.56, 182.67, 301.62 (.9 9 a).

1,3 m,

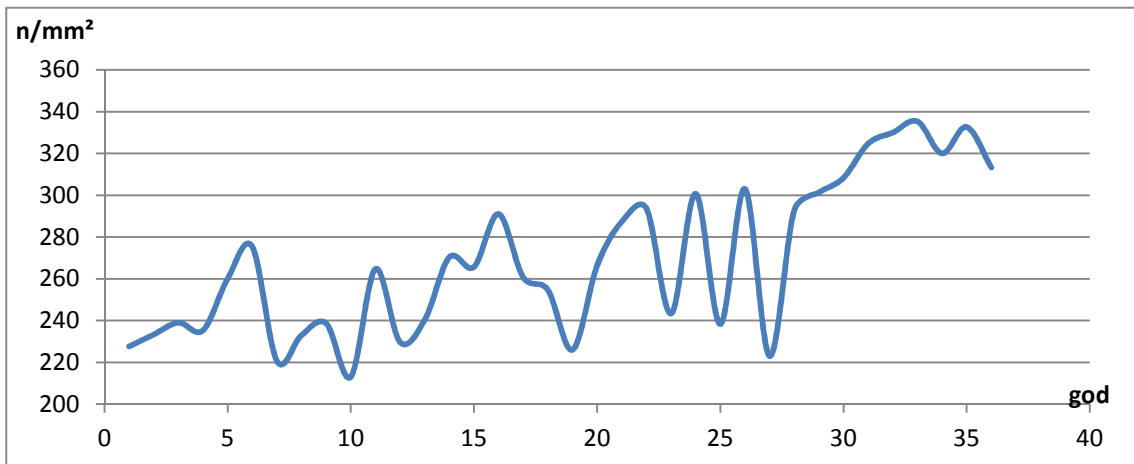
1, 0.97 mm,
0.79 mm, 1.24 mm, ,
mm²: 52.98, 15.67 84.00 (.9 9 a).

2, 1.23 mm, 0.80
mm, 1.82 mm, mm²
58.86, 23.67, 86.33 (.9 9 a).

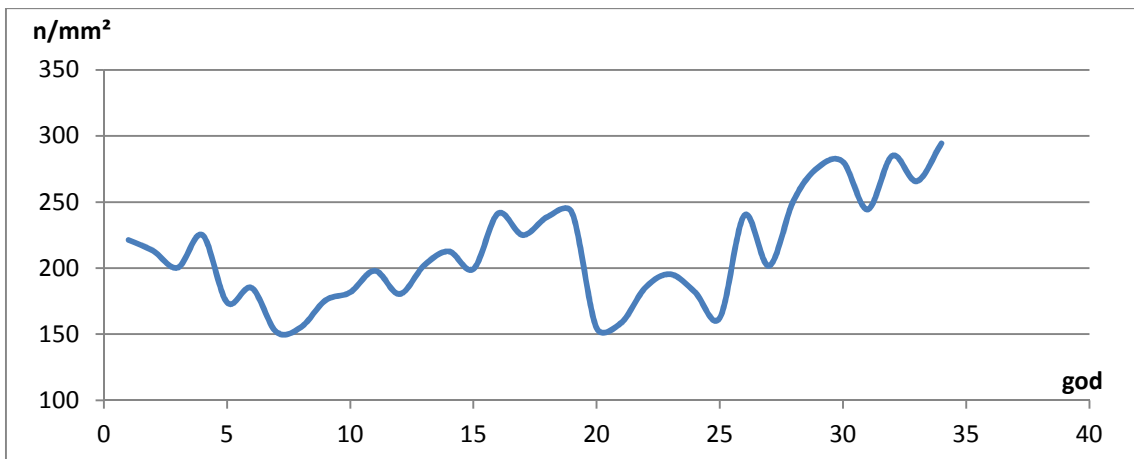
3, 0.73 mm,
0.58 mm, 0.96 mm, ,
mm² : 64.39, 28.33 86.33
(.9 9 a).

. 61-84, mm²

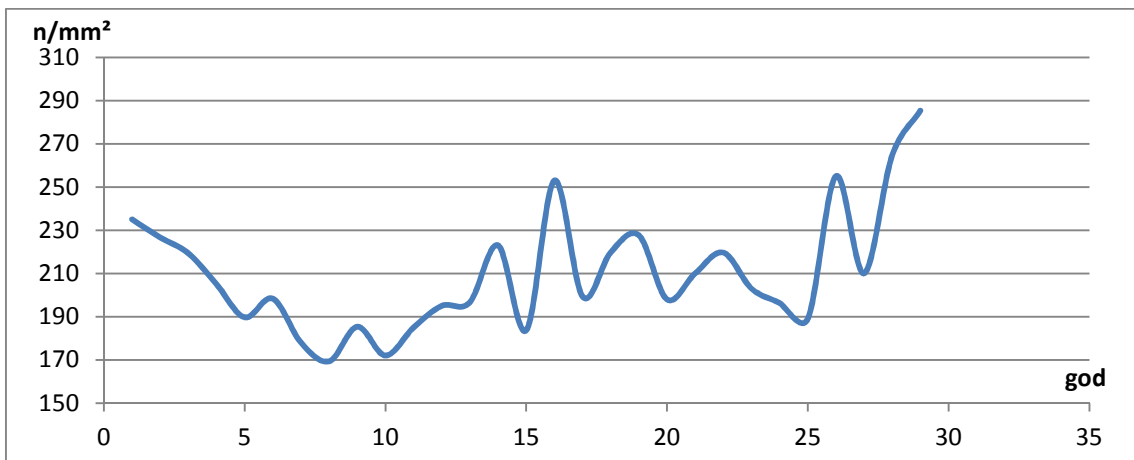
:



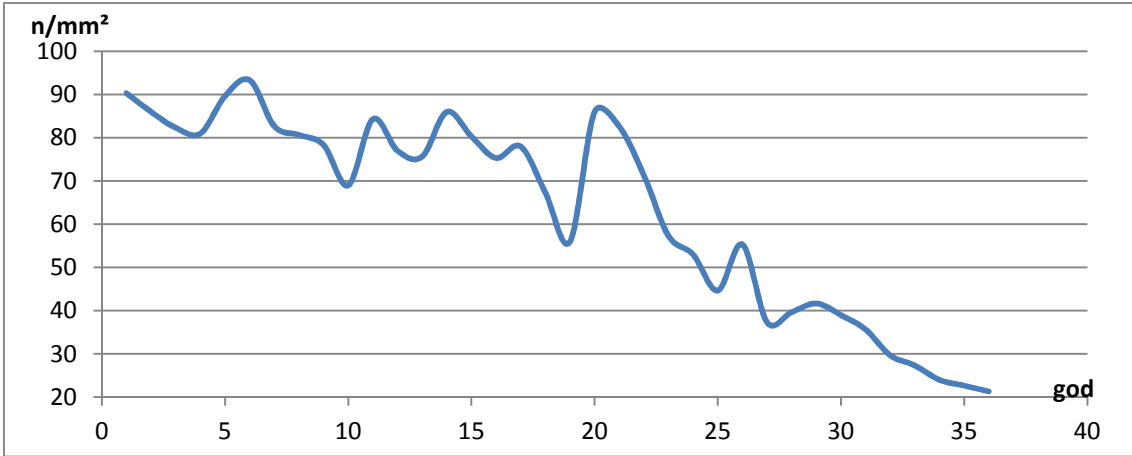
. 61. , .1 0.3 m,



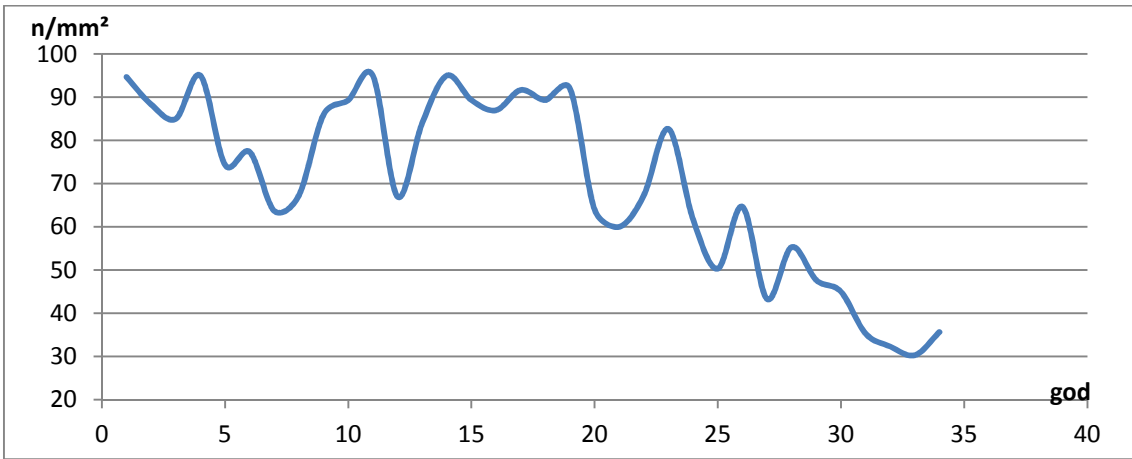
. 62. , .2 0.3 m,



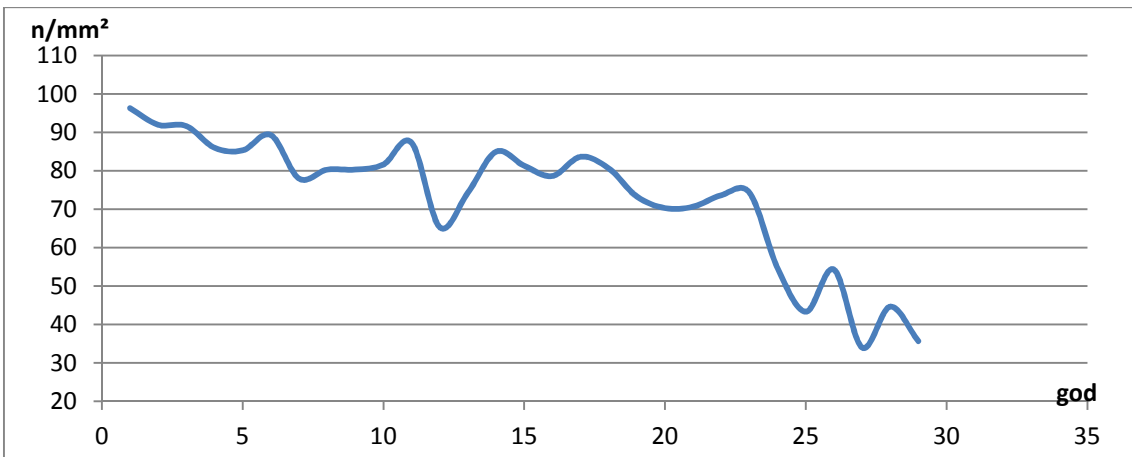
. 63. , .3 0.3 m,



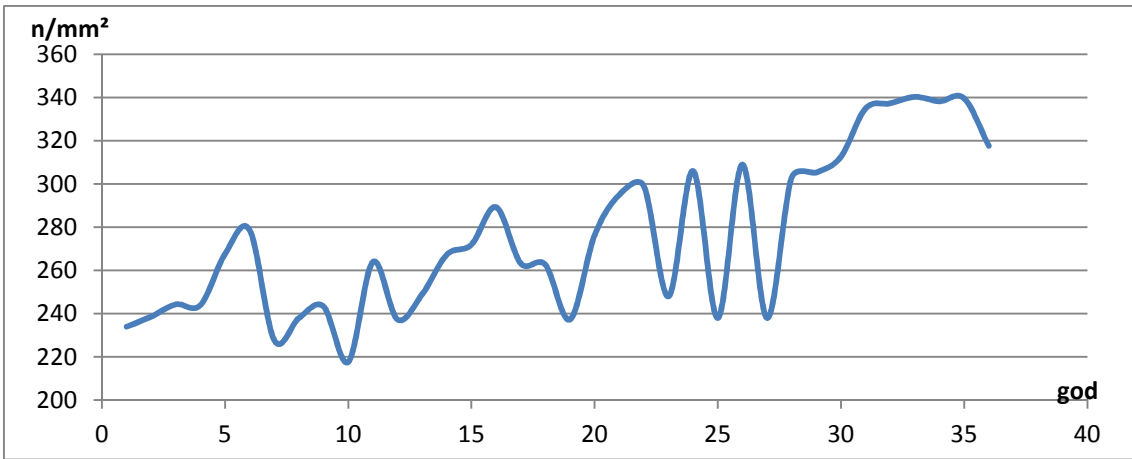
.64. , .1 0.3 m,



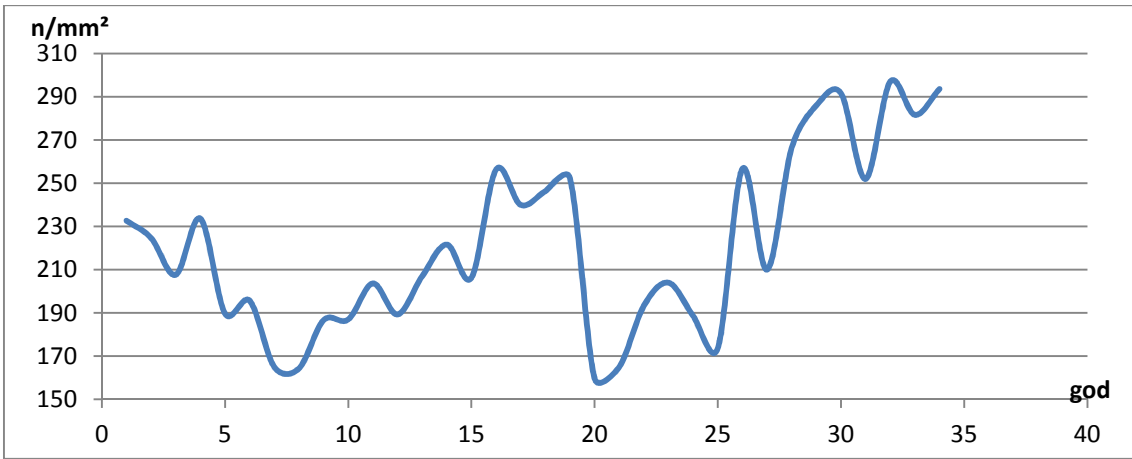
.65. , .2 0.3 m,



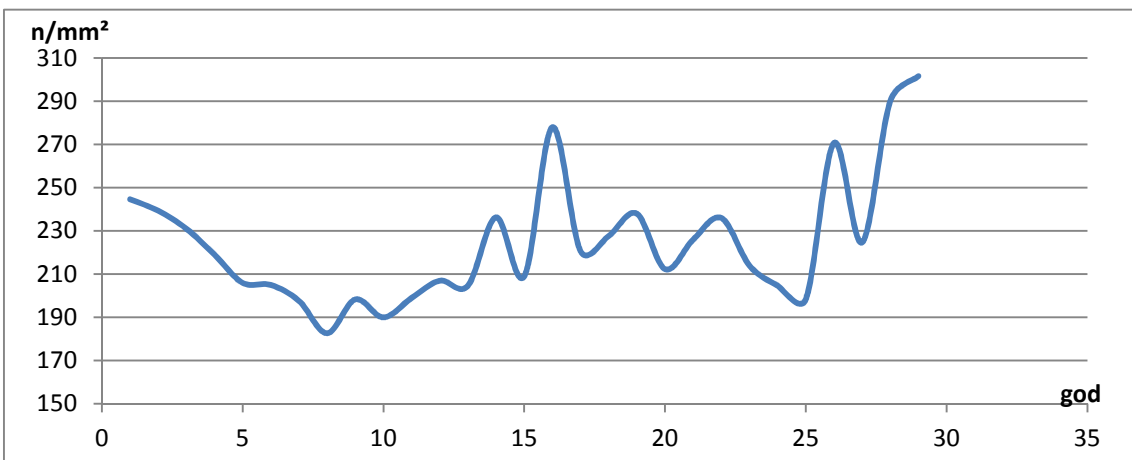
.66. , .3 0.3 m,



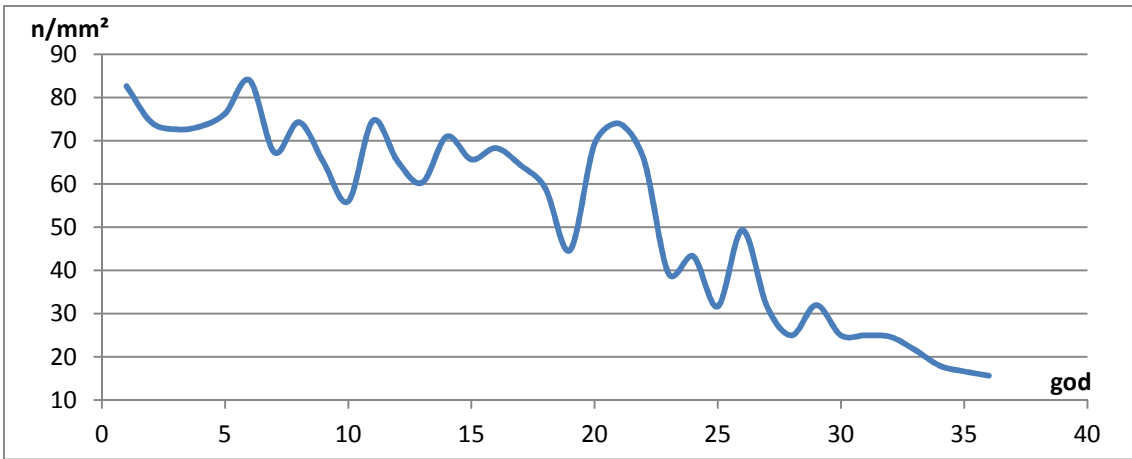
. 67. , .1 1.3 m,



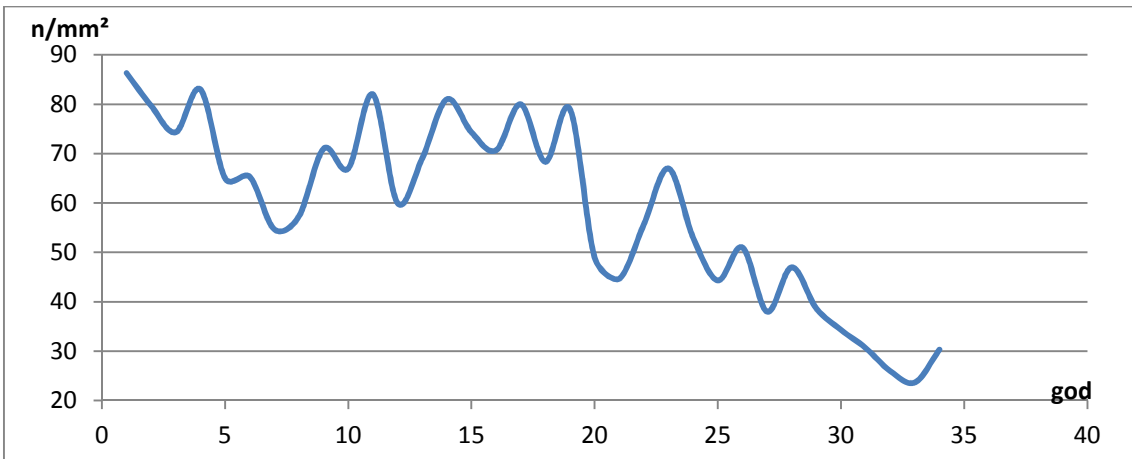
. 68. , .2 1.3 m,



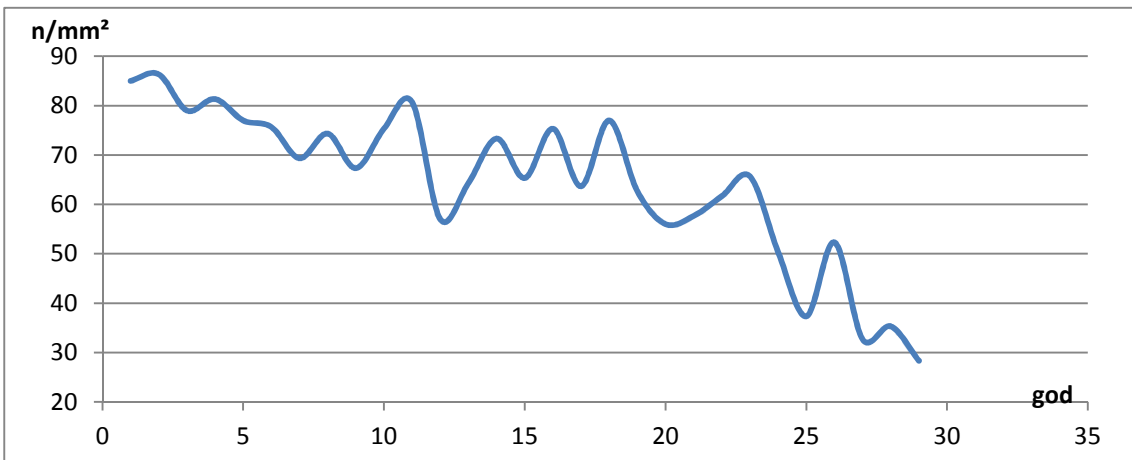
. 69. , .3 1.3 m,



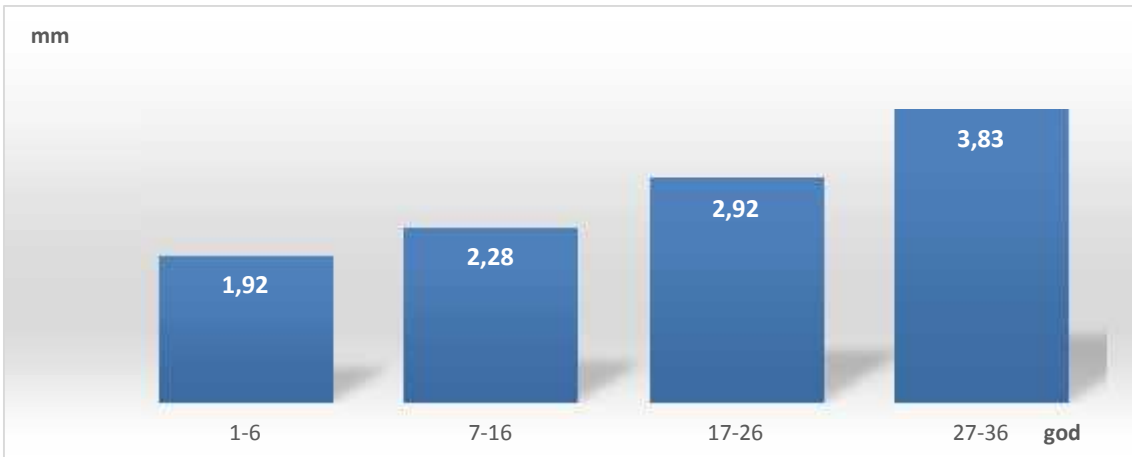
.70. , .1 1.3 m,



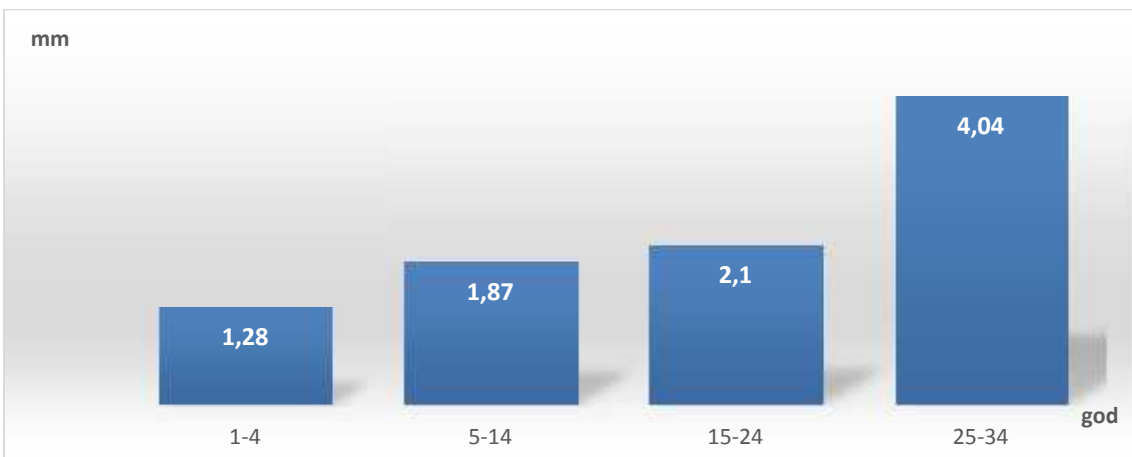
.71. , .2 1.3 m,



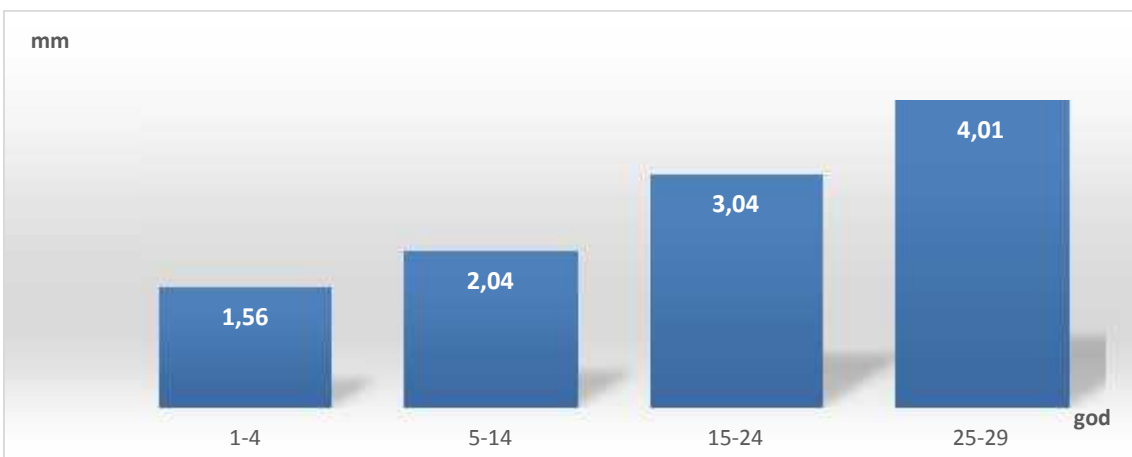
.72. , .3 1.3 m,



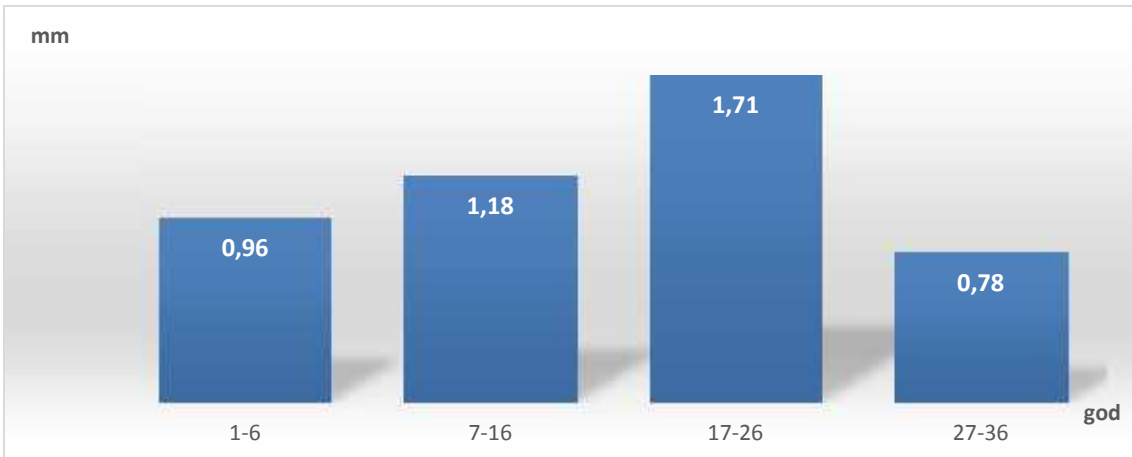
.73. , .1 0.3 m,



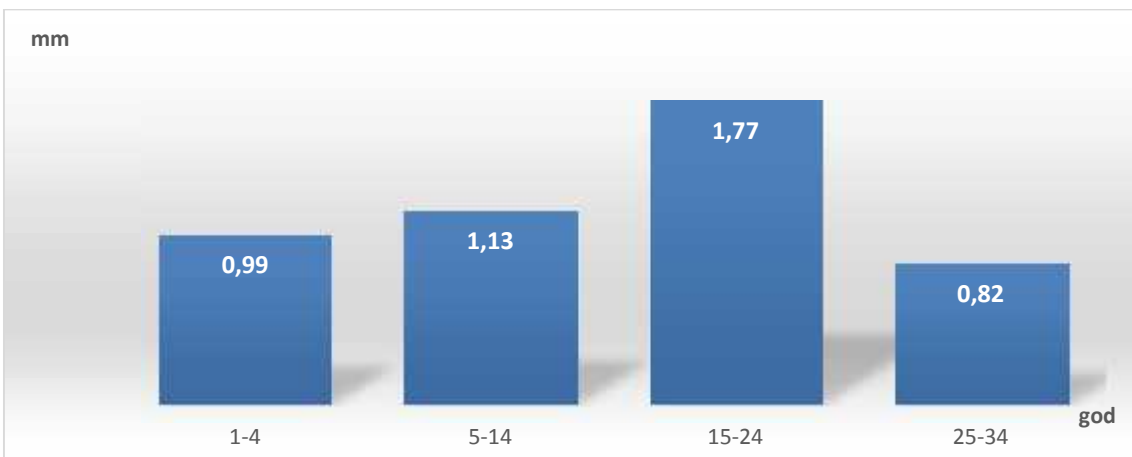
.74. , .2 0.3 m,



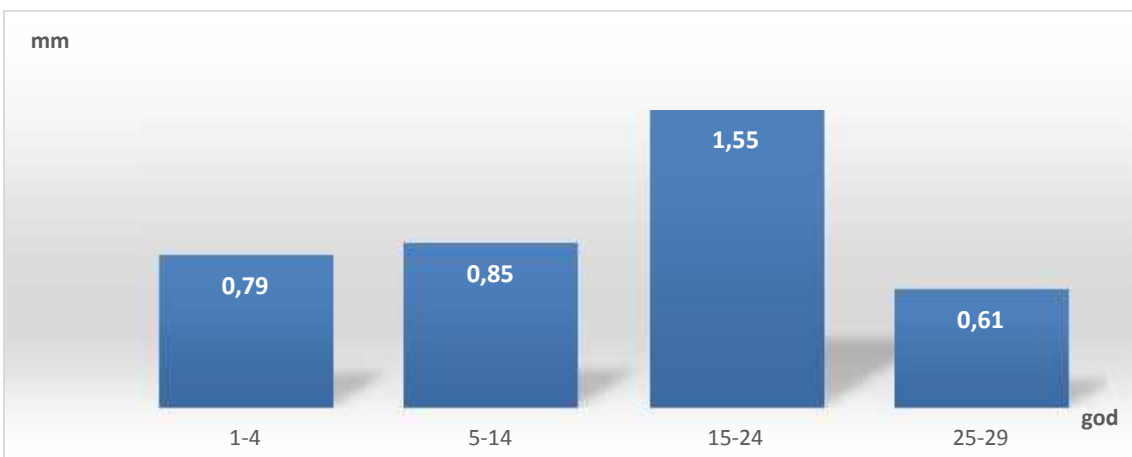
.75. , .3 0.3 m,



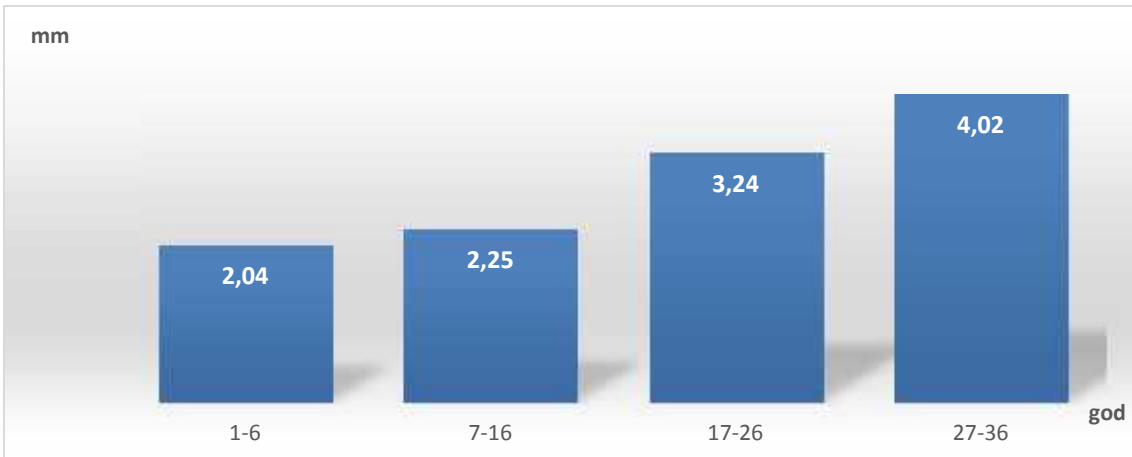
.76. , .1 0.3 m,



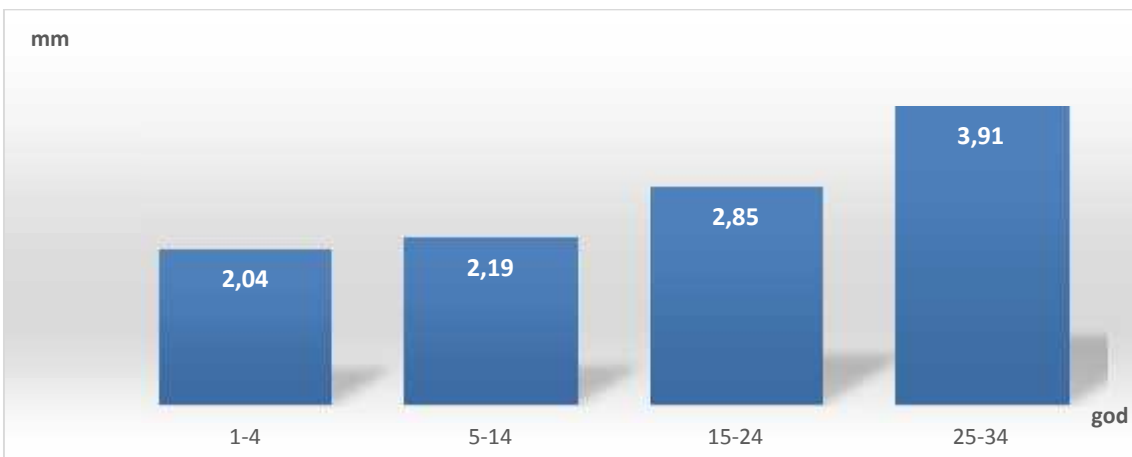
.77. , .2 0.3 m,



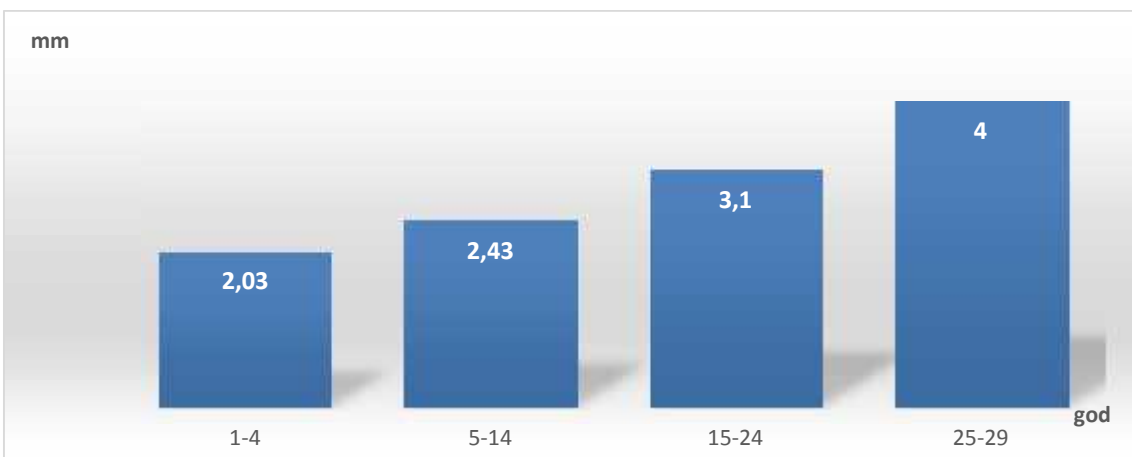
.78. , .3, 0.3 m,



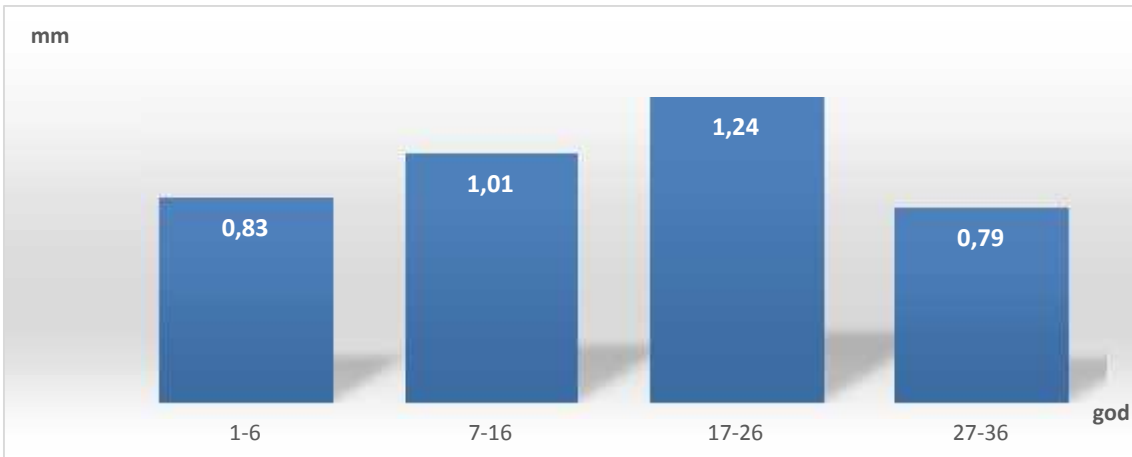
. 79. , .1 1.3 m,



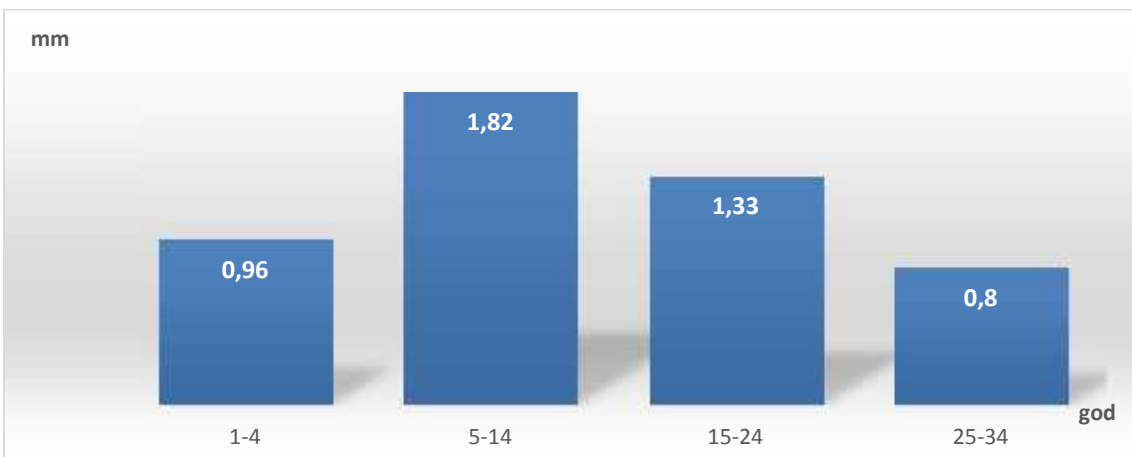
. 80. , .2 1.3 m,



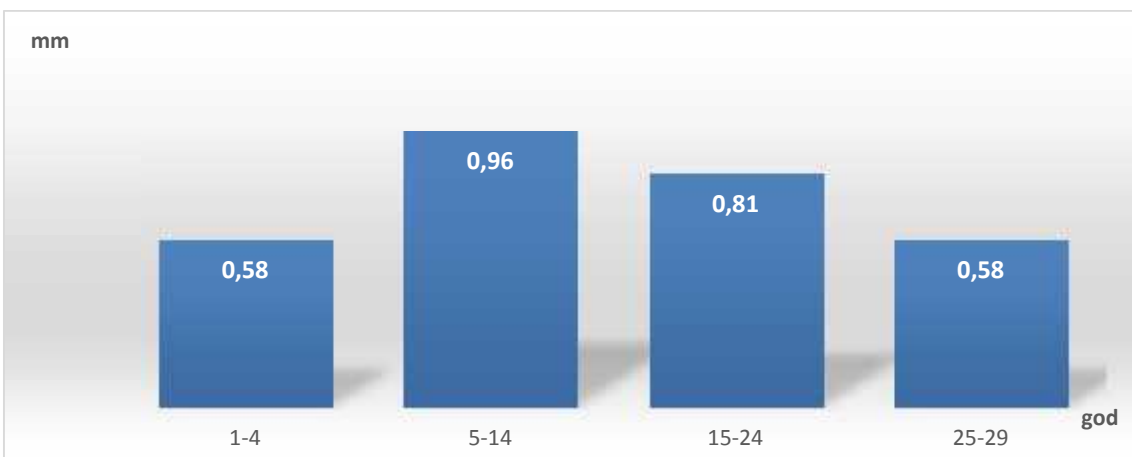
. 81. , .3 1.3 m,



. 82. , .1 1.3 m,



. 83. , .2 1.3 m,



. 84. , .3 1.3 m,

.9. (mm²)

	e									
.1, (0.3 m)	(mm ²)	269,25	210	345	36,79	135	1353,16	235	265	
.1, (0.3 m)	(mm ²)	63,39	20	95	22,88	75	523,34	85	73	
.1, (1.3 m)	(mm ²)	275,42	215	347	37,08	132	1374,62	241	268	
.1, (1.3 m)	(mm ²)	52,98	14	86	21,76	72	473,63	62	62	
