UDK 63 **ISSN 1512-6412**

АГРОЗНАЊЕ

Agro – knowledge Journal

University of Banjaluka

Faculty of Agriculture

Agroznanje, Vol. 15, br. 1, 2014.

Универзитет у Бањој Луци
ПОЉОПРИВРЕДНИ ФАКУЛТЕТ
University of Banjaluka, Faculty of Agriculture

Телефон: (051) 330901
Телефакс: (051) 312 580
E-mail: agrobl@blic.net
Web: www.agroznanje.com

Бања Лука, Република Српска, Булевар војводе Петра Бојовића 1А
Banja Luka, Republic of Srpska, Bulevar vojvode Petra Bojovica 1A

ТЕХНИЧКИ УРЕДНИК
TECHNICAL EDITOR

Јелена Марковић, дипл. инж.
Jelena Marković, dipl.ing.

ПРЕВОДИЛАЦ/ЛЕКТОР/КОРЕКТОР
TRANSLATOR/EDITOR/PROOFREADER

мр Јелена Бркић, проф. јез. и књиж.
Jelena Brkić, MA (Lang & Lit.).

ПРЕЛОМ И ШТАМПА
LAYOUT AND PRINTING

GRAFOMARK
LAKTAŠI

Часопис „Агрознање“ се цитира у издањима CAB International Abstracts
Agro-knowledge Journal is cited in CAB International Abstracts

Штампање часописа суфинансира Министарство науке и технологије Републике Српске
The Journal is financially supported by Ministry of Science and Tehnology of Republic of Srpska

САДРЖАЈ / *CONTENTS*

ОРИГИНАЛНИ НАУЧНИ РАДОВИ / *ORIGINAL SCIENTIFIC PAPERS*

СТРУЧНИ РАДОВИ / *PROFESSIONAL PAPERS*

ПРИКАЗ КЊИГЕ / *BOOK REVIEW*

Original scientific paper
Originalan naučni rad
UDK: 634.5(497.2)
DOI:10.7251/AGREN1401005G

University of Banjaluka, Faculty of Agriculture
Agro-knowledge Journal

Evaluation of Some Walnut Cultivars under the Climatic Conditions of South Bulgaria

Stefan Gandev[1], Vasiliy Dzhuvinov[1]

[1]*Fruit-Growing Institute, Plovdiv, Bulgaria*

Abstract

Introduced walnut cultivars grown as main cultivars in countries with climatic conditions different from Bulgaria, were included in the present study. This evaluation aimed at selecting walnut cultivars with suitable biological and pomological characteristics when grown under the climatic conditions of South Bulgaria.The trial demonstrated that the cultivars 'Fernor', 'Lara' and 'Tiszacsecsi 83'were later blooming than the other cultivars as 'Serr', 'Hartley', 'Izvor 10' and 'Sheynovo'. That phenological characteristic is very important to avoid spring frost damages. During the period of evaluation the results showed that the yields from the cultivars 'Izvor 10', 'Serr', 'Hartley', 'Fernor' and 'Lara' were higher compared to 'Sheynovo' and 'Tiszacsecsi 83'. This is the reason to recommend the first group of walnut cultivars to be grown under the climatic conditions of South Bulgaria.

Key words: *Juglans regia* L., cultivar, growth, fruit characteristics, yield

Introduction

Walnut as a fruit species became a priority after the accession of Bulgaria to the European Union. The century-old walnut trees found on the territory of the country are an indisputable proof that the soil and climatic conditions in our country are favorable for the optimal development of that fruit crop.

The walnut cultivars grown around the world have been selected from local resources or bred in countries with varied soil and climatic conditions. They differ from one another in their pomological and agrobiological characteristics (Solar, 1990; Malvolti et al.,1994 and 1996; Germain et al., 1997; Balci et al., 2001; Rouskas and Zakynthinos, 2001; Dogan et al., 2005).

The prevailing cultivars grown in walnut orchards in Bulgaria are local ones, of a terminal or intermediate bearing type (Nedev et al., 1976). This does not comply with the modern requirements for a walnut cultivar. The only exception is 'Izvor 10' cv., bearing fruit from lateral buds (Nedev et al., 2002). According to Ramos (1985), lateral bearing cultivars are of a higher productivity than terminal and intermediate bearing. Germain et al. (1999) established that the lateral bearing cultivars have a higher productivity due to the larger number of fruit buds than the terminal and intermediate bearing cultivars. According to Dzhuvinov et al. (2013), the productivity of the cultivar depends not only on the type of bearing and on number of female flowers, but also on the percentage of the useful fruit set and the fruit weight. The percentage of useful fruit set is a cultivar specificity, but it could be significantly influenced by some agrotechnical activities, such as pruning, fertilization, irrigation, as well as the larger distance from the pollinator. The yield of each cultivar depends of the kernel weight, which is about 5-7 g for most of the commercial cultivars.

Germain et al. (1999) found out that Californian cultivars are not suitable for growing in France due to the colder climate. In the Carpathian region of Romania the drop down of winter temperatures to minus 22.7ºC does not affect the normal growth and fruiting of the Californian and French lateral bearing cultivars (Botu et al., 2010). According to Nedev et al. (1976) the Bulgarian cultivars could be frostbitten by low winter temperatures below minus 20ºC. The Carpathian walnut is considered to be the most frost resistant in the world, as it can resist without any damages temperatures about minus 32-35 ºC (Mitra et al., 1991; Domoto, 2002).

The aim of the study was to carry out agrobiological evaluation of the introduced walnut cultivars 'Fernor', 'Lara', 'Tiszacsecsi 83', 'Serr' and 'Hartley' and to assess the possibilities of their growing in South Bulgaria.

Material and Methods

The experimental plantation was established in the spring of 2003 and the study was carried out in 2009-2013, i.e. from 7th till 11th vegetation season of the walnut trees. The type of soil is alluvial and the climate is

humid subtropical with considerable humid continental influences. The introduced cultivars 'Serr', 'Hartley', 'Fernor', 'Lara', 'Tiszacsecsi 83' plus 'Izvor 10' and the control 'Sheynovo', grafted on common walnut (*Juglans regia* L.) rootstock, were included in the study. The trees were planted at a distance of 8 x 8 m, trained to the improved layered crown system. Micro sprinkling irrigation was applied in the trial. The soil of the experimental plantation was maintained as black fallow.

Three trees of each cultivar were studied, randomly planted in the orchard, each tree being a separate replication. Data were statistically processed following Duncan's test (Steele and Torrie, 1980).

The following characteristics were reported:

Time of flowering of female and male flowers – early-flowering, 6-8 days before 'Sheynovo'; medium-flowering – their flowering period coinciding with that of the control; late-flowering –10 or more days after 'Sheynovo'. *Growth vigor* – according to the vegetative length increment of the leader and the extensions of the skeletal branches and spurs: poor growth – 10-20 cm length increment; moderate growth –20-30 cm length increment; vigorous growth – length increment over 31 cm. *Crown habit and volume* – shape, density, volume, angle of divergence of the first three skeletal branches to the leader. *Fruit-bearing type* – terminal, intermediate, lateral. *Time of ripening*: very early – 20-25 August; early – 26 August till 5 September; medium-early – 6 September till 15 September; medium-late – from 16 September till 25 September; late – after 26 September. *Yield per tree*–kg/tree. *Morphometric measurements:* fruit size in mm; mean weight of 30 fruits, grouped as: very small < 8.5 g; small –from 8.5 g to 10.5 g; medium–from 10.5 g to 12.5 g; large–from 12.5 g to 14.5 g and very large > 14.5 g. *Shell thickness*: thin – to 1.2 mm; medium thick – from 1.3 to 1.7 mm; thick – over 1.8 mm. *Kernel percentage (output in percentage*): very low–below 40%; low – 40-44%; medium–from 45 to 49%; high–from 50 to 55%; very high–over 55%. Characteristics used follow the methods of studying genetic resources of Nedev et al. (1979) and Germain (2004).

Results and Discussion

Beginning of vegetation and time of flowering are specific biological traits of common walnut (*Juglans regia* L.) and they depend on the genotype of the cultivar and the climatic conditions, under which it is grown (Germain et al., 1999). Table 1 shows that in average for the period, the standard 'Sheynovo' entered the phenological stage Cf (bud

break) on 10th April. Out of the other studied cultivars, the earliest to enter the period of vegetation was ‘Serr’ – 10 days before ‘Sheynovo’. ‘Izvor 10’ cultivar also developed early, i.e. 6 days before the control. In ‘Hartley’ the Cf stage began 7 days after the control cultivar. The latest to enter the bud burst stage were ‘Lara’, ‘Fernor’ and‘Tiszacsecsi 83’. The first one entered Cf phenological stage 15 days after the standard ‘Sheynovo’ and the others – 16 days after the standard (Table 1).

The mass flowering of the female flowers data (Ff2 phenological stage)shows that ‘Serr’ and ‘Izvor 10’ flowered before ‘Sheynovo’, while ‘Hartley’ and ‘Lara’ entered the mass flowering stage immediately after the control. The latest mass flowering season of the female flowers was reported in ‘Tiszacsecsi 83’ and‘Lara’ –10 and 11 days after the control.

The mass flowering of the male flowers is also different for the separate cultivars. Catkins of ‘Serr’ had the earliest mass flowering phenological stage (Fm2) – 5 days before the standard ‘Sheynovo’. In all the other cultivars flowering of the male flowers was from 7 to 20 days after ‘Sheynovo’. The latest development of the catkins was established for ‘Fernor’ and ‘Lara’ cultivars – 13 and 20 days after the control ‘Sheynovo’.

The obtained results about fruit ripening time of the studied cultivars confirmed the investigations of Nedev et al. (1983) about the time of fruit ripening of the local cultivars ‘Izvor 10’ and ‘Sheynovo’. ‘Izvor 10’ was medium early and the standard ‘Sheynovo’ was medium late. All the other studied cultivars were late ripening. The cultivars ‘Serr’ and ‘Hartley’ ripened 8 and 11 days after the standard ‘Sheynovo’, ‘Lara’ – 18 days after the control, while ‘Tiszacsecsi 83’and‘Fernor’ – 20 days after ‘Sheynovo’. Those results showed that the studied cultivars ripen from 15 September through 10 October under the conditions of South Bulgaria.

Growth vigor, fruiting type and crown habit are very important characteristics of the studied cultivars (Table 2). ‘Sheynovo’, ‘Serr’, ‘Hartley’ and ‘Lara’ belong to the group of vigorously growing cultivars, their annual length increment of the extensions of the leader and the skeletal branches and spurs being over 31 cm. Crown volume of ‘Serr’and ‘Lara’ was the biggest – 139.7 m^3 and 130.4 m^3, respectively, and significant difference between the two cultivars was not established for that characteristics. The other two cultivars of vigorous growth ‘Sheynovo’ and‘Hartley’ had a similar crown volume – 104.1 m^3 and 95.2 m^3, respectively.

Tab. 1. Average phonological data about the walnut cultivars for the period 2009-2013
Prosječni fonološki podaci o sortama oraha za period 2009-2013

Cultivar *Sorta*	Apical bud burst *Pucanje apikalnih pupoljaka*		Flowering of female flowers *Cvjetanje ženskih cvjetova*						Flowering of male flowers *Cvjetanje muških cvjetova*						Time of ripening *Vrijeme zrijenja*	
	Beginning *Početak*	Number of days* *Broj dana* *	Beginning *Početak*	Number of days* *Broj dana* *	Mass flowering *Puno cvjetanje*	Number of days* *Broj dana* *	End of flowering *Kraj cvjetanja*	Number of days* *Broj dana* *	Beginning *Početak*	Number of days* *Broj dana* *	Mass flowering *Puno cvjetanje*	Number of days* *Broj dana* *	End of flowering *Kraj cvjetanja*	Number of days* *Broj dana* *	Ripening *Zrijenje*	Number of days* *Broj dana* *
Izvor 10	04.04.	-6	16.04.	-11	18.04.	-13	24.04.	-13	27.04.	+8	01.05.	+9	06.05.	+8	15.09.	-5
Sheynovo	10.04.	0	27.04.	0	01.05.	0	07.05.	0	19.04.	0	22.04.	0	28.04.	0	20.09.	0
Serr	31.04.	-10	20.04.	-7	27.04.	-4	01.05.	-6	13.04.	-6	17.04.	-5	24.04.	-4	28.09.	+8
Hartley	17.04.	+7	28.04.	+1	04.05.	+3	12.05.	+5	24.04.	+5	30.04.	+8	04.05.	+6	01.10.	+11
Fernor	26.04.	+16	06.05.	+9	12.05.	+11	20.05.	+13	30.04.	+11	05.05.	+13	09.05.	+11	10.10.	+20
Lara	25.04.	+15	02.05.	+5	06.05.	+5	17.05.	+10	07.05.	+18	12.05.	+20	19.05.	+21	08.10.	+18
Tiszacsecsi 83	26.04.	+16	06.05.	+9	11.05.	+10	19.05.	+12	25.04.	+6	29.04.	+7	05.05.	+7	10.10.	+20

* Number of days compared to the control 'Sheynovo'
Broj dana uspoređen sa kontrolom 'Sheynovo'

Tab. 2. Growth vigor, bearing type and crown habit
Snaga rasta, tip plodonošenja i habitus krošnje

Cultivar *Sorta*	Growth vigor *Snaga rasta*	Bearing type (laterality, %) *Tip plodonošenja (linearnost, %)*	Crown habit *Habitus krošnje*		
			Shape *Oblik*	Angle deviation of skeletal branches *Ugao devijacije kod skeletnih grana*	Volume (m^3) *Obim*
Izvor 10	moderate *umjerena*	lateral (90%) *bočno (90%)*	semi-upright *polu-uspravan*	60 - 70º	59.2 c
Sheynovo	vigorous *jaka*	intermediate (25%) *mješovito (25%)*	spreading *raširen*	70 - 80º	104.1 b
Serr	vigorous *jaka*	intermediate (35%) *mješovito (35%)*	spreading *raširen*	70 - 80º	139.7 a
Hartley	vigorous *jaka*	intermediate (10%) *mješovito (10%)*	semi-upright *polu-uspravan*	60 - 70º	95.2 b
Fernor	moderate *umjerena*	lateral (90%) *bočno (90%)*	upright *uspravan*	40 - 45º	65.6 c
Lara	vigorous *jaka*	lateral (45%) *bočno (45%)*	semi-upright *polu-uspravan*	60 - 70º	130.4 a
Tiszacse-csi 83	poor *slaba*	intermediate (15%) *mješovito (15%)*	semi-upright *polu-uspravan*	60 - 70º	34.8 d

Values followed by the same letter in a column were not statistically different ($P < 0.05$).
Vrijednosti u koloni označene istim slovom nisu statistički različite ($P < 0,05$).

'Izvor 10' and 'Fernor' were of a moderate growth rate, the length increment of the extensions being 20-30 cm and the crown volume was similar – 59.2 m^3 for the former and 65.6 m^3 for the latter cultivar. 'Tiszacsecsi 83' had a poor growth rate, the length increment of the extensions being 10-20 cm and the crown volume – 34.8 m^3.

Table 2 also shows that the cultivars are of different fruit bearing types. None of the cultivars is of a typical apical fruit bearing type. The results showed that the cultivars 'Sheynovo', 'Serr', 'Hartley' and 'Tiszacsecsi 83' had intermediate fruit bearing, the laterality varying from 10 to 35%. "Lara' cultivar was characterized by 45% of lateral bearing and by that trait it fell behind the other lateral bearing cultivars in the present study – 'Izvor 10'and'Fernor', which had 80% of fruits from lateral buds .

'Fernor' is the only cultivar having an upright crown shape, 'Sheynovo' and 'Serr' hada spreading shape of the crown and 'Izvor 10', 'Hartley', 'Lara' and 'Tiszacsecsi 83' – a semi-upright crown.

The morphometric data of the walnut fruits, in average for the period 2009-2013,are presented in Table 3. As it could be considered, the

fruit size of the separate cultivars was different, as well as was the shell thickness.The shell of 'Izvor 10' and 'Sheynovo' was less than 1.2 mm and that determined them as cultivars having a thin shell. The cultivars 'Serr', 'Hartley' and 'Lara' were in the next group with shell thickness of 1.3 mm to 1.7 mm. The shell of 'Fernor' and 'Tiszacsecsi 83' was1.8 mm.

The biggest mean weight of the fruits was reported for 'Sheynovo' – 13.7 g, followed by 'Hartley' (13.5 g), 'Serr' and 'Lara' – 12.7 g and 12.8 g, respectively. However there was no significant difference between 'Serr' and 'Hartley'. The above data describing the cultivars 'Sheynovo', 'Hartley', 'Serr' and 'Lara' show that they belong to the group of cultivars with large fruits (a mean weight from 12.5 g to 14.5 g). 'Izvor 10', 'Fernor' and 'Tiszacsecsi 83' with a mean weight of the fruits 11.6g, 12.4g and 10.6g, respectively, belong to the group with a mean fruit weight varying from10.5 to 12.5 g. The cultivars 'Izvor 10' and 'Sheynovo' had a very high kernel percentage. 'Serr' cultivar was the only one with high kernel output –53.6%, 'Hartley' had a medium kernel percentage–46.7%, 'Fernor' and 'Lara' – low and 'Tiszacsecsi 83' – very low, i.e., 38.5%.

Tab. 3. Average morphometric data of walnut fruits for the period 2009-2013
Prosječni morfometrijski podaci o plodovima oraha za period 2009-2013.

Cultivar *Sorta*	Height *Visina*	Width *Širina*	Thickness *Debljina*	Shell thickness *Debljina ljuske*	Weight of 1 fruit *Težina 1 ploda*	Kernel percentage *Procenat jezgra*
	(mm)	(mm)	(mm)	(mm)	(g)	(%)
Izvor 10	41.0 bc	31.4 cd	32.1 bc	1.0 d	11.6 cd	55.5 a
Sheynovo	42.3 ab	30.8 d	32.7 bc	1.2 c	13.7 a	55.5 a
Serr	38.9 cd	34.1 ab	33.2 bc	1.4 b	12.7 abc	53.6 a
Hartley	44.3 a	33.5 ab	33.7 b	1.7 a	13.5 ab	46.7 b
Fernor	41.7 ab	32.8 bc	34.0 b	1.8 a	12.4 bc	42.8 c
Lara	37.5 d	35.4 a	36.1 a	1.4 b	12.8 abc	42.6 c
Tiszacse-csi 83	37.5 d	31.2 cd	31.4 c	1.8 a	10.6 d	38.5 d

Values followed by the same letter in a column were not statistically different ($P < 0.05$)
Vrijednosti u koloni koje su označene istim slovom (slovima) nisu statistički različite ($P < 0,05$)

In 2009 the highest yield per tree was obtained from 'Serr' cultivar – 20.9 kg (Table 4). The yields from 'Izvor 10', 'Hartley' and 'Lara' were similar and statistically proven to be lower than that of 'Serr'. Those cultivars were followed by 'Fernor' with the yield of 12.0 kg, while the average yield of 'Sheynovo' was significantly lower than all the mentioned cultivars, i.e., 9.1 kg. The lowest yield per tree was harvested from 'Tiszacsecsi 83' – only 3.9 kg per tree.

Tab. 4. Yield per tree for the period 2009-2013
Prinos po stablu za period 2009-2013

Cultivar *Sorta*	Yield per tree (kg) *Prinos po stablu (kg)*				Average yield per tree 2009-2013 *Prosječan prinos po stablu* 2009-2013
	2009	2010	2011	2013	
Izvor 10	17.9 b	23.0 b	16.8 d	26.0 a	20.9 a
Sheynovo	9.1 d	15.8 c	12.8 e	15.0 c	13.1 bc
Serr	20.9 a	29.7 a	35.9 a	8.8 e	23.8 a
Hartley	17.7 b	20.7 b	23.9 c	13.0 cd	18.8 ab
Fernor	12.0 c	22.0 b	28.5b	22.0 b	21.1 a
Lara	16.9 b	20.2 b	21.7 c	19.7 b	19.6 ab
Tiszacsecsi 83	3.9 e	7.5 d	5.5 f	10.0 de	6.7 c

Values followed by the same letter in a column were not statistically different ($P < 0.05$)
Vrijednosti u koloni koje su označene istim slovom (slovima) nisu statistički različite ($P < 0,05$)

In 2010, again 'Serr' cultivar showed the highest yield rate (29.7 kg). It was followed by 'Izvor 10', 'Hartley', 'Fernor' and'Lara'. 'Sheynovo' had lower yield compared to the mentioned cultivars, the difference being statistically significant, and, again the yield of 'Tiszacsecsi 83' was unsatisfactory – 7.5 kg.

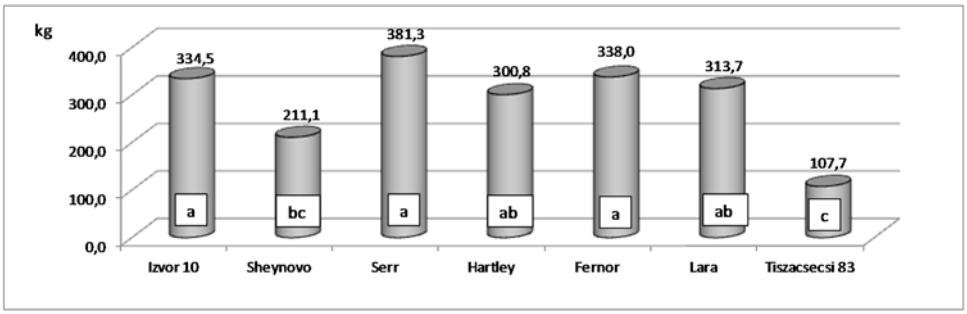
In 2011 the yield of 'Serr'was the highest again – 35.9 kg. It should be noted that referring to the yield per tree, 'Fernor' ranked second with harvested yield amounted to 28.5kg/tree. 'Hartley'and 'Lara' yielded 23.9 kg and 21.7 kg per tree, respectively. The average yield per tree from 'Izvor 10' was 16.8 kg, followed by 'Sheynovo' (12.8 kg) and'Tiszacsecsi 83' (5.5 kg).

In result of the winter frost of minus 24.4ºC on 1 February 2012, the nut yield was compromised to a different degree for the separate cultivars. Those unusual low temperatures are not typical for South Bulgaria.

In 2013 the highest yield per tree was obtained from 'Izvor 10' cv. – 26.0 kg. It was followed by the cultivars 'Fernor' (22.0 kg) and 'Lara (19.7 kg)', whose yields being statistically proven to be lower. The yield obtained from 'Sheynovo' was 15.0 kg per tree and from 'Hartley' – 13.0 kg. The lowest yields were reported from 'Serr' and 'Tiszacsecsi 83' cultivars – 8.8 kg and 10.0 kg, respectively.

The highest average yields per tree for the period 2009-2013 were obtained from the cultivars 'Izvor 10', 'Serr' and'Fernor', the difference between them being statistically insignificant.'Hartley' and 'Lara' ranked

second with average nut yields for the period 18.8 kg and 19.6 kg, respectively. The lowest yield was reported for 'Sheynovo' (13.1 kg) and 'Tiszacsecsi 83' (6.7 kg). The average yield per decare for the period 2009-2013 is presented in Fig. 1.



Values followed by the same letter in a column were not statistically different ($P < 0.05$)
Vrijednosti u koloni koje su označene istim slovom (slovima) nisu statistički različite ($P < 0,05$)

Fig. 1. Average yield kg/da (decare-1000 m^2) for the period 2009-2013
Prosječan prinos po kg/da (decare - 1,000 m^2) za period 2009-2013

From 'Serr' cultivar it were harvested 381.3 kg/da, 338.0 kg from 'Fernor' and 334.5 kg from 'Izvor 10', the difference between the three cultivars being statistically insignificant. The yields from 'Hartley' and 'Lara' cultivars were lower – 300.8 kg and 313.7 kg, respectively. The average yield from 'Sheynovo' was 211.1 kg/da and the difference to the above cultivars was significantly proven to be lower. The lowest average yield was obtained from 'Tiszacsecsi 83' – only 107.7 kg/da.

Conclusion

French cultivars 'Fernor' and 'Lara' are blooming later than the other cultivars – American 'Serr' and 'Hartley', Hungarian 'Tiszacsecsi 83' and Bulgarian 'Izvor 10' and 'Sheynovo'. That phenological characteristic is very important to avoid spring frost damages. During the study period the results showed that the yields from the cultivars 'Izvor 10', 'Serr', 'Hartley', 'Fernor' and 'Lara'were higher compared to 'Sheynovo' and 'Tiszacsecsi 83'. This is the reason to recommend the first group of five walnut cultivars to be grown under the climatic conditions of South Bulgaria.

References

Balci, I., Balta, F., Kazankaya, A. & Sen, S. M. (2001). Promising native walnut genotypes (*Juglans regia* L.) of the East Black Sea region of Turkey. *J. Am. Pomol. Soc., 55*(4), 204-208.

Botu, M., Botu, I., Tudor, M. & Papachatzis, A. (2010). Advantages and disadvantages offered by growing lateral bearing walnut cultivars in the Sub-Carpathian area of Oltenia. Scientific papers of the R.I.F.G. *Pitesti, XXVI*, 32-35.

Dogan, A., Kazankaya, A., Gün, A., Askin, M., Oğuz, H. & Celik, F. (2005). Fruit characteristics of some Turkish walnut genotypes and cultivars (*Juglans regia* L.). *Asian Journal of Plant Sciences, 4*(5), 486-488.

Domoto, P.A. (2002). Walnut tree named 'Domoto'. *United States Plant Patent № US PP12898 P2.* Retreived from http://www. googleapis.com

Dzhuvinov, V., Gandev, S., Kumanov, K. & Arnaudov, V. (2013). *Oreh*. Plovdiv: Biofrut-BG.

Germain, E., Lespinasse, J.M., Reynet, P. and Bayol, M. (1997). Orchard training of lateral fruit-bearing walnut varieties assessment of trials carried out in France. *Acta Horticulturae*, (442), 313-320.

Germain, E., Prunet, E. J. & Garcin, A. (1999). *Le Noyer.* Paris: Centre Technique Interprofessionnel des Fruits et Légumes Publication.

Germain, E. (2004). *Inventory of walnut research, germplasm and references.* Rome: Food and Agriculture Organization of the United Nations,.

Malvolti, M. E., Fineschi, S. & Pigliucci, M. (1994). Morphological integration and genetic variability in *Juglans Regia L. J. Hered., 85*, 389-394.

Malvolti, M.E., Beritolognolo, I. & Spada, M. (1996). Diversita genetica in *Juglans regia*, valutazione delle risorse genetiche in Europa per uno studio agricolo e ferestale sostenibile – SHERWOOD. *Foreste ed Alberi Oggi*, *15*, 11-17.

Mitra, S.K., Rathore, D.S. & Bose, T.K. (1991). *Walnut. Temperate Fruits.* Chakraberia Lane, Calcutta: Published by Horticulture and Allied Publishers.

Nedev, N., Vasilev, V., Kavardzhikov, L. & Zdravkov, K. (1976). *Orehoplodni kulturi*. Plovdiv: H. G. Danov.

Nedev, N., Grigorov, J., Baev, H., Serafimov, S., Stranjev, A., Kavardjikov, L., Lazarov, K., Nikolov, N., Dzhuvinov, V., Popova, L., Slavov, N., Iliev, P., Stoianov, D., Kanev, I., Krinkov, H., Vishanska, Y., Topchiiska, M. & Petrova, L. (1979). *Metodika za izuchavane na pastitelnite resursi pri ovoshtnite pastenia.* Plovdiv: H. G. Danov.

Nedev, N., Serafimov, S., Anadoliev, G., Kavardjikov, L., Krinkov, H., Radev, R., Dochev, D., Stamatov, I., Slavov, N., Vishanska, Y., Rusalimov, J., Iovchev, I., Djeneva, A., Lalev, N., Iliev, I. & Slavcheva, R. (1983). *Orehoplodni kulturi.* Plovdiv: H. G. Danov.

Nedev, N., Kavardjikov, L. & Gandev, S. (2002). Izvor 10 – a promising walnut cultivar. *Plant Science, 39*(1-2), 54-56.

Ramos, D. (Ed.). (1985). *Walnut Orchard Management.* Davis: University of California.

Rouskas, D. & Zakynthinos, G. (2001). Preliminary evaluation of seventy walnut (*Juglans regia* L.) seedings selections in Greece. *Acta Horticulturae,* (544), 61 – 72.

Solar, A. (1990). Phenological and pomological characteristics of walnut cultivars in northeastern Slovenia. *Acta Horticulturae,* (284), 167 – 174.

Steele, R. & J. Torrie (1980). *Principles and procedures of statistics.* New York: McGraw-Hill.

Received: March 28, 2014
Accepted: May 23, 2014

Evaluacija nekih sorti oraha u klimatskim uslovima Južne Bugarske

Stefan Gandev[1], Vasiliy Dzhuvinov[1]

[1]*Voćarski institut, Plovdiv, Bugarska*

Sažetak

U ovu studiju su uključene uvedene sorte oraha koje se gaje kao glavne sorte u zemljama sa klimatskim uslovima različitim od onih u Bugarskoj. Cilj ove evaluacije je selektovanje sorti oraha koje imaju odgovarajuće biološke i pomološke karakteristike kada se gaje u klimatskim uslovima Južne Bugarske. Ispitivanje je pokazalo da sorte 'Fernor', 'Lara' i 'Tiszacsecsi 83' kasnije cvjetaju od drugih sorti kao što su 'Serr', 'Hartley', 'Izvor 10' i 'Sheynovo'. Ova fenološka karakteristika je veoma važna da bi se izbjegla oštećenja uzrokovana proljetnim mrazom. Tokom perioda evaluacije rezultati su pokazali da su prinosi sorti 'Izvor 10', 'Serr', 'Hartley', 'Fernor' i 'Lara' viši u poređenju sa 'Sheynovo' i 'Tiszacsecsi 83'. Iz ovog razloga,

preporučuje se prvopomenuta grupa sorti oraha za uzgoj u klimatskim uslovima Južne Bugarske.

Ključne riječi: *Juglans regia* L., sorta, rast, karakteristike ploda, prinos

Stefan Gandev
E-mail address: s.gandev@abv.bg

Primljeno: 28. marta 2014.
Odobreno: 23. maja 2014.

Original scientific paper
Originalan naučni rad
UDK: 634.713(497.11)
DOI: 10.7251/AGREN1401017M

University of Banjaluka, Faculty of Agriculture
Agro-knowledge Journal

Economic Adequacy of Blackberry Production in Rural Areas of Sirinić District

Goran Maksimović[1], Radomir Jovanović[1], Slavka Mitrović[1], Tatjana Ivanović[1]

[1]*Faculty of Agriculture, University of Priština, Lešak, Serbia*

Abstract

In Sirinićka District, blackberries are mostly grown on smaller farms in highlands, where the best results are reached. However, the demands for this type of berries as well as the interest in its cultivation have steadily increased, recently. Thus, the main goal of this paper was to present the results of an economic analysis of blackberry production with the data obtained during the two years of monitoring a group of farmers in that area. It has been estimated and presented the profitability based on present marketing, agroclimatic and technological conditions and also the slightest blackberry yield achieved in the group of growers. According to the results of the economic analysis of blackberry growing, it can be concluded that production generates income, even with one third of yield potential. Cost-effectiveness in blackberry growing is 2.14. Depending of the investments in blackberry growing, profitability rate is 53.39%. These calculations show the advantages of blackberry growing in Sirinićka District, comparing to other fruits.

Key words: investments, costs, calculations, economic impact

Introduction

Sirinić District covers an area of 250 km^2, including one urban and fifteen rural settlements. It is a jagged mountain region with variable altitude, ranging from 500 m in the Lepenac river valley to 2500 meters above sea level, measured on the highest mountain peak Ljuboten. Agricultural production of Sirinić District in its largest part lags behind real opportunities determined by agro-ecological conditions. Vegetal husbandry is the most dominant agricultural sector, but there also exist good conditions for fruit production, especially for production of berries (raspberries, blackberries, blueberries). Agro-ecological conditions in Sirinić District enable better quality of the blackberry fruit and higher yield per unit area than in most other countries in which larger quantities of this berry type are being produced. Years of experience from different regions of the Republic of Serbia indicate that (in favorable agro-ecological conditions) the production of blackberries is more profitable than other branches and lines of agricultural production. In Sirinić District, blackberries are mainly grown on smaller properties ranging from 10 to 30 *a,* in highland area where the best results are being achieved. All the parcels are located in proximity to the built refrigerator storehouse and linked with asphalt/macadam roads. This enables convenient and cheaper transport of production supplies, packaging and of blackberry fruits without quality diminishing.The commitment to invest in blackberry production stems from the fact that there exist good climatic and other conditions necessary for this type of production in rural areas of Sirinić District. Experiences so far have shown that the production is very profitable and that demand exceeds supply. The rganization of redemption is stable; there are buyers who for many years organize collection and freezing of the fruits. Investing in this type of production is an ideal investment and it represents a good revenue to mixed agricultural holdings in the highlands of Sirinić District for the following reasons:

- ideal conditions for blackberry growing;
- simple and easily managed technology of production and care;
- economical and highly cost-effective production;
- relatively small investments;
- labor-intensive production enabling employment of the workers with lower level qualifications.

Material and Methods

Plots for blackberry plantations are located at the altitude of 500 - 600 *m*, belonging to highland area of Municipality of Strpce. As this mountainous area has abundant rainfall, climatic conditions are very favorable, and the requirements for plenty of moisture in soil and in the air are therefore met. Klimatski uslovi su veoma povoljni jer kao planinsko podrucje ima nesto više padavina čime su obezbedjeni zahtavi kupine za dosta vlage u zemljistu i vazduhu. The most spread type of blackberries in Serbia and in Sirinić District is called *Čačanska bestrna.* Accompanied by specific growing method application, suitable domestic climatic and soil conditions create optimal growing environment for the sort. *Čačanska bestrna* exhibits great yield, good fruit quality and resistance to pests and diseases, which all together makes it the leading sort. If the plantation is formed with *Čačanska bestrna,* it is then recommended to create spacing of 3 x 1.5 *m;* for 1 *ha*, 2200 seedlings are needed (Milic et al., 2008). Other similar distances may also be taken into consideration, but it is always necessary to seize upon blackberry exuberance and the requirements for light, water and nutrition elements. For achieving the good quality of blackberry production it is necessary to provide a good planting material produced in registered stock nurseries, properly packed and declared, and controlled by competent professionals and institutions. Seedlings should all have a well-developed root system with a mass of small vessels, without symptoms of a disease or damage. The best period for planting is autumn, characterized by supreme reception and provision of more exuberant growth during the next growing season (Petrović et al., 2003). Lines with seedlings are best to be oriented north-south, because of the longest sunlit during the day. Producers most often chose row growing system; the best and the most productive is three-wired system with three rows of wire in one plane and with outcrops bending and wiring (Veljkovic et al., 2006). A proper irrigation is an essential factor in a modern, intensive production of blackberries; from this reason, we predicted the drip irrigation system in our investment calculation of blackberry plantation. During the last few years, blackberry production on family agricultural farms in Sirinić District has been monitored; planting investment calculation and calculation of blackberry production were made on the basis of the collected data.

By using an economic analysis method, an investment calculation was developed, as well as a planned calculation. The data were obtained during two years of monitoring a group of growers, as a part of a project focused on developing a strategy for local agricultural development. The prices of the materials used in blackberries production were obtained from the

local dealers who regularly supply blackberry growers. The prices for the blackberry plants were obtained from the local growers while the prices of the output were obtained from the local market. Having in mind that blackberry production in that area is at an early stage of development, the objectives of this study was to estimate the profitability based on present marketing, agroclimatic, and technological conditions with the slightest blackberry yield achieved in the group of growers.

Results and Discussion

Motivation for blackberry planting in Sirinić District are economic interests, provision of additional activity and additional revenue of mixed agricultural holdings and also the underemployment of household members.

Calculation for establishing the blackberry plantation on family farms with the area of 0.50 *ha,* by using sort *Čačanska bestrna* (planting space 3 x 1.50 m), is shown in Table 1.

Tab. 1. Investment calculation for blackberry plantation
Investiciona kalkulacija podizanja zasada kupine

A. Costs of material - *Troškovi materijala*					
No *Red. br.*	Type of material *Vrsta materjala*	Unit of measure *Jed. mere*	Quantity *Količina*	Price per unit *Cena po jed.mere*	Price € *Iznos €*
1	Seedling/*Sadnica*	piece/*kom.*	1110	0.40	800
2	Manure/ *Stajnjak*	t	25	20	500
3	Mineral fertilizer *Mineralno đubrivo* a) NPK 8:12:26+3%Mgo b) KAN (29%N)	 kg kg	 350 150	 0.35 0.30	 123 45
4	Poles/*Stubovi za naslon*	piece/*kom.*	300	1.50	450
5	Supporting poles *Potporni stubovi*	piece/*kom.*	230	1.00	230
6	Wire and nails *Žica i ekseri*	kg	200	1.00	200
7	Drip irrigation system (approximate price) *Sistem zalivanja kap po kap (okvirna cena)*	piece/*kom.*	1	800	800
8	Pesticides/*Pesticidi*	kg	2	90	180
9	TOTAL/*UKUPNO*				2972

B. Costs of service - *Troškovi usluga*					
No *Red. br.*	Type of service *Vrsta usluge*	Unit of measure *Jedinica mere*	Quantity *Količina*	Price per unit *Cena po jed.mere*	Price € *Iznos €*
1	Pedologic and agrochemical soil analysis *Pedološka i agrohem. analiza zemljišta*	sample *uzorak*	2	35	70
2	Land flattening and clearing *Ravnanje i čišćenje terena*	hour/tractor *čas/traktor*	3	15	45
3	Manure transport *Prevoz stajnjaka*	hour/tractor *čas/traktor*	5	15	75
4	Plowing *Oranje*	hour/tractor *čas/traktor*	3	25	75
5	Cultivation *Freziranje*	hour/tractor *čas/traktor*	3	25	75
6	Furrowing *Izvlačenje redova jamica*	hour/cultivator *čas/motk.*	5	6	30
7	Seedlings and fertilizers transportation *Prevoz sadnica i min. đubriva*	hour/tractor *čas/traktor*	1	15	15
8	Poles transportation *Prevoz stubova*	hour/tractor *čas/traktor*	3	15	45
9	Spraying x 3 *Prskanje x 3*	hour/tractor *čas/traktor*	5	20	100
10	Processing between rows x 3 *Međuredna obrada x 3*	hour/cultivator *čas/motk.*	6	6	36
	TOTAL/*UKUPNO*				496

C. Labour costs - *Troškovi radne snage*					
No *Red. br.*	Type of service *Vrste usluga*	Unit of measure *Jedinica mere*	Quantity *Količina*	Price per unit *Cena po jed.mere*	Price € *Iznos €*
1	Ground preparations *Priprema terena*	working day *radni dan*	2	10	20
2	Manure loading and unloading *Utovar i istovar stajnjaka*	"	3	15	45
3	Manure spreading *Rasturanje stajnjaka*	"	3	15	45
4	Raw marking *Obelež. pravca redova i popravka brazde*	"	3	10	30
5	Preparation of seedlings for planting *Priprema sadnica za sadnju*	"	2	10	20
6	Shortening and planting seedlings *Sadnja i prekraćivanje sadnica*	"	4	10	40
7	Watering *Zalivanje*	"	3	10	30
8	Mineral fertilizer spreading *Rasturanje mineralnih đubriva*	"	2	10	20
9	Weeding and ground breaking *Plevljenje i razbijanje pokorice*	"	15	10	150
10	Pruning and removal of cut shoots *Sečenje i iznošenje odsečenih izdanaka*	"	3	10	30
11	Back setting *Postavljanje naslona*	"	15 2	10 15	150 30
12	Shoots decapitation *Pinsiranje izdanaka*				
	TOTAL *UKUPNO*				610

TOTAL (A+B+C) = (2.972 + 496 + 610) = 4.078 €

All the costs for one year of blackberry growing are presented in planned calculation (Table 2.), where the average yield and purchase price is predicted, which served for the calculation of the expected profit.

Tab. 2. Planned calculation of blackberry growing (0.50 ha, planned yield 7,000 kg).
Planska kalkulacija proizvodnje kupine (površina 0,50 ha, planirani prinos 7.000 kg)

I Costs of material - *Troškovi materijala*					
No *Red. br.*	Type of material *Vrsta materjala*	Unit of measure *Jedinica mere*	Quantity *Količina*	Price per unit *Cena po jed.mere*	Price € *Iznos €*
1	Manure/*Stajnjak*	t	7	20	140
2	Mineral fertilizer *Mineralno đubrivo* a) NPK 8:12:26+3%Mgo b) KAN (29%N)	kg kg	300 150	0.35 0.30	105 45
3	Pesticides/*Pesticidi*	kg	5	80	400
4	Binding/*Vezivo*	kg	6	5	30
5	TOTAL/*UKUPNO*				720
II Costs of service - *Troškovi usluga*					
No	Type of service *Vrsta usluge*	Unit of measure *Jedinica mere*	Quantity *Količina*	Price per unit *Cena po jed. mere*	Price € *Iznos €*
1	Manure transportation *Dovoz stajnjaka*	hour/tractor *čas/traktor*	2	15	30
2	Mineral fertilizer transportation *Dovoz min.đubriva*	hour/tractor *čas/traktor*	1	15	15
3	Cultivation (3x) *Kultiviranje (3x)*	hour/cultivator *čas/kult.*	15	6	90
4	Spraying (5-6x) *Prskanje (5-6x)*	hour/tractor *čas/traktor*	9	20	180
5	Transportation of blackberries *Transport plodova*	hour/tractor *čas/traktor*	11	15	165
	TOTAL/*UKUPNO*				480

III Labor costs - *Troškovi radne snage*					
No *Red br.*	Type of service *Vrsta usluge*	Unit of measure *Jedinica mere*	Quantity *Količina*	Price per unit *Cena po jed. mere*	Price € *Iznos €*
1	Manure spreading *Rasturanje stajnjaka*	working day *radni dan*	2	15	30
2	Mineral fertilizer spreading *Rasturanje min. đubriva*	working day *radni dan*	2	10	20
3	Tying and tensioning of the wires *Vezivanje izdanka i zatezanje zice*	working day *radni dan*	5	10	50
4	Removal of young shoots (3x) *Uklanjanje mladih izdanaka (3x)*	working day *radni dan*	6	10	60
5	Hand-hoeing in row direction (2x) *Ručno okopavanje u pravcu reda (2x)*	working day *radni dan*	6	10	60
6	Pruning and removal of old shoots *Rezidba i iznošenje starih izdanaka*	working day *radni dan*	6	10	60
7	Green pruning of exuberant outgrowth and side branches *Rezidba i iznošenje starih izdanaka*	working day *radni dan*	3	10	30
8	Fruit harvest *Berba plodova*	working day *radni dan*	60	10	600
9	TOTAL/*UKUPNO*				910
IV Amortization/*Amortizacija*					300
V Other costs/*Ostali troškovi*					200
A Total costs (I, II, III, IV, V)/*Ukupni troškovi (I, II, III, IV, V)*					2.610
B Production value (7,000 kg x 0.80 €)/ *Vrednost proizvodnje* (7.000 kg x 0.80 €)					5.600
V Profit (B-A)/*Dobit (B-A)*					2.990

Tab. 3. Financial production indicators: profit (p) = production value (pv) - total costs (tc) (€)
Finansijski pokazatelji proizvodnje:dobit (d)=vr.proizvodnje(vp)-ukupni troškovi(ut) (eur-ima)

Fruit type/*Voćna vrsta*	Blackberry/*Kupina*
Production value/*Vrednost proizvodnje*	5.600
Total costs/*Ukupni troškovi*	2.610
Profit/*Dobit*	2.990

$$\text{Cost} - \text{effectiveness (E)} = \frac{\text{production value (V)}}{\text{total costs}} = \frac{5600}{2610} = 2.14$$

$$\text{Profitability rate} = \frac{\text{profit (p)}}{\text{production value (V)}} x100 = \frac{2990}{5600} = 53.39\%$$

There are also labor costs in the calculation which are a half of total production costs (910 €); these remain in the households as compensation for the work, i.e. income. Therefore, both the household profit and economic interest become higher.