.2, (0.3 m)	(mm ²)	211,75	148	299	40,24	151	1619,36	198	204	
.2, (0.3 m)	(mm ²)	70,21	27	98	20,75	71	430,38	92	70	
.2, (1.3 m)	(mm ²)	221,45	154	305	40,77	151	1662,33	201	212	
.2, (1.3 m)	(mm ²)	58,86	21	89	18,36	78	337,01	74	61,5	
.3, (0.3 m)	(mm ²)	210,09	165	287	28,41	122	807,01	185	205	
.3, (0.3 m)	(mm ²)	73,32	32	98	17,03	66	290,1	74	78	
.3, (1.3 m)	(mm ²)	224,56	174	305	29,61	131	876,81	205	218	
.3, (1.3 m)	(mm ²)	64,39	24	89	15,88	65	252,05	74	66	

.9 .

()

.1,	(0.3 m)	(mm)	2,74	1,92	3,83	0,84	1,91	0,7	2,6	2,6
.1,	(0.3 m)	(mm)	1,16	0,78	1,71	0,4	0,93	0,16	1,05	1,07
.1,	(1.3 m)	(mm)	2,89	2,04	4,02	0,92	1,98	0,84	2,7	2,75
.1,	(1.3 m)	(mm)	0,97	0,79	1,24	0,21	0,45	0,04	0,9	0,92
.2,	(0.3 m)	(mm)	2,32	1,28	4,04	1,2	2,76	1,43	1,9	1,99
.2,	(0.3 m)	(mm)	1,18	0,82	1,77	0,41	0,95	0,17	1,06	1,06
.2,	(1.3 m)	(mm)	2,75	2,04	3,91	0,85	1,87	0,72	2,48	2,52
.2,	(1.3 m)	(mm)	1,23	0,8	1,82	0,45	1,02	0,21	1,15	1,15
.3,	(0.3 m)	(mm)	2,66	1,56	4,01	1,09	2,45	1,19	2,54	2,54
.3,	(0.3 m)	(mm)	0,95	0,61	1,55	0,41	0,94	0,17	0,8	0,82
.3,	(1.3 m)	(mm)	2,89	2,03	4	0,86	1,97	0,74	2,77	2,77
.3,	(1.3 m)	(mm)	0,73	0,58	0,96	0,17	0,38	0,03	0,58	0,7

6.4.2.2.

mm²

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mm²

~

mm² (. 61, 62, 63, 67, 68, 69)

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mm²,

(. 64, 65, 66, 70, 71, 72)

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()

a a mm²

(),

mm²

(. 61, 62,

63, 67, 68, 69)

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mm²,

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mm² (

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(

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mm²

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mm²

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mm²

6.4.2.3.

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(. 73-84)

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(. 73, 74, 75, 79, 80, 81)

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 , 2, (.76,
 77, 78, 82, 83, 84)

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 ~ e a ()
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 ,

6.4.2.4. mm²

0.3 m,
 , 1.61 mm, 1.04
 mm, 2.22 mm, ,
 mm² : 205.39, 127.00 287.33 (.10 10a).
 , 1.77 mm,
 0.97 mm, 2.35 mm, mm²
 199.23, 160.33, 254.33 (.10 10a).
 ,
 : 1.73 mm, 0.95 mm 2.38 mm,
 mm² 152.67, 245.67, 194.28 (
 .10 10a).

0.3 m,
 1, 1.60 mm, 0.94
 mm, 2.26 mm, ,
 mm² : 101.30, 85.00 122.33 (.10 10a).

2, ,
: 1.75 mm, 0.74 mm 2.40 mm, mm²
96.15, 72.67, 121.67 (. 10 10a).
3, 1.78 mm, 0.83
mm, 2.33 mm,
mm²: 94.40, 69.00 130.33 (. 10 10a).

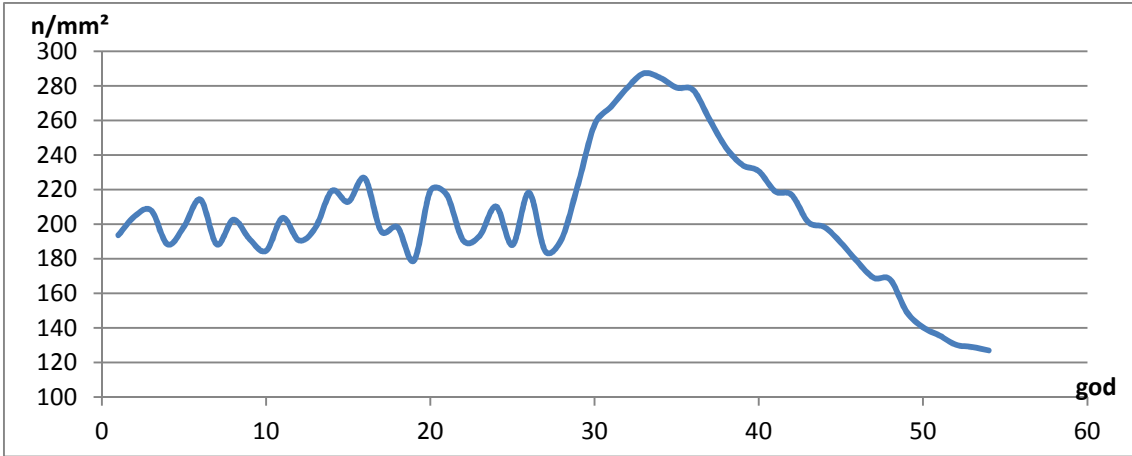
1.3 m,

, 1.77 mm,
1.22 mm, 2.30 mm,
mm² 212.67, 134.00, 299.00 (. 10 10a).
, ,
: 1.88 mm, 1.28 mm 2.48 mm,
mm² 165.00, 262.00, 206.02 (.
10 10a).
, 1.79 mm, 1.32
mm, 2.35 mm,
mm² : 201.60, 154.00 260.00 (. 10 10a).

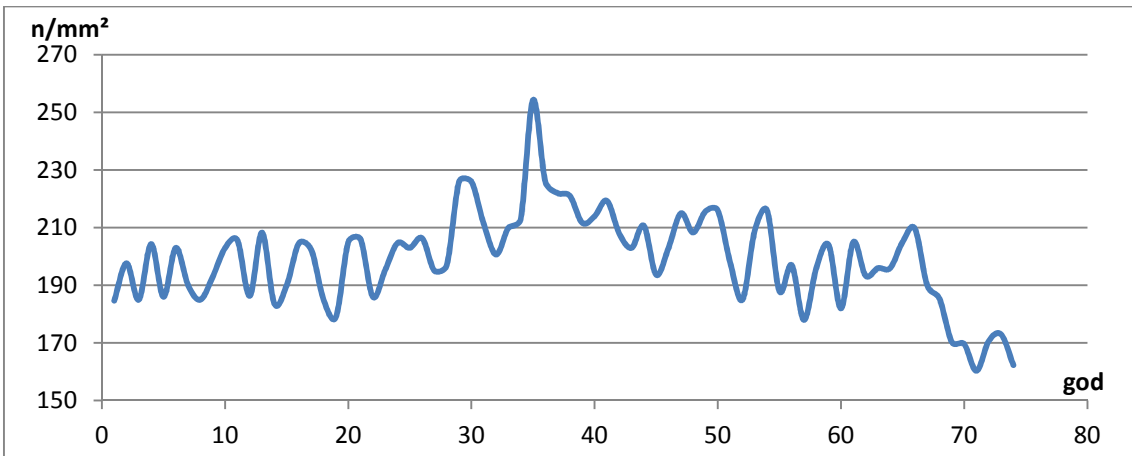
1.3 m,

1, 1.53 mm,
0.81 mm, 2.36 mm, mm² 91.67,
77.00, 112.00 (. 10 10a).
2, ,
: 1.76 mm, 0.93 mm 2.43 mm,
mm² : 85.62, 63.00 116.33 (. 10
10a).
3, 1.72 mm, 0.91
mm, 2.44 mm,
mm²: 85.49, 59.00 122.00 (. 10 10a).
. 85-108, mm²