Conclusion

According to the results of economic analysis of blackberry growing, it can be concluded that production generates income. Average calculation costs are predicted and production value is planned. Cost-effectiveness value in blackberry growing is 2.14. Depending of investments in blackberry growing, profitability rate is 53.39%. These calculations show the advantages of blackberry growing in Sirinićka District, comparing to other fruit. Blackberry gives the fruits early, in the second year, while the full yield may be expected in the third year. With an adequate use of agro-technical measures, blackberry growing can be cost-effective in a period of 12 - 15 years; the growing period lasts for 2 years, the full yield period for 8 years, the decreasing yield period for 5 years. Realized production and purchase price in the market directly affect profitability level.

References

Maksimović, G. & Milačić, Lj. (2013). *Cost effectiveness of raspberries growing in rural areas of North Kosovo*. Paper presented at IV International simposium "AGROSYM 2013", Jahorina. Bosnia and Herzegovina.

Milić, D. (2008). Utvrđivanje isplativosti investicionog ulaganja u podizanje zasada kupine. *Savremena poljoprivreda, 57*(1-2), 77-84.

Petrović, S. i Milošević, T. (2002). *Malina - tehnologija i organizacija proizvodnje.* Agronomski fakultet u Čačku.

Petrović, S. i Leposavić, A. (2005). *Savremena proizvodnja maline-gajenje, zaštita, prerada.* Beograd: Institut za istraživanje u poljoprivredi.

Petrović, S., Milošević, T., Veljković, B., Leposavić, A. i Glišić, I. (2003). Analiza proizvodnje maline u R. Srbiji u periodu 1971-2002.godine. *Ekonomika poljoprivrede, L*(3), 243-253.

Veljković, B., Petrović, S., Milošević, T. i Leposavić, A. (2003). Proizvodi od malina u Evropi i SAD-u. *Ekonomika poljoprivrede, L*(3), 277-285.

Veljković, B., Petrović, S., Leposavić, A. i Glišić, I. (2006). Profitabilnost proizvodnje maline na području Srbije. *Ekonomika poljoprivrede, 53*(4), 1013-1021.

Received: March 28, 2014
Accepted: June 6, 2014

Ekonomska opravdanost proizvodnje kupine u ruralnim područjima Sirinićke Župe

Goran Maksimović[1], Radomir Jovanović[1],
Slavka Mitrović[1], Tatjana Ivanović[1]

[1]*Poljoprivredni fakultet, Univerzitet u Prištini, Lešak, Srbija*

Sažetak

U Sirinićkoj Župi kupine se uglavnom uzgajaju na manjim posedima u brdsko – planinskom području gde se postižu najbolji rezultati, ali se u poslednje vreme tražnja za ovom vrstom jagodičastog voća stalno povećava i interesovanje za njen uzgoj raste. Stoga je glavni cilj ovog rada da prikaže rezultate ekonomske analize proizvodnje kupina sa podacima dobijenim tokom dve godine praćenja grupe farmera u tom regionu. U skladu sa tim je izračunata i prezentovana profitabilnost bazirana na postojećim tržišnim, agroklimatskim i tehnološkim uslovima kao i na najmanjem postignutom prinosu kupina u grupi uzgajivača. Prema rezultatima ekonomske analize gajenja kupine, može se zaključiti da proizvodnja donosi prihod čak i sa jednom trećinom potencijala prinosa. Ekonomičnost proizvodnje kupina iznosi 2,14. Zavisno od investicija u proizvodnju kupina, profitabilnost iznosi 53,39%. Ove kalkulacije pokazuju prednost gajenja kupina u Sirinićkoj Župi u odnosu na drugo voće.

Ključne reči: investicije, troškovi, kalkulacije, ekonomski značaj

Goran Maksimović
E-mail address: goran.maksimovic@pr.ac.rs

Primljeno: 28. marta 2014.
Prihvaćeno: 6. juna 2014.

Originalan naučni rad
Original scientific paper
UDK: 632.4:582.788.1
DOI: 10.7251/AGRSR1401029J

University of Banjaluka, Faculty of Agriculture
Agro-knowledge Journal

Otpornost na niske temperature, prouzrokovače bolesti i štetočine izdvojenih genotipova drijena sa područja Gornjeg Polimlja

Vučeta Jaćimović[1], Đina Božović[1]

[1]*Biotehnički fakultet, Univerzitet Crne Gore, Podgorica, Crna Gora*

Sažetak

U ovom radu su prikazani trogodišnji rezultati ispitivanja otpornosti na niske temperature, prouzrokovače bolesti i štetočine 30 genotipova drijena koji su izdvojeni iz prirodne populacije sa područja Gornjeg Polimlja. Drijen odlikuju vrlo korisna i izražena biološka svojstva, koja nemaju većina voćnih vrsta: otpornost na prouzrokovače biljnih bolesti i štetočine voćaka, uspijevanje na siromašnijim zemljištima koja su ne kultiviraju i ne obrađuju, otpornost na niske temperature i otpornost na sušu. Kroz dugi period uspijevanja na ovom prostoru drijen se prilagodio i izgradio otpornost prema nepovoljnim, kako biotičkim tako i abiotičkim uticajima sredine. Ta prirodna otpornost je od ogromnog značaja jer omogućava gajenje po organskom konceptu proizvodnje.

Ključne riječi: *Cornus mas* L., abiotički i biotički faktori, organska proizvodnja

Uvod

Od skoro se javlja povećano interesovanje potrošača za upotrebu zdrave hrane. Napravljen je poseban tržišni segment za visoko kvalitetno alternativno voće kao što je drijen (*Cornus mas* L.). U svijetu postoje zahtjevi za proizvodnjom voća sa što manjom upotrebom pesticida, tj. za

proizvodnjom zdravstveno ispravne hrane po konceptu integralne i biološke proizvodnje (Keserović, 1996; Ogašanović i sar., 1996; Baboviću i sar., 2005). U obzir su uzete i vrste koje se trenutno manje gaje u obliku plantažnih zasada, kao što je slučaj sa drijenom, jer su one u ovom pogledu sa izuzetnim potencijalom i od velikog značaja.

Drijen daje zdrave plodove, bez upotrebe hemijske zaštite, koji se u svježem ili prerađenom stanju mogu koristiti kao zdrava, ukusna i ljekovita hrana (Zdravković, 2000). Proizvodnja plodova je vrlo ekonomična, jer u cijenu proizvoda ulaganje počinje tek troškovima berbe (Mratinić i Kojić, 1998).

Materijal i metode rada

U ovom radu korišćena je prirodna populacija drijena u rejonu Gornjeg Polimlja. U početku istraživanja obilježeno je oko 1100 stabala (žbunova) drijena na raznim lokacijama, pa se selekcijom došlo do 30 koji su prikazani u radu. Opštine Andrijevica, Berane, Plav, Gusinje i Bijelo Polje predstavljaju jednu teritorijalnu, klimatsku i orografsku cjelinu poznatu pod imenom Gornje Polimlje. Ovo područje se prostire od 42^{o} i 10$^{`}$ do 43$^{o}$ i 50$^{`}$ sjeverne geografske širine i od 19^{o} 40$^{`}$ do 20$^{o}$ i 30$^{`}$ istočne geografske dužine i obuhvata sliv gornjeg toka rijeke Lima. Ono uglavnom zauzima teritoriju koja se nalazi između planinskih vrhova Prokletija, Komova, Mokre Gore, Murgaša i visoravni Pešter, a sa zapada se graniči s Lisom i Bjelasicom.

Podaci o klimatskim pokazateljima odnose se na najveću opštinu u ovom području – Bijelo Polje, a obrađeni su od strane HMZ-a iz Podgorice (tab. 1).

Za prikazane tri godine najniža temperatura je zabilježena 2000. godine u januaru -26,6 ^{o}C, a najveća iste godine u avgustu bila je 37,3 ^{o}C. Apsolutne minimalne temperature u martu su bile od -2,8 ^{o}C (2001) do – 9,5 ^{o}C (2000), a u aprilu od – 1,5 ^{o}C (2000) do – 6 ^{o}C (2001). Otpornost na niske temperature ocjenjivana je osmatranjem cijelog stabla, a naročito na jugozapadnoj strani. Oštećenja cvjetnih pupoljaka od niskih temperatura utvrđivana su posmatranjem poprečnog presjeka pod optičkim mikroskopom („Konus - Campus“). Posmatrana je promjena boje; presjek zdravih pupoljaka je normalne zelene boje, dok oštećeni dobijaju tamnu, skoro crnu boju.

Tab. 1. Klimatske karakteristike ispitivanog područja
Climatic characteristics of the study area

Klimatski faktori *Climatic factors*	Mjeseci-*Months*													
	godina *year*	I	II	III	IV	V	VI	VII	VII	IX	X	XI	XII	godina *year*
Maksimalna	2000	9,7	11	20	26,8	28,8	32,6	36,5	37,3	27,5	-	-	14,2	37,3
temperatura	2001	17,2	17	24,6	26	28,8	32,4	33,2	35,4	28,8	27	20,8	11	35,4
Max. T	2002	12,8	16,8	22,4	22,2	27,2	34	33	29,6	24,6	22,6	21,4	14,4	34
Minimalna	2000	-26,6	-14,6	-9,5	-1,5	4,4	2,5	5,2	4	3	0	-3,8	-11,2	-26,6
temperatura	2001	-5,5	-9,5	-2,8	-6	0,6	3,4	10	8,3	4,3	0,1	-8	-18,2	-18,2
Min. T	2002	-18,2	-5,7	-3,6	-5,7	4,2	4,8	11	9	3,5	-4,2	-2,8	-10,4	-18,2
Srednja	2000	-5,7	-0,3	4	11,8	15,8	18	19,6	19,8	14,5	11,4	7,4	1,4	9,8
temperatura/	2001	2,6	2	9,8	8,8	15	16,1	19,8	20,5	13,7	11,2	3,6	-3,6	9,9
Average T	2002	-3,7	4	7,5	9	15,6	18,9	20,1	18,3	13,6	10,3	7,1	2,8	10,3

Otpornost prema prouzrokovačima bolesti i štetočinama utvrđivana je obilaskom proučavanih genotipova jednom mjesečno od marta do septembra i registrovanjem eventualnih promjena na listovima, plodovima i granama.

Rezultati i diskusija

Karakteristika drijena kao voćne vrste je da je on izuzetno otporan na nepovoljne uslove spoljašnje sredine. Populacija drijena u Gornjem Polimlju je izložena uticaju niskih temperatura, kako u zimskim mjesecima, tako i u proljeće. Otpornost na niske temperature ispitivanih genotipova drijena prikazana je u tabeli 2. Može se uočiti da zimski mrazevi, uglavnom, drijenu ne nanose štete. Rijetki su slučajevi oštećenja mladih izdanaka, dok kod višegodišnjih, zadebljalih grana i na kori debla oštećenja skoro da nema. Sličnu konstataciju iznijeli su i Mratinić i Kojić (1998).

U proučavanom periodu apsolutni temperaturni minimum od -26,6 ^{o}C u januaru prve godine nije izazvao otećenja cvjetnih pupoljaka ispitivanih genotipova drijena. To se može objasniti time da drijen u dubokom zimskom mirovanju može bez problema da podnese temperature i do – 30 ^{o}C, kao što navode Dudukal i Rudenko (1984). Mnogo veće štete drijenu nanose niske temperature koje se javljaju krajem zime i tokom proljeća kao pozni mrazevi. Od izučavanih genotipova samo su kod cvjetova genotipova BP 25, BP 01, BP 48 i BP 33 uočena oštećenja izazvana proljećnim mrazevima. Ovi genotipovi su izloženi velikoj insolaciji, tako da je moguće da kod njih i

ranije dolazi do kretanja sokova preko zime i u rano proljeće. Kada poslije toplijeg drugog dijela zime i ranog proljeća dođe do kretanja vegetacije kod drijena, odnosno cvjetanja, kasni proljećni mrazevi mogu nanijeti velike štete. Može se desiti da izmrznu cvjetovi i drijen ostane bez roda.

Tab. 2. Procjena otpornosti na niske temperature odabranih genotipova drijena
Resilience to low temperatures of selected Cornelian cherry genotypes

Genotip *Genotype*	Otpornost stabla na niske temperature *Tree resilience to low temperatures*	Oštećenja cvjetnih pupoljaka od niskih temperatura *Damages of flower buds caused by low temperatures*	Oštećenja cvjetnih pupoljaka od poznih proljećnih mrazeva *Damages of flower buds caused by late spring frosts*
	Ocjena/*mark*	Ocjena/*mark*	Ocjena/*mark*
BP 01	1*	1	3
BP 04	1	1	1
BP 06	1	1	1
BP 07	1	1	1
BA 13	1	1	1
BP 16	1	1	1
BP 17	1	1	1
BP 21	1	1	1
BP 22	1	1	1
PL 23	1	1	1
BP 25	1	1	3
BP 33	1	1	3
BP 36	1	1	1
BP 38	1	1	1
BP 40	1	1	1
BP 41	1	1	1
BP 44	1	1	1
BP 48	1	1	3
BA 49	1	1	1
AN 50	1	1	1
BP 51	1	1	1
BP 53	1	1	1
BP 54	1	1	1
BP 58	1	1	1
BA 70	1	1	1
BP 75	1	1	1
PL 98	1	1	1
PL 99	1	1	1
AN 103	1	1	1
AN 104	1	1	1

*1 - vrlo otporan / *very resistant,* 3 – otporan / *resistant*

U toku ovog istraživanja u periodu od 2000. do 2002. godine, to se nije desilo. Međutim, pošto je drijen voćka koja ima skoro najranije cvjetanje, opasnost od pojave mraza u periodu mart - april uvijek postoji. To se desilo pri ranijem praćenju fenoloških faza na području rejona Bijelog Polja, kada je 1997. godine drijen ove oblasti ostao bez roda (Jaćimović, 1999). Pošto rano cvjeta, ova voćna vrsta ima niz mehanizama koji su izgrađeni u borbi za opstanak u prirodnim populacijama. Naime, veliki broj cvjetova po jednoj biljci, koji po Jovančeviću i saradnicima (1990) iznosi oko 240000 i sukcesivno otvaranje cvjetova omogućavaju izbjegavanje mraza i dobar prinos čak i u lošim uslovima.

Prisutno je mišljenje da drijen praktično nije podložan bolestima, odnosno da je biljka jako otporna na prouzrokovače bolesti i štetočine. Međutim, neki istraživači navode podatke o oboljenjima kod osnovnih izdanaka i listova drijena. Na njima se ponekad javljaju karakteristične žute pjege, takozavane rđe, izazvane od strane gljive *Fungosporanium chavarieformae* (Dudukal i Rudenko, 1990). Vrlo rijetko plodove napada krastavost (*Venturia cerasi* Aderh.) ili trulež (*Monilia fructigena* Honey). Poslednja se javlja pri dužem čuvanju plodova. Ponekad se na listovima drijena sreću različite pjege koje slabe fotosintezu, a to snižava vegetativni prirast. Ovu pjegavost izazivaju gljive *Ascochyta cornicola* Dearn.& House, *Cercospora cornicola* Tracy et Earle i *Septoria cornicola* Desm (Dudukal i Rudenko, 1990). U borbi protiv njih koristi se bordovska čorba, kao i sakupljanje i spaljivanje lišća (Leontjak, 1981).

Sl. 1. Oštećeni rubovi lista od *Phyllobius oblongus* L. genotipa BP 48
Damaged edges of a leaf of Phyllobius oblongus L. *genotypes BP 48*

Šumsko šiblje je domaćin smeđeg listojeda (*Phyllobius oblongus* L.), sl.1., štetočine koja napada voćnjake, a štetu nanosi oštećenjem prvenstveno rubova mlađeg lišća, praveći polukružne izgrizine koje se nadovezuju jedna na drugu, tako da čitav rub postaje nazubljen. Smeđi listojed najradije napada koštičavo voće, ali se sreće i na jabučastom. Pored smeđeg, štete nanose i druge vrste listojeda. Žute pjege koje izaziva gljiva *Fungosporanium chavarieformae* nisu uočene na listovima nijednog genotipa (tab.3). Krastavost ploda (prouzrokovač *Venturia cerasi*), sl.2., primijećena je na malom broju plodova kod genotipova BP 04, BP25 i BP 33. *Monilia fructigena* je prouzrokovala truljenje plodova kod genotipa BP 41 (sl.3). Trulih plodova naročito je bilo 2002. godine, koja je bila jedna od godina sa najviše padavina u području Gornjeg Polimlja u periodu jun – septembar. Gljive koje izazivaju pjegavost listova (*Cercospora cornicola, Ascochyta cornicola, Septoria cornicola*), sl.3., smanjujući intenzitet fotosinteze, odnosno rast tih genotipova, zabilježene su kod BP 01 i BA 49. Od štetočina neznatna oštećenja u vidu izgrizanja rubova listova nanosio je smeđi listojed (*Phyllobius oblongus* L.). Ta oštećenja su bila od 1 do 5 % lisne površine kod listova genotipa BP 04 i od 4 do 7 % kod genotipa BP 48.

Sl.2. Pjegavost lista kod genotipa BP 01
Leaf spot in the genotype BP 01

Tab. 3. Procjena otpornosti na prouzrokovače bolesti i štetočine genotipova drijena

Resilience to pest and disease - causing agents of selected Cornelian cherry genotypes

Genotip *Genotype*	*Fungosp. chavarieformae* Ocjena / *mark*	*Venturia cerasi* Ocjena /*mark*	*Monilia fructigena* Ocjena/ *mark*	*Cercospora cornicola* Ocjena/ *mark*	*Ascochyta cornicola* Ocjena/ *mark*	*Phylobius oblongus* L. Ocjena/ *mark*	*Septoria cornicola* Ocjena/ *mark*
BP 01	1*	1	1	3	3	1	3
BP 04	1	3	1	1	1	3	1
BP 06	1	1	1	1	1	1	1
BP 07	1	1	1	1	1	1	1
BA 13	1	1	1	1	1	1	1
BP 16	1	1	1	1	1	1	1
BP 17	1	1	1	1	1	1	1
BP 21	1	1	1	1	1	1	1
BP 22	1	1	1	1	1	1	1
PL 23	1	1	1	1	1	1	1
BP 25	1	3	1	1	1	1	1
BP 33	1	3	1	1	1	1	1
BP 36	1	1	1	1	1	1	1
BP 38	1	1	1	1	1	1	1
BP 40	1	1	1	1	1	1	1
BP 41	1	1	3	1	1	1	1
BP 44	1	1	1	1	1	1	1
BP 48	1	1	1	1	1	3	1
BA 49	1	1	1	3	3	1	3
AN 50	1	1	1	1	1	1	1
BP 51	1	1	1	1	1	1	1
BP 53	1	1	1	1	1	1	1
BP 54	1	1	1	1	1	1	1
BP 58	1	1	1	1	1	1	1
BA 70	1	1	1	1	1	1	1
BP 75	1	1	1	1	1	1	1
PL 98	1	1	1	1	1	1	1
PL 99	1	1	1	1	1	1	1
AN 103	1	1	1	1	1	1	1
AN 104	1	1	1	1	1	1	1

*1 - vrlo otporan / *very resistant,* 3 – otporan / *resistant*

U odnosu na divlju floru, Kremenović (1996) smatra da gajene voćke imaju mnogo veću osjetljivost prema patogenima i uslovima sredine jer su kroz bioevoluciju, od divljih do kulturnih, izgubile niz odbrambenih biohemijsko – fizioloških mehanizama, jer je selekcija bila usmjerena prije svega na kvalitet.

Sl.3. Monilia fructigena na plodovima genotipa BP 41
Monilia fructigena on the fruits of the genotype BP 41

Otpornost prema prouzrokovačima bolesti i štetočinama kod novostvorenih sorti, po Ciglaru (1998), je narušena nepovoljnim uticajem čovjeka, koji je štiteći gajene voćke od tih činilaca, oslabio njihove vlastite odbrambene sposobnosti. U stvari, došlo je do izmjene prevalentnosti parazita, pa se stvarao prostor za širenje novih rasa – mutanata. Zato, upoznavanje genetičke otpornosti gajenih sorti i vrsta, stvaranje novih otpornih sorti prema parazitima i štetočinama, kako bi se upotreba hemijskih sredstava svela na minimum i time zaštitila životna sredina, imperativ je proizvođača i oplemenjivača voća. U okviru zahtjeva ostvarenja programa integralne zaštite voćaka od bolesti, stvaranju i selekciji otpornih sorti na najznačajnije bolesti u svijetu se poklanja izuzetna pažnja, pa su kao rezultat dugogodišnjeg rada stvorene brojne, potpuno otporne sorte različitih voćnih vrsta (Ognjanov i sar., 2002).

U intenzivnoj voćarskoj proizvodnji, skoro je nezamislivo da najznačajnije voćne vrste mogu iznijeti rod do zrelog ploda bez upotrebe zaštite u vidu raznih hemijskih sredstava. Posmatranjem genotipova drijena u populaciji Gornjeg Polimlja, može se doći da zaključka da se sporadično javljaju neka oštećenja od bolesti i štetočina kod par genotipova. S obzirom na ove prirodne predispozicije drijena kao vrste, on bi sigurno morao naći svoje mjesto u organskoj proizvodnji voća. Mora se istaći i činjenica da se u prirodnim uslovima gdje drijen uspijeva, dešava da nema pojave oboljenja i štetočina i to ga preporučuje za proizvodnju zdrave hrane i u obliku plantaža. Ali, zasigurno se ne može tvrditi da će to tako biti i onda kada se drijen bude gajio u obliku plantažnih zasada. Ne postoje potvrđeni nalaziM ali postoje pretpostavke da bi moglo doći do razmnožavanja neke štetočine ili povećanje pojave bolesti, ali to daje osnovu za dalju selekciju na otpornost.

Zaključak

Kroz dugi period uspijevanja na ovim prostorima drijen se prilagodio i izgradio otpornost prema nepovoljnim abiotičkim i biotičkim uticajima sredine. Drijen odlikuju vrlo korisna i izražena biološka svojstva, koja nemaju većina voćnih vrsta: otpornost na prouzrokovače biljnih bolesti i štetočine voćaka, uspijevanje na siromašnijim zemljištima koja su ne kultiviraju i ne obrađuju, otpornost na niske temperature kao i otpornost na sušu. Činjenice da nije potrebno vršiti hemijsku zaštitu drijena u borbi protiv bolesti i štetočina, te da su mali zahtjevi u pogledu ishrane, uz dobijanje dobrih prinosa svake godine, stavljaju drijen na listu preporučenih voćnih vrsta za organsku proizvodnju.

Literatura

Babović, J., Lazić, B., Malešević, M. i Gajić, Ž. (2005). *Agrobiznis u ekološkoj proizvodnji hrane.* Novi Sad: Naučni institut za ratarstvo i povrtarstvo.

Дудукал, Д. Галина и Руденко, И. С. (1984). *Особенности роста кизила в лесных насаждениях.* ССР: Академия наук молдавской ССР.

Дудукал, Д. Галина и Руденко, И. С. (1990). *Кизил*. Москва: Агропромиздат, Древесные породы.

Ciglar, I. (1998). *Integralna zaštita voćnjaka i vinograda.* Čakovec: Zrinjski dd.

Jaćimović, V. (1999). *Varijabilnost populacije i vrijednost selekcija drijena (Cornus mas L.) u rejonu Bijelog Polja* (Magistarska teza). Poljoprivredni fakultet Univerziteta u Novom Sadu.

Jovančević, R., Jovančević, M. i Raičević, Svetlana (1990). Samoniklo korisno bilje u slivovima rijeke Ćehotine, Lima i Tare. *Poljoprivreda i šumarstvo, 35*(4), 99-111.

Keserović, Z. (1996). *Pravci proizvodnje zdravstveno bezbednog voća. Proizvodnja zdravstveno – bezbedne hrane, ekonomsko - ekološki aspekt.* Beograd: Institut za ekonomiku poljoprivrede.

Kremenović, G. (1996). *Opšte voćarstvo.* Banja Luka: Glas srpski.

Леонтяк, Г. П. (1981). Поражаемость кизила болезянми и вредителями. *Сельское хозяйство Молдавии, 12,* 52-54.

Mratinić, Evica i Kojić, M. (1998). *Samonikle vrste voćaka Srbije.* Beograd: Institut za istraživanja u poljoprivredi „Srbija".

Ogašanović, D., Vujanić-Varga, Dinka, Stanisavljević, M., Milutinović, M., Miranović, Kseanija i Mišić, P. (1996). Struktura i perspektive voćarstva SR Jugoslavije. *Jug. voć., 113-114*(30), 5-20.

Ognjanov, V., Vračar, Lj., Cerović, S. i Božović, Đina (2002). *Integralna proizvodnja voća za industrijsku preradu.* Rad je prezentovan na Šestom savetovanju industrije alkoholnih i bezalkoholnih pića i sirćeta sa međunarodnim učešćem, Vrnjačka Banja, Srbija.

Stamenković, S i Stamenković, T. (2002). *Atlas štetočina i bolesti šljiva sa programom mera zaštite.* Čačak: Grafika Jureš.

Zdravković, M. (2000). *Moć lekovitog bilja. Lekovito bilje – hrana i lek.* Niš: Prosveta.

Primljeno: 28. marta 2014.
Odobreno: 12. juna 2014.

Resilience to Low Temperatures, Pests and Disease - Causing Agents of Selected Cornelian Cherry Genotypes in Gornje Polimlje Region

Vučeta Jaćimović[1], Đina Božović[1]

[1]*Biotechnical faculty, University of Montenegro, Podgorica, Montenegro*

Abstract

This paper presents the results of a three-year study of the resilience to low temperatures, pests and disease-causing agents of 30 Cornelian cherry genotypes (*Cornus mas L.*) selected from natural population in the Gornje Polimlje Region. Cornelian cherry has many useful and important biological features, which are not the characteristics of many other fruit species, such as the resilience to pests and disease-causing agents; growing in poor soil which can not be reclaimed and cultivated; and the resilience to low temperatures and drought, as well. For a long time Cornelia cherry has thrived in this region, so it got adapted and become resistant to biotic and abiotic influences. Their natural resistance is very important because it enables the cultivation according to the concept of organic production.

Key words: *Cornus mas* L., biotic and abiotic influences, organic production

Vučeta Jaćimović
E – mail address:ivajacim@t-com.me

Received: March 28, 2014
Accepted: June 12, 2014

Original scientific paper
Originalan naučni rad
UDK: 634.5:632.4(497.2)
DOI: 10.7251/AGREN1401041A

University of Banjaluka, Faculty of Agriculture
Agro-knowledge Journal

Susceptibility of Some Walnut Cultivars to *Gnomonia leptostyla* and *Xanthomonas arboricola* pv. *juglandis* in Bulgaria

Veselin Arnaudov[1], Stefan Gandev[1], Milena Dimova[2]

[1]*Fruit Growing Institute, Plovdiv, Bulgaria*
[2]*Agricultural University, Plovdiv, Bulgaria*

Abstract

The aim of the present research was to study and compare the susceptibility of 13 walnut cultivars – 5 Bulgarian (B), 3 French (F), 2 Hungarian (H), and 3 American (A) – to *Gnomonia leptostyla* (Fr.) and *Xanthomonas arboricola* pv. *juglandis* (Pierce) Dye, the pathogens causing leaf spot and walnut blight. The study was conducted under natural environmental conditions in a 5-8-year-old walnut collection orchard of the Fruit Growing Institute – Plovdiv, during the period 2006-2010. The evaluation of the attack produced by these pathogens was carried out on different organs leaves and nuts in two periods of the year (June and October). All the studied cultivars were distributed in 6 different levels of susceptibility to a given pathogen based on the degree of attack. The article presents data on the sensitivity of the studied walnut cultivars to the attack to *G. leptostyla* (Fr.) and X. *arboricola* pv. *juglandis* (Pierce) Dye and discusses the results obtained.

Key words: Juglans regia, cultivars, leaf spot, walnut blight, infection

Introduction

The English (Persian) walnut (*Juglans regia* L., *Juglans andaceae*) is attacked by great number of diseases. Among all known walnut diseases

at present the greatest economic importance in the climatic conditions in Bulgaria have walnut bacterial blight, caused by *Xanthomonas arboricola pv. juglandis* (Xaj), and walnut anthracnose, caused by a fungus which has two forms – sexual *Gnomonia leptostyla* (Fr.) Ces. et de Not.) and asexual (*Marssonina juglandis* (Lib.) Magn.). Both diseases attack the aboveground organs of the walnut tree. The causal agent of the anthracnose attacks mostly leaves, petioles and fruits while causal bacterium *Xanthomonas arboricola* pv. *juglandis* can infect leaves, catkins, female flowers, green branches, and nuts. Blight reduces yield and frequently lowers quality of harvested nuts.

Walnut blight was an object of many studies abroad – Miller and Bollen (1946), Mulerean and Schroth (1982), Gardan et al. (1986), Germain (1990), Germain, et al. (1990a), Belisario (1995), Martins (1996), Ninot et al. (1997), etc. Quite a lot data could be found in literature about the different degree of susceptibility of the walnut genotypes to the causal agent of the disease.

Total resistance to walnut blight was not established in any of the studied genotypes, but some of them, especially those of the early leafing genotypes, were attacked more strongly, which was due to the spring rains that provided more favourable conditions for infection and spreading of the disease (Mulerean & Schroth, 1982; Teviotdale et al., 1985; Olson et al., 1997; Belisario et al., 1997). Investigating the interrelation between the fruiting habit of walnut trees and the walnut blight attacks, Gardan et al. (1986) concluded that the early leafing cultivars, which most often set fruits on lateral fruit shoots, were more severely infected by the causal agent of walnut blight.

The walnut anthracnose was also an object of many studies in our country and abroad. In Bulgaria the disease was found and described for the first time by Malkov (1905, 1906) and investigated in the next years by a number of authors (Savov, 1923; Trifonov, 1962; Penev, 1964; Stefanov, 1964; Hristov, 1967, 1972; Nedev, 1976, 1983). Systematic studies on the biology, ecology and pathophysiology of its causative agent were carried out by Dimova (2003). In those studies a special attention was paid to the susceptibility of the different walnut cultivars to damages by that disease.

After some comparative research held in Hungary (Veghelyi and Penzes-Toth, 1990) and former Yugoslavia (Balaz et al., 1991) it was found that none of the investigated walnut cultivars appear to be resistant to the causal agent of anthracnose, and most of the genotypes demonstrate middle to high level of susceptibility. In similar experiments in Italy

Belisario et al. (1997) establishes that cultivars `Franquette` and `Hartley` display high level of stability to antharcnose, `Feltre` and `Malizia` - middle while `Payne`, `Serr` and `Sorrento`- low. For the climatic conditions of Spain Pastore et al. (2001) reports that the cultivars `Hartley` and `Mayette` are not attacked by the anthracnose agent while `J. Jefe` and `VZ5` show intense susceptibility to that pathogen.

The available controversial data in literature about the susceptibility of different local walnut cultivars to anthracnose as well as the lack of enough complete information about the susceptibility of some newly introduced walnut cultivars in our country was the reason to initiate that research.

The aim of the present study was to investigate and compare the susceptibility to *Gnomonia leptostyla* (*Marssonina juglandis*) and *Xanthomonas arboricola pv. Juglandis* of 13 local and introduced walnut cultivars – 3 of them American (A), 3 French (F), 2 Hungarian (H) and 5 Bulgarian (B).

Material and Methods

Susceptibility to the economically important diseases anthracnose (*Gnomonia leptostyla*) and walnut blight (*Xanthomonas arboricola pv. juglandis*) was evaluated by the infection index calculated following the formula of McKinney (1923), using collected walnut leaves and fruits. The level of *G. leptostyla* infection was detected from randomly collected 100 leaves and 50 fruits from 5 different walnut trees of each cultivar, reporting the affected tissue with developed acervuli. The attacks of *X. arboricola pv. juglandis* were reported as a percentage of the leaves and fruits infected by the bacterium. Necrotic spots of a diameter less than 3 mm were analyzed using a stereo microscope. All the studied cultivars were distributed in 6 different levels of susceptibility to a given pathogen based on the degree of attack.

Data were statistically processed by Duncan's test (Steele & Torrie, 1980).

Results and Discussion

In climatic aspect the five years of the research could be characterized as warm and moderately humid, with normal distribution of rainfall through the years. The weather in the spring months was warm and humid,

the intensity of rainfall in March was higher and in May and June lower than normal level. The summer months could be described as dry and hot (with temperatures exceeding the normal in the period June – September) and only in particular years and months the rainfall intensity was above the normal (Table 1).

Tab. 1. Climatic data registered in the Fruit Growing Institute of Plovdiv in the period 2006-2010
Klimatski podaci registrovani na Institutu za voćarstvo u Plovdivu u periodu 2006-2010

	Year *Godina*	Months *Mjeseci*							
		III	IV	V	VI	VII	VIII	IX	X
Temperature°C *Temperatura °C*	2006	7.2	12.8	17.6	21.1	22.8	23.6	18.4	13.7
	2007	8.3	12.9	18.7	23.2	25.5	23.0	-	-
	2008	9.7	13.3	17.7	22.2	24.2	24.7	-	-
	2009	6.9	12.0	19.0	22.0	24.5	23.5	18.1	13.2
	2010	7.2	12.8	18.5	21.2	24.1	25.7	19.1	-
Humidity % *Vlažnost %*	2006	80	29	74	78	74	73	76	86
	2007	76	67	78	74	58	75	-	-
	2008	74	83	76	79	64	64	-	-
	2009	78	78	75	73	68	70	80	89
	2010	78	80	76	78	78	71	74	-
Rainfall mm *Padavine mm*	2006	69	79	17	132	22	58	19	26
	2007	40	17	159	156	0	185	-	-
	2008	15	84	21	38	39	5	-	-
	2009	74	25	31	15	66	43	44	81
	2010	56	43	24	77	94	4	16	-

*****The data were collected by automatic computer system
Podaci su prikupljeni automatizovanim kompjuterskim sistemom

It is evident from the data in Table 1 that the meteorological conditions during the research period favor in a higher or lower degree the development of both diseases.

The first symptoms of anthracnose were found from the end of May to the beginning of June, when on the leaves of the trees appeared lesions, caused by the wintering stage of the fungus, *G. leptostila.* The same were found on young leaves, mainly in the form of small to medium-large round light brown spots, outlined by a dark brown band on the

periphery. On the leaves of some of the cultivars could be seen merging of the separate spots and forming of bigger ones, with irregular shape, often confined by nervation of leaves. Similar spots but of elongated oval form could be seen on the petioles of leaves and their nervation as well as on the young shoots. The spots on the fruits were small, grey-brown, on the surface.

Fig 1. Symptoms of walnut leaf spot *(Gnomonia leptostyla* (Fr.))
Simptomi antraknoze oraha (Gnomonia leptostyla (Fr.))

Walnut blight is usually manifested in two forms: continuous necrosis and local spotting. In the first case the disease is manifested as blackening of the main and side veins of the young growing leaves. When the bacterium penetrates into the closely located parenchyma tissue of the leaf, large necrotic spots are formed. Hence, the bacterium can pass through the leaf stalk into the shoot, causing the latter to wither and dry out. The local spotting appears in the old leaves as small angular brownish spots of an oily type (fig. 2).

The spots on the shoots are black, oily, slightly sunken, with longitudinal or ring shaped, affecting both the bark and the wood that turns black. The bacterium attacks the catkins and the young fruit sets, which turn black and fall off. The spots on the growing fruits are large, rounded, black, with a shiny and wrinkled surface.

Fig. 2. Symptoms of bacterial blight on the leaves *(Xanthomonas arboricola* pv. *juglandis* (Pierce) Dye)
Simptomi bakteriozne pjegavosti oraha (*(Xanthomonas arboricola* pv. *juglandis* (Pierce) Dye)

The rainfall during the second half of the vegetation period favored the development of the two diseases and created conditions for arising of new, secondary infections and appearance of new lesions on different green parts of the walnut trees. In such climatic conditions some research was conducted to determine the level of susceptibility of the different walnut cultivars to attacks of anthracnose and bacterial blight.

The results of the conducted research for determining the level of susceptibility of the walnut cultivars to anthracnose attack show, that all investigated cultivars are susceptible to a certain extent to attack by the agent of the disease, regardless of the fluctuation through the years (Table 2).

From the data in Table 2 it is evident that the early leafing cultivars, which most often set fruits on apical fruit shoots, re more susceptible to the causal agent, *Gnomonia leptostyla* (Fr.) Ces. et de Not, compare to later leafing cultivars and lateral fruit-bearing - a regularity which was observed through all the years of this study.

In the group of apical fruit-bearing cultivars on leaf level the highest infestation index was reported in `Seer` (41.6%), and the lowest one –

in `Silistrenski`(10.3%). In cultivars `Slivenski`,`Izvor 10`,`Sheinovo` and `Kuklenski` the degree of *G. leptostyla* infestation varied within 29.8 and 19,4 % in average. In the group of lateral fruit-bearing cultivars, in contrast to the above group, were reported considerably lower values of anthracnose attack, ranging from 13.9 to 5.2%. The highest infestation index in the leaves was reported in cultivars `Hartley` (13.9%), `Milotai` (9.0%), `Tiszacsecsi` (9.0%)` and Lara` (8.8%), and the lowest in cultivars `Fernette`(8.0), `Fernor`(7,0%) and `Chandler` (5.2%) (Table 2).

Tab. 2. Response of walnut cultivars to *G. leptostyla* attacks in the period 2006-2010, Fruit Growing Institute – Plovdiv.
Reakcija sorti oraha na patogena G. leptostyla u periodu 2006-2010, Voćarski institut - Plovdiv

Cultivar *Sorta*	Leaf infestation index, by McKinney *Indeks bolesti lista prema McKinney-u*						Fruit infestation index, by McKinney *Indeks bolesti ploda prema McKinney-u*			
	2006	2007	2008	2009	2010	Average *Prosjek*	2008	2009	2010	Average *Prosjek*
Serr	61.4	82.1	28.3	5.5	30.7	41.60 a(4)	1.50	2.20	19.5	7.73a(6)
Slivenski	45.8	49.0	31.2	6.2	17.0	29.84 b(4)	0.65	1.73	3.51	1.96b(4)
Izvor 10	50.8	39.3	31.2	5.0	16.0	28.46 b(4)	0.60	1.40	3.30	1.77b(4)
Sheynovo	47.5	30.9	15.3	3.4	12.8	21.98 bc(3)	0.50	0.65	0.50	0.55b(3)
Kuklenski	34.1	32.0	14.2	3.5	13.2	19.40 bcd(3)	0.47	1.15	2.70	1.44b(3)
Silistrenski	12.4	10.8	13.0	2.3	13.2	10.34 cde(3)	0.42	0.98	2.65	1.35b(3)
Hartley	20.4	14.5	18.0	3.0	13.4	13.86 cde(3)	0.16	0.21	0.05	0.14b(1)
Lara	15.0	13.4	5.7	1.0	8.7	8.76 cde(3)	0.05	0.06	0.10	0.07b(1)
Milotai 10	16.0	9.8	8.3	1.4	9.7	9.04 cde(3)	0.19	0.22	0.18	0.20b(1)
Tiszacsecsi	21.0	8.0	6.9	1.2	8.0	9.02 cde(3)	0	0.20	0	0.07b(1)
Fernette	29.8	1.6	0	0.1	8.4	7.98 de(3)	0.30	0	0	0.10b(1)
Fernor	10.2	9.6	4.0	0.9	10.1	6.96 de(3)	0.05	0	0.10	0.05b(1)
Chandler	8.2	3.4	5.5	0.9	7.8	5.16 e(3)	0.03	0	0.05	0.03b(1)

The means followed by the same letter do not differ significantly from one another ($p = 0.05$).
Označene vrijednosti se ne razlikuju značajno jedna od druge ($p = 0.05$).
Leaf cultivar susceptibility: (1) Highly resistant (up to 1 % infected area; (2) Resistant (1 – 5 % infected area); (3) Slightly susceptible (5 – 25 % infected area); (4) Susceptible (25 -50 % infected area); (5) Highly susceptible (50 - 75 % infected area), (6) Very highly susceptible (75 - 100 %) infected area.
***Osjetljivost lista kod sorte**: (1) Veoma otporan (do 1 % zaraženog područja; (2) Otporan (1 – 5 % zaraženog područja); (3) Neznatno osjetljiv (5 – 25 % zaraženog područja); (4) Osjetljiv (25 -50 % zaraženog područja); (5) Veoma osjetljiv (50 - 75 % zaraženog područja), (6) Izuzetno osjetljiv (75 - 100 %) zaraženog područja.*
Fruit cultivar susceptibility: (1) Highly resistant (up to 0.25% % infected area; (2) Resistant (0.25 – 0.5% infected area); (3) Slightly susceptible (0.5 – 1.5% infected area); (4) Susceptible (1.5 – 3.5% infected area); (5) Highly susceptible (3.5 – 5% infected area); (6) Very highly susceptible (> 5% infected area).
***Osjetljivost ploda kod sorte:** (1) Veoma otporan (do 0,25% zaraženog područja; (2) otporan (0,25 – 0,5% zaraženog područja); (3) Neznatno osjetljiv (0,5 – 1,5% zaraženog područja); (4) Osjetljiv (1,5 – 3,5% zaraženog područja); (5) Veoma osjetljiv (3,5 – 5% zaraženog područja); (6) Izuzetno osjetljiv (> 5% zaraženog područja).*

The results were similar at fruit level. In the group of apical fruit-bearing cultivars the highest infestation index in the fruits was reported in `Seer` (7.7%) and middle in the rest cultivars (`Slivenski`, `Izvor` 10, `Kuklenski`, `Silistrenski` and `Sheinovo` varying from 2.0 to 0.6 % (Table 2). In the group of lateral fruit-bearing cultivars a higher level of attack was reported in cultivars 'Millotay'(0.20%) and 'Hartley'(0.14%), while in the rest of the cultivars (`Lara`,`Fernette`, `Tiszacsecsi`, `Fernor` and `Chandler` it was low and varied from 0.1 to 0.03 %. (Table 2).

The investigated walnut cultivars are not attacked equally regarding the bacterial agent, *Xanthomonas arboricola* pv. *juglandis* (Pierce) Dye, which is very well illustrated by the data in Table 3. Apical fruit-bearing cultivars, as most of Bulgarian cultivars are, demonstrate high susceptibility to anthracnose. Regarding the bacterial blight, they show some tolerance and are not so intensely attacked by this disease as lateral fruit bearing cultivars.

Tab. 3. Response of walnut leaves to *X. arboricola* pv. *juglandis* attacks in the period 2006-2010, Fruit Growing Institute – Plovdiv
Reakcija lišća oraha na patogena X. arboricola pv. juglandis u periodu 2006-2010, Voćarski institut - Plovdiv

Cultivar *Sorta*	Leaf infestation index, by McKinney *Indeks bolesti lista prema McKinney-u*						Fruit infestation index, by McKinney *Indeks bolesti ploda prema McKinney-u*			
	2006	2007	2008	2009	2010	Average *Prosjek*	2008	2009	2010	Average *Prosjek*
Serr	5.1	7.0	14.7	0.5	1.0	5.66 bc(2)	0.5	1.0	1.0	0.83 e(3)
Slivenski	3.9	5.3	20.1	4.5	2.0	7.16 bc(2)	4.0	4.5	2.0	3.50 bc(5)
Izvor 10	4.0	8.2	27.8	1.8	2.0	8.76 bc(2)	1.8	1.0	2.0	1.60 cde(4)
Sheynovo	1.1	4.9	18.6	1.3	1.0	5.38 bc(2)	1.3	1.0	1.0	1.10 de(3)
Kuklenski	5.3	7.8	23.0	3.8	5.0	8.98 bc(3)	4.6	3.8	5.0	4.47 ab(5)
Silistrenski	2.3	7.8	14.8	0.6	1.5	5.40 bc(2)	3.7	0.3	1.0	1.67 cde(4)
Hartley	15.8	21.9	22.2	7.6	13.4	16.18 a(3)	7.6	4.0	6.5	6.03 a(5)
Lara	4.3	7.8	10.4	3.0	5.0	7.50 bc(2)	2.5	1.0	1.3	1.60 cde(4)
Milotai 10	3.6	4.1	9.1	6.0	10.0	6.56 bc(2)	1.8	6.0	10.0	5.93 a(5)
Tiszacsecsi	2.0	6.4	15.3	5.8	8.0	7.50 bc(2)	3.1	1.2	3.0	2.43 bcd(4)
Fernette	3.6	2.8	10.2	0.9	2.5	4.00 c(2)	0.9	0.1	1.0	0.67 e(3)
Fernor	0.7	1.3	8.1	2.8	4.0	3.38 c(2)	1.6	0.3	1.2	1.03 de(3)
Chandler	3.7	4.6	3.5	2.5	7.0	3.66 c(2)	1.4	0.5	1.3	1.07 de(3)

The means followed by the same letter do not differ significantly from one another ($p = 0.05$).
Označene vrijednosti se ne razlikuju značajno jedna od druge (p = 0.05).
Leaf cultivar susceptibility: (1) Highly resistant (0 - 3 % infected area); (2) Resistant (3 - 10 % infected area); (3) Slightly susceptible (10 - 25 % infected area); (4) Susceptible (25 - 50 % infected area); (5) Highly susceptible (50 - 75 % infected area), (6) Very highly susceptible (75 - 100 % infected area).
Osjetljivost lista kod sorte: *(1) Veoma otporan (0 - 3 % zaraženog područja); (2) Otporan (3 - 10 % zaraženog područja); (3) Neznatno osjetljiv (10 - 25 % zaraženog područja); (4) Osjetljiv (25 - 50 % zaraženog područja); (5) Veoma osjetljiv (50 - 75 % zaraženog područja), (6) Izuzetno osjetljiv (75 - 100 % zaraženog područja).*
Fruit cultivar susceptibility: (1) Highly resistant (up to 0.25% % infected area; (2) Resistant (0.25 – 0.5% infected area); (3) Slightly susceptible (0.5 – 1.5% infected area); (4) Susceptible (1.5 – 3.5% infected area); (5) Highly susceptible (3.5 – 5% infected area); (6) Very highly susceptible (> 5% infected area).
Osjetljivost ploda kod sorte*: (1) Veoma otporan (do 0.25% % zaraženog područja; (2) Otporan (0.25 – 0.5% zaraženog područja); (3) Neznatno osjetljiv (0.5 – 1.5% zaraženog područja); (4) Osjetljiv (1.5 – 3.5% zaraženog područja); (5) Veoma osjetljiv (3.5 – 5% zaraženog područja); (6) Izuzetno osjetljiv (> 5% infected area).*

In the group of apical fruit-bearing cultivars on leaf level, the highest infestation index was reported in cultivars `Kuklenski`(9.0%), `Izvor` 10`(8.8%) and `Slivenski`(7.2%), and considerably lower in the rest of the cultivars like `Sheinovo`(5.4%), `Silistrenski` (5.4%) and `Silistrenski` (5.7%), (Table 3).

In the group of lateral fruit-bearing cultivars, the highest level of attack was reported in `Hartley`(16.2%) and `Lara`(11.0%), middle – in `Tiszacsecsi` (7,5 %) and `Millotay`(5.6 %) and low – in `Chandler`(4.4%), `Fernette`(4.0%) and `Fernor`(3.4%) (Table 3).

The results at level fruit were similar. In apical fruit-bearing cultivars, the average level of attack is reported for cultivars `Kuklenski`(4.5%) and `Slivenski` (3.5%), and low level of attack for `Silistrenski`, `Izvor` 10, `Sheinovo` and `Seer`, varying from 1,7% to 0.8%. For cultivars of lateral fruit-bearing the highest level was reported for `Hartley` (6.0%), and `Millotay` (5.9%), middle for `Tiszacsecsi`(2.4%) and `Lara` (1.6%) and the lowest for `Chandler` (1.1%), `Fernor`(1.0%) and `Fernette` (0.7%) (Table 3).

Conclusion

Summarizing the results of the research, we can make the conclusion that all investigated cultivars are susceptible to attack of walnut anthracnose and walnut bacterial blight agents to some extent.

Cultivars of apical fruit-bearing are more susceptible to anthracnose attack compare to cultivars of lateral fruit-bearing. The cultivars of apical fruit-bearing and earlier leafing are more susceptible to anthracnose attack compare to those of the same type of fruit-bearing and later leafing. From the group of apical fruit-bearing cultivars the most sensitive to anthracnose are `Seer`, `Slivenski` and `Izvor` 10, and the less sensitive - `Silistrenski` and `Sheinovo`. The cultivar `Kuklenski` takes a middle position. For lateral fruit-bearing walnut cultivars a more intense attack of anthracnose is observed in cultivars with earlier leafing compare to those of the same type of fruit-bearing but with later development. The most susceptible of this group are cultivars `Hartley`, `Lara`, `Tiszacsecsi` and `Millotay`, and the least susceptible are `Chandler` `Fernor` and `Fernette`.

The cultivars of lateral type of fruit-bearing are more susceptible to bacterial blight attack compare to those of apical fruit-bearing. From the apical fruit-bearing cultivars more susceptible to bacterial blight at level leaves and fruits are cultivars `Kuklenski`, `Slivenski` and `Izvor 10`, while

`Silistrenski` and `Sheinovo` are with low degree of sensitivity. The cultivars of lateral type of fruit-bearing and earlier leafing are more susceptible to bacterial blight attack compare to those of the same type of fruit-bearing and later development. In this group the most sensitive at leaf level is are cultivar `Hartley`, followed by cultivars `Lara`,`Tiszacsecsi`, and `Millotay`, and the least sensitive - `Chandler`, `Fernor` and `Fernette`.

At fruit level the most sensitive to this disease are cultivars `Hartley` and `Millotay`, followed by cultivars `Tiszacsecsi`, and `Lara`, and the least sensitive - `Chandler`, `Fernor` and `Fernette`.

In conclusion we must note the fact that in conditions of Bulgaria, respectively the region of Plovdiv, anthracnose occurs more often. It is observed every year and causes serious damages on the green organs of walnut trees (Arnaoudov & Gandev, 2009). The cultivars of earlier development and apical fruit-bearing, to which almost all Bulgarian cultivars belong to, are more susceptible to anthracnose compare to those of lateral type of fruit-bearing and later development.

Bacterial blight on walnuts in Bulgaria is spread on a smaller scale. Most probably, on one hand, this is due to the lower sensitivity of the popular walnut cultivars and genotypes and on the other hand – the geographical position and climatic conditions of the region. From the point of view of the local walnut cultivars, this disease could cause big damage only in regions and years with higher humidity. Regarding the introduced walnut cultivars of lateral fruit-bearing type, the situation is different. For some of them it has been ascertained in this, as well as in previous our research (Arnaoudov at al., 2009), that they are highly sensitive to bacterial blight attack. This makes it necessary when planting new orchards in future to make the right choice, assuming not only the economic characteristics of the cultivar but its sensitivity to economically important diseases, as well.

References

Arnaoudov, V. & Gandev, S. (2009). Susceptibility of some cultivars to *Gnomonia leptostilla* (Fr.) Ces. et de Not. The First Balkan Symposium on Fruit Growing, *Plovdiv, 15-17 November 2007. Acta Horticulturae,* (825), 407-412.

Arnaoudov, V., Gandev, S. & Dimova, M. (2009). *Susceptibility of some walnut varieties to walnut blight (Xanthomonas arboricola pv.*

juglandis (pierce die). Paper presented at 3rd International Scientific Horticulture Conference. Nitra. Slovaka.

Balaž, J., Korać, M. i Cerović, S. (1991). Osetljivost genotipova oraha prema Gnomonia leptostyla (Fr) Ces et Not. prouzrokovaču lisne pegavosti. Jugoslovensko voćarstvo, *95-96,* 91-94.

Belisario, A. & Zoina, A. (1995). Occurrence of Persian walnut bacterial blight and control in the nursery. *Europ. J. for Path., 25*(4), 224-237.

Belisario, A., Zoina, A., Pezza, L., Caboni, E., Damiano, C. & Corazza, L., (1997). *Preliminary investigations on population dynamics of Xanthomonas campestris* pv. *juglandis and* other *Xanthomonas in English (Persian) walnut in vitro plants.* Paper presented 10th Congress of the Mediterranean Phytopathological Union, Montpellier (France), 1-5 June 1997.

Gardan, L., Luisetti, J., Gaignard, J.L. (1986). La bactériose du noyer. *Phytoma, La Défense des Végétaux,* (11) 35-41.

Germain, E. (1990). *I portinnesti del noce. Rivista di Frutticoltura, 52*(12), 29-32.

Germain, E. (1990a). Inheritance of late leafing and lateral bud fruitfulness in walnut (*Juglans regia* L.), phenotypic correlations among some traits of the trees. First Intern. Symp. on Walnut Production, Budapest (Hungary), 25-29 Sept. 1989. *Acta Horticulturae,* 284, 125-134.

Germain, E. (2004). *Inventory of walnut research, germplasm and references.* Rome: Food and Agriculture Organization of the United Nations. FAO Technical Series 66.

Hristov, A. (1956). *Bolesti po kulturnite rasteniya v Bulgaria.* Sofia: Zemizdat.

Hristov, A. (1972). *Opredelitel na bolestite po rasteniyata.* Sofia: Zemizdat.

Josifović, M. (1956). Poljoprivredna fitopatologija. Beograd: Naučna knjiga.

Malkov, K. (1905). Die schadlichsten Insekten und Pflanzenkrankheiten, welche an der Kulturpflanzen in Bulgarien wahrend des Jahres 1903 geschadigt haben. *Zeitschrift fur Pflanzenkrankheiten, 15*(1,) 50-53.

Malkov, K. (1906). Contribution to the parasitic fungi in Bulgaria. *Travaux de la Societe Bulgare des Sciences Naturelles,*(3) 14-25.

Martins, J.M.S. (1996). A method for measuring the intensity of walnut bacterial blight on fruits. *Nucis,* (5),15-17.

Miller, P.W. & Bollen, W.B. (1946). Walnut bacteriosis and its control. *Tech. Bull. Ore. agric. Exp. Sta.*, (9), 107.

Mulerian, E. N. & Schroth, M. N. (1982). Ecology of *Xanthomonas campestris* pv. *juglandis* on Persian (English) walnut. *Phytopathology*, (72), 434-438.

Nedev, N., Serafimov, S., Anadoliev, G., Kavardjikov, L., Krinkov, H., Radev, R., Dochev, D., Stamatov, I., Slavov, N.,Vishanska, Y., Rusalimov, J., Iovchev, I., Djeneva, A., Lalev, N., Iliev, I. & Slavcheva, R.(1983). *Orehoplodni culturi*. Plovdiv: Christo G. Danov.

Nedev, N., Vasilev, V., Kavardjikov, L. & Zdravkov, K. (1976). *Orehoplodni culturi*. Plovdiv: Christo G. Danov.

Ninot, A., Moragrega, C., Montesinos, E. & Aletà, N., (1997). El control filosanitari de la bacteriosi al noguer. Calendari d'aplicacions amb coure. *2a Jornada de Protecció Vegetal. ICEA. 21-26.*

Olson, W. H., Buchner, R .P., Adaskaveg, J. E. & Lindow S. E. (1997). Walnut blight control in California. *Acta Horticulture (ISHS),* (442), 361-365.

Pastore, M., Consoli, D. & Cristinzio, G. (1997). Susceptibility of 32 walnut varieties to *Gnomonia leptostyla* and *Xanthomonas campestris pv juglandis*. *Acta Hort.*, (442), 379–384.

Penev, S. & Nedev, N. (1964). Ovoshtarstvo. Tsenni orekhovi semenacheta - nasha selektsiya. *Fruit Growing*, (11), 16-19.

Petrova-Dimova, M. (2003). *Antraknosa po oreha* (Doctoral dissertation). Agrarian University, Plovdiv, Bulgaria.

Rosnev, B. & Tsanova, P. (1980). Vŭrkhu razprostranenieto na antraknosata i borbata za namalyavane povredite prichineni ot neya po orehite (Juglans regiya L .) v naschata strana. *Forestry Science, 17*, 44-56.

Savov, C. (1923). Razprostranenie na gŭbnata, bakterialna i fanerogamna flora po kulturnite i divi rasteniya v Shumenska okoliya In *Scientific works of Agricultural Institute of Bulgaria*, *1924.*Sofia.

Steele, R. & Torrie, J. (1980). *Principles and procedures of statistics*. New York: McGraw-Hill.

Stefanov, N. (1964). A pomological study of the Silistrenski walnut variety (In Bulgarian). *Grad. lozar. Nauka, 1*(7), 25-28.

Teviotdale, B.L., Schroth, M.N. & Mulrean, E.N. (1985). Bark, fruit and foliage diseases. In Ramos, D. (Ed.)*, Walnut orchard management* (pp. 153-157). The Regents of the Univ. of California, Div. of Agricultural and Natural Resources, Oakland, Publ. 21410.

Trifonov, D. (1962). Antraknosa po oreha *Gnomonia leptospila* (Fr.) Ces et de Not. *Plant protection*, (6), 10-14.

Veghelyi, K & Penzes-Toth, T. (1990). Life cycle, forecast and control of Gnomonia leptostyla Fr. Ces et de Not. *Acta horticulturae,* (284), 303.

Received: March 28, 2014
Accepted: June 3, 2014

Osjetljivost nekih sorti oraha na patogene *Gnomonia leptostyla* i *Xanthomonas arboricola* pv. *juglandis* u Bugarskoj

Veselin Arnaudov[1], Stefan Gandev[1], Milena Dimova[2]

[1]*Voćarski institut, Plovdiv, Bugarska*
[2]*Poljoprivredni univerzitet, Plovdiv, Bugarska*

Sažetak

Cilj ovog istraživanja bio je da se prouči i uporedi osjetljivost 13 sorti oraha – 5 bugarskih (B), 3 francuske (F), 2 mađarske (H), and 3 američke (A) – na *Gnomonia leptostyla* (Fr.) i *Xanthomonas arboricola* pv. *juglandis* (Pierce) Dye, patogene koji prouzrokuju antraknozu oraha i bakterioznu pjegavost oraha. Ispitivanje je sprovedeno u prirodnim uslovima okruženja na kolekcionom zasadu starom od 5 do 8 godina u Voćarskom institutu u Plovdivu tokom perioda 2006-2010. Evaluacija napada kojeg su prouzrokovali ovi patogeni sprovedena je na 6 različitih nivoa osjetljivosti na dati patogen, a baziraju se na stepenu napada. Članak prezentuje podatke o osjetljivosti ispitivanih sorti na patogene *G. leptostyla* (Fr.) i X. *arboricola* pv. *juglandis* (Pierce) Dye, kao i diskusiju u vezi sa dobijenim rezultatima.

Ključne riječi: Juglans regija, sorte, antraknoza oraha, bakteriozna pjegavost oraha, infekcija

Veselin Arnaudov
E-mail address:vaarnaudov@abv.bg

Primljeno: 28. marta 2014.
Odobreno: 3. juna 2014.

Original scientific paper
Originalan naučni rad
UDK: 634.63(497.16)
DOI: 10.7251/AGREN1401055L

University of Banjaluka, Faculty of Agriculture
Agro-knowledge Journal

Variability of Oil Content in Fruit of Olive Variety Žutica on Montenegrin Coast

Biljana Lazović [1], Mirjana Adakalić [1], Stoja Ljutica [1], Tatjana Perović[1], Miroslav Čizmović[1]

[1]*University of Montenegro, Biotechnical faculty-Podgorica, Centre for Subtropical Cultures-Bar, Montenegro*

Abstract

Žutica, the major variety on Montenegrin Coast, belongs to the group of olive varieties for oil production, with oil content in average above 21%. During the research of the properties of Žutica variety, the existence of variability in the oil content was recorded. In order to determine the degree of the variability of oil content within this variety, the fruits of 42 accessions were analyzed. The results confirmed high content of oil as well as the existence of variability of this parameter between the studied accessions. Twenty two accessions had the content of oil of over 20%, while 13 accessions had the oil content greater than 22% in fresh matter. The highest oil content was in fruit of VAL2 (24.3%) and in dry matter in DUB (63.77%). The results suggest Žutica accessions (clones) with higher oil content promising for spread in the new plantations.

Key words: olive accessions, Montenegro, olive oil

Introduction

Olives have been grown on the Montenegrin Coast for more than 2000 years, as evidenced by two exemplars situated in Bar and Budva. The main cultivar that dominates in the olive assortments of Montenegro is Žutica. This cultivar is present with 98% in the southern coastal area or with 65% in relation to other cultivars. During the long period of cultivation and influences of different ecological conditions along the coast, many differences have evolved in the frame of this variety recognizable on the phenotype (Lazović et al., 2002). In general, Žutica is characterized as a variety for oil production, with a small to medium-sized fruit and a high content of oil of more than 21% (Miranović, 1994; Lazović, 2001). This variety is also used for table consumption, prepared in local ways as green and black.

During the research related to morphological and chemical properties of this variety, the existence of variability in the oil content was recorded. With recording of the phenotype differences among individuals of this variety, we considered the possibility to find clones with the valuable morphological traits that can be used in production and/or in breeding programs. In spite of overall opinion that clone selection has not produced much innovation in terms of better genotypes (Bellini et al., 2008), the clones with high oil content can be used to improve olive oil production. The aim of this work was to analyze the range of olive oil content among Žutica individuals/clones and the capacities represented with the most prominent clones for the olive oil production.

Material and Methods

During the three-year period (2009-2011) the study was conducted on 42 individuals /clones of cultivar Žutica. Individual trees /clones were marked according to their original location along the coast of Montenegro (Bar: DAB1, DAB2, DAB3, DAB4, SUS1, SUS2, CSV1, CSV2, DM5, STM1, STM2, KAP1, KAP2, BRI1, BRI2, KUR, ZAVG; Ulcinj: VAL1, VAL2, VALD, VALL, STUL, VALVO; Budva: REZ, PET1, PET2, PET3, PET4, MAES, DIVA, MIRI2; Tivat: GRAB1, GRAB2, GRAB3, KRST; Kotor: KAV1, KAV2, DUB; Lustica: LUS14, LUS15, LUS2, LUS3). Phenological phases (here presented with the end of flowering and beginning of ripening, respectively) were observed and the period of development of fruit was calculated (Baranco et al., 2000). The fruit samples collected in quantity of 1kg per tree were used for the analyses of

moisture and dry matter at 105ºC (drier Memmert UFB400) and olive oil content (Soxtec apparatus with diethyl ether), as well. The data obtained were statistically processed with STATISTIX 7.0 program. The $LSD_{0.05}$ test was used to define the significance of the differences among Žutica individuals/clones. The data were standardized and a dendrogram was constructed using Unweighted pair-group average (UPGMA) method with Squared Euclidean distance in the program STATISTICA 5.0.

Results and Discussion

Flowering in Žutica clones (Table 1) occurred in the last decade of May and the beginning of June. Flowering ended with 9 days of difference among the clones. Flowering intensity was not significantly different. No influence of the location on the clone flowering was noticed.

Tab. 1. Flowering and maturation of 42 clones of cv. Žutica (2009-2011)
Cvjetanje i zrenje 42 klona sorte Žutica (2009-2011)

No. *Br.*	Clone *Klon*	End of flowering *Kraj cvjetanja*	Degree of flowering *Stepen cvjetanja*	Beginning of maturation *Početak zrenja*	Days from the end of flowering to the beginning of maturation *Broj dana od kraja cvjetanja do početka zrenja*
1	DAB1	28th May	1	6th October	130
2	DAB2	27th May	1	6thOctober	131
3	DAB3	30th May	1	16th October	139
4	DAB4	29th May	1.5	16th October	140
5	SUS1	29th May	3	17thOctober	141
6	SUS2	29th May	1	16th October	140
7	CSV1	25th May	1.5	18thOctober	146
8	CSV2	26th May	2.5	12thOctober	139
9	REZ	28th May	3	21th October	146
10	LUS14	2nd June	1.5	15thOctober	135
11	LUS15	2nd June	1.5	15th October	135
12	DM5	23th May	3	14th October	143
13	VAL1	29th May	3	17th October	141
14	VAL2	27th May	4	15th October	141
15	VALD	30th May	3	15th October	138
16	VALL	31st May	2	17th October	139
17	STUL	29th May	2.5	9th October	131
18	VALVO	28th May	3	17th October	142
19	STM1	27th May	1	11th October	137
20	STM2	26th May	2	11th October	138
21	KAP1	25th May	1	8thOctober	136
22	KAP2	25th May	0.5	8th October	136
23	PET1	20th May	2.5	17th October	149
24	PET2	20th May	3	16th October	148

No. *Br.*	Clone *Klon*	End of flowering *Kraj cvjetanja*	Degree of flowering *Stepen cvjetanja*	Beginning of maturation *Početak zrenja*	Days from the end of flowering to the beginning of maturation *Broj dana od kraja cvjetanja do početka zrenja*
25	PET3	20th May	2.5	17thOctober	149
26	PER4	21st May	1	14th October	145
27	BRI1	3rd June	2	13thOctober	132
28	BRI2	2nd June	1.5	13th October	133
29	MAES	26th May	0.5	21st October	148
30	DIVA	25th May	0.5	15th October	143
31	KAV1	27th May	2.0	09th October	135
32	KAV2	27th May	1	10th October	136
33	KRST	28th May	3	10th October	135
34	GRAB1	30th May	2	8th October	131
35	GRAB2	29th May	2.5	8th October	132
36	GRAB3	30th May	3	9th October	131
37	LUS2	30th May	1	13th October	136
38	MIRI2	24th May	5	23th October	152
39	LUS3	29th May	2	10th October	134
40	KUR	29th May	4	17th October	141
41	ZAVG	30th May	1	15th October	138
42	DUB	30th May	3	7th October	130
P-value		0.0002**	0.0941ns	1.0000ns	0.8189ns
$LSD_{0,05}$		5.2062	1.9217	29.848	18.569

Maturation, presented with the beginning of this phase, started in October with a difference of 17 days between the earliest (DAB1 and 2) and the latest (MIR2). Regarding the olive descriptor (Baranco et al., 2000), the early ripening occurred in late October.

The period for fruit to develop and start ripening was differed in 22 days among Žutica clones and it was not significant. The shortest period for fruits to start maturation was 130 days (DAB1 and DUB) and the longest was of 152 days in MIR2. The amount of yield did not influence the maturation beginning. This period is very important for the development of the fruit and in regard of the accumulation of olive oil. It is also in accordance with the previous results (Lazović et al., 2006; Hamidoghli et al., 2008).

The harvesting period is very important since the oil content (in dry and fresh matter) and olive oil quality parameters decreased during ripening (Hamidoghli et al., 2008). Therefore, the data presented in Table 1 are of importance in relation to the oil content and chemical properties of the fruits (Table 2). The chemical properties obtained were significantly different among Žutica clones.

The oil content in fruit of 22 examined clones was over 20% on fresh matter. The range was from the lowest 14.63% (LUS2) up to 24.28% (VAL2). The moisture content in the fruit influenced the oil content which

calculated on dry matter was in range from 33.42% (PET4) to 63.44% (DUB) and it was above 50% in 13 clones, respectively. Similar olive oil values in dry matter were obtained for Turkish varieties (Arslan, 2012), mentioning the conclusion of Tous and Romero (1994) that olive varieties with more than 46% total oil in dry matter are classified as high oil containing varieties. Thus, our results confirm Žutica as high oil containing variety with average of 46.77% oil in dry matter. From the other hand, a high level of variability in olive oil content suggests the presence of even more oily accessions of Žutica.

The influence of ecological conditions of the site cannot be recognized as a rule (Sladonja et al., 2006) since the clones from the same area showed very different oil content. More likely is that differences in oil content is the potential within this variety that should be subject of the deeper research considering the oil qualitative standards (Cantini et al., 1999) to insure more flavoring olive oil production.

The influence of the period end of flowering - beginning of maturation (Table 1) on oil accumulation was not confirmed.

Tab. 2. Chemical properties of fruit in 42 individuals/clones of cv. Žutica
Hemijske osobine ploda 42 individue/klona sorte Žutica

No. *Br.*	Clone *Klon*	Moisture *Vlaga* (%)	Dry matter *Suva materija* (%)	Oil content in fresh matter *Sadržaj ulja na svježu mat.* (%)	Oil content in dry matter *Sadržaj ulja na suvu mat.* (%)
1	DAB1	57.92	42.08	23.90	56.80
2	DAB2	55.06	44.94	22.99	51.15
3	DAB3	55.93	44.07	21.65	49.13
4	DAB4	59.58	40.43	20.31	50.23
5	SUS1	57.69	42.31	17.00	40.17
6	SUS2	55.69	44.32	22.27	50.25
7	CSV1	55.41	44.59	17.96	40.27
8	CSV2	57.62	42.39	19.49	45.97
9	REZ	61.66	38.34	18.46	48.15
10	LUS14	57.41	42.59	17.73	41.62
11	LUS15	55.55	44.45	17.88	40.22
12	DM5	58.44	41.56	20.08	48.32
13	VAL1	56.66	43.34	22.36	51.60
14	VAL2	57.08	42.92	24.28	56.57
15	VALD	58.59	41.41	19.46	47.01
16	VALL	55.23	44.77	21.77	48.63

No. *Br.*	Clone *Klon*	Moisture *Vlaga* (%)	Dry matter *Suva materija* (%)	Oil content in fresh matter *Sadržaj ulja na svježu mat.* (%)	Oil content in dry matter *Sadržaj ulja na suvu mat.* (%)
17	STUL	56.78	43.22	22.40	51.83
18	VALVO	59.33	40.67	18.36	45.14
19	STM1	59.12	40.88	18.67	45.67
20	STM2	61.31	38.69	17.96	46.42
21	KAP1	58.95	41.05	18.14	44.17
22	KAP2	55.50	44.50	20.28	45.57
23	PET1	63.55	36.45	19.46	53.40
24	PET2	63.05	36.95	22.01	59.56
25	PET3	56.44	43.56	21.15	48.57
26	PET4	51.62	48.38	16.17	33.42
27	BRI1	49.72	50.29	23.08	45.90
28	BRI2	53.77	46.23	23.73	51.33
29	MAES	59.75	40.25	19.77	49.11
30	DIVA	53.71	46.29	21.86	47.23
31	KAV1	56.91	43.10	21.99	51.02
32	KAV2	50.16	49.85	23.24	46.61
33	KRST	48.13	51.88	22.00	42.40
34	GRAB1	46.95	53.05	19.90	37.51
35	GRAB2	46.85	53.15	24.20	45.52
36	GRAB3	47.11	52.90	22.04	41.66
37	LUS2	64.33	35.67	14.63	41.01
38	MIRI2	54.65	45.35	19.39	42.76
39	LUS3	58.36	41.64	14.68	35.25
40	KUR	61.11	38.89	20.41	52.47
41	ZAVG	56.09	43.91	19.50	44.41
42	DUB	68.87	31.13	19.75	63.44
Average		56.61	43.39	20.29	46.77
P-value		0.0000**	0.0000**	0.0000**	0.0001**
$LSD_{0,05}$		5.1165	5.1165	3.7196	9.4790

To elaborate further the differences in chemical parameters, the dendrogram was constructed (Fig. 1) dividing Žutica clones into 4 groups. The first group is composed of two subgroups with 12 and 18 individuals. The clones linked in first subgroup have high oil content in fresh and in dry matter. The second group is with the highest dry matter content (51.52%); the third group has the lowest oil content in fresh matter

(15.16%), while the three clones in the fourth group have the highest moisture and oil in dry matter content (65.16% and 56.8%, respectively).

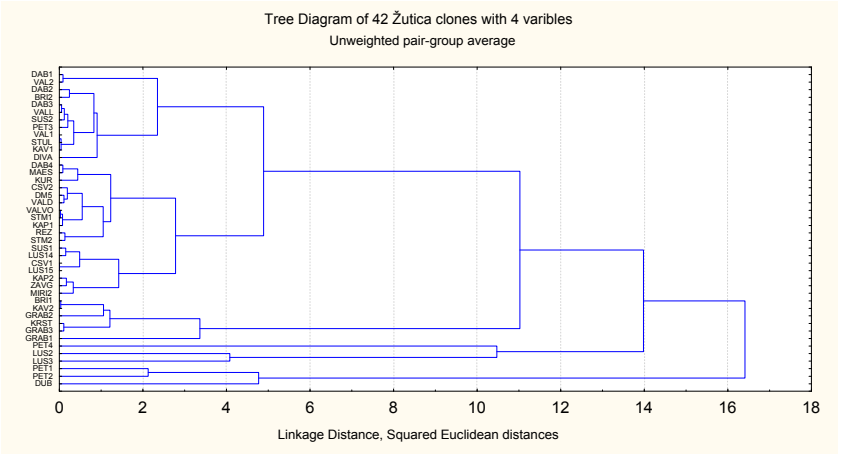


Fig. 1. Dendrogram of 42 Žutica clones derived from UPGMA analysis of chemical properties
Dendrogram za 42 klona sorte Žutica dobijen UPGMA analizom hemijskih osobina

Conclusion

The study of 8 parameters in 42 individuals/clones showed the high level of variability among Žutica variety regarding the olive oil content. The results showed the presence of the clones with high oil content in the fruit, 22 clones with more than 20% and in two clones of over 24% (GRAB2 and VAL2). The clones should be further studied for olive oil quality, while the expressed variability should be confirmed by DNA analysis. The clones with higher oil content are potential for multiplication and growing in new plantations.

Acknowledgements

The research project was funded by the Ministry of Science of Montenegro.

References

Arslan, D. (2012). Physico-chemical characteristics of olive fruits of Turkish varieties from the province of Hatay. *Grasas y Aceites, 63(2),* 158-166.

Barranco, D., Cimato, A., Fiorino, P., Rallo, L., Touzani, A., Castañeda, C., Serafini, F. & Trujillo, I. (2000). *World Catalogue of Olive Varieties.* Madrid: Consejo Oleícola Internacional.

Benito, M., Oria, R. & Sanchez-Gimeno, A.C. (2010). Characterization of the Olive Oil from Three Potentially Interesting Varieties from Aragon (Spain). *Food Sci Tech Int 2010, 16(*6), 523-530.

Cantini, C., Cimato, A. & Sani, G. (1999). Morphological evaluation of olive germplasm present in Tuscany region. *Euphytica*, *109*, 173-181.

Hamidoghli, Y., Jamalizadeh, S. & Malakroudi, M.R. (2008). Determination of harvesting time effect on quality and quantity of olive (Olea europea L.) oil in Roudbar regions. *Journal of Food, Agriculture & Environment, 6*(2), 238-241.

Lazović, Biljana, Bošković, R., Gašić, Ksenija, James, Celia & Tobutt, K. (2002). Genetic diversity of olives grown along the coast of Montenegro. *Acta Hort. (ISHS), 2*(586),167-170.

Lazović, B., Adakalić, M., Perović, T., Hrnčić, S., Pucci, C., Terrosi, A. & Spanedda, A.F. (2006). Increased olive oil yield and quality in Montenegrin cv. Žutica by *Bactrocera oleae* Gmel. (Diptera Tephritidae) control and improved harvest techniques. *IOBC wprs Bulletin, 30* (9), 337-342.

Lazović, B. (2001). Osobine ploda nekih sorti masline (*Olea europaea* L.). *Poljoprivreda i šumarstvo,47*(3-4), 15-25.

Miranović, K. (1994):. Investigation of Elayographic Properties of the Olive Cultivar Žutica (*Olea europaea* L.). *Acta Horticulturae (ISHS), 1*(356), 74-77.

Sladonja, B., Brkić, K., Radulović, M., Lukić, I., Šetić, E. & Krapac, M. (2006): Oil content in fruits of leading autochthonous olive varieties in Istria. *Pomologia Croatica 12*(2), 153-158.

Received: May 7, 2014
Accepted: June 11, 2014

Varijabilnost sadržaja ulja u plodu masline sorte Žutica na Crnogorskom primorju

Biljana Lazović[1], Mirjana Adakalić[1], Stoja Ljutica[1], Tatjana Perović[1], Miroslav Čizmović[1]

[1]*Univerzitet Crne Gore, Biotehnički fakultet-Podgorica, Centar za suptropske kulture-Bar, Crna Gora*

Sažetak

Žutica je najvažnija sorta masline na Crnogorskom primorju za proizvodnju ulja, čiji je sadržaj u plodu u prosjeku iznad 21%. Tokom istraživanja osobina ove sorte zapažena je varijabilnost u sadržaju ulja. Za utvrđivanje stepena varijabilnosti sadržaja ulja u plodu analizirano je 42 aksešena (klona) ove sorte. Rezultati su potvrdili visok sadržaj ulja kao i postojanje varijabilnosti ovog parametra između analiziranih aksešena sorte Žutica. Od ukupnog broja ispitivanih, kod 22 aksešena sadržaj ulja u plodu bio je preko 20%, dok je sadržaj ulja veći od 22% u svježoj materiji imalo 13 aksešena/klonova. Najveći sadržaj ulja u svježem plodu bio je kod VAL2 (24,3%), a u suvoj materiji kod DUB (63,44%). Rezultati ukazuju da aksešeni (klonovi) Žutice sa većim sadržajem ulja u plodu predstavljaju potencijal za širenja u novim zasadima.

Ključne riječi: aksešeni, Crna Gora, maslinovo ulje

Biljana Lazović
E-mail address: biljanal@t-com.me

Primljeno: 7. maja 2014.
Odobreno: 11. juna, 2014.

Originalan naučni rad
Original scientific paper
UDK: 645.25:581.19
DOI: 10.7251/AGRSR1401065Ć

University of Banjaluka, Faculty of Agriculture
Agro-knowledge Journal

Kvalitativne i kvantitativne osobine novih sorti crvenog luka

Josip Ćota[1], Azra Hadžić[2], Jelena Ćota[3], Milana Šilj[4]

[1]*Federalni zavod za poljoprivredu, Sarajevo, Bosna i Hercegovina*
[2]*Pedagoški fakultet, Univerzitet u Sarajevu, Bosna i Hercegovina*
[3]*Farmaceuski fakultet, Univerzitet u Beogradu, Srbija*
[4]*Poljoprivredni fakultet, Univerzitet u Istočnom Sarajevu, Bosna i Hercegovina*

Sažetak

Cilj rada je bio da se prikažu karakteristike novih sorti crvenog luka (Zenički i Konjički), stvorene u Federalnom zavodu za poljoprivredu Sarajevo i njihova pogodnost za uzgoj u Bosni i Hercegovini. Ispitivanja su obavljena tokom dvije godine (2012; 2013) na lokalitetu Butmir (Sarajevo). Ogledi su izvedeni po randomiziranom blok sistemu u pet ponavljanja. Ispitivane su proizvodne osobine crvenog luka: prinos i dužina vegetacije. U okviru kvalitativnih osobina utvrđen je sadržaj suhe materije, šećera i bijelančevina u lukovici. Za standard je korištena sorta Stuttgarter. Nove sorte se odlikuju dužinom vegetacije od 114 do 115 dana. Sorta Zenički je ostvarila viši prinos lukovica za 17 %, a sorta Konjički za 31 % u odnosu na Stuttgarter. U 2013. su prinosi lukovica viši za 15 % u odnosu na 2012. godinu. Ispitivane sorte odlikuje visok kvalitet, jer je sadržaj suhe materije od 13,8 do 15,88%, ukupnih šećera od 8,20 do 10,98% i bjelančevina od 1,50 do 1,70%, kao i blago ljut ukus i dobra obavijenost lukovice.

Ključne riječi: Zenički luk, Konjički luk, prinos, kvalitet

Uvod

Najveći prinosi crnog luka su u zemljama gde se on uzgaja direktno iz sjemena uz potpunu primjenu savremene tehnologije i odgovarajućeg sortimenta, a najmanji gdje se proizvodi iz arpadžika, što je inače tipično za zemlje jugoistočne Evrope. U uslovima BiH, proizvodnja se najčešće odvija na manjim površinama, bez sistema za zalivanje te zato dominira proizvodnja iz arpadžika, gdje se ostvaruju vrlo niski prinosi od 7,8 t/ha (http://www.fao.org). U 2012. pod crvenim lukom je bilo zasijano 5.223 ha, a 2013. godini 4.887 ha (Agencija za statistiku BiH [AZSBiH], 2012).

Crni luk se tradicionalno koristi kao svježa, zatim termički obrađena (sastavni dio mnogih jela), a zadnjih godina i kao prerađena namirnica (kiseljenjem, sušenjem).

Svaki od ovih vidova korišćenja zahtjeva odgovarajuću tehnologiju gajenja kao i sortiment, te su i različiti ciljevi oplemenjivanja ove povrtne vrste (Gvozdanović-Varga i sar., 1996; Gvozdanović-Varga i sar., 2005)**.**

Uz visinu prinosa domaćih sorata crnog luka, dosadašnja istraživanja su ukazala i na neke nutritivne vrijednosti i potvrdila značaj ove namirnice kroz sadržaje mikro nutrijenata u lukovici (Ćota i sar., 2013). Rezultati utvrđenih količina minerala u uzorcima luka uzgojenog u našim agroekološkim uslovima, u prosjeku za sve tri sorte, ukazuju da crveni luk sadrži najviše cinka (1.3126 mg/kg), pa željeza (0,7196 mg/kg), mangana (0,3243 mg/kg), bakra (0,2210 mg/kg) i kadmija (0,01467 mg/kg). Prisustvo i količine nekih minerala u luku se mogu vezati za lokalitet uzgoja kroz načine i mogućnosti dospijevanja iz tla u biljku. Dobijeni rezultati istraživanja ukazuju da sa 100 g luka ispitivanih sorata uzgojenih na našem području možemo zadovoljiti dnevne potrebe sa 55,25% bakra, željeza sa čak 126,21%, cinka sa 82,06 % i mangana sa 83,15% u odnosu na propisane po USDA (USDA, 2003).

Krupnoća lukovice je sortna oznaka, ali na krupnoću u velikoj mjeri utiču i uslovi uzgoja. Prema masi razlikujemo sitne lukovice koje su lakše od 60 g, srednje 60-100 g i krupne iznad 100 g (Lazić i sar., 2001). Isti autori navode da je oblik lukovice sortna oznaka koja u mnogome varira u zavisnosti od tipa i strukture zemljišta (na zbijenim zemljištima formira se pljosnatija lukovica), i dubine sjetve (ako je sjetva dublja, lukovica se izdužuje).

Cilj ovog rada je prikaz rezultata istraživanja novih sorata crvenog luka kreiranih u Federalnom zavodu za poljoprivredu u Sarajevu i njihova pogodnost za uzgoj u Bosni i Hercegovini. Priznavanjem, uzgojem i

kontrolisanom proizvodnjom arpadžika novih sorata crvenog luka, povećala bi se proizvodnja domaćeg crvenog luka i smanjio uvoz.

Materijal i metode rada

Na lokalitetu Butmir (Sarajevo) je postavljen ogled tokom dvije godine (2012. i 2013.) sa novim sortama crvenog luka, pod oznakom Zenički i Konjički. Za standard je korištena sorta Stuttgarter, koja se proizvodi iz arpadžika i raširena je u proizvodnji. Ogledi su postavljeni po randomiziranom blok sistemu u pet ponavljanja. Veličina osnovne parcele je 4,5 m^2 (5 x 0,9 m), sa tri reda na parceli (30 x 10 cm), odnosno 150 biljaka na parceli (330 hiljada biljaka/ha).

Sadnja crnog luka je obavljena ručno, 18.3.2012. i 06.03.2013. godine. U toku vegetacije primjenjene su sve potrebne mjere njege u proizvodnji crvenog luka. Prilikom đubrenja vodilo se računa o predusjevu i tipu tla. Nastojalo se biljkama obezbjediti takve uvjete koji će omogućiti ispoljavanje maksimalnog kapaciteta rodnosti sorte. U tlo su unesena mineralna đubriva u slijedećim količinama čistih hraniva: 56 kg/ha N, 112 kg/ha P_2O_5 i 294 kg/ha K_2O. U rano proljeće su unesena NPK gnojiva. Prihrana je obavljena prije prvog okopavanja. Evidentiran je datum tehnološke zrelosti, odnosno dužine vegetacije za ispitivane sorte. Nakon vađenja i sušenja lukovica određivani su prinosi crnog luka, a od hemijskih analiza:

- udio suhe materije (sušenjem na temperaturi od 102-105^{0}C);
- sadržaj ukupnih proteina metodom po Kjeldahl-u;
- sadržaj ukupnih šećera po Luff-Schoorl-u (gravimetrijski).

Prinosi su obrađeni analizom varijanse. Testiranje razlika obavljeno je LSD-testom za nivo značajnosti P=0,05 i P=0,01.

Agroekološki uslovi u toku izvođenja ogleda

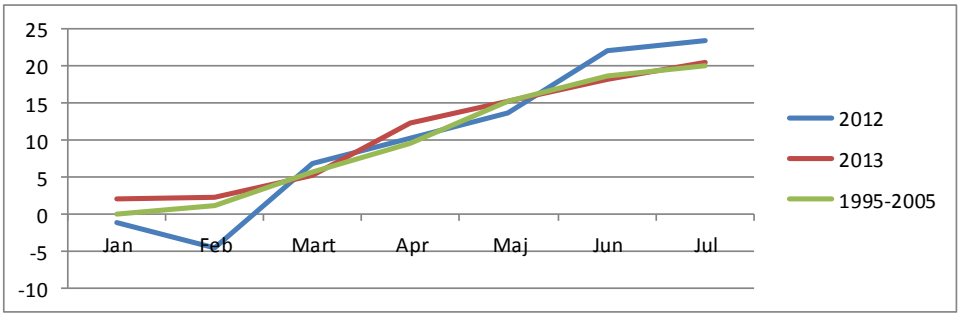
Prije postavljanja ogleda uzeti su prosječni uzorci zemljišta i izvršena je hemijska analiza (Tab.1). Na lokalitetu Butmir je smeđe dolinsko tlo, a po sastavu hraniva tlo je umjereno opskrbljeno fosforom i kalijmom.