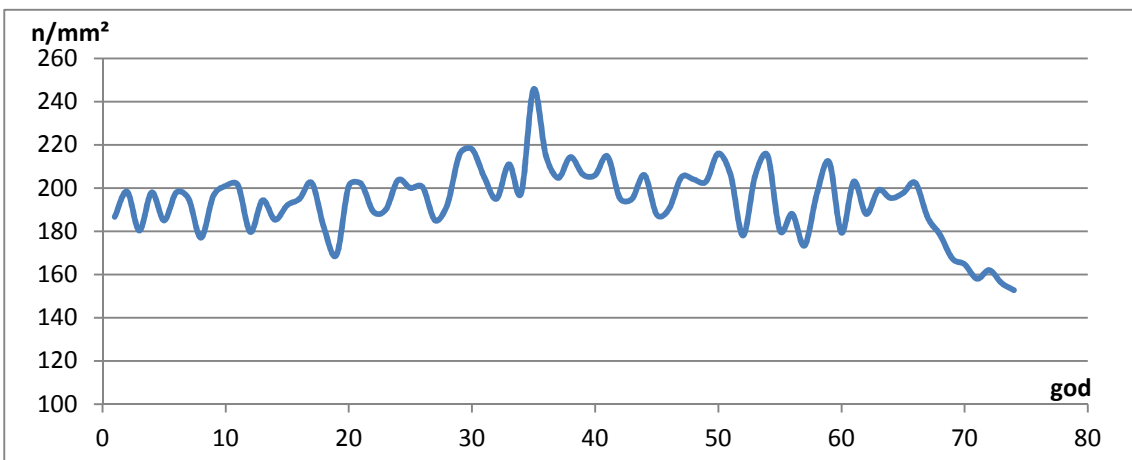
:



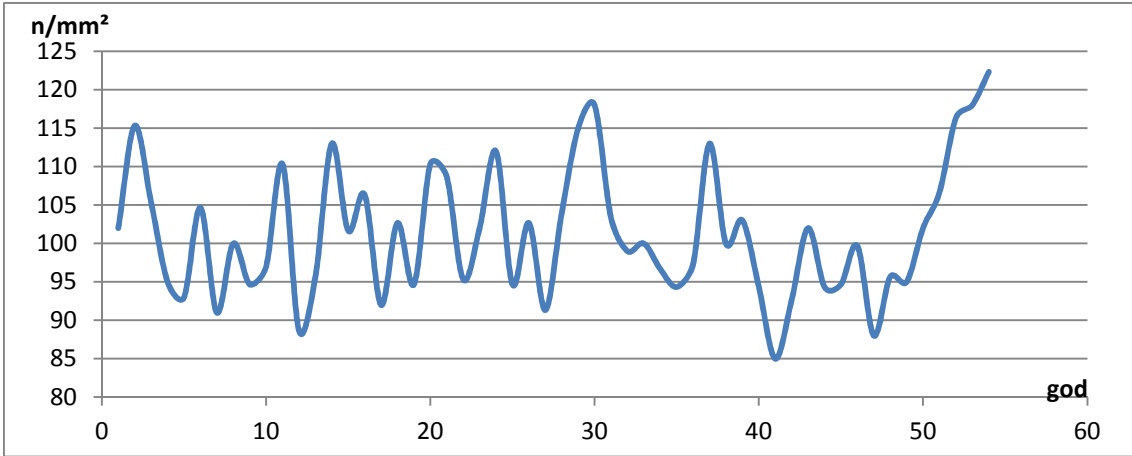
.85. , .1 0.3 m,



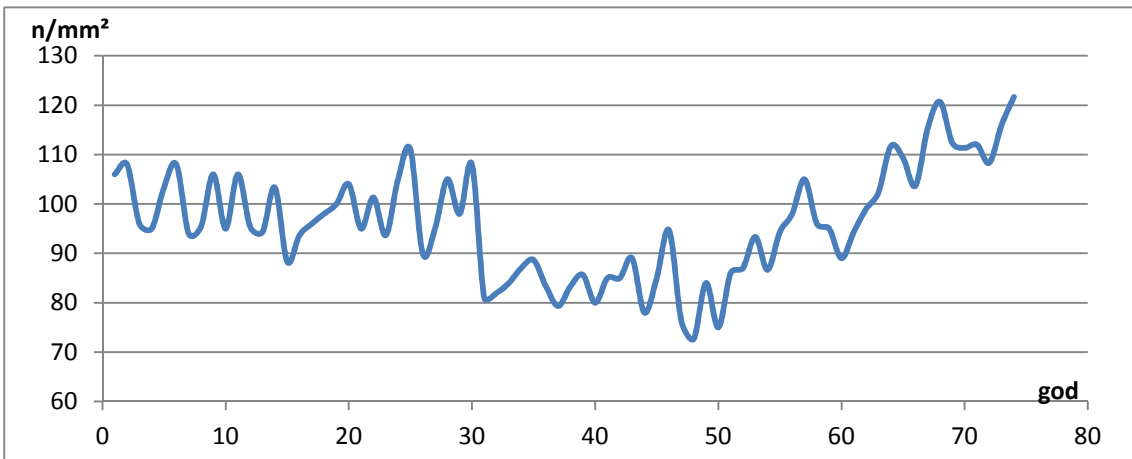
.86. , .2 0.3 m,



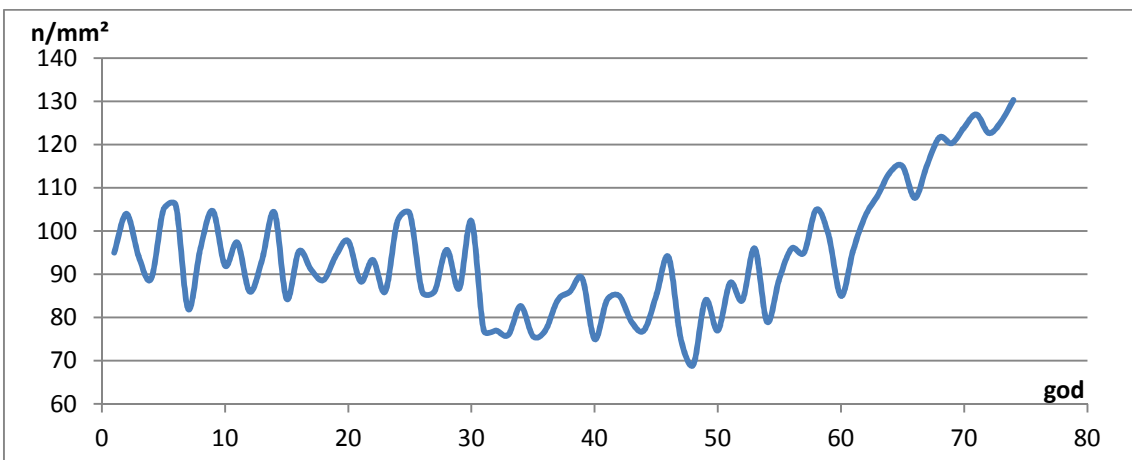
.87. , .3 0.3 m,



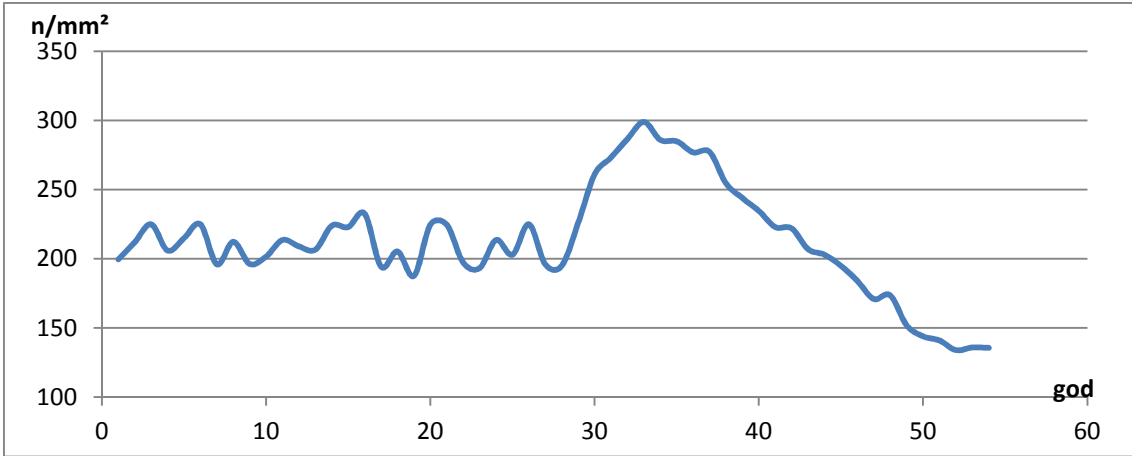
. 88. , .1 0.3 m,



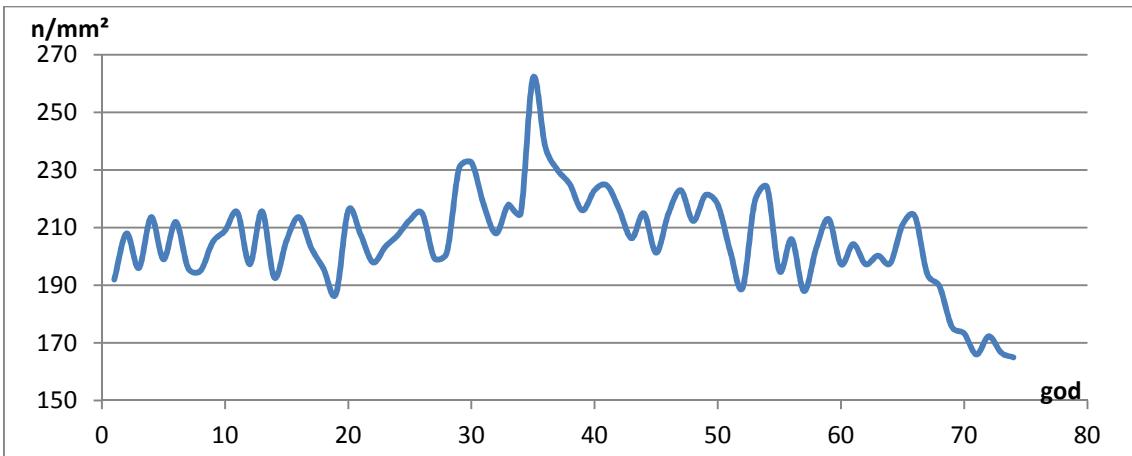
. 89. , .2 0.3 m,



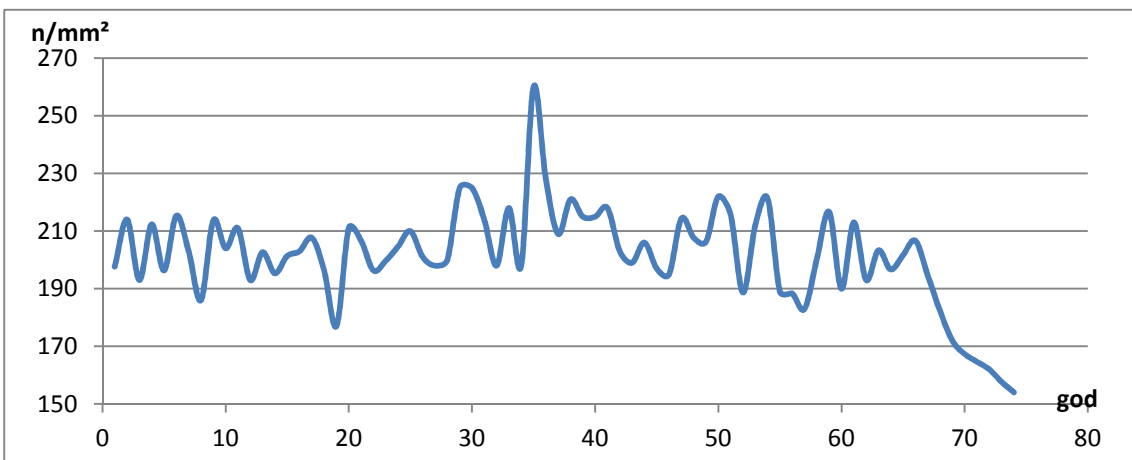
. 90. , .3 0.3 m,



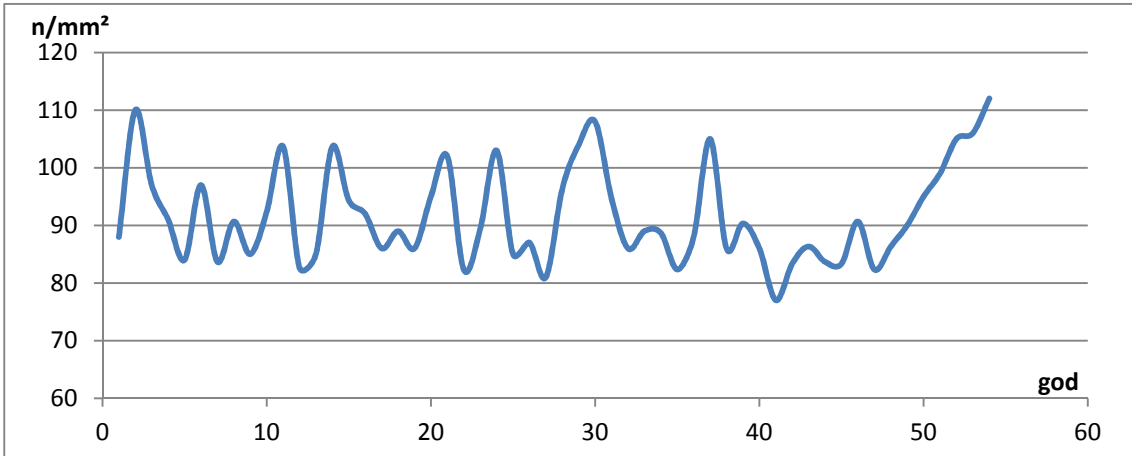
.91. , .1 1.3 m,



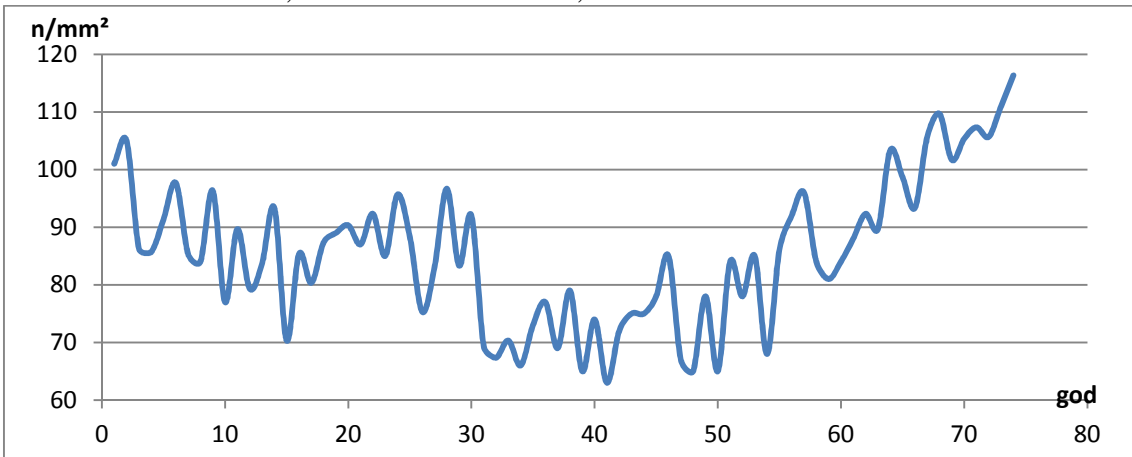
.92. , .2 1.3 m,



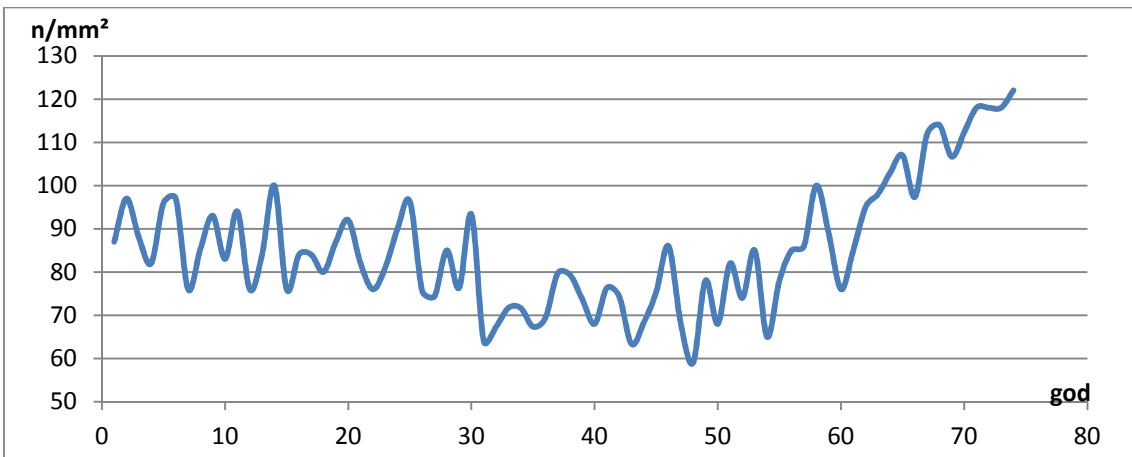
.93. , .3 1.3 m,



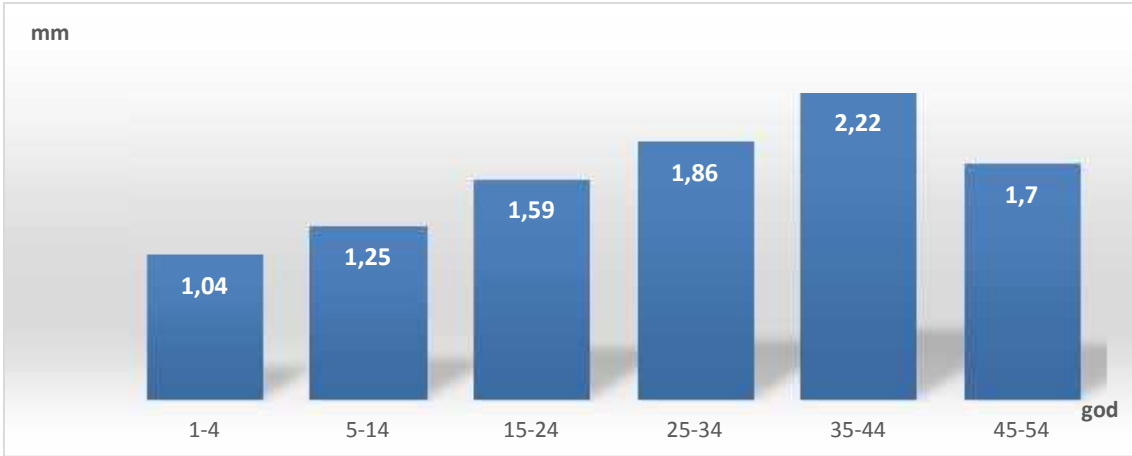
.94. , .1 1.3 m,



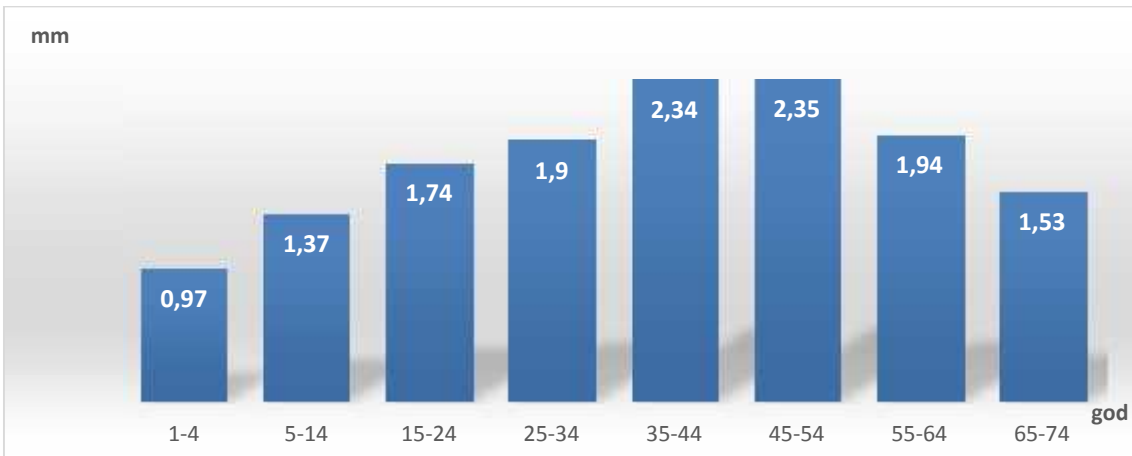
.95. , .2 1.3 m,



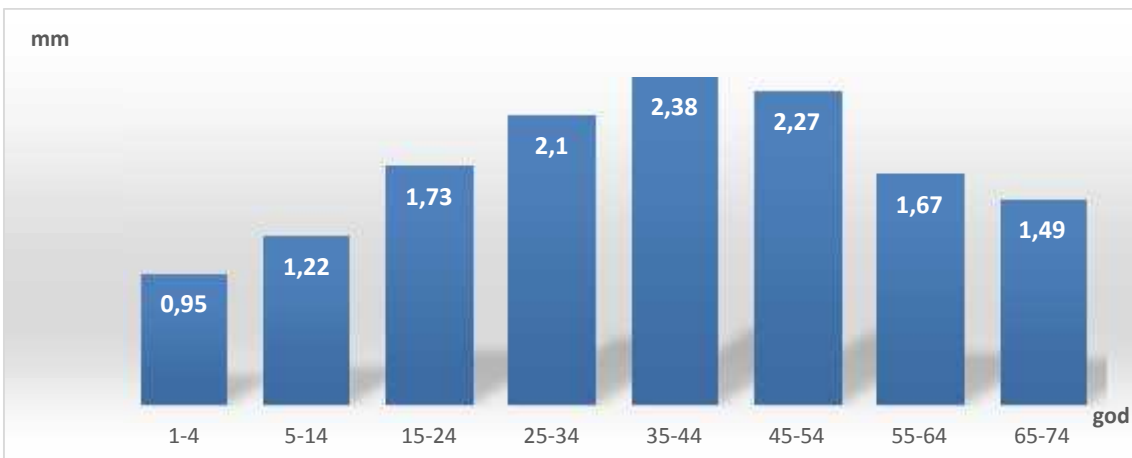
.96. , .3 1.3 m,



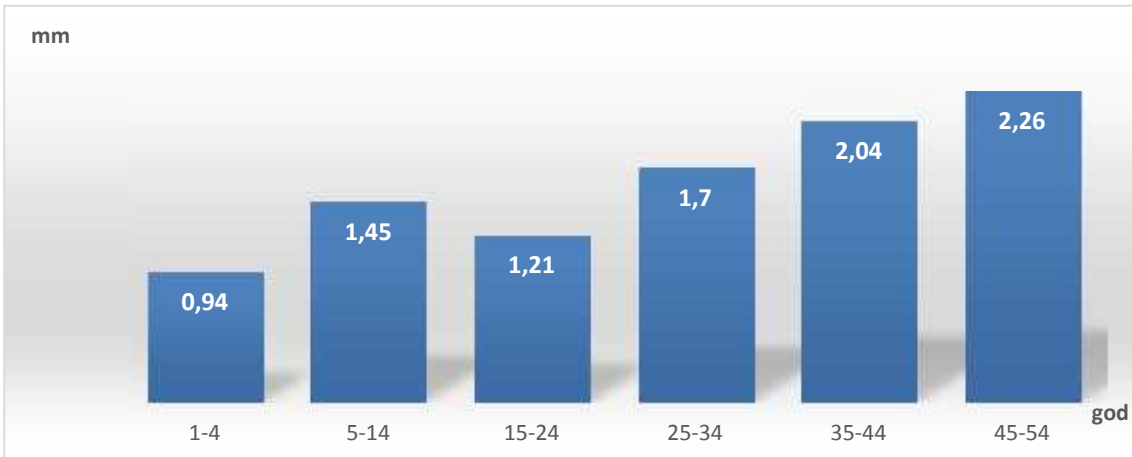
. 97. , .1 0.3 m,



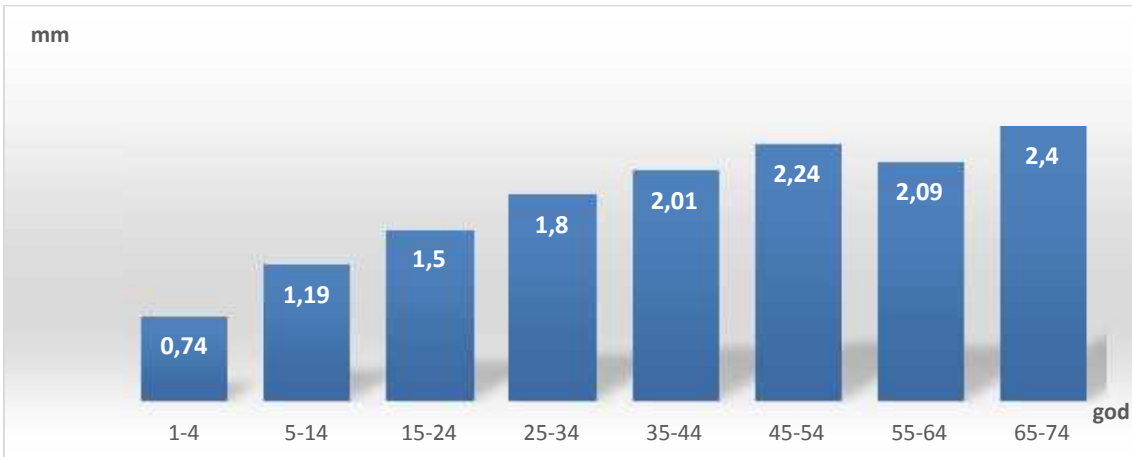
. 98. , .2 0.3 m,



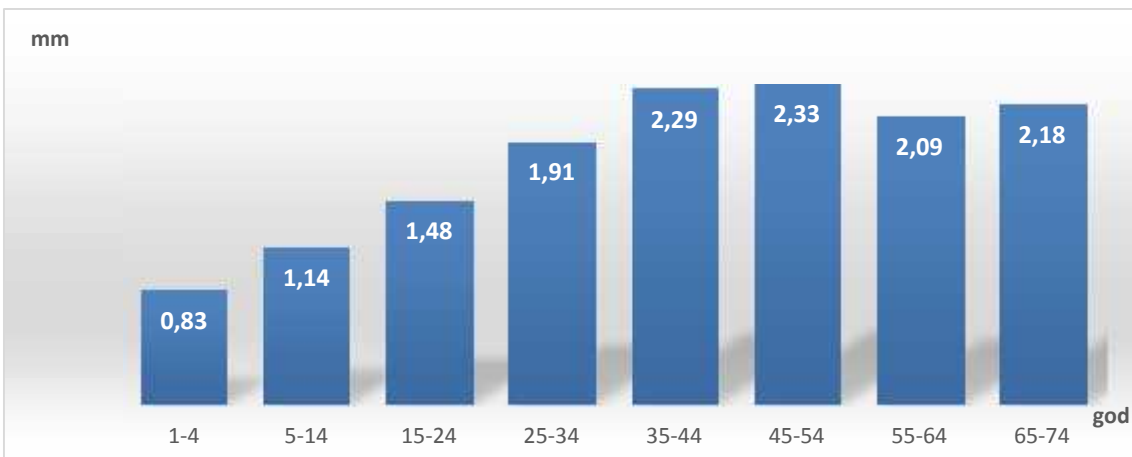
. 99. , .3 0.3 m,



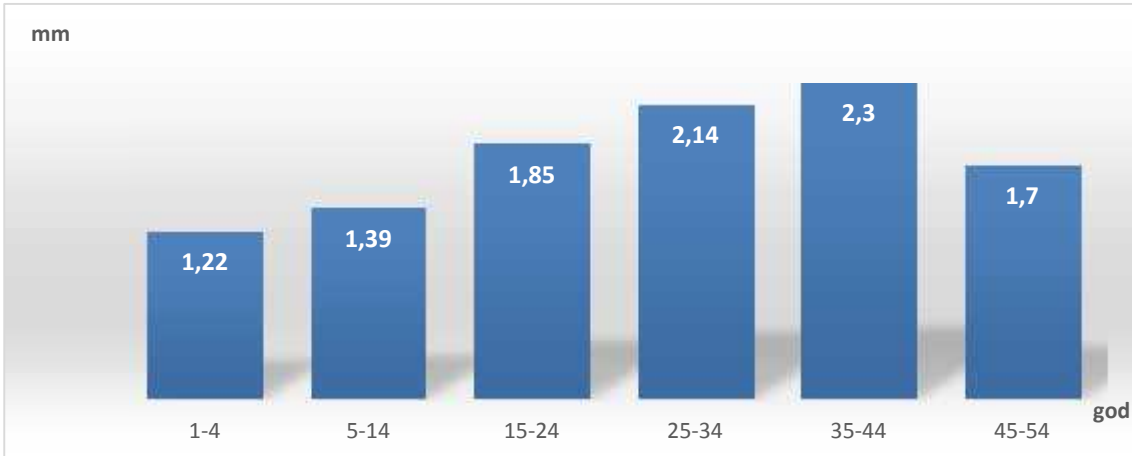
. 100: , .1 0.3 m,



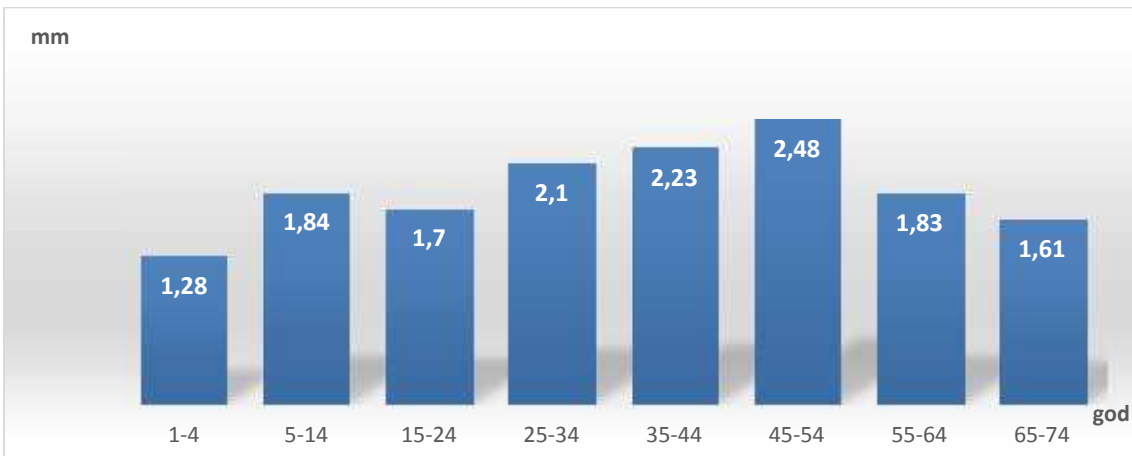