Za prikaz klimatskih uslova u vegetacionom periodu korišteni su podaci sa meteorološke stanice Sarajevo (lokalitet Butmir). Prikazane su srednje mjesečne temperature i sume padavina za vegetacioni period crnog luka (Graf. 1, 2, 3, i 4).

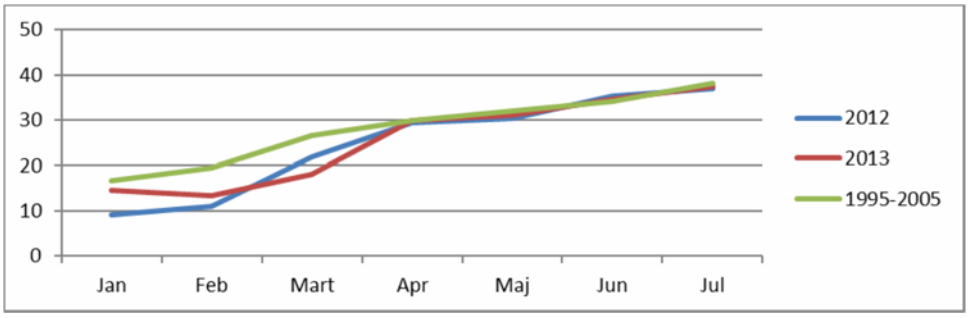
Tab. 1. Hemijske osobine tla
Chemical properties of soil

Godina *Year*	Reakcija pH u *Reaction pH*		Sadržaj u % *Content %*			mg u 100g tla sadrži fiziološki aktivnog *mg in 100g of soil contains phisiologially active*	
	H_2O	KCl	Ukupan N *Total N*	$CaCO_3$	Humus	P_2O_5	K_2O
2012.	5,89	-	0,09	-	1,80	12,50	10,9
2013.	6,02	-	0,08	-	1,80	8,45	14,20

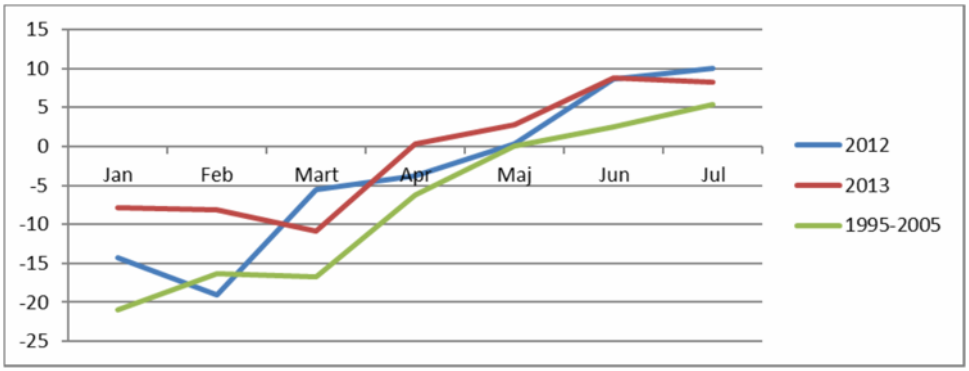
Klimatski uslovi variraju od godine do godine. U Butmiru su oštre zime i umjereno topla ljeta. U godinama ispitivanja temperature zraka su se kretale u okviru višegodišnjeg prosjeka.



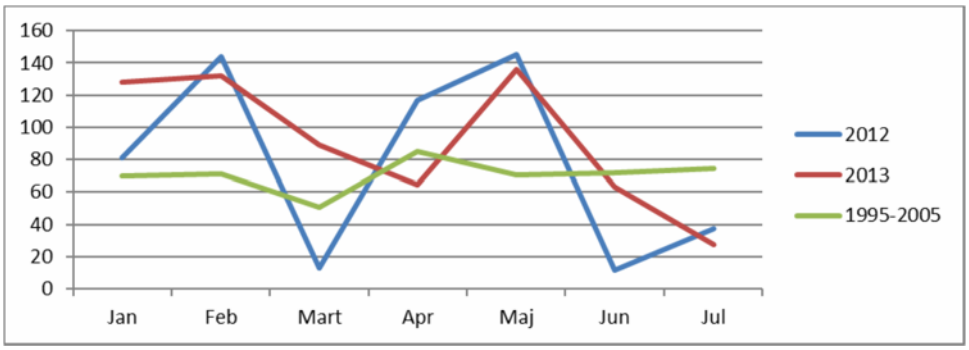
Graf. 1 Srednje mjesečne temperature zraka (Cº) /
Mean monthly air temperatures (Cº)



Graf. 2 Maksimalne mjesečne temperature zraka (Cº)
Maximum monthly air temperatures (Cº)



Graf. 3 Minimalne mjesečne temperature zraka (Cº)
Minimum monthly air temperatures (Cº)



Graf. 4 Mjesečne količine padavina (l/m^2)
Monthly precipitation (l/m^2)

Ako se analiziraju podaci temperatura, može se uočiti da su temperature u periodu izvođenja ogleda sa sortama crnog luka (2012. i 2013.) bile zadovoljavajuće u odnosu na višegodišnji prosjek. Više srednje mjesečne temperature su bile u III, IV, VI i VIII mjesecu (2012.), a u II, IV i VII mjesecu (2013.) u odnosu na višegodišnji prosjek. Maksimalne temperature su bile više u VI mjesecu (2012.) i IV i VI mjesecu (2013.), dok su minimalne temperature bile nešto više, osim V mjeseca (2012.) u odnosu na višegodišnji prosjek. U toku vegetacije manjak oborina je bio u III, VI i VII mjesecu (2012.) i u IV, VI i VII mjesecu (2013.), što nije značajno uticalo na nicanje luka jer je zemljište imalo dovoljno akumulirane vlage.

Rezultati i diskusija

Ispitivane osobine novih sorata crvenog luka prikazane su u poređenju sa sortom Stuttgarter, koja se proizvodi iz arpadžika i ima veoma dugu tradiciju gajenja na ovim prostorima. Nove sorte su srednje kasne vegetacije, kao i standard, dužine vegetacije od 122 do 142 dana. Biljke su dobro razvijene sa uspravnim položajem listova, tamno zelene boje sa izraženom voštanom prevlakom (Ćota i sar., 2013).

Tab. 2. Prinos crvenog luka po sortama i godinama u t/ha
Onion yield by the varieties and years in t/ha

Sorta *Variety*	Prinos u t/ha *Yield in t/ha*			
	2012.		2013.	
	t/ha	%	t/ha	%
Stuttgarter	25,4	100	27,9	100
Konjički	34,0**	134	36,3**	130
Zenički	27,0	106	35,7**	127
LSD P= 5 %	3,63		2,13	
LSD P= 1%	5,23		3,12	

Rezultati prinosa crvenog luka ukazuju na signifikantnu varjabilnost sorta u 2012. i 2013. godini. Prinosi crnog luka su bili visoko značajno viši 2012. godine, kod Konjičkog za 34%, a za 27 % kod Zeničkog i 30% Konjičkog u 2013. godini u odnosu na standardnu sortu Stuttgarter (Tab. 2).

Sorta Zenički je ostvarila viši prinos lukovica za 17%, a Konjički za 31% u odnosu na Stuttgarter, ali rezultati nisu statistički značajni (Tab. 3).

Tab. 3. Utjecaj faktora sorte
The impact of factors of sorts

Sorta/*Variety*	Prinos t/ha */Yield t/ha*	%
Stuttgarter	26,65	100
Konjički	35,5	131
Zenički	31,35	117
LSD P = 5%	11,05	
LSD P= 1 %	25,49	

Tab. 4. Utjecaj faktora godine
The impact of factors of years

Godina/*Year*	Prinos t/ha */Yield in t/ha*	%
2012.	28,8	100
2013.	33,3	115
$LSD_{P=5\%}$	9,3	
$LSD_{P=1\%}$	20,82	

Uočavaju se razlike u prinosu lukovica po godinama. U 2013. su prinosi lukovica viši za 15 % u odnosu na 2012. Godinu (Tab. 4).

Tab.5. Hemijski sastav lukovica ispitivanih sorata crnog luka
Chemical composition of the examined onion varieties

Parametar *Parameter*	Konjički		Zenički		Stuttgarter	
	2012.	2013.	2012.	2013.	2012.	2013.
Suha materija %/ *Dry content %*	14,04	14,15	15,88	15,23	14,29	13,80
Ukupni šećeri %/ *Total sugars %*	8,20	10,98	10,05	10,98	8,60	10,58
Ukupne bjelančevine %/ *Total proteins %*	1,55	1,54	1,50	1,58	1,70	1,51

Sadržaja suhe materije, uz ostale pokazatelje (sadržaj šećera i eteričnog ulja) svrstava sorte crnog luka u tri grupe: ljute sorte koje se odlikuju visokim sadržajem suhe materije preko 14%, poluljute sorte sadrže od 10-14% suhe materije i slatke sorte sadrže do 10% suhe materije (Lazić i sar., 2001). Prema dobijenim podacima, sadržaj suhe materije u uzorcima lukovica ispitivanih sorata se kreće od 14,04 do 15,88 %, te se može reći da spadaju u grupu ljutih sorti. Prema podacima Nacionalnog Instituta za javno zdravlje Finske (National Public Health Institute of Finland) ukupnih proteina u crnom luku ima oko 19% ili 1,3 g/100 g svježe sirovine (http://www.fine.fi), odnosno prema podacima FAO-a iz 2009 1,5 g/100 g (http://www.fao.org). U odnosu na navedene podatke, ispitivane sorte u ovim istraživanjima su sa uočljivo nižim sadržajima bjelančevina koje se kreću se od 1,50 do 1,70 %. Prema istim izvorima, količina ugljenih hidrata u luku kreće se oko 72% ili 12,7 g/100 g svježe sirovine, od čega šećera ima oko 30% ili 4,8 g/100 g. I po sadržaju ukupnih šećera, ispitivane sorte crnog luka u uslovima uzgoja u Bosni i

Hercegovini su sa izrazito niskim sadržajem ovih nutrijenata (od 8,20 do 10,98 %) (Tab. 5).

Dobijeni podaci ukazuju na potrebu detaljnijih istraživanja, a posebno agroekoloških uslova uzgoja. Poznato je da padavine utiču na obezbijeđenost biljaka vodom, i mogu utjecati na sastav ubranih biljnih plodova. Zbog relativno slabo razvijenog korjenovog sistema, koji je rasprostranjen plitko, crni luk zahtijeva dobru vlažnost površinskog sloja zemljišta. Nedostatak vode u periodu intenzivnog porasta biljke dovodi do zaostajanja rasta i smanjenja kvaliteta lukovice. U uslovima navodnjavanja biljna tkiva su hidratisanija. Potrebe luka za vodom razlikuju se tokom vegetacije. Najveće zahtjeve luk ima u periodu nicanja do faze intenzivnog obrazovanja listova, dok se njegovi zahtjevi smanjuju ka fazi zrenja. U fazi zrenja nedostatak vlage povoljno utiče na kvalitet lukovice. Suvišak vode dovodi do formiranja krupnijih, sočnijih, manje kvalitetnih lukovica, a veoma često i usporava dozrijevanje lukovice (Lazić i sar., 2001; http://tehnologijahrane.com).

Zaključak

Nove sorte crvenog luka (Zenički i Konjički), stvorene su u Federalnom zavodu za poljoprivredu u Sarajevu. Postignuti kvantitativni i kvalitativni rezultati ukazuju da ove sorte imaju potencijale za gajenje u agroklimatskim uslovima Bosne i Hercegovine i po nekim parametrima su bolje u odnosu na standarnu sortu Stuttgarter.

- Prinosi crnog luka su bili visoko značajno viši 2012. godine i to kod sorte Konjički za 34%, a za 27% kod Zeničkog i za 30 % kod Konjičkog u 2013. godini u odnosu na standardnu sortu Stuttgarter.
- U 2013. godini su prinosi lukovica bili viši za 15 % u odnosu na 2012. godinu.
- Sadržaja suhe materije u uzorcima lukovica ispitivanih sorata se kretao od 14,04 do 15,88 %.
- Ispitivane sorte u ovim istraživanjima su sa uočljivo nižim sadržajem bjelančevina (oko 1,50%) u odnosu na standard (oko 1,60%).
- Po sadržaju ukupnih šećera, sve ispitivane sorte crnog luka, u uslovima uzgoja u Bosni i Hercegovini, su sa izrazito niskim sadržajem ovih nutrijenata (8,20 do 10,98 %).

Literatura

Agencija za statistiku Bosne i Hercegovine. (2012). *Zasijana površina, požnjevena površina i proizvodnja po usjevima* (Godina VII, Broj 3, strana 2). Sarajevo: Agencija za statistiku Bosne i Hercegovine.

Cota, J., Gvozdanovic-Varga, Jelica, Hadžic, Azra, Petrovic, Anamarija, Saric, Edita, Savic, Aleksandra & Cota, Jelena (2013). *Yield and mineral composition of two new onion varieties from Bosnia and Herzegovina*. IV International Symposium „Agrosym 2013. (pp. 251-256). DOI: 10.7251/AGSY1303251C.

Gvozdanović-Varga, Jelica, Takač, A., Vasić, Mirjana, Panajotović, J. & Červenski, J. (1996). Characters of bulbs of diferent onion populations (*Allium cepa* L.). *Genetika, 28*(2), 85-89.

Gvozdanović-Varga, J., Lazić, B., Vasić, M. & Červenski, J. (2005). Evaluation of onion (Allium cepa L.) genotypes. *Natura Monte-negrina,* (4), 113-120.

Lazić, B., Urovka, M., Marković, V. i Ilin, Ž. (2001). *Povrtarstvo (Drugo izdanje).* Poljoprivredni fakultet u Novom Sadu.

USDA (July 2003). *National Nutrient Database for Standard Reference, Release* 16. USDA

Primljeno: 21. marta 2014.
Odobreno: 5. juna 2014.

Quantitative and Qualitative Characteristics of New Onion Varieties

Josip Ćota[1], Azra Hadžić[2], Jelena Ćota[3], Milana Šilj[4]

[1]*Federal Institute for Agriculture, Sarajevo, Bosnia and Herzegovina*
[2]*Faculty of Educational Sciences*, *University of Sarajevo*, *Bosnia and Herzegovina*
[3]*Faculty of Pharmacy, University of Belgrade, Serbia*
[4]*Faculty of Agriculture, University of East Sarajevo, Bosnia and Herzegovina*

Abstract

The aim of this paper is to present the characteristics of new varieties of the onion (Zenički and Konjički), created in the Federal Institute for Agriculture Sarajevo and their suitability for cultivation in Bosnia and Herzegovina. The tests were carried out in two years (2012 and 2013) at the site Butmir (Sarajevo). The experiments were conducted in a randomized block system in five repetitions. The examination included the following productive traits of the onion: yield and length of the growing season. Within the qualitative characteristics, the contents of dry matters, sugars and proteins were determined in the bulb. The variety Stuttgarter was used as a standard. The new varieties are distinguished by the length of the growing period of 114-115 days. The variety Zenički has achieved a higher yield of bulbs for 17%, while Konjički for 31%, comparing to Stuttgarter. The yields of bulbs in 2013 were higher by 15% comparing to 2012. These varieties are characterized by high quality, because the dry matter content is from 13.8 to 15.88%, total sugars from 8.20 to 10.98%, and proteins from 1.50 to 1.70%, with slightly spicy taste and well wrapped bulb.

Key words: Zenički, Konjički, yield, quality

Josip Ćota
E-mail address:j.cota@fzzp.com.ba

Received: March 21, 2014
Accepted: June 5, 2014

Originalan naučni rad
Original scientific paper
UDK: 635.262:[631.54:582.573.16]
DOI: 10.7251/AGRSR1401075M

University of Banjaluka, Faculty of Agriculture
Agro-knowledge Journal

Uticaj gustine useva na produktivnost fotosinteze i prinos belog luka proletnjaka

Đorđe Moravčević[1], Jelica Gvozdanović Varga[2], Anamarija Stojanović[2], Damir Beatović[1], Vida Todorović[3], Nenad Pavlović[4]

[1]*Poljoprivredni fakultet, Univerzitet u Beogradu, Republika Srbija*
[2]*Institut za ratarstvo i povrtarstvo, Novi Sad, Republika Srbija*
[3]*Poljoprivredni fakultet, Univerzitet u Banjoj Luci, Bosna i Hercegovina*
[4]*Institut za povrtarstvo, Smederevska Palanka, Republika Srbija*

Sažetak

Beli luk je ispitan u poljskim ogledima koji su izvedeni u centralnom delu Srbije (Beograd). Ispitan je beli luk proletnjak. Postavljen je cilj da se ispita uticaj gustine useva na produktivnost fotosinteze (LAR-Leaf Area Ratio, NAR- Net Assimilation Rate) i prinos belog luka. Ispitivanjima su bile obuhvaćene sledeće gustine useva: 300 (G1), 450 (G2), 600 (G3), 750 (G4) i 900 (G5) hiljada biljaka ha^{-1}. Beli luk je ostvarivao bolje rezultate u gušćim usevima. Na to jasno ukazuje prinos koji je beli luk ostvarivao u ogledima. Prosečne vrednosti prinosa kreću se u rasponu od 5,6 (G1) do 12,5 t ha^{-1} (G5). Rezultati pokazuju da beli luk treba gajiti u usevima veće gustine.

Ključne reči: Allium sativum, gustina useva, LAR, NAR, prinos

Uvod

Fotosinteza je biohemijski proces u kome nastaju složena organska jedinjenja (šećeri, skrob, vitamini). Karakteristike fotosinteze zavise od raznih faktora biotičke i abiotičke prirode. Najvažniji abiotički faktori su svetlost, temperatura, voda i CO_2. Za fotosintezu je neophodna i mineralna

ishrana. Od biotičkih faktora treba istaći koncentraciju hlorofila, veličinu lisne površine, te starost i položaj listova na biljci. Veliki značaj ima i genotip. Fotosinteza se određuje na razne načine. Najlakše se određuje tako da se na kraju vegetacije nekog useva izmeri (odredi) prinos suve materije. Međutim, mnogo je realnije da se određuje preko priraštaja suve materije po jedinici lisne površine u jedinici vremena (Net Assimilation Rate ili NAR). Fotosinteza se može određivati i preko odnosa koji postoji između površine lista jedne biljke i mase suve materije cele biljke (Leaf Area Ratio ili LAR), kao i na druge načine. Na fotosintezu treba uticati, a cilj je da ona ostvaruje visoke vrednosti. Time se utiče i na prinos, koji se formira od produkata fotosinteze. U prinos se ugrađuje i do 90% fotosintetskih produkata. Produktivnost fotosinteze belog luka maksimalne vrednosti dostiže 90 dana posle sadnje čenova (Kastori, 1989; Halan et al., 1990; Ledesma et al., 1997).

Gustina useva je veoma važan faktor u biljnoj proizvodnji. Biljke se normalno razvijaju samo u usevima odgovarajuće gustine. Smanjivanje gustine useva pozitivno utiče na veličinu i kvalitet lukovica, a negativno utiče na prinos belog luka (Moravčević et al., 2011). Različiti autori navode kod belog luka kao optimalne gustine one od 300 hiljada (Lewis et al., 1995), oko 600 hiljada (Kilgori et al., 2007), pa čak i od 2 milona biljaka ha^{-1} (Ahmad & Iqubal, 2002).

Cilj ovih ispitivanja je da se prošire naučna saznanja o uticaju gustine useva na fotosintezu i prinos belog luka u uslovima kontinentalne klime gde su prosečni prinosi belog luka proletnjaka jako niski (2-4 t ha^{-1}).

Materijal i metode rada

Beli luk (*Allium sativum*) je ispitivan na oglednom dobru Poljoprivrednog fakulteta Univerziteta u Beogradu (Radmilovac, Srbija). Korišćen je metod poljskih ogleda. Ispitivanja su trajala dve godine (2007. i 2008). Ogledi su postavljeni po slučajnom blok-sistemu u četiri ponavljanja. Veličina elementarne parcelice iznosila je 4 m^2 (2x2 m).

Zemljište, na kojem je beli luk ispitivan, je u tipu gajnjače, sledećih hemijskih osobina: pH-5.60 (KCl), sadržaj humusa 2,51 %, ukupnog azota – 0,11 %, fosfora 11,9 mg i kalijuma - 21,2 mg u 100 g zemljišta. Osnovna, jesenja, obrada zemljišta (oranje) izvođena je na dubinu od 30cm. Neposredno pred postavljanje ogleda (sredina marta) izvršena je predsetvena obrada zemljišta i startno đubrenje (400 kg ha^{-1}, 15:15:15). Sadnja belog luka izvođena je tokom marta, u obe ispitivane godine (24. i

23). Luk je sađen na međuredni razmak koji je bio konstantan (25 cm), dok je razmak između čenova (biljaka) varirao i kretao se od 4,4 do 13,3 cm. Tako su dobijene gustine useva od: 300 (G1), 450 (G2), 600 (G3), 750 (G4) i 900 (G5) hiljada biljaka ha^{-1}. Korišćena je sorta belog luka proletnjaka „piros“ (Institut za povrtarstvo, Smederevska Palanka). Svi radovi oko ogleda izvođeni su ručno.

Merenje belog luka započeto je 40 dana posle sadnje i vršeno je svakog desetog dana (dekadno). Luk je meren 8 puta u toku ispitivanja. Određivani su sledeći parametri: LAR (relativna lisna površina), NAR (neto produktivnost fotosinteze) i prinos lukovica.

Za određivanje LAR i NAR korišćeni su sledeći postupci (Kastori, 1989): LAR=A/W, [cm^2 g^{-1}]; A- površina lista po biljci [cm^2], W – masa suve materije po biljci (bez korena), [g]; NAR=1/A x (W_2-W_1)/T_2-T_1, [g m^{-2} d^{-1}]; A - površina lista po biljci [m^2], W_1 - ukupna suva masa biljke u vremenu T_1 [g], W_2 - ukupna suva masa biljke u vremenu T_2 [g], T (T_2-T_1) - interval između dva merenja [dan].

Berba belog luka, u obe ispitivane godine, obavljana je u julu (22. i 29), kada je zapaženo da su lažna stabla potpuno omekšala, a biljke još nisu počele masovno da polažu. Nakon sušenja lukovice su odvajane od nadzemnog dela biljke i merene. Prinos je izražen u t ha^{-1}. Padavine i temperature za vreme izvođenja ogleda prikazane su u Tabeli 1.

Tab. 1. Srednje mesečne temperature i padavine
Mean monthly temperature and monthly rainfall

Mesec *Month*	Temperatura [ºC], *Temperature*			Padavine [mm], *Rainfall*		
	2007	2008	1982-2011	2007	2008	1982-2011
Mart *(March)*	9,3	9,1	6,8	93,3	75,5	43,9
April *(April)*	12,8	13,5	12,3	1,0	27,3	50,0
Maj *(May)*	18,3	18,3	17,3	96,1	14,8	59,7
Jun *(June)*	22,2	22,3	20,2	114,7	62,5	90,8
Jul *(July)*	23,5	22,4	22,0	17,2	56,8	68,4
Prosek/Suma *Mean/Sum*	17,2	17,1	15,7	64,5 / 322,3	47,4 / 236,9	62,6 / 312,8

Rezultati su statistički obrađeni po modelu jedno i dvofaktorijalne analize varijanse (ANOVA) i LSD testa na dva nivoa značajnosti ($p<0.05$ i $p<0.01$). Jednogodišnji rezultati su prikazani tabelarno, a dvogodišnji grafički (Excel 2007, DSAASTAT).

Rezultati i diskusija

Relativna lisna površina (LAR)

Najveće prosečne vrednosti LAR je ostvarivao u periodu od I do III merenja belog luka, kada su one bile i veoma ujednačene (Graf. 1). Navedene vrednosti variraju od 55,4 do 56,6 $cm^2 g^{-1}$. U narednih 20 dana (III-V merenja) usledilo je naglo smanjivanje LAR, kada se on smanjio na 30,3 $cm^2 g^{-1}$. U periodu koji je trajao od VI do VIII merenja LAR se i dalje smanjivao, ali znatno sporije. Na kraju je dostigao prosečnu vrednost na svim gustinama koja iznosi 15,3 $cm^2 g^{-1}$.

Tab. 2. Relativna lisna površina u 2007. godini [$cm^2 g^{-1}$]
Leaf Area Ratio in 2007[$cm^2 g^{-1}$]

Gustina (A) [biljaka ha^{-1}] *Density*	Merenje (B) *Measurement*								Prosek *Average*
	I	II	III	IV	V	VI	VII	VIII	
300.000 (G1)	59,0	53,7	38,1	31,4	14,4	14,7	12,7	5,9	28,7
450.000 (G2)	74,0	44,9	47,3	34,0	22,7	17,5	11,4	6,2	32,2
600.000 (G3)	80,8	59,9	50,2	39,6	23,7	18,4	12,2	6,7	36,4
750.000 (G4)	66,8	66,9	50,7	36,3	21,7	16,2	10,7	5,2	34,3
900.000 (G5)	69,5	65,4	72,2	37,3	21,1	17,2	11,0	6,2	37,5
Prosek / *Average*	70,0	58,2	51,7	35,7	20,7	16,8	11,6	6,0	33,8

LSD	A	B	A x B
0.05	3,9	5,0	11,1
0,01	5,2	6,6	14,8

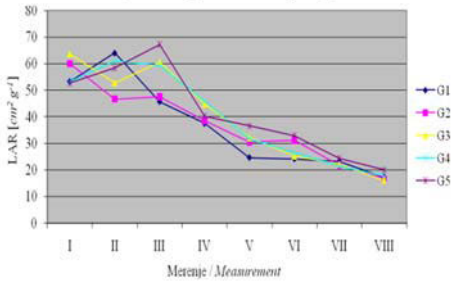
LAR se ovako ponašao i po godinama ispitivanja, ali su postojale i određene specifičnosti (Tabela 2 i 3). U 2007. godini LAR se intenzivnije smanjivao u toku vegetacije belog luka. Specifičnost je i to da je gustina useva različito uticala na ponašanje LAR. U 2007. godini uticaj gustine na LAR ispoljavao se do VI merenja, dok se u 2008. godini ispoljavao do kraja vegetacije. Gušći usevi su u celini pokazivali stimulativniji uticaj na posmatrani parametar.

Tab. 3. Relativna lisna površina u 2008. godini [$cm^2\ g^{-1}$]
Leaf Area Ratio in 2008 [$cm^2\ g^{-1}$]

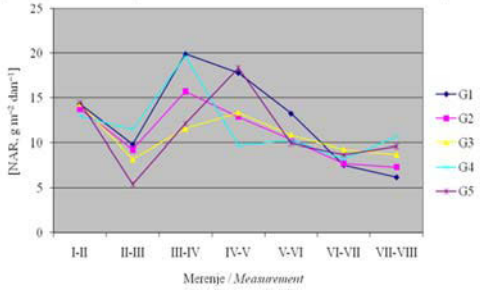
Gustina (A) [biljaka ha^{-1}] *Density*	Merenje (B) *Measurement*								Prosek *Average*
	I	II	III	IV	V	VI	VII	VIII	
300.000 (G1)	47,8	67,5	53,4	43,6	33,6	30,2	28,8	23,8	41,1
450.000 (G2)	46,1	46,2	45,2	42,9	36,4	42,8	31,8	23,5	39,4
600.000 (G3)	46,8	45,8	71,0	47,3	38,7	32,0	31,7	20,1	41,6
750.000 (G4)	39,8	55,4	68,3	55,5	37,8	34,9	29,7	23,9	43,2
900.000 (G5)	35,9	48,5	62,2	43,3	51,8	48,8	37,1	31,8	44,9
Prosek / *Average*	43,2	52,7	60,0	46,5	39,6	37,7	31,8	24,6	42,0

LSD	A	B	A x B
0.05	5,9	7,4	16,6
0,01	7,7	9,8	21,9

LAR je dostizao veće vrednosti u periodu koji je prethodio formiranju lukovice, a koji je obeležen intenzivnim formiranjem lisnog aparata (površina lista). Sa pojavom lukovice započeto je brzo nagomilavanje suve materije u belom luku, što je uticalo da vrednosti LAR postanu manje. LAR se objektivnije pokazao u 2007. godini, koja se odlikovala veoma povoljnim uslovima za razvoj belog luka, naročito u pogledu padavina. U 2008. godini vladali su sušni uslovi i visoke temperature vazduha, pa se beli luk nije prirodno ponašao kao u prethodnoj godini. To je doprinelo da LAR ostvaruje ujednačene vrednosti tokom cele vegetacije, što se razlikuje od opšte tendencije za ponašanje posmatranog parametra (Stahlschmidt et al., 1997).



Graf. 1 LAR (2-godišnji prosek)
Leaf Area Ratio (two-year means)



Graf. 2 NAR (2-godišnji prosek)
Net Assimilation Rate (two-year means)

Neto produktivnost fotosinteze (NAR)

Najveće vrednosti NAR je ostvarivao u intervalima III-IV, IV-V i I-II. Karakterističan je interval II-III kada je NAR dostizao relativno male

vrednosti. Posebno je karakterističan interval V-VI u kome je NAR počeo trajno da se smanjuje (Graf. 2).

Tab. 4. Neto produktivnost fotosinteze u 2007. godini [g m^{-2} dan^{-1}]
Net Assimilation Rate in 2007 [g m^{-2} dan^{-1}]

Gustina (A) [biljaka ha^{-1}] *Density*	Merenje (B) *Measurement*							Prosek *Average*
	I-II	II-III	III-IV	IV-V	V-VI	VI-VII	VII-VIII	
300.000 (G1)	20,1	12,7	27,3	24,6	21,0	9,8	9,5	17,8
450.000 (G2)	17,5	14,2	21,7	14,9	15,0	11,4	8,4	14,7
600.000 (G3)	19,2	10,5	15,1	19,6	15,3	15,3	9,5	14,9
750.000 (G4)	14,9	15,2	30,4	12,3	16,6	14,5	15,7	17,1
900.000 (G5)	16,9	6,9	12,4	30,0	16,6	14,7	15,6	16,2
Prosek / *Average*	17,7	11,9	21,4	20,3	16,9	13,1	11,7	16,1

LSD	A	B	A x B
0.05	5,7	6,8	15,2
0,01	7,6	9,0	20,1

To se naročito ispoljilo u 2007. godini, dok je u 2008. godini pokazao određeno kolebanje (Tabela 4 i 5). NAR je izrazito veće vrednosti ostvarivao u 2007. godini, u kojoj je stizao do 21,4 g m^{-2} dan^{-1} (interval III-IV). U 2008. godini nije prelazio 10,3 g m^{-2} dan^{-1} (interval I-II). Gustina useva je ograničeno uticala na NAR. U stvari, uticaj gustine javljao se samo u 2007. godini i to u određenom delu vegetacije belog luka (intervali II-III i III-IV). Gušći usevi su u proseku povoljnije uticali na NAR.

Tab. 5. Neto produktivnost fotosinteze u 2008. godini [g m^{-2} dan^{-1}]
Net Assimilation Rate in 2008 [g m^{-2} dan^{-1}]

Gustina (A) [biljaka ha^{-1}] *Density*	Merenje (B) *Measurement*							Prosek *Average*
	I-II	II-III	III-IV	IV-V	V-VI	VI-VII	VII-VIII	
300.000 (G1)	8,6	6,9	12,6	11,1	5,6	5,4	3,0	7,6
450.000 (G2)	10,0	4,3	9,7	10,8	5,7	4,1	6,2	7,3
600.000 (G3)	9,5	5,9	8,1	7,1	6,4	3,2	7,9	6,9
750.000 (G4)	11,1	7,8	9,0	7,1	4,0	2,0	5,6	6,7
900.000 (G5)	12,1	3,8	11,8	6,8	3,2	2,6	3,6	6,3
Prosek / *Average*	10,3	5,7	10,2	8,6	5,0	3,5	5,3	6,9

LSD	A	B	A x B
0,05	3,1	3,7	8,3
0,01	4,2	4,9	11,0

Za beli luk je karakteristično da NAR najveće vrednosti dostiže oko tri meseca posle zasnivanja useva (Halan et al., 1990; Ledesma et al., 1997). U našim ispitivanjima to se ispoljilo nešto ranije, čemu je doprinela sorta (domaća) i lokalni ekološki uslovi. Slabije ispoljavanje NAR u intervalu II-III je normalna reakcija belog luka, koji u tom delu vegetacije pokazuje velike vrednosti za površinu lista, a za suvu materiju je obrnuto (parametri od kojih zavisi NAR). Beli luk je imao povoljnije uslove za svoj razvoj u 2007. godini, što je uticalo da se NAR jače ispolji u toj godini. Takvi uslovi su doprineli da se ispolji određeni uticaj gustine useva na beli luk, što nije došlo do izražaja u 2008. godini.

Prinos lukovica

Najveća prosečna vrednost za prinos iznosi 12,5 t ha^{-1}. Navedenu vrednost prinos je ostvario u najgušćem usevu (G5). U najređem usevu (G1) prinos je dostigao samo 5,6 t ha^{-1}. Ostale vrednosti za prinos kreću se od 7,4 t ha^{-1} (G2) do 10,4 t ha^{-1} (G4). Posmatrani parametar dostizao je znatno veće vrednosti u 2007. godini, u kojoj je ostvaren apsolutni maksimum u ovim ispitivanjima. Radi se o maksimumu koji iznosi 15,5 t ha^{-1}, a ostvaren je u najgušćem usevu. Najmanji prinos ima vrednost koja iznosi 6,6 t ha^{-1} i dobijena je u najređem usevu. Prinos se tako ispoljio i u 2008. godini, ali je dostizao znatno manje vrednosti. Gustina useva je značajno uticala na visinu prinosa, a karakter tog uticaja je bio isti u obe godine ispitivanja. U stvari, povećanje gustine za po 300 hiljada biljaka ha^{-1} uvek je ostvarivalo značajan ili vrlo značajan uticaj na prinos, što nije slučaj sa povećanjem gustine za po 150 hiljada biljaka ha^{-1} (susedne varijante). Ukupni prosek za prinos iznosi 9 t ha^{-1}.

Tab. 6. Prinos lukovica [t ha^{-1}]
Bulb yield [t ha^{-1}]

Gustina (A) [biljaka ha^{-1}] *Density*		2007	2008	Prosek *Average*
300.000 (G1)		6,6	4,6	5,6
450.000 (G2)		8,3	6,5	7,4
600.000 (G3)		10,8	7,7	9,2
750.000 (G4)		12,5	8,3	10,4
900.000 (G5)		15,5	9,4	12,5
Prosek / *Average*		10,7	7,3	9,0
LSD	0,05	1,9	1,6	1,2
	0,01	2,6	2,3	1,6

Beli luk nije izrazito reagovao na povećavanje gustine za po 150 hiljada biljaka ha^{-1} (kako je to bilo u ogledu), pa se može konstatovati da ova vrsta povrća ne ispoljava veliku osetljivost na gustinu useva. To je u najužoj vezi sa morfološkim karakteristikama belog luka (uski i uspravni listovi, niske biljke). Navedene karakteristike pružaju mogućnost da beli luk dobro podnosi uslove koji vladaju u gustim usevima, što se pozitivno projektuje na prinos. Ne postoji univerzalna gustina za proizvodnju posmatranog luka, jer ona ne utiče samostalno na razvoj useva, već utiče interaktivno sa drugim faktorima (zemljište, klima, agrotehnika). Ovakve konstatacije za gustinu useva ističu i drugi autori (Haque et al., 2002; Cortes et al., 2003; Gvozdanović-Varga, 2005).

Zaključak

U konkretnim uslovima (centralna Srbija) beli luk proletnjak treba proizvoditi u gustim usevima. U gustinama većim od 600 hiljada biljaka ha^{-1} ostvaruju se značajno veći prinosi po jedinici površine. Ukoliko je beli luk namenjen industrijskoj preradi ili farmaciji, takve gustine su za preporuku. Beli luk za svežu potrošnju, gde se zahteva krupnija lukovica, treba gajiti u gustinama manjim od gore pomenute.

Napomena

Rad predstavlja deo istraživanja na projektu pod nazivom "Stvaranje sorata i hibrida povrća za gajenje na otvorenom polju i u zaštićenom prostoru" (Ministarstvo prosvete i nauke Republike Srbije, TR 31030).

Literatura

Ahmad, S. & Iqbal, J. (2002). Optimizing Plant Density Cum Weed Control Method For Puccinial Rust Management and Yield in Garlic. *Asian Journal of Plant Sciences*, *1*(2), 97-198.

Cortes, C.F., Olalla, F.M.S. & Urrea, R.L. (2003). Production of garlic (*Allium sativum* L.) under controlled deficit irrigation in a semi-arid climate. *Agricultural Water Management, 59*, 155-167.

Gvozdanović-Varga Jelica (2005). *Analiza stabilnosti komponenata prinosa prolećnog belog luka (Allium sativum* L.*)* (Doktorska diser-

tacija). Poljoprivredni fakultet Univerziteta u Novom Sadu, Novi Sad, Srbija.

Halan Shoba, Arumugam, R. & Halan, S. (1990). Physiology of growth and development of garlic (*Allium sativum* L.). *South-Indian-Horticulture 38*(6), 323-328.

Haque, S., Sattar, A. & Pramanik, H.R. (2002). Land Configuration and Varietal Effect on Yield Contributing Traits and Yield of Garlic. *Pak J Biol Sci, 5*(10), 1024-1027.

Kastori, R. (1989). *Fiziologija biljaka*. Novi Sad: Matica srpska.

Kilgori, M.J., Magaji, M.D. & Yakubu, A.I. (2007). Effect of Plant Spacing and Date of Planting on Yield of Two Garlic (*Allium sativum* L.) Cultivars in Sokoto, Nigeria. *American-Eurasian J. Agric.& Environ. Sci., 2*(2), 153-157.

Ledesma, A., Nunez, S.B., Arguello, J.A., Burba, J.L. & Galmarini, C.R. (1997). Bulbing physiology in garlic (*Allium sativum* L.) cv. Rosado Paraguayo. Characterization of ontogenic stages by shoot growth dynamics and its relation to bulbing. *Acta Horticulturae, 433,* 405-416.

Lewis, L.A., Ojeda, D.L., Salazar, M.O. & Campbell, R.J. (1995). Effect of population density on growth, development and yield of garlic (*Allium sativum* L.) cv. *Vietnamita*. *Proceedings of the Interamerican Society for Tropical Horticulture*, *39*(6), 23-26.

Moravčević, Đ., Bjelić, V., Moravčević, M., Gvozdanović Varga, J., Beatović, D. & Jelačić, S. (2011). Effect of plant density on the bulb quality and spring garlic yield (A. *sativum* L.). *Proceedings of the Interamerican Society for Tropical Horticulture, 39*(6), 23-26.

Stahlschmidt, O., Cavagnaro, J.B., Borgo, R., Burba, J.L. & Galmarini, C.R. (1997). Growth analysis of three garlic (*A. sativum* L.) cultivars with differences in yield. *Acta Horticulturae, 433*, 27-434.

Primljeno: 23. aprila 2014.
Odobreno: 1. jula 2014.

Effect of Plant Density on Photosynthesis Productivity and Yield of Spring Garlic

Đorđe Moravčević[1], Jelica Gvozdanović Varga[2], Anamarija Stojanović[2], Damir Beatović[1], Vida Todorović[3], Nenad Pavlović[4]

[1] Faculty of Agriculture, University of Belgrade, Republic of Serbia
[2]Institute of Field and Vegetable Crops, Novi Sad, Republic of Serbia
[3]Faculty of Agriculture, University of Banja Luka, Republic of Srpska
[4]Institute of Vegetable Crops, Smederevska Palanka, Republic of Serbia

Abstract

Garlic was examined in field experiments conducted in central Serbia (Belgrade). Spring garlic was examined. The objective was to examine the effect of plant density on photosynthesis productivity (LAR-Leaf Area Ratio, NAR- Net Assimilation Rate) and the yield of garlic. The analysis involved the following plant densities: 300 (G1), 450 (G2), 600 (G3), 750 (G4) and 900 (G5) thousand plants ha^{-1}. The garlic exhibited better results in denser crop establishment. It is clearly indicated by the yield of garlic attained in the experiments. Average yield rates range from 5.6 (G1) to 12.5 t ha^{-1} (G5). The results demonstrate that the garlic should be grown in high density establishment.

Key words: Allium sativum, plant density, LAR, NAR, yield

Đorđe Moravčević
E-mail address:djordjemor@agrif.bg.ac.rs

Received: April 23, 2014
Accepted: July 1, 2014

Originalan naučni rad
Original scientific paper
UDK: 633.31:631.52
DOI: 10.7251/AGRSR1401085B

University of Banjaluka, Faculty of Agriculture
Agro-knowledge Journal

Uticaj međurednog rastojanja na prinos, komponente prinosa i kvalitet semena lucerke

Dragoljub Beković[1], Rade Stanisavljević[2], Milan Biberdžić[1], Slaviša Stojković[1], Jasmina Knežević[1]

[1]*Poljoprivredni fakultet – Kosovska Mitrovica – Lešak, Univerzitet u Prištini, Srbija*
[2]*Institut za zaštitu bilja i životnu sredinu, Beograd, Srbija*

Sažetak

U agroekološkim uslovima južne Srbije izvršena su istraživanja radi utvrđivanja uticaja međurednog rastojanja na prinos, komponente prinosa i kvalitet semena lucerke sorte K-23. Najviši prosečan prinos semena ostvaren je na međurednom rastojanju od 40 cm (271,7 kg ha^{-1}), zatim pri rastojanju od 20 cm (249,4 kg ha^{-1}), a najniži pri rastojanju od 60 cm (244,0 kg ha^{-1}). Najviše cvasti ostvareno je setvom na rastojanju od 60 cm (13,37 cvasti/stabljici), a najmanje pri rastojanju od 20 cm (8,57 cvasti/stabljici). Međuredno rastojanje od 60 cm uslovilo je najviše mahuna po cvasti (7,15), dok je najmanje mahuna (5,50) bilo pri rastojanju od 20 cm. Broj zrna po mahuni se kretao od 3,55 (rastojanje od 20 cm) do 4,05 (međuredno rastojanje od 60 cm). Najbolji kvalitet semena ostvaren je setvom na međurednom rastojanju od 60 cm. Najviša masa 1000 semena ostvarena je pri setvi na rastojanju od 60 cm, a najniža na 20 cm (2,07, odnosno 1,97 g). Najviša klijavost semena ostvarena je pri rastojanju od 60 cm (88,00%), a najniža pri rastojanju od 20 cm (85,76 %).

Ključne reči: cvasti, mahune, masa 1000 semena, klijavost

Uvod

Lucerka je vrsta koja se odlikuje visokim genetskim potencijalom za prinos krme, što je često u negativnoj korelaciji sa prinosom semena. Odlikuje se bujnim vegetativnim rastom, visokim udelom lista u prinosu nadzemne biomase i tankim nežnim stabljikama koje lako poležu. Zbog ovih osobina, prinos semena lucerke je pod velikim uticajem ekoloških činilaca i značajno varira u zavisnosti od vremenskih uslova u toku godine, više nego kod drugih biljnih vrsta. Osnovna karakteristika proizvodnje semena lucerke u Srbiji je izuzetno veliko variranje visine prinosa u zavisnosti od vremenskih uslova godine. Tako prinos semena u nepovoljnoj godini može biti i 10 puta manji nego u povoljnoj. Upravo zbog izraženog variranja visine prinosa semena u Srbiji ne postoje specijalizovani usevi za proizvodnju semena jer je rizik od gubitka prihoda u nepovoljnim godinama vrlo veliki. Umesto toga, proizvodnja semena se odvija na usevima kombinovane namene (proizvodnja krme i semena). Na ovakvim usevima prvi i treći otkos se koriste za proizvodnju krme, dok se seme proizvodi iz drugog otkosa. U godinama sa većom količinom padavina, proizvođači odustaju od proizvodnje semena, i prihod ostvaruju samo proizvodnjom krme i na taj način smanjuju rizik proizvodnje (Karagić i Katić, 2012).

Značajan uticaj na visinu prinosa semena, pored klimatskih činilaca ima međuredno rastojanje, odnosno optimalan broj biljaka po jedinici površine. Prema brojnim istraživanjima visoki prinosi i kvalitet semena lucerke dobija se setvom lucerke u šire redove i sa manjim količinama semena (Erić, 1988; Lukić, 2000; Beković, 2005; Stanisavljević, 2006 i drugi). Međutim, širokoredni usev sa manjom količinom semena ne obezbeđuje uvek viši prinos semena u odnosu na uskoredni usev sa međurednim rastojanjem manjim od 25 cm i većim količinama semena, kao što se koristi za proizvodnju kabaste stočne hrane (Lovato and Montanari, 1991; Vučković, 1994 i drugi).

Kvalitet semena lucerke uslovljen je prvenstveno biologijom ove vrste, ali i nizom drugih faktora, prvenstveno spoljašnjih. Način i gustina setve utiču na kvalitet semena lucerke više nego što je to slučaj kod drugih biljaka. Postoji veliko variranje u pogledu kvaliteta semena lucerke u zavisnosti od izbora otkosa za seme, načina setve, količine semena i godine proizvodnje. Setvom lucerke na većim međurednim rastojanjima redovno se dobija seme boljeg kvaliteta, prvenstveno sa većom masom 1000 semena i klijavošću (Erić,1988; Vučković, 1994; Stanisavljević, 2006). Ekološki uslovi značajno utiču na kvalitet semena lucerke pa je klijavost

semena znatno niža u godini sa više padavina u odnosu na suvu, toplu i sunčanu godinu (Vučković, 1994; Karagić, 2004).

Imajući u vidu značaj proizvodnje kvalitetnog semena lucerke, cilj ovih istraživanja je bio da se u agroekološkim uslovima niškog regiona ispita uticaj međurednog rastojanja i uslova uspevanja na prinos, komponente prinosa i kvalitet semena lucerke što bi predstavljalo značajan doprinos unapređenju gajenja ove krmne biljke.

Materijal i metode rada

Radi ostvarivanja postavljenih ciljeva izvršena su trogodišnja eksprimentalna istraživanja na lokaciji „Ledena stena“ u predgrađu Niša. Kao materijal je poslužila sorta lucerke K-23 nastala u Institutu za krmno bilje u Kruševcu. Odlikuje se razgranatim stabljikama dobro obraslim lišćem i brzom regeneracijom nakon košenja. Otporna je na poleganje i prema važnijim bolestima. Visokoprinosna je sorta; sa 4-5 košenja daje godišnje do 20 t ha^{-1} suve materije. Prosečan sadržaj sirovih proteina u suvoj materiji kreće se od 18 % do 20 %. Lucerka je sejana polovinom aprila, na tri međuredna rastojanja, i to 20 cm, 40 cm i 60 cm. Ogled je postavljen po slučajnom blok sistemu u 4 ponavljanja.Veličina osnovne parcele za rastojanje od 20 cm bila je 5 m^2, za rastojanje od 40 cm 6 m^2, a za međuredno rastojanje od 60 cm 9 m^2. Zemljište na kome su obavljena istraživanja pripada tipu aluvijum. U godini zasnivanja useva za ispitivanje prinosa i komponenti prinosa semena lucerke korišćen je prvi porast, a u drugoj i trećoj godini drugi porast.

Na osnovu višegodišnjih podataka, područje Niša se odlikuje dugim sušnim letnjim periodom, koji se proteže kroz sve letnje mesece. Međutim, tokom 2005. godine veća količina i povoljniji raspored padavina uslovili su ravnomerno i ujednačeno klijanje i nicanje useva lucerke (tab. 1). U toku 2006. godine zabeležena je nešto veća količina padavina posebno tokomu avgusta, što je uticalo na sazrevanje semena lucerke, otežanu žetvu pa i gubitke prinosa semena. Najpovoljniji uslovi za proizvodnju semena lucerke bili su tokom 2007. godine koju je karakterisao duži sušni period u toku celog leta (tab.1).

Tab.1. Srednje mesečne temperature (°C) i mesečne sume padavina (mm) – Niš 2005-2007.
Mean monthly temperatures (°C) and total precipitation (mm)- Niš 2005-2007

Godina *Year*	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	I-XII Prosek/ suma *Aver./ Amount*
Temperature – (°C) –*Temperatures*													
2005	0,8	-1,7	5,1	11,8	16,8	19,0	22,3	20,5	17,9	12,3	5,7	3,5	10,9
2006	-1,5	1,2	6,3	13,3	17,0	20,0	22,9	21,2	18,3	14,0	6,7	2,4	11,8
2007	5,4	6,6	10,0	13,3	18,8	23,6	26,2	24,6	16,1	11,6	4,6	0,8	13,5
Količina padavina-(mm)- *Amount of precipitation*													
2005	49,2	60,8	69,5	89,0	103,6	50,8	44,8	85,0	21,1	38,3	42,5	76,4	731
2006	34,0	56,6	85,7	62,6	39,2	67,8	30,9	111,7	15,7	37,2	27,8	51,2	620
2007	29,0	35,9	26,2	16,4	66,5	13,9	7,7	32,2	58,6	131,7	117,3	24,8	550,2

Prinos semena lucerke utvrđivan je u fazi kada je 70- 80% mahuna bilo mrke boje. Broj cvasti po stabljici je utvrđen nakon uzimanja uzorka od 30 stabljika po ponavljanju. Broj cvetova po cvasti i mahuna/cvasti je utvđivan na uzorku od po 30 dobro razvijenih cvasti ravnomerno sa vršnih, središnih i donjih delova stabljike sa svakog ponavljanja. Broj semena po mahuni utvrđen je brojanjem 30 slučajno odabranih mahuna sa svakog ponavljanja. Masa 1000 semena (g) određivana je brojanjem i merenjem 8 puta po 100 semena za svaku varijantu. Klijavost semena (%) je utvrđivana u laboratorijskim uslovima naklijavanjem u petri kutijama na filter papiru pri temperaturi od 20°C, brojanjem klijavih semena nakon 10 dana. Dobijeni rezultati su obrađeni metodom analize varijanse (ANOVA), a značajnosti između dobijenih vrednosti utvrđene su LSD testom.

Rezultati i diskusija

Na osnovu trogodišnjih rezultata u ovim istraživanjima, najviši prinos semena lucerke je ostvaren pri međurednom rastojanju od 40 cm (271,7 kg ha^{-1}), a najniži pri rastojanju od 60 cm (244,0 kg ha^{-1}), dok je setvom na rastojanju od 20 cm ostvaren prinos od 249,4 kg ha^{-1} (tab. 2).

Tab. 2. Prinos semena, komponente prinosa i kvalitet semena lucerke
Seed yield, yield components and seed quality of alfalfa

Godina *Year*	Međur. rastoj. *Row spacing*	Prinos semena kg ha^{-1} *Seed yield kg ha^{-1}*	Komponente prinosa *Yield components*			Kvalitet semena *Seed quality*	
			Cvasti/stabljici *Inflor. per stem*	Mahuna/ cvasti *Pods per inflores-cence*	Sem./ mahuni *Grains per pod*	Masa 1000 sem. *1000-seed weight* (g)	Klijav. *Shoot. potential* %
2005 (A_0)	20 cm	147,8	7,16	4,25	3,36	2,01	90,55
	40 cm	133,1	8,47	6,05	3,60	2,13	92,25
	60 cm	140,4	9,12	5,75	3,55	2,15	92,50
Pros-*Aver.*		140,1	8,25	5,35	3,59	2,09	91,77
LSD 0.05		17,78	0,56	0,32	0,19	0,038	1,56
0.01		23,65	0,75	0,42	0,25	0,050	2,07
2006 (A_1)	20 cm	210,7	9,34	5,40	3,45	2,01	86,75
	40 cm	245,8	16,27	6,12	3,80	2,05	89,25
	60 cm	239,7	16,75	6,35	4,05	2,08	90,25
Pros-*Aver.*		232,1	14,12	5,78	3,76	2,05	88,75
LSD 0.05		21,15	1,18	0,34	0,25	0,036	1,44
0.01		28,13	1,57	0,46	0,33	0,048	1,90
2007 (A_2)	20 cm	389,7	9,22	6,86	3,85	1,90	80,00
	40 cm	436,2	13,61	8,58	4,25	1,94	80,25
	60 cm	351,8	14,25	9,35	4,55	1,98	81,25
Pros-*Aver.*		392,6	12,36	8,26	4,22	1,94	80,50
LSD 0.05		26,33	0,94	0,55	0,29	0,030	1,66
0.01		35,02	1,25	0,73	0,38	0,039	2,21
Prosek	20 cm	249,4	8,57	5,50	3,55	1,97	85,76
Average	40 cm	271,7	12,78	6,92	3,88	2,00	87,25
2005-2007	60 cm	244,0	13,37	7,15	4,05	2,07	88,00

Posmatrano po godinama, zapaža se da je u 2005. godini, tj. u godini zasnivanja lucerišta (A_0) ostvaren prosečan prinos od 140,5 kg ha^{-1}, koji se može smatrati zadovoljavajućim. U drugoj godini istraživanja odnosno u prvoj godini punog iskorišćavanja (A_1) prosečan prinos je bio 230,8 kg ha^{-1} što je na nivou republičkog proseka, dok je najviši prinos ostvaren u trećoj godini istraživanja tj. u drugoj godini punog iskorišćavanja (A_2) i iznosio je prosečno 403,7 kg ha^{-1}. Rezultate slične ovima navodi Erić (1988) koji ističe da se najviši prinosi semena ostvaruju pri setvi na rastojanju od 30 cm i 40 cm (251,4 kg ha^{-1}, odnosno 221,2 kg ha^{-1}), dok je niži prinos semena ostvaren sa daljim povećanjem međurednog rastojanja na 50 cm (194,6 kg ha^{-1}). Askarian et *al.* (1995) navode da se najviši prinos semena dobija pri setvi na rastojanju od 45 cm (177,0 kg ha^{-1}), te da prinos opada sa povećanjem međurednog rastojanja na 60 cm (149,0 kg ha^{-1}), ali i sa smanjenjem rastojanja na 30 cm, odnosno 15cm

(166,0 kg ha^{-1} odnosno 136,0 kg ha^{-1}). Slično ovome, Stanisavljević i saradnici (2007) u uslovima istočne Srbije su najviše prinose semena ostvarili pri srednjoj gustini useva (343,6 kg ha^{1}) dok je sa smanjenjem i povećanjem međurednog rastojanja prinos opadao.

Najviše cvasti/stabljici ostvareno je pri najvećem međurednom rastojanju (13,37 cvasti/stabljici) a najmanje na rastojanju od 20 cm (8,57 cvasti/stabljici). Posmatrano po godinama, najviše cvasti/stabljici bilo je 2006 godine (14,12 cvasti/stabljici), najmanje u godini zasnivanja (8,25 cvasti/stabljici), dok je u 2007. godini ostvareno prosečno 12,36 cvasti/stabljici (tab.2). Broj mahuna/cvasti se kretao od 5,50 koliko je bilo pri setvi na međurednom rastojanju od 20 cm, do 7,15 mahuna/cvasti (međuredno rastojanje od 60 cm). Posmatrano po godinama, najveći broj mahuna/cvasti zabeležen je u 2007. godini (8,26 mahuna/cvasti), koja je okarakterisana kao najpogodnija za proizvodnju semena, a najmanji u 2005. godini (5,35 mahuna/cvasti). Najviše semena/mahuni ostvareno je setvom na međurednom rastojanju od 60 cm (4,05 semena/mahuni), a najmanje na rastojanju od 20 cm (3,55 semena/mahuni). U 2007. godini je ostvareno najviše semena/mahuni (4,22 semena/mahuni), dok je najmanje semena/mahuni bilo 2005. godine (3,50 semena/mahuni). Karagić (2004) navodi da je u drugoj i trećoj godini života lucerke bilo prosečno 9,66 cvasti po izdanku, 9,03 mahuna/cvasti i 5,47 semena/mahuni. Prema Ilićevoj (2005) broj cvetova/cvasti za 17 ispitivanih genotipova je bio prosečno 14,0 cvasti/stabljici, dok Đurović i sar. (2007) za 5 ispitivanih genotipova navode prosek od 9,37 cvasti/stabljici, 7,31 mahuna/cvasti i 5,53 semena/mahuni.

Masa 1000 semena je značajna komponenta kvaliteta semena, jer ukazuje na krupnoću i nalivenost semena. Najviša prosečna masa 1000 semena ostvarena je pri međurednom rastojanju od 60 cm (2,07g), a najniža (1,97 g) pri rastojanju od 20 cm (tab. 2) U prvoj godini istraživanja ostvarena je najviša masa 1000 semena (2,09 g), a najniža u trećoj godini (1,94 g). Da se pri većim međurednim rastojanjima dobija seme sa većom masom potvrđuju i rezultati koje su dobili Erić (1988), Lovato i Montanari (1991), Vučković (1994), Askarian et al. (1995) i drugi.

Najviša prosečna klijavost semena ostvarena je pri međurednom rastojanju od 60 cm (90,5%) a najniža pri rastojanju od 20 cm (88,0%). Posmatrano po godinama najviša klijavost je ostvarena je u 2005. godini (91,77 %), a najniža u 2007. godini (80,5%). Na variranje klijavosti semena usled ekoloških uslova ukazuju i rezultati koje iznose Kostić (1996), Katić i sar. (1999), Jevtić (2001), Karagić (2004) i drugi.

Zaključak

Na osnovu izvršenih trogodišnjih istraživanja može se zaključiti sledeće:

Međuredno rastojanje je značajno uslovilo visinu prinosa semena koja se kretala od 244,0 kg ha^{-1} (međuredno rastojanje od 60cm) do 271,7 kg ha^{-1} (međuredno rastojanje od 60cm). Posmatrano po godinama prinos semena se kretao od 140,5 kg ha^{-1} u godini zasnivanja do 392,6 kg ha^{-1} u trećoj godini istraživanja.

Najveći broj cvasti po stabljici (13,37) ostvaren je pri međurednom rastojanju od 60 cm, a najniži (8,57) pri rastojanju od 20 cm.

Najviše mahuna po cvasti i zrna po mahuni ostvareno je takođe pri rastojanju od 60 cm (7,15 odnosno 4,05), a najmanje pri rastojanju od 20 cm (5,50 odnosno 3,55).

Najveća prosečna masa 1000 semena ostvarena je pri međurednom rastojanju od 60 cm (2,07 g), a najniža (1,97 g) pri rastojanju od 20 cm. Ekološki uslovi uticali da se masa 1000 semena kretala od 1,94 g u trećoj do 2,09 g u godini zasnivanja.

Prosečna klijavost semena se kretala od 91,77 % u prvoj do 80,50 % u trećoj godini istraživanja. Pri međurednom rastojanju od 60 cm, prosečna klijavost semena je bila 88,00% dok je sa smanjenjem međurednog rastojanja klijavost semena opadala do 85,76% (međuredno rastojanje od 20cm), što ukazuje na značajan uticaj ovog faktora na klijavost semena.

Napomena

Ova istraživanja obavljena su kao deo projekta TR 31016 „Unapređenje tehnologije gajenja krmnih biljaka na oranicama i travnjacima“ koje finansira Ministarstvo prosvete i nauke Republike Srbije.

Literatura

Ascarian, M., Hempton, J.G., & Hill, M. J. (1995). Effect of row spacing and sowing rate on seed production of lucerne (*Medicago sativa* L.) cv Grasslands Oranga. *New Zealand Journal of Agricultural Research*, *38*, 289-296.

Beković, D. (2005). *Uticaj ekoloških uslova i načina setve na prinos i kvalitet semena i krme lucerke (Medicago sativa* L.*)* (Doktorska disertacija). Poljoprivredni fakultet Lešak, Univerzitet u Prištini.

Đurović, D., Stevović, V., Đukić, D., Petkova, D. i Madić, M. (2007). Prinos i komponente prinosa semena genotipova lucerke. *Zbornik radova Instituta za ratarsvo i povrtarstvo Novi Sad*, *44*(1), 151-157.

Erić, P. (1988). *Uticaj načina i gustine setve na prinos i kvalitet semena lucerke (Medicago sativa* (L) *em Wass.) sorte "NS Banat ZMS II" na zemljištu tipa cernozem* (Doktorska disertacija). Poljoprivredni fakultet Univerziteta u Novom Sadu.

Ilić, O. (2005). *Geneticka varijabilnost fertilnosti lucerke u uslovima slobodne oplodnje* (Magistarska teza). Poljoprivredni fakultet Univerziteta u Novom Sadu.

Jevtić, G., Radović Jasmina i Lugić, Z. (2001). Uticaj medonosne pčele (*Apis mellifera* L.) na prinos i komponente prinosa semena. *Arhiv za poljoprivredne nauke, 62*(220), 45-52.

Karagić, Đ. (2004). *Komponente prinosa, prinos i kvalitet semena u zavisnosti od sistema kosidbe* (Doktorska disertacija). Poljoprivredni fakultet Univerziteta u Novom Sadu.

Karagić, Đ. i Katić, S. (2012). Proizvodnja semena višegodišnjih krmnih mahunarki. U: Đukić D. i Stevović V. (ur.), *Oplemenjivanje krmnih biljaka i proizvodnja stočne hrane na oranicama.* Univerzitet u Kragujevcu, Agronomski fakultet Čačak, 109-138.

Katić, S., Mihajlović, V., Karagić Đ.,Vujaković, M. i Pataki, I. (1999). Biološke i tehnološke
osobine semena lucerke. *Selekcija i semenarstvo, 6*(3-4*)*, 45-50.

Kostić, Ž. (1996). Uticaj ekoloških uslova na prinos i kvalitet semena ucerke. *Selekcija i Semenarstvo,* (1-2), 84-86.

Lovato, A., & Montanari, M. (1991). Influence of Row Spacing and Sowing Rates on Lucerne (*Medicago sativa* L.) Seed Production. *Rivista di agronomia*, *25*(4), 78-81.

Lukić, D. (2000). *Lucerka*. Naučni institut za ratarstvo i povrtarstvo Novi Sad.

Stanisavljević, R. (2006). *Uticaj gustine useva na prinos i kvalitet krme i semena lucerke* (*Medicago sativa* L.*)* (Doktorska disertacija). Poljoprivredni fakultet Univerziteta u Novom Sadu.

Stanisavljević, R., Djukić, D., Milenković, J., Jevtić, G., Beković, D. i Terzić, D. (2007). Prinos i komponente prinosa semena u zavisnosti od gustine useva. *Zbornik radova Instituta za ratarsvo i povrtarstvo Novi Sad, 44*(1), 107-114.

Vučković, S. (1994). *Uticaj načina setve i đubrenja borom i cinkom na prinos i kvalitet semena* (Doktorska disertacija). Poljoprivredni fakultet Univerziteta u Beogradu.

Primljeno: 23. marta 2014.
Odobreno: 9. jula 2014.

Effect of Row Spacing on Seed Yield, Yield Components and Seed Quality of Alfalfa

Dragoljub Beković[1], Rade Stanisavljević[2], Milan Biberdžić[1], Slaviša Stojković[1], Jasmina Knežević[1]

[1]Faculty of Agriculture - Kosovska Mitrovica - Lešak, University of Priština, Serbia
[2] Institute for Plant Protection and Environment, Belgrade, Serbia

Abstract

Under agro-environmental conditions of Southern Serbia, the research was conducted over a three-year period to evaluate the effect of row spacing on seed yield, yield components and seed quality of alfalfa *cv.* 'K-23'. The average seed yield of alfalfa was highest at a row spacing of 40 cm (271.7 kg ha^{-1}), followed by row spacing of 20 cm (249.4 kg ha^{-1}) and 60 cm (244.0 kg ha^{-1}). The highest and lowest number of inflorescences per stem were obtained in rows spaced 60 cm (13.37 inflorescences/stem) and 20 cm apart (8.57 inflorescences/stem), respectively. The widest row spacing of 60 cm (7.15 pods / inflorescence) resulted in the highest number of pods per inflorescence, whereas the lowest number was produced at 20 cm spacing (5.50 pods / inflorescence). Grain number per

pod ranged from 3.55 (at 20 cm row spacing) to 4.05 (at 60 cm). The highest quality of alfalfa seed during the three years of the research was obtained at the widest row spacing (60 cm). Thousand-seed weight was highest at 60 cm and lowest at 20 cm (1.97 g and 2.07 g, respectively). The highest average values for seed germination rate were reported for 60 cm row spacing (88.00%) and the lowest for 20 cm row spacing (85.76 %).

Key words: inflorescences, pods, 1000 seed weight, germination rate

Dragoljub Beković
E-mail address: dragoljub_bekovic@yahoo.com

Received: March 23, 2014
Accepted: July 9, 2014

Professional paper
Stručni rad
UDK: 634.5-154.1
DOI: 10.7251/AGREN1401095G

University of Banjaluka, Faculty of Agriculture
Agro-knowledge Journal

State-of-the-art and Problems of Walnut Propagation Methods

Stefan Gandev[1]

[1]*Fruit-Growing Institute, Plovdiv, Bulgaria*

Abstract

At present budding and grafting are the most widely used approaches in the production of grafted walnut trees. Poor callus formation in walnut makes it difficult to propagate. Walnut propagation by cuttings is a method difficult to be realized. The presence of high concentration of phenolic compounds in its tissue and their oxidation, is the major reason of using micropropagation as a suitable method. The most commonly used technique is patch budding. Other used methods are bench grafting and hot callus. In the last years hot callus as a technique has been successfully used for propagation of walnut cultivars, but the height of the trees is not enough at the end of the season. A new walnut propagation method is called epicotyl grafting. All the methods of walnut propagation are discussed in the present paper.

Key words: Juglans regia L., budding, scion grafting

Introduction

The high protein and fat content in walnut kernels makes them an essential food for the people. That is why walnut is a strategic species for human nutrition and it was included in the list of FAO as a priority crop to be grown (Gandev, 2007). That necessitates the propagation of only those cultivars that possess good biological and economic properties. Due to heterozygosity of walnut, its propagation by seeds does not result in the inheritance of the characteristics of the chosen cultivar (Sharma et al.,

2003). What is more, seed-propagated trees start bearing fruit later. Those disadvantages could be overcome by vegetative propagation, which, unfortunately, is a difficult process due to the poor callus formation in that fruit species (Kuniyuki and Forde, 1985; Coggeshall and Beineke, 1997).

Analysis

Propagation by budding and scion grafting

At present ***budding*** and ***scion grafting*** are the most popular grafting methods in the production of walnut trees. In walnut, budding is basically carried out by the method of **patch *budding***. That is among the oldest and the most popular techniques of walnut propagation in a nursery in the open (Kuniyuki and Forde, 1985), adapted in our country (Nedev, 1967). The efficiency of that grafting method is different in the separate countries (Nedev et al., 1976; Ozkan et al., 2001). Solar et al. (2001) announced that in Slovenia the success rate of the *patch budding* method applied in walnut propagation is only 16%. In Turkey it is 88.3%, 72.5% in the spring of the following year and 41.25% before taking out the trees from the nursery (Ozkan et al., 2001). Probably the success in that case depends on the climatic conditions in the countries where applied. Winter frosts and spring late frosts reduce the percentage of the tree survival rate, but they are not the only limiting factors. Air temperature after grafting is also important. According to Lagerstedt and Roberts (1972) grafting in the open could be unsuccessful due to low temperatures after grafting, which make difficult or compromise good callus formation. Gandev and Dzhuvinov (2006) established that when growing walnut in the open under the conditions of South Bulgaria, temperature variation during days and nights decreases the percentage of the survival rate. That is the reason why the great difference between the day and night temperatures in the West European countries makes the survival of grafted tree difficult in the open.

The major walnut grafting method in Bulgaria is ***patch budding***. Non-stratified seeds are sown at a depth of 8-12 cm from the middle of November to the first decade of December. During vegetation soil is maintained free of weeds by applying herbicides and by tilling and earthing up the plants in order to form a thinner and tender soil crust at the grafting place. The aim is that the rootstocks reach a minimum thickness of 12 mm at the place of grafting. Hardwood cuttings are used, not less

than 12-14 mm thick. The best time for grafting in the climatic conditions of Bulgaria is from 20 August to 5 September. Grafting is performed at 5-10 cm above the soil surface, using a double knife. One month later the bandage is removed. In the second half of November the patch is covered with 20-30 cm of soil in order to protect the buds from winter cold. In spring (in March) the rootstocks are uncovered and the rootstock is cut off above the grafted bud. Soil is maintained free of weeds to enable the rapid growth of the grafted buds. The ready planting material is taken out after leaf fall.

The disadvantages of that method are: the short period suitable for carrying out the grafting and the dependence on the climatic conditions. In some years the winter cold, the excessive soil moisture during the stage of winter dormancy and the early autumn and late spring frosts could compromise the production of grafted planting material to 100%.

Chip budding is another method of walnut propagation in the open. In the climatic conditions of the high himalaya, chandel et al. (2006) announced that the optimal time for grafting is the middle of may till the first week of june and for patch budding – from the middle till the end of june. Grafting is carried out on annual rootstocks (*j. Regia* l.) With buds collected in the same season. In the time mentioned the survival rate is 89.0% for chip budding and about 50.0% for patch budding. Data about the conditions in turkey are controversial. A survival rate of only 13% was reported for chip buding and 43% for patch budding (polat and ördek, 2006).

According to achim and botu (2001), under the climatic conditions of the carpathian region in romania, chip budding could be performed in the open from 15 may till 15 june, using buds collected during the winter dormancy stage of the trees and stored in a refrigerator at a temperature of 1-4°c. Rootstock age and the time of their cutting off after grafting exert an effect on the survival rate. Using common walnut rootstocks (*j. Regia* l.), planted early in spring, forced and grafted in the same year in the period mentioned above, results in a survival rate of 78.0%. When using rootstocks planted in the previous year and grafted in the period mentioned, the survival rate decreases to 40.0%. In both cases, cutting off the rootstocks immediately after grafting leads to a decreased percentage of survival. That is why the rootstocks should be cut off 15 days after grafting. In Romania that method should be applied under controlled temperature in winter months.

Under the climatic conditions of Poland, Porebski (1994) also found out that summer chip budding is risky and it is possible to be used only in seasons when the average daily temperature is not lower than 18ºC.

Chip budding could be performed not only during vegetation, but also in winter months during tree dormancy, however the grafted plants should be kept under controlled temperature. In such cases the patch budding method is not very suitable due to the difficult separating of the bud from the scion (Bayazit et al., 2005). That problem does not exist in the chip budding method. Özkan and Gümüs (2001) applied chip budding to one-year old rootstocks in January, February and March. The grafted plants were put in wooden containers and covered with wet sawdust at a temperature of 27°C for 25 days. In that trial the highest survival rate percentage was obtained in Tokat cultivar in March – 53.0% versus the survival rate of 50.0% in September. The careful analysis shows that the authors calculated the percentage of the survived plants in September on the basis of the successfully propagated plants in March. We think that a clearer picture of the efficiency of that method would be obtained if calculation is done by taking into consideration all the grafted plants. After re-calculating, the method shows an efficiency from 16.0% to 26.0% for the studied cultivars and grafting time, which, in our opinion, is not an efficient method to use. A similar survival rate (26.9%) was reported by Porebski et al. (2002) after winter application of the chip budding method. According to them, the percentage of the plant survival rate could be increased if the rootstocks are forced and if they are in full vegetation at the time of winter grafting. Applying that practice, the authors obtained 81.9% of successfully propagated plants in March.

In Bulgaria the chip budding method is not recommended neither during the dormancy period under controlled temperature, nor during vegetation under natural conditions, due to the unsatisfactory results (Gandev, unpublished data).

Scion grafting of walnut under natural climatic conditions resulted in a worse result compared to most fruit species. In Turkey Demiroren and Buyukyilmaz (1988) obtained 20% of successfully propagated plants after ***cleft grafting*** and improved copulation. The results of Barut (2001) after ***splice grafting*** were similar, i.e. – from 20% to 33% survival rate.

Bark grafting is another approach for walnut propagation by scion grafting. 80% of successfully propagated plants were obtained under the warm conditions of South Africa (Rotondo Walnuts, 2004). The method is

not recommended for industrial-scale production, because rootstocks need to be grown for about 3-4 years before reaching the necessary thickness of 30 mm to 100 mm (Reil et al., 1998; Hartmann et al., 2002).

Due to the above mentioned disadvantages, *scion grafting* is applied in practice basically when walnut is propagated *indoors* (under controlled temperature). According to the different technologies, temperature, humidity, the grafting method and time of grafting are controlled, to provide permanent temperature necessary for the callus formation process.

It is well known that temperature has a definite effect on callus formation in fruit plants, the temperature values varying for the different species (Hartmann et al., 2002). As early as the beginning of the 30s last century, Sitton (1931) established that the optimal temperature for callus formation in walnut is 27°C. Later studies of Rongting and Pinghai (1993) and Reil et al. (1998) showed that the optimal temperature is from 26°C to 27°C, however 22°C is also favourable for the process (Rongting and Pinghai, 1993), while callus formation in walnut is unsatisfactory at temperatures below 20°C (Reil et al., 1998; Hartmann et al., 2002).

Temperatures have an effect on the amount of the callus tissue, as well as on the speed of callus formation. At a temperature of 22°C callus formation begins on the 6th day after grafting, while at 27°C the process starts on the 5th day. When the temperature increases up to 32°C, callus formation begins in 4 days only but at that temperature, less callus tissue is produced (Rongting and Pinghai, 1993).

The temperature of 27°C (± 2°C) has been adopted as a standard used by a large number of researchers and producers of planting material from around the world in their trials to carry out successful walnut grafting under controlled temperature (Zachej, 1976; Lagerstedt, 1981b; Millikan, 1984; Avanzato and Tamponi, 1988; Tsurkan, 1990; Avanzato and Atefi, 1997; Stanisavljević and Mitrović, 1997; Achim and Botu, 2001; Solar et al., 2001; Porebski et al., 2002; Avanzato et al, 2006; Erdogan, 2006; Vahdati & Zareie, 2006).

There is not a common opinion worldwide on the choice of a certain grafting method. *Improved copulation* (Radicati and Me, 1986; Lantos, 1990; Stanisavljević and Mitrović, 1997; Achim and Botu, 2001; Erdogan, 2006; Muzaffar and Kumar, 2011), *cleft grafting* (Pathak and Srivastava, 1975; Gautam, 1990; Atefi, 1997; Qian and Qian, 2000; Achim and Botu, 2001), *omega type grafting* (Lagerstedt, 1982; Ferhatoğlu, 1997; Solar et al., 2001; Dehgan et al., 2010) and *side grafting* (Germain et al., 1999) are all used. In previous studies of Gandev (2007,

2008 and 2009) it was found out that *cleft grafting* results in obtaining a high percentage of successfully propagated plants.

Along with the method chosen, the heating period is also important for the grafting success. There are announcements (Pieniazek, 1972; Avanzato and Atefi, 1997; Özkan and Gümüs, 2001; Karadeniz, 2003, Vahdati and Zareie, 2006; Erdogan, 2006), that the period of heating necessary for good callus production varies from 21 to 33 days. According to Cerny (1965), when the period is shorter than 14 days, the produced callus is insufficient for the good development of the propagated plants.

Studying the phenolic content of walnut, Pinghai and Rongting (1993b) mentioned that the amount of yuglon is different in the studied cultivars and according to Solar et al. (2006) it varies in the different seasons. They admitted that the high content of yuglon is the reason for poorer callus formation. In later studies, Karadeniz and Kazankaya (1997) confirmed those results and they established a reverse correlation between the callus formation process and the content of phenols in nine walnut cultivars. Lantos (1990) reported from 56% to 71% of survival rate after grafting of three cultivars; Stanisavljević and Mitrović (1997) – from 55% to 93% in a study with seven cultivars, while the results of Erdogan (2006) varied for the same cultivars, tested in two consecutive years. According to a number of authors (Pieniazek, 1972; Farmer, 1973; Lagerstedt, 1979; Atefi, 1997; Erdogan, 2006) callus formation in the grafted plants is cultivar specific, however it also depends on air humidity, which should be about 80% (Ferhatoğlu, 1997; Stansavljević and Mitrović, 1997; Germain et al., 1999; Achim and Botu, 2001; Özkan and Gümüs, 2001; Solar et al., 2001). Optimal time for ***scion budding*** is during winter dormancy of both the rootstock and the scion (Lagerstedt, 1979, 1982; Hartmann et al., 2002) and grafting could be carried out at the beginning, in the middle or at the end of the dormancy period. The results of the conducted investigations are controversial. In the US Lagerstedt (1982) recommended to carry out scion budding in the middle of the winter dormancy, i.e. from the middle of December to the middle of January and not in February and March. In the climatic conditions of Israel, Ebadi et al. (2002) obtained a significantly higher percentage of survival when grafting was conducted in December, not in January. Also in Iran, Vahdati and Zareie (2006) preferred to carry out grafting in March, i.e. at the end of the dormancy period, just like Ferhatoğlu (1997) and Erdogan (2006) in Turkey. Our data (FAO project, 2002-2004) showed that *scion budding* in March resulted in successful walnut propagation during the period of winter dormancy.

Various scion budding technologies have been applied indoors in many parts of the world. The most popular and widely used technology for callus formation in walnut is putting the grafted plants in wooden containers and placing them in a room with controlled temperature (Nedev et al., 1983). Throughout the world that propagation method is known as ***bench grafting***. The authors Sen (1986), Kantarci (1989), Tsurkan (1990), Flores et al. (1995) underlined the following advantages of *bench grafting* over *patch* and *chip budding:*

- The period suitable for grafting is extended and a larger number of plants could be produced;
- Grafting is carried out in winter, i.e. in a season of less agricultural work;
- Bench grafting could be mechanized, thus the amount will be increased and the production costs will be reduced.

In Bulgaria *bench grafting* was studied by Anadoliev (1983). One-year old seedlings grown in the open should be used as rootstocks. Scions are collected during the winter dormancy of the mother plants. Grafting is performed by the method of improved copulation from the first decade of February till the middle of March. After grafting the scions are dipped in paraffin at the place of grafting and put in containers. The plant roots are covered with sawdust mixed with perlite at equal amounts. The ready containers are put in a room where the temperature of 26-27°C is maintained for 3-4 weeks. The successfully grafted plants are adapted and planted in the open, in the fields.

Tsurkan (1990) reported that following that technology, he obtained a considerably lower percentage of successfully propagated plants – from 5% to 45% – explaining that the variation in the survival rate depended on the method of grafting. According to Özkan and Gümüs (2001) the percentage varied within 33% – 53% for the separate cultivars. Terziev (personal correspondence) obtained about 40% plants with callus formation in three consecutive years.

Another method of walnut propagation is ***hipocotyl grafting*** (Frutos, 1995; Avanzato, 2001). In the recent years the method gained greater importance (Vahdati and Zareie, 2006; Gandev and Dzhuvinov, 2006; Gandev, 2008). Potted seedling rootstocks are used in that method. Grafting is carried out during the vegetation period. The growing tip of the rootstock is cut off and a growing tip from the propagated cultivar is grafted. The pot is firmly covered with a plastic bag in order to provide high air humidity, necessary for callus formation. Then the plant is placed

for 4 weeks in a greenhouse at a temperature of 26°C (± 1°C). The successfully propagated plants are put for adaptation in a shaded place for 2-3 weeks, after which are taken in the open. Gandev and Dzhuvinov (2006) reported that they obtained 83% of survival rate by that grafting method.

The ***hot callus*** method was described in details by Lagerstedt (1981a, 1981b, 1982, 1983, 1984). Using a heating cable, a temperature of 26°C (± 2°C) is maintained at the place of grafting. The one-year old rootstocks are taken out of the soil, grafted on and put horizontally over the heating source, covering their roots with sawdust. The positive results obtained by Erdogan (2006) who used electric heating cable, confirmed the method efficiency. Avanzato and Atefi (1997) and Avanzato (1999) developed an alternative approach for heating the place of grafting without taking the rootstocks out of soil, using also an electric cable. In that way the stress of the rootstocks is avoided as they are not taken out of soil and the growth of the graftage after the grafting process is favoured.

In Bulgaria the method with electric heating was successfully tested and adapted by Gandev (2007, 2008, 2009). In that case a simple appliance is used in a steel-and-glass greenhouse, placing the electric cable in a groove, covering it with peat. The thermal regulator maintains the necessary temperature. The cleft grafted plants are placed horizontally, perpendicular to the groove, at a distance 10-15 cm from one another and their roots are covered with sand. The place of grafting should be just above the heating cable. The place of grafting is covered with wet foam, firmly fixed above the groove and the grafted plant in order to provide high air humidity. The scions are 12-15 cm long, with 2-3 buds. For 4 weeks high air humidity is maintained at the place of grafting and the temperature should be about 27°C (± 1°C). The plants that have formed callus are adapted and in spring they are planted in the fields. Using radioisotopes, Nacheva and Gandev (2009) studied the transport and distribution of ^{14}C-photoassimilates in walnut plants propagated by the hot callus method. It was established that there was not any negative effect on the movement of photoassimilates in the grafted plants in result of the method applied. The adapted hot callus method of walnut propagation by using an electric cable, described above, has some disadvantages, such as the big energy consumption and the risk of using electricity in humid environment.

Suk-In et al. (2006) announced that along ***hipocotyl grafting***, ***epicotyl grafting*** could also be used for walnut propagation. Taking into con-

sideration the advantages of epicotyl grafting, Gandev and Arnaudov (2011) started the first investigations on the method at the Fruit-Growing Institute – Plovdiv. Similar to the other techniques for winter scion grafting, the parameters in that method are the same: providing a temperature of about 27°C (± 1°C) and high air humidity at the place of grafting for 3-4 weeks. Some elements of the technological process, such as reaching the necessary thickness of the rootstocks before grafting and the types of scions suitable to be grafted, are still understudied.

According to Rodriquez et al. (1989) and Preece et al. (1989) walnut belongs to the group of species, difficult to be cultivated *in vitro*. Rongting and Pinghai (1993a) think that this is due to the high content of phenolic components in the plant tissue and their oxidizing after the injury. The major difficulties in walnut micropropagation are related to setting and stabilizing the tips from matured plants in *in vitro* culture, the low coefficient of multiplication, difficult root-formation, as well as the great losses during plant adaptation. The first announcements about successes in setting and stabilizing in culture are from the beginning of 90s last century (Rodriguez, 1982a,b). Later, a number of studies have been carried out, most of them being based on the nutrient medium for *in vitro* cultivation of *Juglans* spp., developed by Driver and Kuniyuki (1984). It is well known that the genetic type plays an important role at all the stages of vegetative propagation, especially at the rooting stage. In the recent years, successful examples for rooting and acclimatization of different walnut cultivars were announced (Ripetti et al., 1994 and Nacheva, 2012). Unfortunately, there are still unsolved problems in walnut micropropagation and it has not yet found industrial application in the production of walnut planting material.

Conclusion

In many countries the most commonly used technique is ***patch budding***. Other popular methods are ***bench grafting*** and ***hot callus***. In the last years hot callus method has been successfully used for propagation of walnut cultivars, but the tree height at the end of the season is unsatisfactory. The new walnut propagation method is called ***epicotyl grafting***. Depending on the climatic conditions and equipment, each of the methods could be used successfully.

References

Anadoliev, G. (1983). Razmnojavane na oreha v stratifikalnia. In Nedev, N. (Ed.), *Orehoplodni* (pp. 81-100). Plovdiv: 'Hristo G. Danov'.

Nacheva, L. (2012). *Godishen doklad na Instituta po ovoshtarstvo-Plovdiv za 2012 godina.* Instituta po ovoshtarstvo-Plovdiv

Nacheva, L. & Gandev, S (2009). Transport and distribution of ^{14}C-photo-assimilates in walnut plants grafted by the hot callus method. *Plant Science, 46*, 210-213

Nedev, N., Serafimov, S., Anadoliev, G., Kavardzhikov, L., Krinkov, H. , Radev, R., Dochev, D., Stamatov, I., Slavov, N., Vishanska, Y., Rusalimov, Z., Yovchev, I., Dzheneva, A., Lalev, N., Iliev, I. & Slavcheva, R. (1983). *Orehoplodni*. Plovdiv: 'Hristo G. Danov'.

Achim, G. & Botu, I. (2001). Results in walnut propagation by using different methods. *Acta Horticulturae, 544*, 503-509.

Atefi, J. (1997). Comparison of hypocotyl and hot callus cable graft with traditional grafting method. *Acta Horticulturae*, *442*, 309-312.

Avanzato, D. (1999). Un sistema mobile di riscaldamento locallizzato del punto d'innesto applicato in situ su semenzali di noce. *Riv. Fruttic. Ortofloric., 61*(11), 74-76.

Avanzato, D. (2001). Effect of different hygro-thermic environments on growth of potted grafted seedlinds. *Acta Horticulturae, 544*, 546-464.

Avanzato, D. & Tamponi, G. (1988). The effect of heating of walnut graft unions on graft success. *Acta Horticulturae, 277*, 79-83.

Avanzato, D. & Atefi, J. (1997). Walnut grafting by heating the graft point directly in the field. *Acta Horticulturae 442*, 291-294.

Avanzato, D., Ducci, D., Gorian, F., Gui, L., Major, A., Malvolti, E., Mezzalira, G., Pollegioni, P. & Proietti, R. (2006). Propagation ability of selected walnut hybrids (*Juglans regia* L. x *J. nigra* L.). *Acta Horticulturae, 705*, 359-364.

Barut, E. (2001). Different whip grafting methods of walnut. *Acta Horticulturae, 544*, 511-513.

Bayazit, S., Imrak, B. & Küden, A. (2005). Determination of grafting times and methods of walnut under Adana ecological conditions. *Bançe Ceviz, 34*(1), 231-234.

Cerny, L. (1965). Veredelung der walnuss und anderer holzarten in der zeit der echten winterruhe. *Biol. Plant. 7*, 226-237.

Chandel, J.S., Gautam, D.R. & Sharma, N.C. (2006). Chip budding: an excellent method of propagation of walnut (*Juglans regia L.)*. *Acta Horticulturae, 705*, 335-339.

Coggeshall, M.V. & Beineke, W.F. (1997). *Black walnut vegetative propagation: the challenge continues.* Paper presented at Proc., 5-th Black Walnut Symposium, U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. United States.

Dehgan, B., Vahdati, K., Rezaee, R. & Hassani, D. (2010). Walnut grafting success as affected by different grafting methods, cultivars and forcing treatmens. *Acta Horticulturae, 861*, 345-352.

Demiroren, S. & Buyukyilmaz, M. (1988). *Studies on propagation methods of walnut.* Paper presented at International conference of walnuts. 19-23 September 1988, Ataturk Central Horticultural Research Institute, Yalova, Turkey.

Driver, J.A. & Kuniyuki, A.H. (1984). In vitro propagation of Paradox walnut rootstock. *HortScience 19*, 507–509.