. 101. , .2 0.3 m,



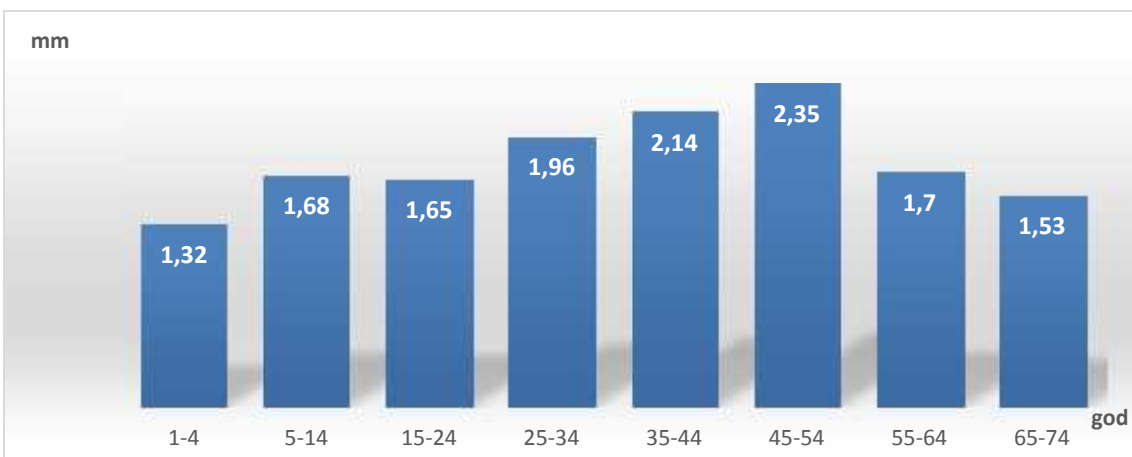
. 102. , .3 0.3 m,



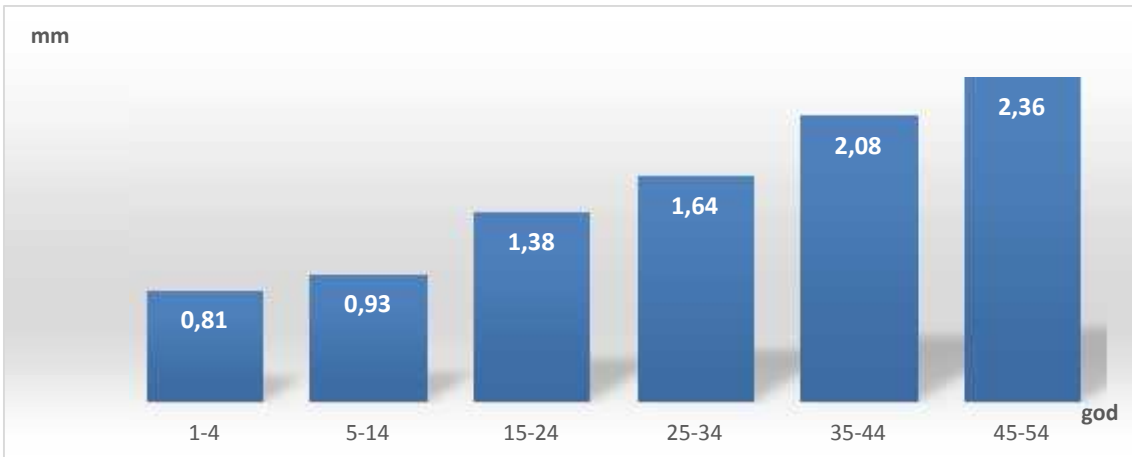
. 103. , .1 1.3 m,



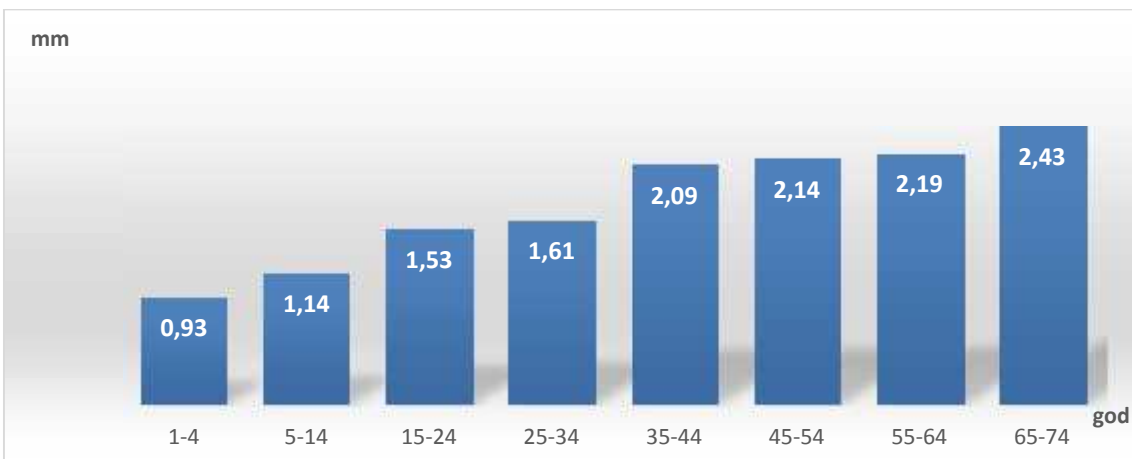
. 104. , .2 1.3 m,



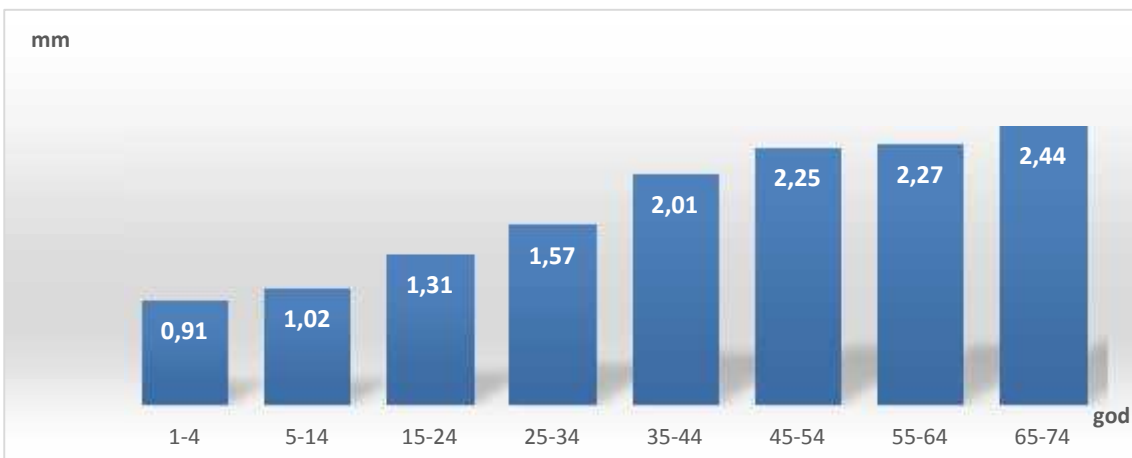
. 105. , .3 1.3 m,



. 106. , .1 1.3 m,



. 107. , .2 1.3 m,



. 108. , .3 1.3 m,

. 10.

(mm²)

.1,	(0.3 m)	(mm ²)	205,39	124	295	39,5	171	1560,33	195	201
.1,	(0.3 m)	(mm ²)	101,3	82	124	9,08	42	82,37	95	100
.1,	(1.3 m)	(mm ²)	212,67	132	303	39,26	171	1541,19	225	210
.1,	(1.3 m)	(mm ²)	91,67	74	114	8,81	40	77,61	84	89
.2,	(0.3 m)	(mm ²)	199,23	154	259	16,72	105	279,67	201	201
.2,	(0.3 m)	(mm ²)	96,15	70	125	11,68	55	136,42	98	95
.2,	(1.3 m)	(mm ²)	206,02	160	266	16,92	106	286,19	215	207
.2,	(1.3 m)	(mm ²)	85,62	62	118	12,99	56	168,83	84	85
.3,	(0.3 m)	(mm ²)	194,28	148	248	16,48	140	271,57	195	198
.3,	(0.3 m)	(mm ²)	94,4	65	135	14,52	70	210,8	84	92
.3,	(1.3 m)	(mm ²)	201,6	152	265	17,27	113	298,31	198	201,5
.3,	(1.3 m)	(mm ²)	85,49	56	124	14,9	68	222,02	74	84

. 10 .