Ebadi, A., Solgi, M. & Zamani, Z. (2002). Effects of date of grafting and kind of callusing bed on grafting success of side and saddle grafting in Persian walnut (*Juglans regia* L.). *Seed Plant 18*(3), 294-305.

Erdogan, V. (2006). Use of hot callusing cable in walnut propagation. *Acta Horticulturae, 705*, 313-317.

Farmer, R.E. (1973). *Vegetative propagation: problems and prospects.* Paper presented at Black walnut symposium, 14-15 August 1973, Carbondale, Illinois.

Ferhatoğlu, Y. (1997). The studies on the effect of potting and omega grafting in relation to different time on graft taking percents of some standard walnut varieties. *Acta Horticulturae, 442*, 303-308.

Flores, P., Moyano, M. & Seta, S. (1995). Selection of the most suitable management techniques for walnut grafts in Zavalla. *Horticulturae Argentina, 14*(37), 52-54.

Frutos, D. (1995). *Walnut propagation research: Hypocotyl grafting*. FAO Report, Rome.

Gandev, S. (2007). Budding and grafting of the walnut (*Juglans regia* L.) and their effectiveness in Bulgaria. *Bulgarian Journal of Agricultural Science, 13*, 683-689.

Gandev, S. (2008). Extending the period for propagation of walnut (*Juglans regia* L.) by combining hot callusing, hypocotyl grafting and patch budding methods. *Voćarstvo, 42*, 49-53.

Gandev, S. (2009). Propagation of walnut under controlled temperature by the mehods of omega bench grafting, hot callus and epicotyl grafting. *Bulgarian Journal of Agricultural Science, 15*, 105-108.

Gandev, S. & Arnaudov, V. (2011). Propagation method of epicotyl grafting in walnut (*Juglans regia* L.) under Production Condition. *Bulgarian Journal of Agricultural Science, 17*, 173-176.

Gandev, S. & Dzhuvinov, V. (2006). Performance of hypocotyl grafting of walnut under uncontrolled temperature conditions. *Acta Horticulturae, 705*, 351-353.

Gautam, D.R. (1990). Studies on the winter and summer vegetative propagation techniques of walnut (*J. regia* L.). *Acta Horticulturae, 284*, 27-31.

Germain, E., Prunet, E.J. & Garcin, A. (1999). *Le Noyer*. Paris: Centre Technique Interprofessionnel des Fruits et Légumes Publication.

Hartmann, H.T., Kester, D.E., Davies, F.T. & Geneve, R.L. (2002). *Plant propagation: principles and practices*. New Jersey: Prentice Hall Inc.

Kantarci, M. (1989). The effect of different conditions and methods on the grafting of walnuts. *Doga Türk Tarim ve Ormancilik Dergisi, 13*(36), 1089-1095.

Karadeniz, T. (2003). Flavan content of annual shoots affects graft take success in walnut (*Juglans regia* L.). *S. Afr. J. Bot. 69*(3), 292-294.

Karadeniz, T. & Kazankaya, A. (1997). Relations between phenolic compounds and graft success in walnut. *Acta Horticulturae, 442*, 193-196.

Kuniyuki, A. & Forde, H. (1985). Walnut propagation. In Ramos, D. (Ed.), *Walnut orchard management* (pp. 38-46). Publication 21410, University of California, USA.

Lagerstedt, H.B. (1979). Propagation-Seed, Grafting, Budding. In Jaynes, R.A. (ed.), *Nut Tree Culture in North America,* (pp.240-271). USA: NNGA Broken Arrow., Road Hamden, Conn.,

Lagerstedt, H.B. (1981). A new device for hot callusing graft unions. *HortScience, 16*, 529-530.

Lagerstedt, H.B. (1982). A device for hot callusing graft unions of fruit and nut trees. *Proc. Inter. Plant. Propag. Soc.,* 31, 151-159.

Lagerstedt, H.B. (1984). Hot callusing pipe speeds up grafting. *Am. Nurseryman, 15*, 113-117.

Lagerstedt, H. B. and W. W. Roberts (1972). Walnut grafting in Oregon-problem and solutions. *Ann. Rep. NNGA,* Iova State University.

Lantos, A. (1990). Bench Grafting of walnut. *Acta Horticulturae, 284*, 53-57.

Millikan, D.F. (1984). Propagation of Juglans Species by Fall Grafting. *Ann. Report North Nut Grow Ass.,* 61, 41-44.

Muzaffar, M. & Kumar, A. (2011). Effect of different methods, time and environmental condition on grafting in walnut. *International Journal of Farm Sciences 1*(2), 17-22.

Nedev, N., Vasilev, V., Kavardzhikov, L. & Zdravkov, K. (1976). *Oreh*. Plovdiv: 'Hristo G. Danov'.

Özkan, Y., Edizer, Y. & Auca, Y. (2001). A study on propagation with patch budding of some walnut cultivars (*Juglans regia* L.). *Acta Horticulturae, 544*, 521-525.

Özkan, Y. & Gümüs, A. (2001). Effects of different applications on grafting under controlled conditions of walnut (*Juglans regia* L.). *Acta Horticulturae, 544*, 515-520.

Pathak, K. & Srivastava, R. (1975). Walnut propagation by vegetative method. *Indian Horticulture, 19*(4), 13-16.

Pinghai, D. & Rongting, Xi. (1993). Effect of phenols on the survival of walnut grafting. *Acta Horticulturae, 311*, 134-140.

Polat, A. & Ördek, G. (2006). Increasing of grafting success rate on walnut. *Acta Horticulturae, 722*, 253-256.

Porebski, S. (1994). Szczepienie orzechow wloskich. *Szkolkarstwo, 4*, 14-15.

Porebski, S., Rzeźnicka, B. & Poniedzialek, W. (2002). Comparison of two methods of walnut grafting. *J. Fruit Orn. Pl. Res. 10*, 55-62.

Preece, J.E., Van Sambeek, J.W., Huetteman, C.A. & Gaffney, G. R. (1989). *Biotechnology: in vitro studies with walnut (Juglans) species: the continuing quest for quality.* Paper presented at Proceedings of the 4th Black Walnut Symposium, Carbondale, Illinois, Walnut Council, Indianapolis.

Qian-Chun & Qian, C. (2000). Study on walnut seedling grafting techniques. *South China Fruit, 29*(6), 41-45.

Radicati, L. & Me, G. (1986). Further experiments on different grafting and budding methods of walnut in the Northern Italy. *HortScience. 21*(3), 768-772.

Reil, W.O., Leslie, C.A., Forde, H.I. & Mckenna, J.R. (1998). Propagation. In Ramos, D.E. (ed.). *Walnut production manual*. Publication 3373. University of California, Division of Agricultural and Natural Resources.

Ripetti, V., Kevers, C.L. & T. Gaspar, T. (1994). Two successive media for the rooting of walnut shoots in vitro. Changes in peroxidases activity and in ethylene production. *Adv. Hort.Sci. 8*, 29-32.

Rodriguez, R. (1982a). Callus initiation and root formation from in vitro culture of walnut cotyledons. *HortScience, 17*,195–196.
Rodriguez, R. (1982b). Stimulation of multiple shoot-bud formation in walnut seeds. *HortScience, 17*, 587-592.
Rongting, Xi & Pinghai, D. (1993). A study on the uniting processes of walnut grafting and the factor affecting. *Acta Horticulturae, 311,* 160-170.
Rotondo Walnuts (2004). *Progress report for the period June to October 2004.* Paper presented at IDC Board meeting, 25 November 2004. Rotondo Farm, Aliwal North, South Africa.
Sharma, A., Singh, S. & Srivastava, K. & Sounduri, A. (2003). Studies on success of walnut grafting as affected by time and environment. *Indian Journal of Ecology, 18*, 123-125.
Sitton, B.G. (1931). Vegetative propagation of the black walnut. *Mich. Agric. Exp. Stn. Tech. Bull.,* (119)*,* 45.
Solar, A., Colariac, M., Usenik, V. & Stampar, F. (2006). Seasonal variations of selected flavonoids, phenolic acids and quinones in annual shoots of common walnut. *Plant Science, 170*, 453–461.
Solar, A., Stampar, F., Trost, M., Barbo, J. & Avsec, S. (2001). Comparison of different propagation methods in walnut (*Juglans regia* L.) made in Slovenia. *Acta Horticulturae, 544*, 527-530.
Stanisavljević, M. & Mitrović, M. (1997). Effect of variety on successful grafting and development of nursery trees of walnut (*Juglans regia* L.). *Acta Horticulturae, 442*, 281-283.
Suk-In, H., Moon-Ho, L. & Yong-Seok, J. (2006). Study on new vegetative propagation method 'Epicotyl grafting' in walnut trees (*Juglans* Spp.). *Acta Horticulturae, 705*, 371-374.
Tsurkan, L.P. (1990). Production technology of English walnut planting materialising winter table grafting. *Acta Horticulturae, 284*, 65-68.
Vahdati, K. & Zareie, N. (2006). Evaluation of side-stub and hypocotyle grafting efficiency for walnut propagation in Iran. *Acta Horticulturae, 705*, 347-350.
Zachej, S. (1976). Determination of the optimum time for grafting walnuts with the use of heat. *Hort. Abstr,. 46*(10), 780-786.

Received: March 28, 2014
Accepted: June 23, 2014

Stanje i problemi u proizvodnji sadnog materijala oraha

Stefan Gandev[1]

[1]*Voćarski institut, Plovdiv, Bugarska*

Sažetak

Danas su okuliranje i kalemljenje kalem grančicom najčešće korišćeni pristupi u proizvodnji kalemljenog oraha. Slabo formiranje kalusa otežava razmnožavanje. Razmnožavanje reznicama je metod koji nije lako realizovati. Prisustvo visokih koncentracija fenolnih jedinjenja u tkivu i njihova oksidacija su glavni razlog za korišćenje mikropropagacije kao odgovarajuće metode. Najčešće korištena tehnika je okuliranje na prozorče. Ostale tehnike koje se koriste su kalemljenje iz ruke i stratifikovanje. Posljednjih godina se stratifikovanje kao tehnika uspješno koristi za razmnožavanje, ali visina stabla ne bude dovoljna na kraju sezone. Nova metoda razmnožavanja oraha je kalemljenje epikotila. U ovom radu se diskutuje o svim metodama razmnožavanja oraha.

Ključne riječi: Juglans regia L., okuliranje, kalemljenje na zrelo

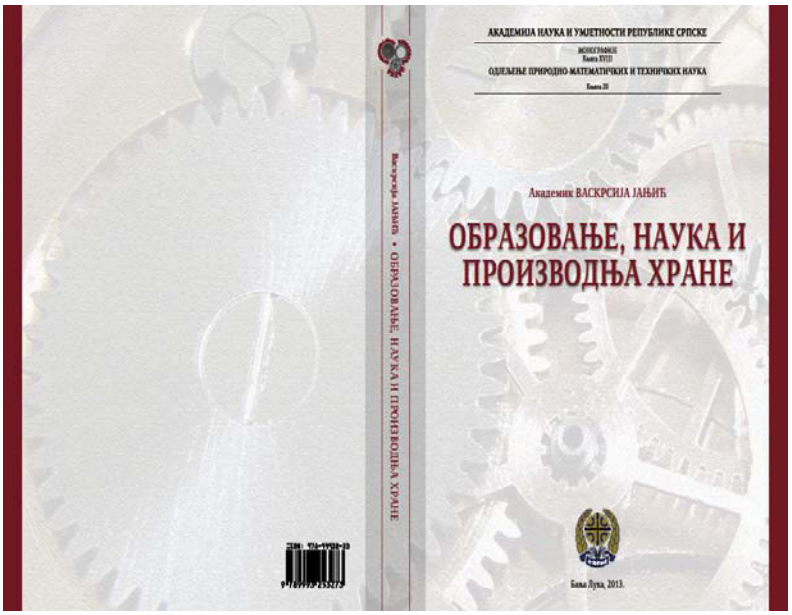
Stefan Gandev
E-mail address:s.gandev@abv.bg

Primljeno: 28. marta 2014.
Odobreno: 23. juna 2014.

Vaskrsija Janjić

Obrazovanje, nauka i proizvodnja hrane

Akademija nauka i umjetnosti Republike Srpske
Odeljenje prirodno-matematičkih i tehničkih nauka, Banja Luka, 2013, 678 str.



Ovo izuzetno monografsko delo autor je posvetio Akademiji nauka i umjetnosti Republike Srpske čiji je član, povodom obeležavanja 20 godina njenog postojanja i rada, u znak zahvalnosti za sve što je uradila za svoj narod.

Monografija je po svojoj koncepciji i sadržaju neobična, pošto se u njoj razmatraju problemi na prvi pogled tri različite oblasti: obrazovanja, nauke i proizvodnje hrane. U stvarnosti ove oblasti su usko povezane. Bez dobrog obrazovanja nema vrhunske nauke, a bez nauke uspešne proizvodnje hrane. Tako posmatrano, dolazi se do zaključka da publikacija predstavlja znalački dobro komponovanu celinu, pošto obrazovanje, nauka i proizvodnja hrane predstavljaju najznačajniji oslonac opstanka i prosperiteta svakog društva. Zahvaljujući višegodišnjem, istrajnom i uspešnom naučnoistraživačkom i pedagoškom radu kao i svestranom uvidu u najnovija zbivanja u pomenute tri oblasti, iz pera akademika V. Janjića nastalo je izuzetno delo, velike vrednosti.

Knjiga je napisana na 678 stranica komjuterski pripremljenog teksta, ima 435 tabela, 314 grafikona, 29 shema, 8 mapa i 75 slika. Posle svakog poglavlja naveden je spisak literature koji ukupno obuhvata 778 literaturnih navoda. Na kraju knjige dat je izvod publikacije na engleskom jeziku i izveštaj recenzenata. Pored autorskih publikacija, autor je obimno koristio i najnoviju statističku građu OECD, FAO, UNESCO, naših statističkih zavoda i Narodne biblioteke Srbije. Knjiga je napisana jasnim jezikom i stilom. Posebno treba istaći da je tehnička izvedba knjige na izuzetno zavidnom nivou.

Publikacija je podeljena na tri velika poglavlja. Prvo poglavlje posvećeno je obrazovanju i obuhvata osam podnaslova: Uloga i značaj obrazovanja; Kratak istorijski pregled visokog obrazovanja; Obrazovanje u Bosni i Hercegovini i Republici Srpskoj; Akademske studije u Srbiji; Ekspanzija i kvalitet visokog obrazovanja; Obrazovanje u svetu; Broj stanovnika u svetu; Metode i kriterijumi za rangiranje univerziteta u svetu; Literatura.

Zahvaljujući višegodišnjem ličnom iskustvu u obrazovanju na redovnim i poslediplomskim studijama, kao i znalačkom i sistematskom prikupljanju, proučavanju i obradi najnovijih raspoloživih podataka, autor je sa velikim uspehom svestrano pikazao i analizirao obrazovanje na različitim stupnjevima na našem prostoru i u svetu i ukazao na pravce razvoja i uticaj globalizacije na obrazovni sistem. Ovo poglavlje istovremeno predstavlja vrednu istorijsku građu obrazovnog sistema u nas.

Poglavlje koje se odnosi na nauku ima deset podnaslova: Stanje, problemi i perspektive naučnoistraživačkog rada; Stanje infrastrukture ustanova u oblasti nauke u Bosni i Hercegovini i Republici Srpskoj; Stanje i izdvajanja za nauku u Republici Srbiji; Programi za stvaranje evropskog istraživačkog prostora; Stanje istraživanja u svetu; Patenti i licence u svetu; Patenti, industrijski dizajni i žigovi u Srbiji; Vrednovanje naučnog rada; Naučni radovi i časopisi u Srbiji i zemljama u okruženju; Vrednovanje naučnih radova i časopisa u svetu iz različitih oblasti nauka; Literatura.

Nauka je veoma dinamična oblast ljudskog stvaralaštva, stoga poznavanje pravaca razvoja i prioriteta u toj oblasti je važan preduslov za uspešan, plodotvoran naučnoistraživački rad. U ovom poglavlju autor svestrano razmatra problematiku naučnog rada na našem prostoru i šire, počev od materijalnih uslova i ljudskog resursa, izbora mladih saradnika, uloge rokovodioca, planiranje u nauci, zahteve svetske nauke, perspektive daljeg razvoja nauke, svetske kriterijume vrednovanja naučnog rada i časopisa i dr. Čitajući ovo poglavlje, dolazi se do saznanja da je baviti se naukom privilegija, ali je istovremeno veoma zahtevno. Potrebna su veća

ulaganja, više truda, znalačko trasiranje razvoja nauke da bi u toj oblasti u nekom doglednom vremenu ostvarili priključak nauci razvijenog sveta.

Proizvodnja dovoljne količine zdravstveno bezbedne hrane je u globalnim razmerana najveći izazov čovečanstva. Poglavlje o proizvodnji hrane je najobimnije i obuhvata 10 podnaslova: Osnovni problemi u proizvodnji hrane u svetu; Osnovni problemi u proizvodnji hrane u Republici Srpskoj i Srbiji; Globalni značaj biljaka; Genetički modifikovane biljke; Genetički modifikovane životinje; Genetički modifikovana hrana; Osnovne karakteristike najvažnijih genetički modifikovanih biljaka; Površine na kojima se gaje genetički modifikovane biljke u svetu; Osnovne karakteristike herbicida koji se primenjuju u genetički modifikovanim usevima; Programi stvaranja i korišćenja genetski modifikovanih biljaka; Literatura.

U ovom poglavlju u uvodnom delu razmatrani su osnovni problemi proizvodnje hrane u svetu i na našem prostoru, kao i značaj biljnog sveta i čoveka u tom procesu. Najveći prostor posvećen je problematici genetički modifikovanim biljkama, njihovom stvaranju, osnovnim karakteristikama, prednostima i rizicima gajenja i rasprostranjenja. Autor ukazuje na kompleksnost ove problematike, ona je podjednako značajna kako iz zdravstveno bezbednih, tako i ekonomskih razloga. Mišljenje među naučnicima o opravdanosti gajenja genetički modifikovanih organizama su podeljenja, što ovu problematiku čini još aktuelnijom. Zahvaljujući veoma svestranom, detaljnom i znalačkom razmatranju ove problematike, čitalac može da se informiše o najnovijem stanju u ovoj oblasti i da stvori svoje sopstveno mišljenje. Genetički modifikovane biljke su stvorene pre svega zbog primene herbicida, ali ne samo zbog toga. U toj oblasti autor ove knjige ima zavidne naučne rezultate i objavljena izuzetno vredna dela.

Ova publikacija je od izuzetnog značaja ne samo za istraživače već istovremeno i za stručnjake koji se bave planiranjem, organizacijom i vrednovanjem obrazovnog i naučnog rada i regulativima u proizvodnji hrane. Za pisanje ovako obimnog, kompleksnog i multidisciplinarnog teksta potrebna je istrajnost, znanje, iskustvo i dar što krasi autora, što je i omogućilo nastajanje ove publikacije. Imajući u vidu značaj i aktuelnost problematike, sadržaj, karakter i visok naučni nivo, za očekivati je da će ovo izuzetno delo trajne vrednosti pobuditi veliko intresovanje i obogatiti naš naučni i duhovni prostor i popuniti prazninu u toj oblasti.

Akademik Rudolf Kastori

Упутство ауторима

Часопис "Агрознање" је научно-стручни часопис који објављује научне и стручне радове, који нису штампани у другим часописима. Сажеци, синопсиси, магистарски и докторски радови се не сматрају објављеним радовима, у смислу могућности штампања у часопису "Агрознање".

Категоризација радова

"Агрознање" објављује рецензиране радове сврстане у сљедеће категорије: прегледни рад, оригинални научни рад, претходно саопштење, излагање на научном или стручном скупу и стручни рад.

Прегледни рад је највиша категорија научног рада. Пишу их аутори који имају најмање десет публикованих научних радова са рецензијом у међународним или националним часописима из домена научног питања које обрађује прегледни рад, што истовремено подразумијева да су ови радови цитирани (аутоцитати) у самом раду.

Оригинални научни рад садржи необјављене научне резултате изворних научних истраживања.

Претходно саопштење садржи нове научне резултате које треба претходно објавити.

Излагање на научном и стручном скупу је изворни научни и стручни прилог необјављен у зборницима, који се може прихватити као прегледни, научни или стручни рад са обавезном назнаком на ком скупу је саопштен.

Стручни рад је прилог значајан за струку о теми коју аутор није досад објавио.

Аутор предлаже категорију рада, али коначну одлуку доноси редакција часописа на приједлог рецензената.

Припрема радова за штампање

Рад може бити написан на српском језику (ћирилично и латинично писмо) и на енглеском језику.

Обим радова треба бити ограничен на 12 страница A_4 формата за прегледни рад, а 8 страница A_4 формата за остале категорије радова. Овај број страница подразумијева и све табеле, графиконе, слике и друге прилоге, уз основни фонт текста Times New Roman, величину фонта 12 pt и проредом 1,5. Све маргине морају бити најмање 2,5 cm.

Текст прегледног рада треба да садржи поглавља: Сажетак, Увод (са прегледом литературе), Дискусија или Анализа рада, Закључак, Литература, Сажетак (преведен на српски ако је написан на енглеском и обрнуто).

Текст оригиналног научног рада треба да садржи сљедећа поглавља: Сажетак, Увод (са прегледом литературе), Материјал и методе рада, Резултати и дискусија, Закључак, Литература, Abstract (прјевод Сажетка).

Наслов рада треба бити што краћи, информативан и писан малим словима величине 14 pt, без наглашавања текста (bold, italic, underline), на средини странице. Испод наслова рада и једног празног реда писати пуно име и презиме аутора без титуле, величина 12 pt. Испод имена аутора у фонту *italic* писати назив институције-организације у којој је аутор запослен, град и земљу у којој се институција-организација налази. У овом дијелу није потребно наводити тачне адресе и поштанске бројеве.

Сажетак представља сажет приказ рада који треба да има између 50 и 150 ријечи, а пише се на језику рада. Елементи које сажетак треба да садржи у кратким цртама су: предмет истраживања, метод рада, резултати рада, идеја за ново истраживање и кратак закључак/пресјек доприноса рада.

Након сажетка, са размаком од једног реда се дају кључне ријечи (до пет укупно) у сљедећем формату: *Кључне ријечи:* кључна ријеч 1, кључна ријеч 2, ..., кључна ријеч 5. Ријечи из наслова не смију да се понављају у Кључним ријечима.

Наслови и поднаслови рада. Главни наслови у раду (наслови поглавља: Увод, Материјал и метод рада, итд.) се пишу величином фонта 13 pt, на средини странице. Између кључних ријечи и Увода су два празна реда. Поднаслови у поглављима се пишу величином фонта 12 pt, поравнати према лијевој маргини. Између наслова поглавља и текста претходног поглавља оставља се један празан ред. Сваки наслов/поднаслов и текст који га прати, између себе имају по један празан ред.

Литература се пише азбучним, односно абецедним редом (у зависности од језика и писма) са пуним подацима према АПА стандарду (види табеле иза Упутства на енглеском језику).

Abstract (пријевод Сажетка) писати на енглеском језику ако је рад на српском, и обрнуто. *Abstract,* такође, мора да садржи наслов рада, имена аутора, назив и сједиште установе-организације у којој је аутор запослен, град и земљу у којој се институција-организација налази и кључне ријечи (*све на истом језику*), а у формату који је наведен раније. Испод кључних ријечи навести име и презиме аутора задуженог за кореспонденцију и његову/њену е-маил адресу.

Табеле, графикони и слике морају бити означени бројем и да имају одговарајући назив (нпр. Таб. 1. / Граф. 1. / Сл. 1. Приказ резултата истраживања у 2011. години). Називи табела се наводе изнад табеле са лијевим поравнањем и једним празним редом између, док се називи графикона и слика наводе испод, на средини странице и једним празним редом између. Табеле, графикони и слике *не смију* излазити изван задатих маргина. У табелама избјегавати сувишне линије, бојење ћелија, подебљавање слова и сл. Графикони и слике се приказују без оквира. Сви текстуални елементи

морају бити наведени на српском и енглеском језику, са величином фонта 8 pt до 12 pt и обичним словима. Слике, шеме и сл., које се налазе у раду, морају имати резолуцију од најмање 300 dpi, а шаљу се као посебни прилози, с тим да се у самом раду поставља слика мање резолуције, како би се знао њен жељени положај и димензије.

Номенклатура и систем јединица - користите међународни систем јединица (SI). Ако се помињу и друге јединице, молим вас дајте свој еквивалент у SI. Аутори и уредник су обавезни да прихвате правила која регулишу биолошку номенклатуру, како је наведено у Међународном кодексу ботаничке номенклатуре, Међународном кодексу номенклатуре бактерија, и Међународном кодексу зоолошке номенклатуре.

Часопис "Агрознање" користи "Приручник за објављивање Америчке писихолошке асоцијације" - (APA) стил и упутства за цитирање и навођење референци.

Цитати у тексту се појављују у загради и садрже презиме аутора и годину издања, одвојене зарезом. Иза године издавања се може позвати и на број странице, а он се такође одваја зарезом.

Скраћенице је најбоље избјегавати, осим општепознатих. Сваку скраћеницу је, приликом првог навођења, потребно објаснити, тј. навести пуни назив. Скраћенице у табелама, графиконима и на сликама је потребно објаснити.

Фусноте треба избјегавати и користити их само у случају да је неопходно додатно објашњење за неки дио текста.

Напомене се наводе на крају рада, иза поглавља Закључак и обично садрже забиљешке о подршци истраживању, пројектима, и сл.

Литература се пописује на крају рада и мора да садржи све изворе који су коришћени у раду. У попис литературе се не уносе персонални документи, писма, меморандуми и неформална електронска комуникација. Навођење имена града у ком је дјело издато се изоставља уколико је име града садржано у називу издавача (нпр. Универзитет у Бањој Луци). Попис литературе се изводи азбучним, односно абецедним редослиједом у зависности од језика и писма на ком је рад написан. Уколико наводимо више радова од истог аутора, прво се наводе раније издати радови, а затим новији. Референце једног аутора које су објављене у истој години треба писати абецедним редом према насловима, нпр., (1995а), (1995б). Уколико рад нема аутора, наслов дјела или институција заузима мјесто аутора. Позивање на секундарну литературу треба избјегавати и користити само за изворе који нису доступни на уобичајени начин или нису доступни на неком од уобичајених свјетских језика. У списку референци наводи се само секундарни извор.

Примјери цитирања извора у тексту и навођења извора у попису литературе

Ови примјери имају за циљ да аутору пруже преглед система цитирања и навођња извора који се примјењује у часопису. Примјери су дати у Табели 1 (након текста Guide for Authors).

Све радове након пријема прегледају главни и технички уредник и, уколико за то постоји потреба, враћају их ауторима на корекцију. Радови који нису припремљени према Упутству за ауторе неће бити узети у даље разматрање. Након исправки, главни уредник шаље радове на рецензију, а по завршеној рецензији, ако има одређених примједби и сугестија рецензената, радови се враћају ауторима на исправку. Након урађених исправки рад се поново шаље на рецензију. Сваки рад пролази кроз двије анонимне рецензије.

Радови се достављају у електронској верзији на имејл адресу: *agroznanje@gmail.com* или путем поште на CD-у или USB-у, на адресу Пољопривредног факултета, Универзитета у Бањој Луци са назнаком: *За редакцију часописа "Агрознање"*. Радови се достављају као отворени документ сачињен у *Microsoft Word*-у (в. 97-2003 или в. 2007), у формату који је дат у Упутству ауторима и у предвиђеном року. Радови који не стигну до предвиђеног датума неће бити предати на рецензију.

Сви радови добијају УДК класификациони број и DOI број.

Сви радови подлијежу језичној лектури и техничкој коректури, те праву техничког уредника на евентуалне мање корекције у договору са аутором.

Након штампања часописа и објаве радова, сви аутори добијају рад у PDF формату путем електронске поште.

Контакт адреса редакције часописа:
Универзитет у Бањој Луци
Пољопривредни факултет (за редакцију часописа "Агрознање")
Булевар војводе Петра Бојовића 1А
78000 Бањалука
Република Српска
Босна и Херцеговина

E-mail: *agroznanje@gmail.com*

Guide for Authors

Agro-knowledge Journal is a scientific journal publishing scientific and professional papers that have not been previously published in other journals. As abstracts, synopses, masters and PhD thesis are not considered as published papers, they can be published in *Agro-knowledge Journal.*

Types (category) of papers

Agro-knowledge Journal publishes reviewed papers according to the following categories: review papers, original scientific papers, preliminary communication, scientific and expert conference papers as well as professional papers.

Review papers are written by the authors who have at least ten scientific papers published and reviewed in international and national journals dealing with the subject related to the review paper. At the same time this implies that the ten scientific papers mentioned above have to be cited in review papers.

Original scientific papers include the unpublished scientific results of an original scientific research.

Preliminary communications include new scientific results that need to be published previously.

Scientific and experts conferences papers are considered as review papers, scientific or professional papers with a special emphasis on the conference they have been expounded.

Professional papers are a significant contribution to the profession on the subject that the author has not previously published.

The author suggests the type (category) of his paper, while the final decision is made by the editorial board on the proposal of the reviewers.

Preparing papers for printing

Papers can be written in Serbian (Cyrillic and Latin alphabet) and English.

Paper length is limited to 12 pages in A4 paper for review papers. For all the other categories it is limited to 8 pages in A4 paper. This paper length includes all the tables, graphs, figures, schemes, etc. The paper should be written in 12pt, Times New Roman, 1.5 lines spacing. All the margins should be less than 2.5 cm.

Review papers should consist of the following sections: Abstract, Introduction (with Literature Review), Discussion or Analysis, Conclusion, References and Abstract (translated into Serbian if it is written in English or vice versa)

Original scientific papers should consist of the following sections: Abstract, Introduction (with Literature Review), Material and Methods, Results and Discussion, Conclusion, References and Abstract (translated into Serbian if the papers are written in English or vice versa).

The paper title should be concise, informative and written in small letters, font size 14 pt, without highlighting the text (bold, italic, underline), centered. The name and surname of the authors should be written without title of rank, in font size 12pt, centered, one empty line below the paper title. The name and address of the institution (organization) in which the respective authors are employed should be below the name of the authors, followed by the name of the city and country where the institution is placed (in *italics*). The correct address and zip code are not necessary to be given.

Abstract provides a brief description (summary) of the paper that needs to be between 50 and 150 words, written in the language of the paper. The abstract should contain the following elements: the objective (purpose) of the research, methods, results, ideas for new research and a short conclusion.

Key words (maximum 5 words), with a single space below the Abstract, are given in the following way: *Key words*: 1st key word, 2nd key word...5th key word. The title words should not be repeated in *Key words*.

Headings and subheadings are given in the following way: the main section headings, such as Introduction, Material, etc., are written in font size 13pt, centered. There are two empty lines between Key words and Introduction. Subheadings in sections should be written in font size 12 pt, aligned to the left margin. There is one empty line between a section heading and the text of the previous section. Also, there is one empty line between each heading / subheading and the text that accompanies it.

References are written in alphabetical order with full data according to APA standard (see the tables following the text).

Abstract (translation) should be translated into English if the papers are written in Serbian, or vice versa. Following the pattern above, the Abstract (translation) should also include the paper title, author's name, the name of the institution (organization) in which the respective authors are employed, the name of the city and country where the institution (organization) is placed and Key words, as well, all in the format specified above and in the same language. Also, the name and surname of the author responsible for correspondence and his / her e-mail address should be written below Key words.

Tables, graphs and figures in the paper must be numbered and have a proper caption/title (e.g. Tab. 1 / Graph 1 / Fig. 1 / Research results in 2011). The captions of the tables are above them with left alignment and one blank line in between, while the names of graphs and figures are below them, centered, with

one blank line in between. Tables, graphs and figures should not go beyond the set margins. Redundant lines, cell staining, bold letters, and the like, should be avoided in tables. Graphs and figures are to be displayed without a frame. All text elements have to be specified in Serbian and English, the font size 8 pt to 12 pt and regular font style. Figures, schemes, etc., must be at least 300 dpi and sent as separate attachments, while the figures of the lower resolution should be actually set in the paper in order to demonstrate their desired position and dimensions.

Nomenclature and units - use the international system of units (SI). If other units are mentioned, please give their equivalent in SI. Authors and Editor(s) are, by general agreement, obliged to accept the rules governing biological nomenclature, as laid down in the International Code of Botanical Nomenclature, the International Code of Nomenclature of Bacteria, and the International Code of Zoological Nomenclature.

***Agro-knowledge Journal* applies Publication Manual of the American Psychological Association (APA) style and advice for citing and listing references.**

Citations in the text (in-text citations) are in parentheses and include the author's name and year of publication, separated by commas. The number of the cited pages can be put after the year of publication and it is also separated by commas.

It is best to avoid the *abbreviations* unless they are generally known. When it is cited for the first time, each abbreviation need to be explained, i.e., the full name has to be stated. The abbreviations in tables, graphs and figures need to be explained.

Footnotes should be avoided and only used when it is necessary to give further explanation for a part of the text.

Acknowledgements are placed at the end of the paper, after the section Conclusion and they usually includes information about the research support, projects, etc.

References are placed at the end of the paper and it must have all the sources used in the paper. Personal documents, letters, memoranda and informal electronic communication should not be placed in References. The name of the city where the work was published is omitted if the name is included in the publisher's name (e.g. University of Banjaluka). References are written in alphabetical order (if the papers are in English) or in *Cyrillic alphabetical order* in case the papers are written in Serbian. If you cite more than one paper of the same author, the earlier published ones should be cited first, then the latest, while the ones published in the same year should be cited in alphabetical order according to the titles, e.g., (1995a), (1995b). In case they have no author, the title and the name of the institution takes the place of the author's name.

Secondary sources citation should be avoided and used only for the sources not available in generally spoken languages. In the reference list, only the secondary source is included.

Examples of in-text citations and reference list

These examples are intended to provide an overview of the citation style applied in this journal. The examples are given in Table 1.

After submission all papers are read by the managing and technical editor. If it is necessary, the papers will be returned to the authors for correction. The papers which have not been done in accordance with Guide for Authors will not be taken into further consideration. As soon as they have undergone the correction, the managing editor sends them for review. After the reviews have been completed, in case there are some comments or suggestions, the papers will be returned to the authors for additional correction. When the correction is over, the papers will be sent for review again. Each paper goes through two anonymous reviews.

Submit the paper in electronic format *via* e-mail at *agroznanje@gmail.com* or *via* regular postal mail as CD or USB to the address of Faculty of Agriculture in Banjaluka with notification: for editor's office of Agro-knowledge Journal. The papers should be submitted as an open document made in Microsoft Word 97-2003 or 2007, in the format given in the Guide for Authors in due time. The papers that do not meet the deadline will not be submitted for review.

All the papers will be UDC and DOI assigned.

They will undergo technical and linguistic proofreading. The technical editor may do possible minor corrections in agreement with the author.

After the Journal has been published, all the authors will receive his/her papers in PDF file *via* e-mail.

Contact:
University of Banjaluka
Faculty of Agriculture (for editor's office of Agro-knowledge Journal)
Bulevar vojvode Petra Bojovića 1A
78000 Banjaluka
Republic of Srpska
Bosnia and Herzegovina

E-mail: *agroznanje@gmail.com*

Таб. 1. Примјери цитирања извора у тексту и навођења извора у попису литературе
Examples of in-text citations and citing reference sources

Категорија *Category*	Подкатегорија *Subcategory*	Цитирање у тексту *In-text citations*	Навођење извора у попису литературе *Citing sources*
Књиге *Books*	Један аутор *One author*	Кастори (1998) наводи ... (Кастори, 1998)	Кастори, Р. (1998). *Физиологија биљака*. Нови Сад: Фељтон.
		Hopkins (2009) presents... (Hopkins, 2009)	Hopkins, W. G. (2009). *Introduction to Plant Physiology*. New York: John Wiley & Sons.
	Два аутора *Two authors*	Мратинић и Којић (1998) наводе ... (Мратинић и Којић, 1998)	Мратинић, Евица и Којић, М. (1998). *Самоникле врсте воћака Србије*. Београд: Институт за истраживања у пољопривреди "Србија".
		Teiz and Zeiger (2002) present ... (Teiz & Zeiger, 2002)	Taiz, L., & Zeiger, E. (2002). *Plant physiology*. Sunderland: Sinauer.
	Више аутора *More authors*	Јовановић и сарадници (2012) наводе... (Jovanović i sar., 2012)	Јовановић, Р., Важић, Б. и Шарић, М. (2012). *Савремена исхрана коза за млеко*. Пољопривредни факултет Бања Лука.
		Sharp et al. (2002) presented ... (Sharp et al., 2002)	Sharp, J.A., Peters, J. & Howard, K. (2002). *The management of a student research project*. Aldershot: Gower.
	Уредник, преводилац или приређивач умјесто аутора *Editor or translator instead of the author*	(Brikel, 2006)	Brikel, K. (ur.) (2006). *Biljke i cveće: veliki ilustrovani vodič*. Beograd: Mladinska knjiga.
		(Brickell, 2004) (Royal Horticultural Society, 2004) – прво навођење/*first citation* (RHS, 2004) – сљедеће навођење/*following citation*	Brickell, C. (Ed.). (2004). *Encyclopedia of gardening*. London: Dorling Kindersley. Royal Horticultural Society. (2004). *Encyclopedia of gardening*. London: Dorling Kindersley.
	Поглавље или неки други дио књиге *Chapter or some other part of the book*	(Поповић и Маленчић, 2005)	Поповић, М., Маленчић, Ђ. (2005). Метаболизам органских азотних једињења. У Кастори, Р. (ур.), *Азот: агрохемијски, агротехнички, физиолошки и еколошки аспекти* (стр. 81-116). Пољопривредни факултет Нови Сад.

Таб. 1. Примјери цитирања извора у тексту и навођења извора у попису литературе (наставак)
Examples of in-text citations and citing reference sources (continued)

Категорија *Category*	Подкатегорија *Subcategory*	Цитирање у тексту *In-text citations*	Навођење извора у попису литературе *Citing sources*
Књиге *Books*	Поглавље или неки други дио књиге *Chapter or some other part of the book*	(Silber, 2008)	Silber, A. (2008). Chemical characteristics of soilless media. In Raviv, M., & Lieth, J.H. (Eds.), *Soilless culture: theory and practice* (pp. 209-244). London: Elsevier.
	Електронска књига *Electronic book*	(Seton, 1911)	Seton, E.T. (1991). *The Arctic prairies: A canoe-journey of 2,000 miles in search of the caribou*. Преузето 16.05.2013., sa http://www.gutenberg.org/etext/6818
		(Conoloff, 2012)	Conoloff, A. (2012). *Salvaging the suburbs*. doi: 11.8870/6001/2122.442.261
		(Gladwell, 2008)	Gladwell, M. (2008). *Outliers: The story of success*. New York: Back Bay Books. Retrieved May 16, 2013, from http://www.amazon.com
Чланци *Articles*	У штампаним часописима *In printed journals*	(Тодоровић и сар., 2012) Тодоровић и сар. (2012)	Тодоровић, В., Гаврић Рожић, А., Марковић, С., Ђуровка, М. и Васић, М. (2012). Утицај температуре на раностасност и принос салате гајене у зимском периоду. *Агрознање, 13*(3), 475-481.
		Todorović et al. (2012)	Todorović, V., Gavrić Rožić, A., Marković, S., Đurovka, M. & Vasić, M. (2012). Influence of temperature on yield and earliness of lettuce grown in the winter period. *Agroznanje, 13*(3), 475-481.

Таб. 1. Примјери цитирања извора у тексту и навођења извора у попису литературе (наставак)
Examples of in-text citations and citing reference sources (continued)

Категорија *Category*	Подкатегорија *Subcategory*	Цитирање у тексту *In-text citations*	Навођење извора у попису литературе *Citing sources*
Чланци *Articles*	У електронским (*on-line*) издањима часописа: *In electronic (on-line) journal publications:*		
	Радови са DOI бројем: *Papers with DOI assigned*	(Wieger, 2012)	Wieger, M. (2012). The agri-food sector in Poland – an analysis and assessment of CAP results in 2000-2011. *Agroznanje, 13*(4), 619-631. doi: 10.7251/ AGREN1204619W
	Радови без DOI броја: *Papers with no DOI assigned:*	(Shen et al., 2012)	Shen, G., Huhman, D., Lei, Z., & Snyder, J. (2012). Characterization of an isoflavonoid-specific prenyltransferase from *Lupinus albus*. *Plant Physiology, 159*(1), 70-80. Преузето са (Retreived from) http://www.plantphysiol.org /content/159/1/70.full.pdf+html
Остале публикације *Other publications*	Публикације различитих организација и институција *Publications of various organizations and institutions*	(Федерално министарство околиша и туризма [ФМОТ], 2009) – прво навођење/*first citation* (FMOT, 2009) – сљедеће навођење/*following citation*	Федерално министарство околиша и туризма. (2009). *Босна и Херцеговина – земља разноликости: први извјештај Босне и Херцеговине за Конвенцију о биолошкој разноликости*. Сарајево: Федерално министарство околиша и туризма.
		(U.S. Governent Accountability Office [U.S. GAO], 2010) – прво навођење/*first citation* (U.S. GAO, 2010) – сљедеће навођење/*following citation*	U.S. Government Accountability Office. (2010, March). *Information security: Concerted effort needed to consolidate and secure Internet connections at federal agencies*. Retrieved from http://www.gao.gov/assets/310/301876.pdf
	Закони, правилници и остала легислатива *Laws, regulations and other legislation*	(Закон о пољопривреди, 2006)	Закон о пољопривреди. (2006). *Службени гласник Републике Српске, 24. јул, 2006, 70/06*.
		(Law on agriculture, 2006)	Law on agriculture. (2006). *Official gazette of the Republic of Srpska, July, 24, 2006, 70/06.*

Таб. 1. Примјери цитирања извора у тексту и навођења извора у попису литературе (наставак)

Examples of in-text citations and citing reference sources (continued)

Категорија *Category*	Подкатегорија *Subcategory*	Цитирање у тексту *In-text citations*	Навођење извора у попису литературе *Citing sources*
Остале публикације *Other publications*	Докторска или магистарска теза *Doctoral dissertation or master's thesis*	Штампана верзија *Printed version*	Caprette, C. L. (2005). *Conquering the cold shudder: The origin and evolution of snake eyes* (Doctoral dissertation/ Master's thesis). Ohio State University, Columbus, OH.
		Електронска верзија *Electronic version*	Caprette, C. L. (2005). *Conquering the cold shudder: The origin and evolution of snake eyes* (Doctoral dissertation). Преузето са (Retrieved from): http://www.ohiolink.edu/etd/send-pdf.cgi?acc_num=osu1111184984
	Рад представљен на семинару,симпозијуму или конференцији *Papers presented at seminars, symposiums or conferences*	(Drinić & Savić, 2012)	Drinić, Lj., & Savić, M. (2012, March). *Problems in agriculture and rural development in Republic of Srpska*. Paper presented at the I International Symposium and XVII Scientific Conference of Agronomists of Republic of Srpska, Trebinje. Bosnia and Herzegovina.
Електронски извори *Electronic sources*	Интернет презентација *Internet presentation*	(http://www.seaturtles.org)	Уколико се позива на интернет презентацију, а не неки њен одређени дио, онда се овај извор не мора уносити у попис литературе, али се мора јасно нагласити у тексту. На примјер: *If you do not cite a specific part of an internet presentation, but the internet presentation itself, this source needn't be included in the reference list,but it must be clearly emphasized in the text e.g.:* The Sea Turtle Restoration Project homepage presents a wealth of compelling, well-researched information on the struggle to save the world's sea turtles from extinction (http://www.seaturtles.org).

Таб. 1. Примјери цитирања извора у тексту и навођења извора у попису литературе (наставак)
Examples of in-text citations and citing reference sources (continued)

Категорија *Category*	Подкатегорија *Subcategory*	Цитирање у тексту *In-text citations*	Навођење извора у попису литературе *Citing sources*
Електронски извори *Electronic sources*	Специфична страница у оквиру интернет презентације (нпр. извјештај, објашњење, чланак, и сл.) *Specific pages within the internet presentation (eg, report, explanation, article, etc.).*	(Sea Turtle Restoration Project, 2006)	Sea Turtle Restoration Project. (2006). Threats to sea turtles. Retrieved from http://seaturtles.org/section.php?id=104

Original scientific paper
Originalan naučni rad
UDK: 634.5(497.2)
DOI:10.7251/AGREN1401005G

University of Banjaluka, Faculty of Agriculture
Agro-knowledge Journal

Evaluation of Some Walnut Cultivars under the Climatic Conditions of South Bulgaria

Stefan Gandev[1], Vasiliy Dzhuvinov[1]

[1]*Fruit-Growing Institute, Plovdiv, Bulgaria*

Abstract

Introduced walnut cultivars grown as main cultivars in countries with climatic conditions different from Bulgaria, were included in the present study. This evaluation aimed at selecting walnut cultivars with suitable biological and pomological characteristics when grown under the climatic conditions of South Bulgaria.The trial demonstrated that the cultivars 'Fernor', 'Lara' and 'Tiszacsecsi 83'were later blooming than the other cultivars as 'Serr', 'Hartley', 'Izvor 10' and 'Sheynovo'. That phenological characteristic is very important to avoid spring frost damages. During the period of evaluation the results showed that the yields from the cultivars 'Izvor 10', 'Serr', 'Hartley', 'Fernor' and 'Lara' were higher compared to 'Sheynovo' and 'Tiszacsecsi 83'. This is the reason to recommend the first group of walnut cultivars to be grown under the climatic conditions of South Bulgaria.

Key words: *Juglans regia* L., cultivar, growth, fruit characteristics, yield

Introduction

Walnut as a fruit species became a priority after the accession of Bulgaria to the European Union. The century-old walnut trees found on the territory of the country are an indisputable proof that the soil and climatic conditions in our country are favorable for the optimal development of that fruit crop.

The walnut cultivars grown around the world have been selected from local resources or bred in countries with varied soil and climatic conditions. They differ from one another in their pomological and agrobiological characteristics (Solar, 1990; Malvolti et al.,1994 and 1996; Germain et al., 1997; Balci et al., 2001; Rouskas and Zakynthinos, 2001; Dogan et al., 2005).

The prevailing cultivars grown in walnut orchards in Bulgaria are local ones, of a terminal or intermediate bearing type (Nedev et al., 1976). This does not comply with the modern requirements for a walnut cultivar. The only exception is 'Izvor 10' cv., bearing fruit from lateral buds (Nedev et al., 2002). According to Ramos (1985), lateral bearing cultivars are of a higher productivity than terminal and intermediate bearing. Germain et al. (1999) established that the lateral bearing cultivars have a higher productivity due to the larger number of fruit buds than the terminal and intermediate bearing cultivars. According to Dzhuvinov et al. (2013), the productivity of the cultivar depends not only on the type of bearing and on number of female flowers, but also on the percentage of the useful fruit set and the fruit weight. The percentage of useful fruit set is a cultivar specificity, but it could be significantly influenced by some agrotechnical activities, such as pruning, fertilization, irrigation, as well as the larger distance from the pollinator. The yield of each cultivar depends of the kernel weight, which is about 5-7 g for most of the commercial cultivars.

Germain et al. (1999) found out that Californian cultivars are not suitable for growing in France due to the colder climate. In the Carpathian region of Romania the drop down of winter temperatures to minus 22.7ºC does not affect the normal growth and fruiting of the Californian and French lateral bearing cultivars (Botu et al., 2010). According to Nedev et al. (1976) the Bulgarian cultivars could be frostbitten by low winter temperatures below minus 20ºC. The Carpathian walnut is considered to be the most frost resistant in the world, as it can resist without any damages temperatures about minus 32-35 ºC (Mitra et al., 1991; Domoto, 2002).

The aim of the study was to carry out agrobiological evaluation of the introduced walnut cultivars 'Fernor', 'Lara', 'Tiszacsecsi 83', 'Serr' and 'Hartley' and to assess the possibilities of their growing in South Bulgaria.

Material and Methods

The experimental plantation was established in the spring of 2003 and the study was carried out in 2009-2013, i.e. from 7th till 11th vegetation season of the walnut trees. The type of soil is alluvial and the climate is

humid subtropical with considerable humid continental influences. The introduced cultivars 'Serr', 'Hartley', 'Fernor', 'Lara', 'Tiszacsecsi 83' plus 'Izvor 10' and the control 'Sheynovo', grafted on common walnut (*Juglans regia* L.) rootstock, were included in the study. The trees were planted at a distance of 8 x 8 m, trained to the improved layered crown system. Micro sprinkling irrigation was applied in the trial. The soil of the experimental plantation was maintained as black fallow.

Three trees of each cultivar were studied, randomly planted in the orchard, each tree being a separate replication. Data were statistically processed following Duncan's test (Steele and Torrie, 1980).

The following characteristics were reported:

Time of flowering of female and male flowers – early-flowering, 6-8 days before 'Sheynovo'; medium-flowering – their flowering period coinciding with that of the control; late-flowering –10 or more days after 'Sheynovo'. *Growth vigor* – according to the vegetative length increment of the leader and the extensions of the skeletal branches and spurs: poor growth – 10-20 cm length increment; moderate growth –20-30 cm length increment; vigorous growth – length increment over 31 cm. *Crown habit and volume* – shape, density, volume, angle of divergence of the first three skeletal branches to the leader. *Fruit-bearing type* – terminal, intermediate, lateral. *Time of ripening*: very early – 20-25 August; early – 26 August till 5 September; medium-early – 6 September till 15 September; medium-late – from 16 September till 25 September; late – after 26 September. *Yield per tree*–kg/tree. *Morphometric measurements:* fruit size in mm; mean weight of 30 fruits, grouped as: very small < 8.5 g; small –from 8.5 g to 10.5 g; medium–from 10.5 g to 12.5 g; large–from 12.5 g to 14.5 g and very large > 14.5 g. *Shell thickness*: thin – to 1.2 mm; medium thick – from 1.3 to 1.7 mm; thick – over 1.8 mm. *Kernel percentage (output in percentage*): very low–below 40%; low – 40-44%; medium–from 45 to 49%; high–from 50 to 55%; very high–over 55%. Characteristics used follow the methods of studying genetic resources of Nedev et al. (1979) and Germain (2004).

Results and Discussion

Beginning of vegetation and time of flowering are specific biological traits of common walnut (*Juglans regia* L.) and they depend on the genotype of the cultivar and the climatic conditions, under which it is grown (Germain et al., 1999). Table 1 shows that in average for the period, the standard 'Sheynovo' entered the phenological stage Cf (bud

break) on 10th April. Out of the other studied cultivars, the earliest to enter the period of vegetation was ‘Serr’ – 10 days before ‘Sheynovo’. ‘Izvor 10’ cultivar also developed early, i.e. 6 days before the control. In ‘Hartley’ the Cf stage began 7 days after the control cultivar. The latest to enter the bud burst stage were ‘Lara’, ‘Fernor’ and‘Tiszacsecsi 83’. The first one entered Cf phenological stage 15 days after the standard ‘Sheynovo’ and the others – 16 days after the standard (Table 1).

The mass flowering of the female flowers data (Ff2 phenological stage)shows that ‘Serr’ and ‘Izvor 10’ flowered before ‘Sheynovo’, while ‘Hartley’ and ‘Lara’ entered the mass flowering stage immediately after the control. The latest mass flowering season of the female flowers was reported in ‘Tiszacsecsi 83’ and‘Lara’ –10 and 11 days after the control.

The mass flowering of the male flowers is also different for the separate cultivars. Catkins of ‘Serr’ had the earliest mass flowering phenological stage (Fm2) – 5 days before the standard ‘Sheynovo’. In all the other cultivars flowering of the male flowers was from 7 to 20 days after ‘Sheynovo’. The latest development of the catkins was established for ‘Fernor’ and ‘Lara’ cultivars – 13 and 20 days after the control ‘Sheynovo’.

The obtained results about fruit ripening time of the studied cultivars confirmed the investigations of Nedev et al. (1983) about the time of fruit ripening of the local cultivars ‘Izvor 10’ and ‘Sheynovo’. ‘Izvor 10’ was medium early and the standard ‘Sheynovo’ was medium late. All the other studied cultivars were late ripening. The cultivars ‘Serr’ and ‘Hartley’ ripened 8 and 11 days after the standard ‘Sheynovo’, ‘Lara’ – 18 days after the control, while ‘Tiszacsecsi 83’and‘Fernor’ – 20 days after ‘Sheynovo’. Those results showed that the studied cultivars ripen from 15 September through 10 October under the conditions of South Bulgaria.

Growth vigor, fruiting type and crown habit are very important characteristics of the studied cultivars (Table 2). ‘Sheynovo’, ‘Serr’, ‘Hartley’ and ‘Lara’ belong to the group of vigorously growing cultivars, their annual length increment of the extensions of the leader and the skeletal branches and spurs being over 31 cm. Crown volume of ‘Serr’and ‘Lara’ was the biggest – 139.7 m^3 and 130.4 m^3, respectively, and significant difference between the two cultivars was not established for that characteristics. The other two cultivars of vigorous growth ‘Sheynovo’ and‘Hartley’ had a similar crown volume – 104.1 m^3 and 95.2 m^3, respectively.

c

Tab. 1. Average phonological data about the walnut cultivars for the period 2009-2013
Prosječni fonološki podaci o sortama oraha za period 2009-2013

Cultivar *Sorta*	Apical bud burst *Pucanje apikalnih pupoljaka*		Flowering of female flowers *Cvjetanje ženskih cvjetova*						Flowering of male flowers *Cvjetanje muških cvjetova*						Time of ripening *Vrijeme zrijenja*	
	Beginning *Početak*	Number of days* *Broj dana **	Beginning *Početak*	Number of days* *Broj dana **	Mass flowering *Puno cvjetanje*	Number of days* *Broj dana **	End of flowering *Kraj cvjetanja*	Number of days* *Broj dana **	Beginning *Početak*	Number of days* *Broj dana **	Mass flowering *Puno cvjetanje*	Number of days* *Broj dana **	End of flowering *Kraj cvjetanja*	Number of days* *Broj dana **	Ripening *Zrijenje*	Number of days* *Broj dana **
Izvor 10	04.04.	-6	16.04.	-11	18.04.	-13	24.04.	-13	27.04.	+8	01.05.	+9	06.05.	+8	15.09.	-5
Sheynovo	10.04.	0	27.04.	0	01.05.	0	07.05.	0	19.04.	0	22.04.	0	28.04.	0	20.09.	0
Serr	31.04.	-10	20.04.	-7	27.04.	-4	01.05.	-6	13.04.	-6	17.04.	-5	24.04.	-4	28.09.	+8
Hartley	17.04.	+7	28.04.	+1	04.05.	+3	12.05.	+5	24.04.	+5	30.04.	+8	04.05.	+6	01.10.	+11
Fernor	26.04.	+16	06.05.	+9	12.05.	+11	20.05.	+13	30.04.	+11	05.05.	+13	09.05.	+11	10.10.	+20
Lara	25.04.	+15	02.05.	+5	06.05.	+5	17.05.	+10	07.05.	+18	12.05.	+20	19.05.	+21	08.10.	+18
Tiszacsecsi 83	26.04.	+16	06.05.	+9	11.05.	+10	19.05.	+12	25.04.	+6	29.04.	+7	05.05.	+7	10.10.	+20

* Number of days compared to the control 'Sheynovo'
Broj dana upoređen sa kontrolom 'Sheynovo'

Tab. 2. Growth vigor, bearing type and crown habit
Snaga rasta, tip plodonošenja i habitus krošnje

Cultivar *Sorta*	Growth vigor *Snaga rasta*	Bearing type (laterality, %) *Tip plodonošenja (linearnost, %)*	Crown habit *Habitus krošnje*		
			Shape *Oblik*	Angle deviation of skeletal branches *Ugao devijacije kod skeletnih grana*	Volume (m^3) *Obim*
Izvor 10	moderate *umjerena*	lateral (90%) *bočno (90%)*	semi-upright *polu-uspravan*	60 - 70º	59.2 c
Sheynovo	vigorous *jaka*	intermediate (25%) *mješovito (25%)*	spreading *raširen*	70 - 80º	104.1 b
Serr	vigorous *jaka*	intermediate (35%) *mješovito (35%)*	spreading *raširen*	70 - 80º	139.7 a
Hartley	vigorous *jaka*	intermediate (10%) *mješovito (10%)*	semi-upright *polu-uspravan*	60 - 70º	95.2 b
Fernor	moderate *umjerena*	lateral (90%) *bočno (90%)*	upright *uspravan*	40 - 45º	65.6 c
Lara	vigorous *jaka*	lateral (45%) *bočno (45%)*	semi-upright *polu-uspravan*	60 - 70º	130.4 a
Tiszacse-csi 83	poor *slaba*	intermediate (15%) *mješovito (15%)*	semi-upright *polu-uspravan*	60 - 70º	34.8 d

Values followed by the same letter in a column were not statistically different ($P < 0.05$).
Vrijednosti u koloni označene istim slovom nisu statistički različite ($P < 0,05$).

'Izvor 10' and 'Fernor' were of a moderate growth rate, the length increment of the extensions being 20-30 cm and the crown volume was similar – 59.2 m^3 for the former and 65.6 m^3 for the latter cultivar. 'Tiszacsecsi 83' had a poor growth rate, the length increment of the extensions being 10-20 cm and the crown volume – 34.8 m^3.

Table 2 also shows that the cultivars are of different fruit bearing types. None of the cultivars is of a typical apical fruit bearing type. The results showed that the cultivars 'Sheynovo', 'Serr', 'Hartley' and 'Tiszacsecsi 83' had intermediate fruit bearing, the laterality varying from 10 to 35%. "Lara' cultivar was characterized by 45% of lateral bearing and by that trait it fell behind the other lateral bearing cultivars in the present study – 'Izvor 10'and'Fernor', which had 80% of fruits from lateral buds .

'Fernor' is the only cultivar having an upright crown shape, 'Sheynovo' and 'Serr' hada spreading shape of the crown and 'Izvor 10', 'Hartley', 'Lara' and 'Tiszacsecsi 83' – a semi-upright crown.

The morphometric data of the walnut fruits, in average for the period 2009-2013,are presented in Table 3. As it could be considered, the

fruit size of the separate cultivars was different, as well as was the shell thickness.The shell of 'Izvor 10' and 'Sheynovo' was less than 1.2 mm and that determined them as cultivars having a thin shell. The cultivars 'Serr', 'Hartley' and 'Lara' were in the next group with shell thickness of 1.3 mm to 1.7 mm. The shell of 'Fernor' and 'Tiszacsecsi 83' was1.8 mm.

The biggest mean weight of the fruits was reported for 'Sheynovo' – 13.7 g, followed by 'Hartley' (13.5 g), 'Serr' and 'Lara' – 12.7 g and 12.8 g, respectively. However there was no significant difference between 'Serr' and 'Hartley'. The above data describing the cultivars 'Sheynovo', 'Hartley', 'Serr' and 'Lara' show that they belong to the group of cultivars with large fruits (a mean weight from 12.5 g to 14.5 g). 'Izvor 10', 'Fernor' and 'Tiszacsecsi 83' with a mean weight of the fruits 11.6g, 12.4g and 10.6g, respectively, belong to the group with a mean fruit weight varying from10.5 to 12.5 g. The cultivars 'Izvor 10' and 'Sheynovo' had a very high kernel percentage. 'Serr' cultivar was the only one with high kernel output –53.6%, 'Hartley' had a medium kernel percentage–46.7%, 'Fernor' and 'Lara' – low and 'Tiszacsecsi 83' – very low, i.e., 38.5%.

Tab. 3. Average morphometric data of walnut fruits for the period 2009-2013
Prosječni morfometrijski podaci o plodovima oraha za period 2009-2013.

Cultivar *Sorta*	Height *Visina*	Width *Širina*	Thickness *Debljina*	Shell thickness *Debljina ljuske*	Weight of 1 fruit *Težina 1 ploda*	Kernel percentage *Procenat jezgra*
	(mm)	(mm)	(mm)	(mm)	(g)	(%)
Izvor 10	41.0 bc	31.4 cd	32.1 bc	1.0 d	11.6 cd	55.5 a
Sheynovo	42.3 ab	30.8 d	32.7 bc	1.2 c	13.7 a	55.5 a
Serr	38.9 cd	34.1 ab	33.2 bc	1.4 b	12.7 abc	53.6 a
Hartley	44.3 a	33.5 ab	33.7 b	1.7 a	13.5 ab	46.7 b
Fernor	41.7 ab	32.8 bc	34.0 b	1.8 a	12.4 bc	42.8 c
Lara	37.5 d	35.4 a	36.1 a	1.4 b	12.8 abc	42.6 c
Tiszacse-csi 83	37.5 d	31.2 cd	31.4 c	1.8 a	10.6 d	38.5 d

Values followed by the same letter in a column were not statistically different ($P < 0.05$)
Vrijednosti u koloni koje su označene istim slovom (slovima) nisu statistički različite ($P < 0,05$)

In 2009 the highest yield per tree was obtained from 'Serr' cultivar – 20.9 kg (Table 4). The yields from 'Izvor 10', 'Hartley' and 'Lara' were similar and statistically proven to be lower than that of 'Serr'. Those cultivars were followed by 'Fernor' with the yield of 12.0 kg, while the average yield of 'Sheynovo' was significantly lower than all the mentioned cultivars, i.e., 9.1 kg. The lowest yield per tree was harvested from 'Tiszacsecsi 83' – only 3.9 kg per tree.

Tab. 4. Yield per tree for the period 2009-2013
Prinos po stablu za period 2009-2013

Cultivar *Sorta*	Yield per tree (kg) *Prinos po stablu (kg)*				Average yield per tree 2009-2013 *Prosječan prinos po stablu* 2009-2013
	2009	2010	2011	2013	
Izvor 10	17.9 b	23.0 b	16.8 d	26.0 a	20.9 a
Sheynovo	9.1 d	15.8 c	12.8 e	15.0 c	13.1 bc
Serr	20.9 a	29.7 a	35.9 a	8.8 e	23.8 a
Hartley	17.7 b	20.7 b	23.9 c	13.0 cd	18.8 ab
Fernor	12.0 c	22.0 b	28.5b	22.0 b	21.1 a
Lara	16.9 b	20.2 b	21.7 c	19.7 b	19.6 ab
Tiszacsecsi 83	3.9 e	7.5 d	5.5 f	10.0 de	6.7 c

Values followed by the same letter in a column were not statistically different ($P < 0.05$)
Vrijednosti u koloni koje su označene istim slovom (slovima) nisu statistički različite ($P < 0,05$)

In 2010, again 'Serr' cultivar showed the highest yield rate (29.7 kg). It was followed by 'Izvor 10', 'Hartley', 'Fernor' and'Lara'. 'Sheynovo' had lower yield compared to the mentioned cultivars, the difference being statistically significant, and, again the yield of 'Tiszacsecsi 83' was unsatisfactory – 7.5 kg.

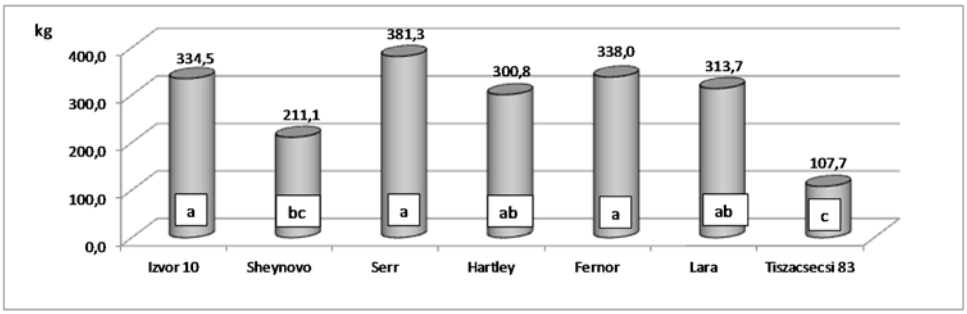
In 2011 the yield of 'Serr'was the highest again – 35.9 kg. It should be noted that referring to the yield per tree, 'Fernor' ranked second with harvested yield amounted to 28.5kg/tree. 'Hartley'and 'Lara' yielded 23.9 kg and 21.7 kg per tree, respectively. The average yield per tree from 'Izvor 10' was 16.8 kg, followed by 'Sheynovo' (12.8 kg) and'Tiszacsecsi 83' (5.5 kg).

In result of the winter frost of minus 24.4ºC on 1 February 2012, the nut yield was compromised to a different degree for the separate cultivars. Those unusual low temperatures are not typical for South Bulgaria.

In 2013 the highest yield per tree was obtained from 'Izvor 10' cv. – 26.0 kg. It was followed by the cultivars 'Fernor' (22.0 kg) and 'Lara (19.7 kg)', whose yields being statistically proven to be lower. The yield obtained from 'Sheynovo' was 15.0 kg per tree and from 'Hartley' – 13.0 kg. The lowest yields were reported from 'Serr' and 'Tiszacsecsi 83' cultivars – 8.8 kg and 10.0 kg, respectively.

The highest average yields per tree for the period 2009-2013 were obtained from the cultivars 'Izvor 10', 'Serr' and'Fernor', the difference between them being statistically insignificant.'Hartley' and 'Lara' ranked

second with average nut yields for the period 18.8 kg and 19.6 kg, respectively. The lowest yield was reported for 'Sheynovo' (13.1 kg) and 'Tiszacsecsi 83' (6.7 kg). The average yield per decare for the period 2009-2013 is presented in Fig. 1.



Values followed by the same letter in a column were not statistically different ($P < 0.05$)
Vrijednosti u koloni koje su označene istim slovom (slovima) nisu statistički različite ($P < 0,05$)

Fig. 1. Average yield kg/da (decare-1000 m^2) for the period 2009-2013
Prosječan prinos po kg/da (decare - 1,000 m^2) za period 2009-2013

From 'Serr' cultivar it were harvested 381.3 kg/da, 338.0 kg from 'Fernor' and 334.5 kg from 'Izvor 10', the difference between the three cultivars being statistically insignificant. The yields from 'Hartley' and 'Lara' cultivars were lower – 300.8 kg and 313.7 kg, respectively. The average yield from 'Sheynovo' was 211.1 kg/da and the difference to the above cultivars was significantly proven to be lower. The lowest average yield was obtained from 'Tiszacsecsi 83' – only 107.7 kg/da.

Conclusion

French cultivars 'Fernor' and 'Lara' are blooming later than the other cultivars – American 'Serr' and 'Hartley', Hungarian 'Tiszacsecsi 83' and Bulgarian 'Izvor 10' and 'Sheynovo'. That phenological characteristic is very important to avoid spring frost damages. During the study period the results showed that the yields from the cultivars 'Izvor 10', 'Serr', 'Hartley', 'Fernor' and 'Lara'were higher compared to 'Sheynovo' and 'Tiszacsecsi 83'. This is the reason to recommend the first group of five walnut cultivars to be grown under the climatic conditions of South Bulgaria.

References

Balci, I., Balta, F., Kazankaya, A. & Sen, S. M. (2001). Promising native walnut genotypes (*Juglans regia* L.) of the East Black Sea region of Turkey. *J. Am. Pomol. Soc., 55*(4), 204-208.

Botu, M., Botu, I., Tudor, M. & Papachatzis, A. (2010). Advantages and disadvantages offered by growing lateral bearing walnut cultivars in the Sub-Carpathian area of Oltenia. Scientific papers of the R.I.F.G. *Pitesti, XXVI*, 32-35.

Dogan, A., Kazankaya, A., Gün, A., Askin, M., Oğuz, H. & Celik, F. (2005). Fruit characteristics of some Turkish walnut genotypes and cultivars (*Juglans regia* L.). *Asian Journal of Plant Sciences, 4*(5), 486-488.

Domoto, P.A. (2002). Walnut tree named 'Domoto'. *United States Plant Patent № US PP12898 P2.* Retreived from http://www. googleapis.com

Dzhuvinov, V., Gandev, S., Kumanov, K. & Arnaudov, V. (2013). *Oreh*. Plovdiv: Biofrut-BG.

Germain, E., Lespinasse, J.M., Reynet, P. and Bayol, M. (1997). Orchard training of lateral fruit-bearing walnut varieties assessment of trials carried out in France. *Acta Horticulturae*, (442), 313-320.

Germain, E., Prunet, E. J. & Garcin, A. (1999). *Le Noyer.* Paris: Centre Technique Interprofessionnel des Fruits et Légumes Publication.

Germain, E. (2004). *Inventory of walnut research, germplasm and references.* Rome: Food and Agriculture Organization of the United Nations,.

Malvolti, M. E., Fineschi, S. & Pigliucci, M. (1994). Morphological integration and genetic variability in *Juglans Regia L. J. Hered., 85*, 389-394.

Malvolti, M.E., Beritolognolo, I. & Spada, M. (1996). Diversita genetica in *Juglans regia*, valutazione delle risorse genetiche in Europa per uno studio agricolo e ferestale sostenibile – SHERWOOD. *Foreste ed Alberi Oggi*, *15*, 11-17.

Mitra, S.K., Rathore, D.S. & Bose, T.K. (1991). *Walnut. Temperate Fruits.* Chakraberia Lane, Calcutta: Published by Horticulture and Allied Publishers.

Nedev, N., Vasilev, V., Kavardzhikov, L. & Zdravkov, K. (1976). *Orehoplodni kulturi*. Plovdiv: H. G. Danov.

Nedev, N., Grigorov, J., Baev, H., Serafimov, S., Stranjev, A., Kavardjikov, L., Lazarov, K., Nikolov, N., Dzhuvinov, V., Popova, L., Slavov, N., Iliev, P., Stoianov, D., Kanev, I., Krinkov, H., Vishanska, Y., Topchiiska, M. & Petrova, L. (1979). *Metodika za izuchavane na pastitelnite resursi pri ovoshtnite pastenia.* Plovdiv: H. G. Danov.

Nedev, N., Serafimov, S., Anadoliev, G., Kavardjikov, L., Krinkov, H., Radev, R., Dochev, D., Stamatov, I., Slavov, N., Vishanska, Y., Rusalimov, J., Iovchev, I., Djeneva, A., Lalev, N., Iliev, I. & Slavcheva, R. (1983). *Orehoplodni kulturi.* Plovdiv: H. G. Danov.

Nedev, N., Kavardjikov, L. & Gandev, S. (2002). Izvor 10 – a promising walnut cultivar. *Plant Science, 39*(1-2), 54-56.

Ramos, D. (Ed.). (1985). *Walnut Orchard Management.* Davis: University of California.

Rouskas, D. & Zakynthinos, G. (2001). Preliminary evaluation of seventy walnut (*Juglans regia* L.) seedings selections in Greece. *Acta Horticulturae,* (544), 61 – 72.

Solar, A. (1990). Phenological and pomological characteristics of walnut cultivars in northeastern Slovenia. *Acta Horticulturae,* (284), 167 – 174.

Steele, R. & J. Torrie (1980). *Principles and procedures of statistics.* New York: McGraw-Hill.

Received: March 28, 2014
Accepted: May 23, 2014

Evaluacija nekih sorti oraha u klimatskim uslovima Južne Bugarske

Stefan Gandev[1], Vasiliy Dzhuvinov[1]

[1]*Voćarski institut, Plovdiv, Bugarska*

Sažetak

U ovu studiju su uključene uvedene sorte oraha koje se gaje kao glavne sorte u zemljama sa klimatskim uslovima različitim od onih u Bugarskoj. Cilj ove evaluacije je selektovanje sorti oraha koje imaju odgovarajuće biološke i pomološke karakteristike kada se gaje u klimatskim uslovima Južne Bugarske. Ispitivanje je pokazalo da sorte 'Fernor', 'Lara' i 'Tiszacsecsi 83' kasnije cvjetaju od drugih sorti kao što su 'Serr', 'Hartley', 'Izvor 10' i 'Sheynovo'. Ova fenološka karakteristika je veoma važna da bi se izbjegla oštećenja uzrokovana proljetnim mrazom. Tokom perioda evaluacije rezultati su pokazali da su prinosi sorti 'Izvor 10', 'Serr', 'Hartley', 'Fernor' i 'Lara' viši u poređenju sa 'Sheynovo' i 'Tiszacsecsi 83'. Iz ovog razloga,

preporučuje se prvopomenuta grupa sorti oraha za uzgoj u klimatskim uslovima Južne Bugarske.

Ključne riječi: *Juglans regia* L., sorta, rast, karakteristike ploda, prinos

Stefan Gandev
E-mail address: s.gandev@abv.bg

Primljeno: 28. marta 2014.
Odobreno: 23. maja 2014.

UDK 63 **ISSN 1512-6412**

АГРОЗНАЊЕ

Agro – knowledge Journal

University of Banjaluka

Faculty of Agriculture

Agroznanje, Vol. 15, br. 1, 2014.

Универзитет у Бањој Луци
ПОЉОПРИВРЕДНИ ФАКУЛТЕТ
University of Banjaluka, Faculty of Agriculture

Телефон: (051) 330901
Телефакс: (051) 312 580
E-mail: agrobl@blic.net
Web: www.agroznanje.com

Бања Лука, Република Српска, Булевар војводе Петра Бојовића 1А
Banja Luka, Republic of Srpska, Bulevar vojvode Petra Bojovica 1A

ТЕХНИЧКИ УРЕДНИК
TECHNICAL EDITOR

Јелена Марковић, дипл. инж.
Jelena Marković, dipl.ing.

ПРЕВОДИЛАЦ/ЛЕКТОР/КОРЕКТОР
TRANSLATOR/EDITOR/PROOFREADER

мр Јелена Бркић, проф. јез. и књиж.
Jelena Brkić, MA (Lang & Lit.).

ПРЕЛОМ И ШТАМПА
LAYOUT AND PRINTING

GRAFOMARK
LAKTAŠI

Часопис „Агрознање“ се цитира у издањима CAB International Abstracts
Agro-knowledge Journal is cited in CAB International Abstracts

Штампање часописа суфинансира Министарство науке и технологије Републике Српске
The Journal is financially supported by Ministry of Science and Tehnology of Republic of Srpska

САДРЖАЈ / *CONTENTS*

ОРИГИНАЛНИ НАУЧНИ РАДОВИ / *ORIGINAL SCIENTIFIC PAPERS*

СТРУЧНИ РАДОВИ / *PROFESSIONAL PAPERS*

ПРИКАЗ КЊИГЕ / *BOOK REVIEW*

Original scientific paper
Originalan naučni rad
UDK: 634.713(497.11)
DOI: 10.7251/AGREN1401017M

University of Banjaluka, Faculty of Agriculture
Agro-knowledge Journal

Economic Adequacy of Blackberry Production in Rural Areas of Sirinić District

Goran Maksimović[1], Radomir Jovanović[1], Slavka Mitrović[1], Tatjana Ivanović[1]

[1]*Faculty of Agriculture, University of Priština, Lešak, Serbia*

Abstract

In Sirinićka District, blackberries are mostly grown on smaller farms in highlands, where the best results are reached. However, the demands for this type of berries as well as the interest in its cultivation have steadily increased, recently. Thus, the main goal of this paper was to present the results of an economic analysis of blackberry production with the data obtained during the two years of monitoring a group of farmers in that area. It has been estimated and presented the profitability based on present marketing, agroclimatic and technological conditions and also the slightest blackberry yield achieved in the group of growers. According to the results of the economic analysis of blackberry growing, it can be concluded that production generates income, even with one third of yield potential. Cost-effectiveness in blackberry growing is 2.14. Depending of the investments in blackberry growing, profitability rate is 53.39%. These calculations show the advantages of blackberry growing in Sirinićka District, comparing to other fruits.

Key words: investments, costs, calculations, economic impact

Introduction

Sirinić District covers an area of 250 km^2, including one urban and fifteen rural settlements. It is a jagged mountain region with variable altitude, ranging from 500 m in the Lepenac river valley to 2500 meters above sea level, measured on the highest mountain peak Ljuboten. Agricultural production of Sirinić District in its largest part lags behind real opportunities determined by agro-ecological conditions. Vegetal husbandry is the most dominant agricultural sector, but there also exist good conditions for fruit production, especially for production of berries (raspberries, blackberries, blueberries). Agro-ecological conditions in Sirinić District enable better quality of the blackberry fruit and higher yield per unit area than in most other countries in which larger quantities of this berry type are being produced. Years of experience from different regions of the Republic of Serbia indicate that (in favorable agro-ecological conditions) the production of blackberries is more profitable than other branches and lines of agricultural production. In Sirinić District, blackberries are mainly grown on smaller properties ranging from 10 to 30 *a,* in highland area where the best results are being achieved. All the parcels are located in proximity to the built refrigerator storehouse and linked with asphalt/macadam roads. This enables convenient and cheaper transport of production supplies, packaging and of blackberry fruits without quality diminishing.The commitment to invest in blackberry production stems from the fact that there exist good climatic and other conditions necessary for this type of production in rural areas of Sirinić District. Experiences so far have shown that the production is very profitable and that demand exceeds supply. The rganization of redemption is stable; there are buyers who for many years organize collection and freezing of the fruits. Investing in this type of production is an ideal investment and it represents a good revenue to mixed agricultural holdings in the highlands of Sirinić District for the following reasons:

- ideal conditions for blackberry growing;
- simple and easily managed technology of production and care;
- economical and highly cost-effective production;
- relatively small investments;
- labor-intensive production enabling employment of the workers with lower level qualifications.

Material and Methods

Plots for blackberry plantations are located at the altitude of 500 - 600 *m*, belonging to highland area of Municipality of Strpce. As this mountainous area has abundant rainfall, climatic conditions are very favorable, and the requirements for plenty of moisture in soil and in the air are therefore met. Klimatski uslovi su veoma povoljni jer kao planinsko podrucje ima nesto više padavina čime su obezbedjeni zahtavi kupine za dosta vlage u zemljistu i vazduhu. The most spread type of blackberries in Serbia and in Sirinić District is called *Čačanska bestrna.* Accompanied by specific growing method application, suitable domestic climatic and soil conditions create optimal growing environment for the sort. *Čačanska bestrna* exhibits great yield, good fruit quality and resistance to pests and diseases, which all together makes it the leading sort. If the plantation is formed with *Čačanska bestrna,* it is then recommended to create spacing of 3 x 1.5 *m;* for 1 *ha*, 2200 seedlings are needed (Milic et al., 2008). Other similar distances may also be taken into consideration, but it is always necessary to seize upon blackberry exuberance and the requirements for light, water and nutrition elements. For achieving the good quality of blackberry production it is necessary to provide a good planting material produced in registered stock nurseries, properly packed and declared, and controlled by competent professionals and institutions. Seedlings should all have a well-developed root system with a mass of small vessels, without symptoms of a disease or damage. The best period for planting is autumn, characterized by supreme reception and provision of more exuberant growth during the next growing season (Petrović et al., 2003). Lines with seedlings are best to be oriented north-south, because of the longest sunlit during the day. Producers most often chose row growing system; the best and the most productive is three-wired system with three rows of wire in one plane and with outcrops bending and wiring (Veljkovic et al., 2006). A proper irrigation is an essential factor in a modern, intensive production of blackberries; from this reason, we predicted the drip irrigation system in our investment calculation of blackberry plantation. During the last few years, blackberry production on family agricultural farms in Sirinić District has been monitored; planting investment calculation and calculation of blackberry production were made on the basis of the collected data.

By using an economic analysis method, an investment calculation was developed, as well as a planned calculation. The data were obtained during two years of monitoring a group of growers, as a part of a project focused on developing a strategy for local agricultural development. The prices of the materials used in blackberries production were obtained from the

local dealers who regularly supply blackberry growers. The prices for the blackberry plants were obtained from the local growers while the prices of the output were obtained from the local market. Having in mind that blackberry production in that area is at an early stage of development, the objectives of this study was to estimate the profitability based on present marketing, agroclimatic, and technological conditions with the slightest blackberry yield achieved in the group of growers.

Results and Discussion

Motivation for blackberry planting in Sirinić District are economic interests, provision of additional activity and additional revenue of mixed agricultural holdings and also the underemployment of household members.

Calculation for establishing the blackberry plantation on family farms with the area of 0.50 *ha,* by using sort *Čačanska bestrna* (planting space 3 x 1.50 m), is shown in Table 1.

Tab. 1. Investment calculation for blackberry plantation
Investiciona kalkulacija podizanja zasada kupine

A. Costs of material - *Troškovi materijala*					
No *Red. br.*	Type of material *Vrsta materjala*	Unit of measure *Jed. mere*	Quantity *Količina*	Price per unit *Cena po jed.mere*	Price € *Iznos €*
1	Seedling/*Sadnica*	piece/*kom.*	1110	0.40	800
2	Manure/ *Stajnjak*	t	25	20	500
3	Mineral fertilizer *Mineralno đubrivo* a) NPK 8:12:26+3%Mgo b) KAN (29%N)	 kg kg	 350 150	 0.35 0.30	 123 45
4	Poles/*Stubovi za naslon*	piece/*kom.*	300	1.50	450
5	Supporting poles *Potporni stubovi*	piece/*kom.*	230	1.00	230
6	Wire and nails *Žica i ekseri*	kg	200	1.00	200
7	Drip irrigation system (approximate price) *Sistem zalivanja kap po kap (okvirna cena)*	piece/*kom.*	1	800	800
8	Pesticides/*Pesticidi*	kg	2	90	180
9	TOTAL/*UKUPNO*				2972

B. Costs of service - *Troškovi usluga*					
No *Red. br.*	Type of service *Vrsta usluge*	Unit of measure *Jedinica mere*	Quantity *Količina*	Price per unit *Cena po jed.mere*	Price € *Iznos €*
1	Pedologic and agrochemical soil analysis *Pedološka i agrohem. analiza zemljišta*	sample *uzorak*	2	35	70
2	Land flattening and clearing *Ravnanje i čišćenje terena*	hour/tractor *čas/traktor*	3	15	45
3	Manure transport *Prevoz stajnjaka*	hour/tractor *čas/traktor*	5	15	75
4	Plowing *Oranje*	hour/tractor *čas/traktor*	3	25	75
5	Cultivation *Freziranje*	hour/tractor *čas/traktor*	3	25	75
6	Furrowing *Izvlačenje redova jamica*	hour/cultivator *čas/motk.*	5	6	30
7	Seedlings and fertilizers transportation *Prevoz sadnica i min. đubriva*	hour/tractor *čas/traktor*	1	15	15
8	Poles transportation *Prevoz stubova*	hour/tractor *čas/traktor*	3	15	45
9	Spraying x 3 *Prskanje x 3*	hour/tractor *čas/traktor*	5	20	100
10	Processing between rows x 3 *Međuredna obrada x 3*	hour/cultivator *čas/motk.*	6	6	36
	TOTAL/*UKUPNO*				496

C. Labour costs - *Troškovi radne snage*					
No *Red. br.*	Type of service *Vrste usluga*	Unit of measure *Jedinica mere*	Quantity *Količina*	Price per unit *Cena po jed.mere*	Price € *Iznos €*
1	Ground preparations *Priprema terena*	working day *radni dan*	2	10	20
2	Manure loading and unloading *Utovar i istovar stajnjaka*	"	3	15	45
3	Manure spreading *Rasturanje stajnjaka*	"	3	15	45
4	Raw marking *Obelež. pravca redova i popravka brazde*	"	3	10	30
5	Preparation of seedlings for planting *Priprema sadnica za sadnju*	"	2	10	20
6	Shortening and planting seedlings *Sadnja i prekraćivanje sadnica*	"	4	10	40
7	Watering *Zalivanje*	"	3	10	30
8	Mineral fertilizer spreading *Rasturanje mineralnih đubriva*	"	2	10	20
9	Weeding and ground breaking *Plevljenje i razbijanje pokorice*	"	15	10	150
10	Pruning and removal of cut shoots *Sečenje i iznošenje odsečenih izdanaka*	"	3	10	30
11	Back setting *Postavljanje naslona*	"	15 2	10 15	150 30
12	Shoots decapitation *Pinsiranje izdanaka*				
	TOTAL *UKUPNO*				610

TOTAL (A+B+C) = (2.972 + 496 + 610) = 4.078 €

All the costs for one year of blackberry growing are presented in planned calculation (Table 2.), where the average yield and purchase price is predicted, which served for the calculation of the expected profit.

Tab. 2. Planned calculation of blackberry growing (0.50 ha, planned yield 7,000 kg).
Planska kalkulacija proizvodnje kupine (površina 0,50 ha, planirani prinos 7.000 kg)

I Costs of material - *Troškovi materijala*					
No *Red. br.*	Type of material *Vrsta materjala*	Unit of measure *Jedinica mere*	Quantity *Količina*	Price per unit *Cena po jed.mere*	Price € *Iznos €*
1	Manure/*Stajnjak*	t	7	20	140
2	Mineral fertilizer *Mineralno đubrivo* a) NPK 8:12:26+3%Mgo b) KAN (29%N)	kg kg	300 150	0.35 0.30	105 45
3	Pesticides/*Pesticidi*	kg	5	80	400
4	Binding/*Vezivo*	kg	6	5	30
5	TOTAL/*UKUPNO*				720
II Costs of service - *Troškovi usluga*					
No	Type of service *Vrsta usluge*	Unit of measure *Jedinica mere*	Quantity *Količina*	Price per unit *Cena po jed. mere*	Price € *Iznos €*
1	Manure transportation *Dovoz stajnjaka*	hour/tractor *čas/traktor*	2	15	30
2	Mineral fertilizer transportation *Dovoz min.đubriva*	hour/tractor *čas/traktor*	1	15	15
3	Cultivation (3x) *Kultiviranje (3x)*	hour/cultivator *čas/kult.*	15	6	90
4	Spraying (5-6x) *Prskanje (5-6x)*	hour/tractor *čas/traktor*	9	20	180
5	Transportation of blackberries *Transport plodova*	hour/tractor *čas/traktor*	11	15	165
	TOTAL/*UKUPNO*				480

III Labor costs - *Troškovi radne snage*					
No *Red br.*	Type of service *Vrsta usluge*	Unit of measure *Jedinica mere*	Quantity *Količina*	Price per unit *Cena po jed. mere*	Price € *Iznos €*
1	Manure spreading *Rasturanje stajnjaka*	working day *radni dan*	2	15	30
2	Mineral fertilizer spreading *Rasturanje min. đubriva*	working day *radni dan*	2	10	20
3	Tying and tensioning of the wires *Vezivanje izdanka i zatezanje zice*	working day *radni dan*	5	10	50
4	Removal of young shoots (3x) *Uklanjanje mladih izdanaka (3x)*	working day *radni dan*	6	10	60
5	Hand-hoeing in row direction (2x) *Ručno okopavanje u pravcu reda (2x)*	working day *radni dan*	6	10	60
6	Pruning and removal of old shoots *Rezidba i iznošenje starih izdanaka*	working day *radni dan*	6	10	60
7	Green pruning of exuberant outgrowth and side branches *Rezidba i iznošenje starih izdanaka*	working day *radni dan*	3	10	30
8	Fruit harvest *Berba plodova*	working day *radni dan*	60	10	600
9	TOTAL/*UKUPNO*				910
IV Amortization/*Amortizacija*					300
V Other costs/*Ostali troškovi*					200
A Total costs (I, II, III, IV, V)/*Ukupni troškovi (I, II, III, IV, V)*					2.610
B Production value (7,000 kg x 0.80 €)/ *Vrednost proizvodnje* (7.000 kg x 0.80 €)					5.600
V Profit (B-A)/*Dobit (B-A)*					2.990

Tab. 3. Financial production indicators: profit (p) = production value (pv) - total costs (tc) (€)
Finansijski pokazatelji proizvodnje:dobit (d)=vr.proizvodnje(vp)-ukupni troškovi(ut) (eur-ima)

Fruit type/*Voćna vrsta*	Blackberry/*Kupina*
Production value/*Vrednost proizvodnje*	5.600
Total costs/*Ukupni troškovi*	2.610
Profit/*Dobit*	2.990

$$\text{Cost} - \text{effectiveness (E)} = \frac{\text{production value (V)}}{\text{total costs}} = \frac{5600}{2610} = 2.14$$

$$\text{Profitability rate} = \frac{\text{profit (p)}}{\text{production value (V)}} x100 = \frac{2990}{5600} = 53.39\%$$

There are also labor costs in the calculation which are a half of total production costs (910 €); these remain in the households as compensation for the work, i.e. income. Therefore, both the household profit and economic interest become higher.