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.1,	(0.3 m)	(mm)	1,61	1,04	2,22	0,42	1,18	0,18	1,6	1,65
.1,	(0.3 m)	(mm)	1,6	0,94	2,26	0,5	1,32	0,25	1,58	1,58
.1,	(1.3 m)	(mm)	1,77	1,22	2,3	0,42	1,08	0,18	1,75	1,78
.1,	(1.3 m)	(mm)	1,53	0,81	2,36	0,62	1,55	0,38	1,51	1,51
.2,	(0.3 m)	(mm)	1,77	0,97	2,35	0,47	1,38	0,22	1,82	1,82
.2,	(0.3 m)	(mm)	1,75	0,74	2,4	0,57	1,66	0,32	1,91	1,91
.2,	(1.3 m)	(mm)	1,88	1,28	2,48	0,38	1,2	0,14	1,8	1,83
.2,	(1.3 m)	(mm)	1,76	0,93	2,43	0,54	1,5	0,29	1,85	1,85
.3,	(0.3 m)	(mm)	1,73	0,95	2,38	0,5	1,43	0,25	1,7	1,7
.3,	(0.3 m)	(mm)	1,78	0,83	2,33	0,57	1,5	0,32	1,9	2
.3,	(1.3 m)	(mm)	1,79	1,32	2,35	0,34	1,03	0,11	1,66	1,69
.3,	(1.3 m)	(mm)	1,72	0,91	2,44	0,6	1,53	0,36	1,79	1,79

6.4.2.5.

mm²

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(

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)(. 10 10a)

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mm²

(. 85, 86, 87, 91, 92, 93)

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mm²

(. 88, 89, 90, 94, 95, 96)

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mm²,

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2 3

mm²

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1

mm²

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2 3

mm²

1

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mm²

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mm²

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mm²

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2 3

mm²

15-

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mm²

6.4.2.6.

~ ,
(. 10 10a)
~ ,
(. 97-108)
~
~ (. 97-108)
~ 1
, 2 3
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~ ,

6.4.2.7.

mm²
mm²
,
— ,
mm²
(. 61, 62, 63, 67, 68, 69). ,
mm²
(. 64, 65, 66, 70, 71, 72).

,
mm²
(. 85-96).
,
mm²,
,
Decoux et al., (2004)
64-117
(, ,) 131-240
(,).
,
,
mm²,
mm²,
(1992)
, 70-80 %
,
-
,
mm².

6.4.2.8.

,
,
(. 73, 74, 75, 79, 80, 81). ,

82, 83, 84).

(76, 77, 78,

103, 104, 105).

(. 97, 98, 99,

(. 100, 101, 102, 106, 107, 108) –

(. 73-84 97-108).

3 mm,

(, 1988),

4.36 mm,

4.70 mm.

Sequoia (*Taxodiaceae* F.W.Neger),

10 mm

(, 2000).

(Seth 1981; Shiokura 1984; Kucera 1994)

(Stairs et al., 1966),

%

(Herman et al., 1998).

(Herman et al., 1998)

a Sirvio & Karenlampi (2001)

: 1.

; 2.

; 3.

(Frimpong-Mensah 1987),

Zobel & Van

Buijtenen (1989).

(Taylor et al., 1982, Zobel & van Buijtenen 1989, Yang &

Hazenbergh 1994),

(, 1992)

2000),

(Fujiwara & Yang,

()

Pinus banksiana Lamb. *Picea mariana* Mill,

()

Abies balsamea Mill.,

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1 mm,

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Adamopoulos et al., (2012)

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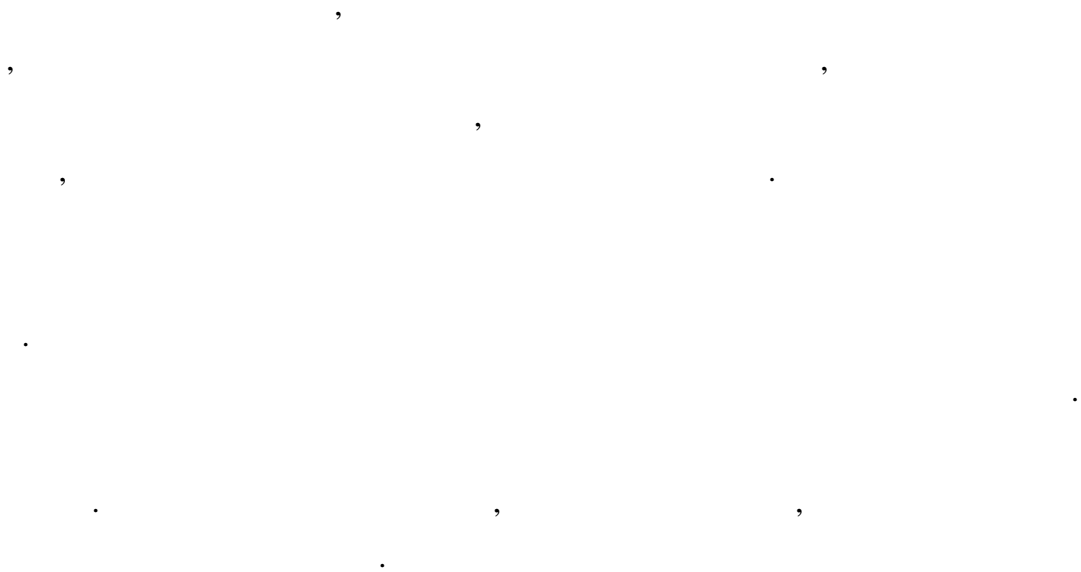
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БИОГРАФИЈА

Душан Јокановић рођен је у Београду, 28.септембра 1980. године, где је завршио основну школу „Дринка Павловић“, а потом и петнаесту београдску гимназију. Шумарски факултет Универзитета у Београду уписао је школске 2001/02 године, а дипломирао јула 2008. године са просечном оценом 8.10 током основних студија.

Школске 2009/10 уписао докторске студије на Катедри Семенарства, расадничарства и пошумљавања. Од септембра 2010. године почео је да ради, најпре као истраживач-приправник, а потом као истраживач-сарадник на истоименој катедри.

Ангажован је у настави на основним студијама у оквиру Одсека за шумарство, где изводи лабораторијске вежбе на два предмета: „Шумарска ботаника и анатомија дрвета“ и „Систематика лековитог биља“.

Што се тиче научно-истраживачког рада, до сада је објавио 21 научни рад, од чега 3 у часописима са СЦИ-листе.

Био је укључен у реализацију неколико научних пројеката:

- “Шумски засади у функцији повећања пошумљености Србије” – пројекат Министарства просвете, науке и технолошког развоја Републике Србије (2011-2016)
- “Садржај микроелемената у земљишту и кртоламачичоке (*Helianthus tuberosus* L.) на пепелишту ТЕНТ "А" као пионирске врсте за стварање повољних услова у циљу будућих пошумљавања” – пројекат Секретаријата за заштиту животне средине града Београда (2011) –
- “Тенеколошки потенцијал таксодијума (*Taxodium distichum* (L.) Rich.) као основа за подизање шумских засада ове врсте у Србији” – пројекат Министарства пољопривреде, трговине, шумарства и водопривреде (2012)
- "Потенцијали основаних плантажа пауловније (*Paulownia* spp. Siebold et Zucc) на подручју АП Војводина" -пројекат код Покрајинског секретаријата за пољопривреду, водопривреду и шумарство (2015)
- “Истраживања нивоа подземних вода на подручју ШГ "Сомбор”, ЈП “Војводина шуме” (2015)
- “Истраживања нивоа подземних вода на подручју ШГ Сремска Митровица”, ЈП “Војводина шуме” (2015)

Учествовао је на више међународних научних скупова.

Течно говори енглески и немачки језик.

Прилог 1.

Изјава о ауторству

Потписани-а дипл.инж. Душан Јокановић

број уписа 21/2009

Изјављујем

да је докторска дисертација под насловом

Анатомске особине стабала *Taxodium distichum* (L.) Rich. на алувијалним стаништима у Србији

- резултат сопственог истраживачког рада,
- да предложена дисертација у целини ни у деловима није била предложена за добијање било које дипломе према студијским програмима других високошколских установа,
- да су резултати коректно наведени и
- да нисам кршио/ла ауторска права и користио интелектуалну својину других лица.

Потпис докторанда

У Београду, април, 2016. године

Прилог 2.

Изјава о истоветности штампане и електронске верзије докторског рада

Име и презиме аутора дипл.инж. Душан Јокановић

Број уписа 21/2009

Студијски програм Шумарство – Семенарство, расадничарство и пошумљавање

Наслов рада: **Анатомске особине стабала *Taxodium distichum* (L.) Rich. на алувијалним стаништима у Србији**

Ментор др Драгица Вилотић, редовни професор

Потписани дипл.инж. Душан Јокановић

изјављујем да је штампана верзија мог докторског рада истоветна електронској верзији коју сам предао/ла за објављивање на порталу **Дигиталног репозиторијума Универзитета у Београду**.

Дозвољавам да се објаве моји лични подаци везани за добијање академског звања доктора наука, као што су име и презиме, година и место рођења и датум одбране рада.

Ови лични подаци могу се објавити на мрежним страницама дигиталне библиотеке, у електронском каталогу и у публикацијама Универзитета у Београду.

Потпис докторанда

У Београду, април 2016. године

Прилог 3.

Изјава о коришћењу

Овлашћујем Универзитетску библиотеку „Светозар Марковић“ да у Дигитални репозиторијум Универзитета у Београду унесе моју докторску дисертацију под насловом:

Анатомске особине стабала *Taxodium distichum* (L.) Rich. на алувијалним стаништима у Србији

која је моје ауторско дело.

Дисертацију са свим прилозима предао/ла сам у електронском формату погодном за трајно архивирање.

Моју докторску дисертацију похрањену у Дигитални репозиторијум Универзитета у Београду могу да користе сви који поштују одредбе садржане у одабраном типу лиценце Креативне заједнице (Creative Commons) за коју сам се одлучио/ла.

1. Ауторство

2. Ауторство - некомерцијално

3. Ауторство – некомерцијално – без прераде

4. Ауторство – некомерцијално – делити под истим условима

5. Ауторство – без прераде

6. Ауторство – делити под истим условима

(Молимо да заокружите само једну од шест понуђених лиценци, кратак опис лиценци дат је на полеђини листа).

Потпис докторанда

У Београду, април 2016.године

1. Ауторство - Дозвољаваате умножавање, дистрибуцију и јавно саопштавање дела, и прераде, ако се наведе име аутора на начин одређен од стране аутора или даваоца лиценце, чак и у комерцијалне сврхе. Ово је најслободнија од свих лиценци.

2. Ауторство – некомерцијално. Дозвољаваате умножавање, дистрибуцију и јавно саопштавање дела, и прераде, ако се наведе име аутора на начин одређен од стране аутора или даваоца лиценце. Ова лиценца не дозвољава комерцијалну употребу дела.

3. Ауторство - некомерцијално – без прераде. Дозвољаваате умножавање, дистрибуцију и јавно саопштавање дела, без промена, преобликовања или употребе дела у свом делу, ако се наведе име аутора на начин одређен од стране аутора или даваоца лиценце. Ова лиценца не дозвољава комерцијалну употребу дела. У односу на све остале лиценце, овом лиценцом се ограничава највећи обим права коришћења дела.

4. Ауторство - некомерцијално – делити под истим условима. Дозвољаваате умножавање, дистрибуцију и јавно саопштавање дела, и прераде, ако се наведе име аутора на начин одређен од стране аутора или даваоца лиценце и ако се прерада дистрибуира под истом или сличном лиценцом. Ова лиценца не дозвољава комерцијалну употребу дела и прерада.

5. Ауторство – без прераде. Дозвољаваате умножавање, дистрибуцију и јавно саопштавање дела, без промена, преобликовања или употребе дела у свом делу, ако се наведе име аутора на начин одређен од стране аутора или даваоца лиценце. Ова лиценца дозвољава комерцијалну употребу дела.

6. Ауторство - делити под истим условима. Дозвољаваате умножавање, дистрибуцију и јавно саопштавање дела, и прераде, ако се наведе име аутора на начин одређен од стране аутора или даваоца лиценце и ако се прерада дистрибуира под истом или сличном лиценцом. Ова лиценца дозвољава комерцијалну употребу дела и прерада. Слична је софтверским лиценцама, односно лиценцама отвореног кода.