Conclusion

According to the results of economic analysis of blackberry growing, it can be concluded that production generates income. Average calculation costs are predicted and production value is planned. Cost-effectiveness value in blackberry growing is 2.14. Depending of investments in blackberry growing, profitability rate is 53.39%. These calculations show the advantages of blackberry growing in Sirinićka District, comparing to other fruit. Blackberry gives the fruits early, in the second year, while the full yield may be expected in the third year. With an adequate use of agro-technical measures, blackberry growing can be cost-effective in a period of 12 - 15 years; the growing period lasts for 2 years, the full yield period for 8 years, the decreasing yield period for 5 years. Realized production and purchase price in the market directly affect profitability level.

References

Maksimović, G. & Milačić, Lj. (2013). *Cost effectiveness of raspberries growing in rural areas of North Kosovo*. Paper presented at IV International simposium "AGROSYM 2013", Jahorina. Bosnia and Herzegovina.

Milić, D. (2008). Utvrđivanje isplativosti investicionog ulaganja u podizanje zasada kupine. *Savremena poljoprivreda, 57*(1-2), 77-84.

Petrović, S. i Milošević, T. (2002). *Malina - tehnologija i organizacija proizvodnje.* Agronomski fakultet u Čačku.

Petrović, S. i Leposavić, A. (2005). *Savremena proizvodnja maline-gajenje, zaštita, prerada.* Beograd: Institut za istraživanje u poljoprivredi.

Petrović, S., Milošević, T., Veljković, B., Leposavić, A. i Glišić, I. (2003). Analiza proizvodnje maline u R. Srbiji u periodu 1971-2002.godine. *Ekonomika poljoprivrede, L*(3), 243-253.

Veljković, B., Petrović, S., Milošević, T. i Leposavić, A. (2003). Proizvodi od malina u Evropi i SAD-u. *Ekonomika poljoprivrede, L*(3), 277-285.

Veljković, B., Petrović, S., Leposavić, A. i Glišić, I. (2006). Profitabilnost proizvodnje maline na području Srbije. *Ekonomika poljoprivrede, 53*(4), 1013-1021.

Received: March 28, 2014
Accepted: June 6, 2014

Ekonomska opravdanost proizvodnje kupine u ruralnim područjima Sirinićke Župe

Goran Maksimović[1], Radomir Jovanović[1],
Slavka Mitrović[1], Tatjana Ivanović[1]

[1]*Poljoprivredni fakultet, Univerzitet u Prištini, Lešak, Srbija*

Sažetak

U Sirinićkoj Župi kupine se uglavnom uzgajaju na manjim posedima u brdsko – planinskom području gde se postižu najbolji rezultati, ali se u poslednje vreme tražnja za ovom vrstom jagodičastog voća stalno povećava i interesovanje za njen uzgoj raste. Stoga je glavni cilj ovog rada da prikaže rezultate ekonomske analize proizvodnje kupina sa podacima dobijenim tokom dve godine praćenja grupe farmera u tom regionu. U skladu sa tim je izračunata i prezentovana profitabilnost bazirana na postojećim tržišnim, agroklimatskim i tehnološkim uslovima kao i na najmanjem postignutom prinosu kupina u grupi uzgajivača. Prema rezultatima ekonomske analize gajenja kupine, može se zaključiti da proizvodnja donosi prihod čak i sa jednom trećinom potencijala prinosa. Ekonomičnost proizvodnje kupina iznosi 2,14. Zavisno od investicija u proizvodnju kupina, profitabilnost iznosi 53,39%. Ove kalkulacije pokazuju prednost gajenja kupina u Sirinićkoj Župi u odnosu na drugo voće.

Ključne reči: investicije, troškovi, kalkulacije, ekonomski značaj

Goran Maksimović
E-mail address: goran.maksimovic@pr.ac.rs

Primljeno: 28. marta 2014.
Prihvaćeno: 6. juna 2014.

Originalan naučni rad
Original scientific paper
UDK: 632.4:582.788.1
DOI: 10.7251/AGRSR1401029J

University of Banjaluka, Faculty of Agriculture
Agro-knowledge Journal

Otpornost na niske temperature, prouzrokovače bolesti i štetočine izdvojenih genotipova drijena sa područja Gornjeg Polimlja

Vučeta Jaćimović[1], Đina Božović[1]

[1]*Biotehnički fakultet, Univerzitet Crne Gore, Podgorica, Crna Gora*

Sažetak

U ovom radu su prikazani trogodišnji rezultati ispitivanja otpornosti na niske temperature, prouzrokovače bolesti i štetočine 30 genotipova drijena koji su izdvojeni iz prirodne populacije sa područja Gornjeg Polimlja. Drijen odlikuju vrlo korisna i izražena biološka svojstva, koja nemaju većina voćnih vrsta: otpornost na prouzrokovače biljnih bolesti i štetočine voćaka, uspijevanje na siromašnijim zemljištima koja su ne kultiviraju i ne obrađuju, otpornost na niske temperature i otpornost na sušu. Kroz dugi period uspijevanja na ovom prostoru drijen se prilagodio i izgradio otpornost prema nepovoljnim, kako biotičkim tako i abiotičkim uticajima sredine. Ta prirodna otpornost je od ogromnog značaja jer omogućava gajenje po organskom konceptu proizvodnje.

Ključne riječi: *Cornus mas* L., abiotički i biotički faktori, organska proizvodnja

Uvod

Od skoro se javlja povećano interesovanje potrošača za upotrebu zdrave hrane. Napravljen je poseban tržišni segment za visoko kvalitetno alternativno voće kao što je drijen (*Cornus mas* L.). U svijetu postoje zahtjevi za proizvodnjom voća sa što manjom upotrebom pesticida, tj. za

proizvodnjom zdravstveno ispravne hrane po konceptu integralne i biološke proizvodnje (Keserović, 1996; Ogašanović i sar., 1996; Baboviću i sar., 2005). U obzir su uzete i vrste koje se trenutno manje gaje u obliku plantažnih zasada, kao što je slučaj sa drijenom, jer su one u ovom pogledu sa izuzetnim potencijalom i od velikog značaja.

Drijen daje zdrave plodove, bez upotrebe hemijske zaštite, koji se u svježem ili prerađenom stanju mogu koristiti kao zdrava, ukusna i ljekovita hrana (Zdravković, 2000). Proizvodnja plodova je vrlo ekonomična, jer u cijenu proizvoda ulaganje počinje tek troškovima berbe (Mratinić i Kojić, 1998).

Materijal i metode rada

U ovom radu korišćena je prirodna populacija drijena u rejonu Gornjeg Polimlja. U početku istraživanja obilježeno je oko 1100 stabala (žbunova) drijena na raznim lokacijama, pa se selekcijom došlo do 30 koji su prikazani u radu. Opštine Andrijevica, Berane, Plav, Gusinje i Bijelo Polje predstavljaju jednu teritorijalnu, klimatsku i orografsku cjelinu poznatu pod imenom Gornje Polimlje. Ovo područje se prostire od 42^{o} i 10$^{`}$ do 43$^{o}$ i 50$^{`}$ sjeverne geografske širine i od 19^{o} 40$^{`}$ do 20$^{o}$ i 30$^{`}$ istočne geografske dužine i obuhvata sliv gornjeg toka rijeke Lima. Ono uglavnom zauzima teritoriju koja se nalazi između planinskih vrhova Prokletija, Komova, Mokre Gore, Murgaša i visoravni Pešter, a sa zapada se graniči s Lisom i Bjelasicom.

Podaci o klimatskim pokazateljima odnose se na najveću opštinu u ovom području – Bijelo Polje, a obrađeni su od strane HMZ-a iz Podgorice (tab. 1).

Za prikazane tri godine najniža temperatura je zabilježena 2000. godine u januaru -26,6 ^{o}C, a najveća iste godine u avgustu bila je 37,3 ^{o}C. Apsolutne minimalne temperature u martu su bile od -2,8 ^{o}C (2001) do – 9,5 ^{o}C (2000), a u aprilu od – 1,5 ^{o}C (2000) do – 6 ^{o}C (2001). Otpornost na niske temperature ocjenjivana je osmatranjem cijelog stabla, a naročito na jugozapadnoj strani. Oštećenja cvjetnih pupoljaka od niskih temperatura utvrđivana su posmatranjem poprečnog presjeka pod optičkim mikroskopom („Konus - Campus“). Posmatrana je promjena boje; presjek zdravih pupoljaka je normalne zelene boje, dok oštećeni dobijaju tamnu, skoro crnu boju.

Tab. 1. Klimatske karakteristike ispitivanog područja
Climatic characteristics of the study area

Klimatski faktori *Climatic factors*	Mjeseci-*Months*													
	godina *year*	I	II	III	IV	V	VI	VII	VII	IX	X	XI	XII	godina *year*
Maksimalna	2000	9,7	11	20	26,8	28,8	32,6	36,5	37,3	27,5	-	-	14,2	37,3
temperatura	2001	17,2	17	24,6	26	28,8	32,4	33,2	35,4	28,8	27	20,8	11	35,4
Max. T	2002	12,8	16,8	22,4	22,2	27,2	34	33	29,6	24,6	22,6	21,4	14,4	34
Minimalna	2000	-26,6	-14,6	-9,5	-1,5	4,4	2,5	5,2	4	3	0	-3,8	-11,2	-26,6
temperatura	2001	-5,5	-9,5	-2,8	-6	0,6	3,4	10	8,3	4,3	0,1	-8	-18,2	-18,2
Min. T	2002	-18,2	-5,7	-3,6	-5,7	4,2	4,8	11	9	3,5	-4,2	-2,8	-10,4	-18,2
Srednja	2000	-5,7	-0,3	4	11,8	15,8	18	19,6	19,8	14,5	11,4	7,4	1,4	9,8
temperatura/	2001	2,6	2	9,8	8,8	15	16,1	19,8	20,5	13,7	11,2	3,6	-3,6	9,9
Average T	2002	-3,7	4	7,5	9	15,6	18,9	20,1	18,3	13,6	10,3	7,1	2,8	10,3

Otpornost prema prouzrokovačima bolesti i štetočinama utvrđivana je obilaskom proučavanih genotipova jednom mjesečno od marta do septembra i registrovanjem eventualnih promjena na listovima, plodovima i granama.

Rezultati i diskusija

Karakteristika drijena kao voćne vrste je da je on izuzetno otporan na nepovoljne uslove spoljašnje sredine. Populacija drijena u Gornjem Polimlju je izložena uticaju niskih temperatura, kako u zimskim mjesecima, tako i u proljeće. Otpornost na niske temperature ispitivanih genotipova drijena prikazana je u tabeli 2. Može se uočiti da zimski mrazevi, uglavnom, drijenu ne nanose štete. Rijetki su slučajevi oštećenja mladih izdanaka, dok kod višegodišnjih, zadebljalih grana i na kori debla oštećenja skoro da nema. Sličnu konstataciju iznijeli su i Mratinić i Kojić (1998).

U proučavanom periodu apsolutni temperaturni minimum od -26,6 ^{o}C u januaru prve godine nije izazvao otećenja cvjetnih pupoljaka ispitivanih genotipova drijena. To se može objasniti time da drijen u dubokom zimskom mirovanju može bez problema da podnese temperature i do – 30 ^{o}C, kao što navode Dudukal i Rudenko (1984). Mnogo veće štete drijenu nanose niske temperature koje se javljaju krajem zime i tokom proljeća kao pozni mrazevi. Od izučavanih genotipova samo su kod cvjetova genotipova BP 25, BP 01, BP 48 i BP 33 uočena oštećenja izazvana proljećnim mrazevima. Ovi genotipovi su izloženi velikoj insolaciji, tako da je moguće da kod njih i

ranije dolazi do kretanja sokova preko zime i u rano proljeće. Kada poslije toplijeg drugog dijela zime i ranog proljeća dođe do kretanja vegetacije kod drijena, odnosno cvjetanja, kasni proljećni mrazevi mogu nanijeti velike štete. Može se desiti da izmrznu cvjetovi i drijen ostane bez roda.

Tab. 2. Procjena otpornosti na niske temperature odabranih genotipova drijena
Resilience to low temperatures of selected Cornelian cherry genotypes

Genotip *Genotype*	Otpornost stabla na niske temperature *Tree resilience to low temperatures*	Oštećenja cvjetnih pupoljaka od niskih temperatura *Damages of flower buds caused by low temperatures*	Oštećenja cvjetnih pupoljaka od poznih proljećnih mrazeva *Damages of flower buds caused by late spring frosts*
	Ocjena/*mark*	Ocjena/*mark*	Ocjena/*mark*
BP 01	1*	1	3
BP 04	1	1	1
BP 06	1	1	1
BP 07	1	1	1
BA 13	1	1	1
BP 16	1	1	1
BP 17	1	1	1
BP 21	1	1	1
BP 22	1	1	1
PL 23	1	1	1
BP 25	1	1	3
BP 33	1	1	3
BP 36	1	1	1
BP 38	1	1	1
BP 40	1	1	1
BP 41	1	1	1
BP 44	1	1	1
BP 48	1	1	3
BA 49	1	1	1
AN 50	1	1	1
BP 51	1	1	1
BP 53	1	1	1
BP 54	1	1	1
BP 58	1	1	1
BA 70	1	1	1
BP 75	1	1	1
PL 98	1	1	1
PL 99	1	1	1
AN 103	1	1	1
AN 104	1	1	1

*1 - vrlo otporan / *very resistant,* 3 – otporan / *resistant*

U toku ovog istraživanja u periodu od 2000. do 2002. godine, to se nije desilo. Međutim, pošto je drijen voćka koja ima skoro najranije cvjetanje, opasnost od pojave mraza u periodu mart - april uvijek postoji. To se desilo pri ranijem praćenju fenoloških faza na području rejona Bijelog Polja, kada je 1997. godine drijen ove oblasti ostao bez roda (Jaćimović, 1999). Pošto rano cvjeta, ova voćna vrsta ima niz mehanizama koji su izgrađeni u borbi za opstanak u prirodnim populacijama. Naime, veliki broj cvjetova po jednoj biljci, koji po Jovančeviću i saradnicima (1990) iznosi oko 240000 i sukcesivno otvaranje cvjetova omogućavaju izbjegavanje mraza i dobar prinos čak i u lošim uslovima.

Prisutno je mišljenje da drijen praktično nije podložan bolestima, odnosno da je biljka jako otporna na prouzrokovače bolesti i štetočine. Međutim, neki istraživači navode podatke o oboljenjima kod osnovnih izdanaka i listova drijena. Na njima se ponekad javljaju karakteristične žute pjege, takozavane rđe, izazvane od strane gljive *Fungosporanium chavarieformae* (Dudukal i Rudenko, 1990). Vrlo rijetko plodove napada krastavost (*Venturia cerasi* Aderh.) ili trulež (*Monilia fructigena* Honey). Poslednja se javlja pri dužem čuvanju plodova. Ponekad se na listovima drijena sreću različite pjege koje slabe fotosintezu, a to snižava vegetativni prirast. Ovu pjegavost izazivaju gljive *Ascochyta cornicola* Dearn.& House, *Cercospora cornicola* Tracy et Earle i *Septoria cornicola* Desm (Dudukal i Rudenko, 1990). U borbi protiv njih koristi se bordovska čorba, kao i sakupljanje i spaljivanje lišća (Leontjak, 1981).

Sl. 1. Oštećeni rubovi lista od *Phyllobius oblongus* L. genotipa BP 48
Damaged edges of a leaf of Phyllobius oblongus L. *genotypes BP 48*

Šumsko šiblje je domaćin smeđeg listojeda (*Phyllobius oblongus* L.), sl.1., štetočine koja napada voćnjake, a štetu nanosi oštećenjem prvenstveno rubova mlađeg lišća, praveći polukružne izgrizine koje se nadovezuju jedna na drugu, tako da čitav rub postaje nazubljen. Smeđi listojed najradije napada koštičavo voće, ali se sreće i na jabučastom. Pored smeđeg, štete nanose i druge vrste listojeda. Žute pjege koje izaziva gljiva *Fungosporanium chavarieformae* nisu uočene na listovima nijednog genotipa (tab.3). Krastavost ploda (prouzrokovač *Venturia cerasi*), sl.2., primijećena je na malom broju plodova kod genotipova BP 04, BP25 i BP 33. *Monilia fructigena* je prouzrokovala truljenje plodova kod genotipa BP 41 (sl.3). Trulih plodova naročito je bilo 2002. godine, koja je bila jedna od godina sa najviše padavina u području Gornjeg Polimlja u periodu jun – septembar. Gljive koje izazivaju pjegavost listova (*Cercospora cornicola, Ascochyta cornicola, Septoria cornicola*), sl.3., smanjujući intenzitet fotosinteze, odnosno rast tih genotipova, zabilježene su kod BP 01 i BA 49. Od štetočina neznatna oštećenja u vidu izgrizanja rubova listova nanosio je smeđi listojed (*Phyllobius oblongus* L.). Ta oštećenja su bila od 1 do 5 % lisne površine kod listova genotipa BP 04 i od 4 do 7 % kod genotipa BP 48.

Sl.2. Pjegavost lista kod genotipa BP 01
Leaf spot in the genotype BP 01

Tab. 3. Procjena otpornosti na prouzrokovače bolesti i štetočine genotipova drijena

Resilience to pest and disease - causing agents of selected Cornelian cherry genotypes

Genotip *Genotype*	*Fungosp. chavarieformae* Ocjena / *mark*	*Venturia cerasi* Ocjena /*mark*	*Monilia fructigena* Ocjena/ *mark*	*Cercospora cornicola* Ocjena/ *mark*	*Ascochyta cornicola* Ocjena/ *mark*	*Phylobius oblongus* L. Ocjena/ *mark*	*Septoria cornicola* Ocjena/ *mark*
BP 01	1*	1	1	3	3	1	3
BP 04	1	3	1	1	1	3	1
BP 06	1	1	1	1	1	1	1
BP 07	1	1	1	1	1	1	1
BA 13	1	1	1	1	1	1	1
BP 16	1	1	1	1	1	1	1
BP 17	1	1	1	1	1	1	1
BP 21	1	1	1	1	1	1	1
BP 22	1	1	1	1	1	1	1
PL 23	1	1	1	1	1	1	1
BP 25	1	3	1	1	1	1	1
BP 33	1	3	1	1	1	1	1
BP 36	1	1	1	1	1	1	1
BP 38	1	1	1	1	1	1	1
BP 40	1	1	1	1	1	1	1
BP 41	1	1	3	1	1	1	1
BP 44	1	1	1	1	1	1	1
BP 48	1	1	1	1	1	3	1
BA 49	1	1	1	3	3	1	3
AN 50	1	1	1	1	1	1	1
BP 51	1	1	1	1	1	1	1
BP 53	1	1	1	1	1	1	1
BP 54	1	1	1	1	1	1	1
BP 58	1	1	1	1	1	1	1
BA 70	1	1	1	1	1	1	1
BP 75	1	1	1	1	1	1	1
PL 98	1	1	1	1	1	1	1
PL 99	1	1	1	1	1	1	1
AN 103	1	1	1	1	1	1	1
AN 104	1	1	1	1	1	1	1

*1 - vrlo otporan / *very resistant,* 3 – otporan / *resistant*

U odnosu na divlju floru, Kremenović (1996) smatra da gajene voćke imaju mnogo veću osjetljivost prema patogenima i uslovima sredine jer su kroz bioevoluciju, od divljih do kulturnih, izgubile niz odbrambenih biohemijsko – fizioloških mehanizama, jer je selekcija bila usmjerena prije svega na kvalitet.

Sl.3. Monilia fructigena na plodovima genotipa BP 41
Monilia fructigena on the fruits of the genotype BP 41

Otpornost prema prouzrokovačima bolesti i štetočinama kod novostvorenih sorti, po Ciglaru (1998), je narušena nepovoljnim uticajem čovjeka, koji je štiteći gajene voćke od tih činilaca, oslabio njihove vlastite odbrambene sposobnosti. U stvari, došlo je do izmjene prevalentnosti parazita, pa se stvarao prostor za širenje novih rasa – mutanata. Zato, upoznavanje genetičke otpornosti gajenih sorti i vrsta, stvaranje novih otpornih sorti prema parazitima i štetočinama, kako bi se upotreba hemijskih sredstava svela na minimum i time zaštitila životna sredina, imperativ je proizvođača i oplemenjivača voća. U okviru zahtjeva ostvarenja programa integralne zaštite voćaka od bolesti, stvaranju i selekciji otpornih sorti na najznačajnije bolesti u svijetu se poklanja izuzetna pažnja, pa su kao rezultat dugogodišnjeg rada stvorene brojne, potpuno otporne sorte različitih voćnih vrsta (Ognjanov i sar., 2002).

U intenzivnoj voćarskoj proizvodnji, skoro je nezamislivo da najznačajnije voćne vrste mogu iznijeti rod do zrelog ploda bez upotrebe zaštite u vidu raznih hemijskih sredstava. Posmatranjem genotipova drijena u populaciji Gornjeg Polimlja, može se doći da zaključka da se sporadično javljaju neka oštećenja od bolesti i štetočina kod par genotipova. S obzirom na ove prirodne predispozicije drijena kao vrste, on bi sigurno morao naći svoje mjesto u organskoj proizvodnji voća. Mora se istaći i činjenica da se u prirodnim uslovima gdje drijen uspijeva, dešava da nema pojave oboljenja i štetočina i to ga preporučuje za proizvodnju zdrave hrane i u obliku plantaža. Ali, zasigurno se ne može tvrditi da će to tako biti i onda kada se drijen bude gajio u obliku plantažnih zasada. Ne postoje potvrđeni nalaziM ali postoje pretpostavke da bi moglo doći do razmnožavanja neke štetočine ili povećanje pojave bolesti, ali to daje osnovu za dalju selekciju na otpornost.

Zaključak

Kroz dugi period uspijevanja na ovim prostorima drijen se prilagodio i izgradio otpornost prema nepovoljnim abiotičkim i biotičkim uticajima sredine. Drijen odlikuju vrlo korisna i izražena biološka svojstva, koja nemaju većina voćnih vrsta: otpornost na prouzrokovače biljnih bolesti i štetočine voćaka, uspijevanje na siromašnijim zemljištima koja su ne kultiviraju i ne obrađuju, otpornost na niske temperature kao i otpornost na sušu. Činjenice da nije potrebno vršiti hemijsku zaštitu drijena u borbi protiv bolesti i štetočina, te da su mali zahtjevi u pogledu ishrane, uz dobijanje dobrih prinosa svake godine, stavljaju drijen na listu preporučenih voćnih vrsta za organsku proizvodnju.

Literatura

Babović, J., Lazić, B., Malešević, M. i Gajić, Ž. (2005). *Agrobiznis u ekološkoj proizvodnji hrane.* Novi Sad: Naučni institut za ratarstvo i povrtarstvo.

Дудукал, Д. Галина и Руденко, И. С. (1984). *Особенности роста кизила в лесных насаждениях.* ССР: Академия наук молдавской ССР.

Дудукал, Д. Галина и Руденко, И. С. (1990). *Кизил*. Москва: Агропромиздат, Древесные породы.

Ciglar, I. (1998). *Integralna zaštita voćnjaka i vinograda.* Čakovec: Zrinjski dd.

Jaćimović, V. (1999). *Varijabilnost populacije i vrijednost selekcija drijena (Cornus mas L.) u rejonu Bijelog Polja* (Magistarska teza). Poljoprivredni fakultet Univerziteta u Novom Sadu.

Jovančević, R., Jovančević, M. i Raičević, Svetlana (1990). Samoniklo korisno bilje u slivovima rijeke Ćehotine, Lima i Tare. *Poljoprivreda i šumarstvo, 35*(4), 99-111.

Keserović, Z. (1996). *Pravci proizvodnje zdravstveno bezbednog voća. Proizvodnja zdravstveno – bezbedne hrane, ekonomsko - ekološki aspekt.* Beograd: Institut za ekonomiku poljoprivrede.

Kremenović, G. (1996). *Opšte voćarstvo.* Banja Luka: Glas srpski.

Леонтяк, Г. П. (1981). Поражаемость кизила болезянми и вредителями. *Сельское хозяйство Молдавии, 12,* 52-54.

Mratinić, Evica i Kojić, M. (1998). *Samonikle vrste voćaka Srbije.* Beograd: Institut za istraživanja u poljoprivredi „Srbija".

Ogašanović, D., Vujanić-Varga, Dinka, Stanisavljević, M., Milutinović, M., Miranović, Kseanija i Mišić, P. (1996). Struktura i perspektive voćarstva SR Jugoslavije. *Jug. voć., 113-114*(30), 5-20.

Ognjanov, V., Vračar, Lj., Cerović, S. i Božović, Đina (2002). *Integralna proizvodnja voća za industrijsku preradu.* Rad je prezentovan na Šestom savetovanju industrije alkoholnih i bezalkoholnih pića i sirćeta sa međunarodnim učešćem, Vrnjačka Banja, Srbija.

Stamenković, S i Stamenković, T. (2002). *Atlas štetočina i bolesti šljiva sa programom mera zaštite.* Čačak: Grafika Jureš.

Zdravković, M. (2000). *Moć lekovitog bilja. Lekovito bilje – hrana i lek.* Niš: Prosveta.

Primljeno: 28. marta 2014.
Odobreno: 12. juna 2014.

Resilience to Low Temperatures, Pests and Disease - Causing Agents of Selected Cornelian Cherry Genotypes in Gornje Polimlje Region

Vučeta Jaćimović[1], Đina Božović[1]

[1]*Biotechnical faculty, University of Montenegro, Podgorica, Montenegro*

Abstract

This paper presents the results of a three-year study of the resilience to low temperatures, pests and disease-causing agents of 30 Cornelian cherry genotypes (*Cornus mas L.*) selected from natural population in the Gornje Polimlje Region. Cornelian cherry has many useful and important biological features, which are not the characteristics of many other fruit species, such as the resilience to pests and disease-causing agents; growing in poor soil which can not be reclaimed and cultivated; and the resilience to low temperatures and drought, as well. For a long time Cornelia cherry has thrived in this region, so it got adapted and become resistant to biotic and abiotic influences. Their natural resistance is very important because it enables the cultivation according to the concept of organic production.

Key words: *Cornus mas* L., biotic and abiotic influences, organic production

Vučeta Jaćimović
E – mail address:ivajacim@t-com.me

Received: March 28, 2014
Accepted: June 12, 2014

Original scientific paper
Originalan naučni rad
UDK: 634.5:632.4(497.2)
DOI: 10.7251/AGREN1401041A

University of Banjaluka, Faculty of Agriculture
Agro-knowledge Journal

Susceptibility of Some Walnut Cultivars to *Gnomonia leptostyla* and *Xanthomonas arboricola* pv. *juglandis* in Bulgaria

Veselin Arnaudov[1], Stefan Gandev[1], Milena Dimova[2]

[1]*Fruit Growing Institute, Plovdiv, Bulgaria*
[2]*Agricultural University, Plovdiv, Bulgaria*

Abstract

The aim of the present research was to study and compare the susceptibility of 13 walnut cultivars – 5 Bulgarian (B), 3 French (F), 2 Hungarian (H), and 3 American (A) – to *Gnomonia leptostyla* (Fr.) and *Xanthomonas arboricola* pv. *juglandis* (Pierce) Dye, the pathogens causing leaf spot and walnut blight. The study was conducted under natural environmental conditions in a 5-8-year-old walnut collection orchard of the Fruit Growing Institute – Plovdiv, during the period 2006-2010. The evaluation of the attack produced by these pathogens was carried out on different organs leaves and nuts in two periods of the year (June and October). All the studied cultivars were distributed in 6 different levels of susceptibility to a given pathogen based on the degree of attack. The article presents data on the sensitivity of the studied walnut cultivars to the attack to *G. leptostyla* (Fr.) and X. *arboricola* pv. *juglandis* (Pierce) Dye and discusses the results obtained.

Key words: Juglans regia, cultivars, leaf spot, walnut blight, infection

Introduction

The English (Persian) walnut (*Juglans regia* L., *Juglans andaceae*) is attacked by great number of diseases. Among all known walnut diseases

at present the greatest economic importance in the climatic conditions in Bulgaria have walnut bacterial blight, caused by *Xanthomonas arboricola pv. juglandis* (Xaj), and walnut anthracnose, caused by a fungus which has two forms – sexual *Gnomonia leptostyla* (Fr.) Ces. et de Not.) and asexual (*Marssonina juglandis* (Lib.) Magn.). Both diseases attack the aboveground organs of the walnut tree. The causal agent of the anthracnose attacks mostly leaves, petioles and fruits while causal bacterium *Xanthomonas arboricola* pv. *juglandis* can infect leaves, catkins, female flowers, green branches, and nuts. Blight reduces yield and frequently lowers quality of harvested nuts.

Walnut blight was an object of many studies abroad – Miller and Bollen (1946), Mulerean and Schroth (1982), Gardan et al. (1986), Germain (1990), Germain, et al. (1990a), Belisario (1995), Martins (1996), Ninot et al. (1997), etc. Quite a lot data could be found in literature about the different degree of susceptibility of the walnut genotypes to the causal agent of the disease.

Total resistance to walnut blight was not established in any of the studied genotypes, but some of them, especially those of the early leafing genotypes, were attacked more strongly, which was due to the spring rains that provided more favourable conditions for infection and spreading of the disease (Mulerean & Schroth, 1982; Teviotdale et al., 1985; Olson et al., 1997; Belisario et al., 1997). Investigating the interrelation between the fruiting habit of walnut trees and the walnut blight attacks, Gardan et al. (1986) concluded that the early leafing cultivars, which most often set fruits on lateral fruit shoots, were more severely infected by the causal agent of walnut blight.

The walnut anthracnose was also an object of many studies in our country and abroad. In Bulgaria the disease was found and described for the first time by Malkov (1905, 1906) and investigated in the next years by a number of authors (Savov, 1923; Trifonov, 1962; Penev, 1964; Stefanov, 1964; Hristov, 1967, 1972; Nedev, 1976, 1983). Systematic studies on the biology, ecology and pathophysiology of its causative agent were carried out by Dimova (2003). In those studies a special attention was paid to the susceptibility of the different walnut cultivars to damages by that disease.

After some comparative research held in Hungary (Veghelyi and Penzes-Toth, 1990) and former Yugoslavia (Balaz et al., 1991) it was found that none of the investigated walnut cultivars appear to be resistant to the causal agent of anthracnose, and most of the genotypes demonstrate middle to high level of susceptibility. In similar experiments in Italy

Belisario et al. (1997) establishes that cultivars `Franquette` and `Hartley` display high level of stability to antharcnose, `Feltre` and `Malizia` - middle while `Payne`, `Serr` and `Sorrento`- low. For the climatic conditions of Spain Pastore et al. (2001) reports that the cultivars `Hartley` and `Mayette` are not attacked by the anthracnose agent while `J. Jefe` and `VZ5` show intense susceptibility to that pathogen.

The available controversial data in literature about the susceptibility of different local walnut cultivars to anthracnose as well as the lack of enough complete information about the susceptibility of some newly introduced walnut cultivars in our country was the reason to initiate that research.

The aim of the present study was to investigate and compare the susceptibility to *Gnomonia leptostyla* (*Marssonina juglandis*) and *Xanthomonas arboricola pv. Juglandis* of 13 local and introduced walnut cultivars – 3 of them American (A), 3 French (F), 2 Hungarian (H) and 5 Bulgarian (B).

Material and Methods

Susceptibility to the economically important diseases anthracnose (*Gnomonia leptostyla*) and walnut blight (*Xanthomonas arboricola pv. juglandis*) was evaluated by the infection index calculated following the formula of McKinney (1923), using collected walnut leaves and fruits. The level of *G. leptostyla* infection was detected from randomly collected 100 leaves and 50 fruits from 5 different walnut trees of each cultivar, reporting the affected tissue with developed acervuli. The attacks of *X. arboricola pv. juglandis* were reported as a percentage of the leaves and fruits infected by the bacterium. Necrotic spots of a diameter less than 3 mm were analyzed using a stereo microscope. All the studied cultivars were distributed in 6 different levels of susceptibility to a given pathogen based on the degree of attack.

Data were statistically processed by Duncan's test (Steele & Torrie, 1980).

Results and Discussion

In climatic aspect the five years of the research could be characterized as warm and moderately humid, with normal distribution of rainfall through the years. The weather in the spring months was warm and humid,

the intensity of rainfall in March was higher and in May and June lower than normal level. The summer months could be described as dry and hot (with temperatures exceeding the normal in the period June – September) and only in particular years and months the rainfall intensity was above the normal (Table 1).

Tab. 1. Climatic data registered in the Fruit Growing Institute of Plovdiv in the period 2006-2010
Klimatski podaci registrovani na Institutu za voćarstvo u Plovdivu u periodu 2006-2010

	Year *Godina*	Months *Mjeseci*							
		III	IV	V	VI	VII	VIII	IX	X
Temperature°C *Temperatura °C*	2006	7.2	12.8	17.6	21.1	22.8	23.6	18.4	13.7
	2007	8.3	12.9	18.7	23.2	25.5	23.0	-	-
	2008	9.7	13.3	17.7	22.2	24.2	24.7	-	-
	2009	6.9	12.0	19.0	22.0	24.5	23.5	18.1	13.2
	2010	7.2	12.8	18.5	21.2	24.1	25.7	19.1	-
Humidity % *Vlažnost %*	2006	80	29	74	78	74	73	76	86
	2007	76	67	78	74	58	75	-	-
	2008	74	83	76	79	64	64	-	-
	2009	78	78	75	73	68	70	80	89
	2010	78	80	76	78	78	71	74	-
Rainfall mm *Padavine mm*	2006	69	79	17	132	22	58	19	26
	2007	40	17	159	156	0	185	-	-
	2008	15	84	21	38	39	5	-	-
	2009	74	25	31	15	66	43	44	81
	2010	56	43	24	77	94	4	16	-

*****The data were collected by automatic computer system
Podaci su prikupljeni automatizovanim kompjuterskim sistemom

It is evident from the data in Table 1 that the meteorological conditions during the research period favor in a higher or lower degree the development of both diseases.

The first symptoms of anthracnose were found from the end of May to the beginning of June, when on the leaves of the trees appeared lesions, caused by the wintering stage of the fungus, *G. leptostila.* The same were found on young leaves, mainly in the form of small to medium-large round light brown spots, outlined by a dark brown band on the

periphery. On the leaves of some of the cultivars could be seen merging of the separate spots and forming of bigger ones, with irregular shape, often confined by nervation of leaves. Similar spots but of elongated oval form could be seen on the petioles of leaves and their nervation as well as on the young shoots. The spots on the fruits were small, grey-brown, on the surface.

Fig 1. Symptoms of walnut leaf spot *(Gnomonia leptostyla* (Fr.))
Simptomi antraknoze oraha (Gnomonia leptostyla (Fr.))

Walnut blight is usually manifested in two forms: continuous necrosis and local spotting. In the first case the disease is manifested as blackening of the main and side veins of the young growing leaves. When the bacterium penetrates into the closely located parenchyma tissue of the leaf, large necrotic spots are formed. Hence, the bacterium can pass through the leaf stalk into the shoot, causing the latter to wither and dry out. The local spotting appears in the old leaves as small angular brownish spots of an oily type (fig. 2).

The spots on the shoots are black, oily, slightly sunken, with longitudinal or ring shaped, affecting both the bark and the wood that turns black. The bacterium attacks the catkins and the young fruit sets, which turn black and fall off. The spots on the growing fruits are large, rounded, black, with a shiny and wrinkled surface.

Fig. 2. Symptoms of bacterial blight on the leaves *(Xanthomonas arboricola* pv. *juglandis* (Pierce) Dye)
Simptomi bakteriozne pjegavosti oraha (*(Xanthomonas arboricola* pv. *juglandis* (Pierce) Dye)

The rainfall during the second half of the vegetation period favored the development of the two diseases and created conditions for arising of new, secondary infections and appearance of new lesions on different green parts of the walnut trees. In such climatic conditions some research was conducted to determine the level of susceptibility of the different walnut cultivars to attacks of anthracnose and bacterial blight.

The results of the conducted research for determining the level of susceptibility of the walnut cultivars to anthracnose attack show, that all investigated cultivars are susceptible to a certain extent to attack by the agent of the disease, regardless of the fluctuation through the years (Table 2).

From the data in Table 2 it is evident that the early leafing cultivars, which most often set fruits on apical fruit shoots, re more susceptible to the causal agent, *Gnomonia leptostyla* (Fr.) Ces. et de Not, compare to later leafing cultivars and lateral fruit-bearing - a regularity which was observed through all the years of this study.

In the group of apical fruit-bearing cultivars on leaf level the highest infestation index was reported in `Seer` (41.6%), and the lowest one –

in `Silistrenski`(10.3%). In cultivars `Slivenski`,`Izvor 10`,`Sheinovo` and `Kuklenski` the degree of *G. leptostyla* infestation varied within 29.8 and 19,4 % in average. In the group of lateral fruit-bearing cultivars, in contrast to the above group, were reported considerably lower values of anthracnose attack, ranging from 13.9 to 5.2%. The highest infestation index in the leaves was reported in cultivars `Hartley` (13.9%), `Milotai` (9.0%), `Tiszacsecsi` (9.0%)` and Lara` (8.8%), and the lowest in cultivars `Fernette`(8.0), `Fernor`(7,0%) and `Chandler` (5.2%) (Table 2).

Tab. 2. Response of walnut cultivars to *G. leptostyla* attacks in the period 2006-2010, Fruit Growing Institute – Plovdiv.
Reakcija sorti oraha na patogena G. leptostyla u periodu 2006-2010, Voćarski institut - Plovdiv

Cultivar *Sorta*	Leaf infestation index, by McKinney *Indeks bolesti lista prema McKinney-u*						Fruit infestation index, by McKinney *Indeks bolesti ploda prema McKinney-u*			
	2006	2007	2008	2009	2010	Average *Prosjek*	2008	2009	2010	Average *Prosjek*
Serr	61.4	82.1	28.3	5.5	30.7	41.60 a(4)	1.50	2.20	19.5	7.73a(6)
Slivenski	45.8	49.0	31.2	6.2	17.0	29.84 b(4)	0.65	1.73	3.51	1.96b(4)
Izvor 10	50.8	39.3	31.2	5.0	16.0	28.46 b(4)	0.60	1.40	3.30	1.77b(4)
Sheynovo	47.5	30.9	15.3	3.4	12.8	21.98 bc(3)	0.50	0.65	0.50	0.55b(3)
Kuklenski	34.1	32.0	14.2	3.5	13.2	19.40 bcd(3)	0.47	1.15	2.70	1.44b(3)
Silistrenski	12.4	10.8	13.0	2.3	13.2	10.34 cde(3)	0.42	0.98	2.65	1.35b(3)
Hartley	20.4	14.5	18.0	3.0	13.4	13.86 cde(3)	0.16	0.21	0.05	0.14b(1)
Lara	15.0	13.4	5.7	1.0	8.7	8.76 cde(3)	0.05	0.06	0.10	0.07b(1)
Milotai 10	16.0	9.8	8.3	1.4	9.7	9.04 cde(3)	0.19	0.22	0.18	0.20b(1)
Tiszacsecsi	21.0	8.0	6.9	1.2	8.0	9.02 cde(3)	0	0.20	0	0.07b(1)
Fernette	29.8	1.6	0	0.1	8.4	7.98 de(3)	0.30	0	0	0.10b(1)
Fernor	10.2	9.6	4.0	0.9	10.1	6.96 de(3)	0.05	0	0.10	0.05b(1)
Chandler	8.2	3.4	5.5	0.9	7.8	5.16 e(3)	0.03	0	0.05	0.03b(1)

The means followed by the same letter do not differ significantly from one another ($p = 0.05$).
Označene vrijednosti se ne razlikuju značajno jedna od druge ($p = 0.05$).
Leaf cultivar susceptibility: (1) Highly resistant (up to 1 % infected area; (2) Resistant (1 – 5 % infected area); (3) Slightly susceptible (5 – 25 % infected area); (4) Susceptible (25 -50 % infected area); (5) Highly susceptible (50 - 75 % infected area), (6) Very highly susceptible (75 - 100 %) infected area.
***Osjetljivost lista kod sorte**: (1) Veoma otporan (do 1 % zaraženog područja; (2) Otporan (1 – 5 % zaraženog područja); (3) Neznatno osjetljiv (5 – 25 % zaraženog područja); (4) Osjetljiv (25 -50 % zaraženog područja); (5) Veoma osjetljiv (50 - 75 % zaraženog područja), (6) Izuzetno osjetljiv (75 - 100 %) zaraženog područja.*
Fruit cultivar susceptibility: (1) Highly resistant (up to 0.25% % infected area; (2) Resistant (0.25 – 0.5% infected area); (3) Slightly susceptible (0.5 – 1.5% infected area); (4) Susceptible (1.5 – 3.5% infected area); (5) Highly susceptible (3.5 – 5% infected area); (6) Very highly susceptible (> 5% infected area).
***Osjetljivost ploda kod sorte:** (1) Veoma otporan (do 0,25% zaraženog područja; (2) otporan (0,25 – 0,5% zaraženog područja); (3) Neznatno osjetljiv (0,5 – 1,5% zaraženog područja); (4) Osjetljiv (1,5 – 3,5% zaraženog područja); (5) Veoma osjetljiv (3,5 – 5% zaraženog područja); (6) Izuzetno osjetljiv (> 5% zaraženog područja).*

The results were similar at fruit level. In the group of apical fruit-bearing cultivars the highest infestation index in the fruits was reported in `Seer` (7.7%) and middle in the rest cultivars (`Slivenski`, `Izvor` 10, `Kuklenski`, `Silistrenski` and `Sheinovo` varying from 2.0 to 0.6 % (Table 2). In the group of lateral fruit-bearing cultivars a higher level of attack was reported in cultivars 'Millotay'(0.20%) and 'Hartley'(0.14%), while in the rest of the cultivars (`Lara`,`Fernette`, `Tiszacsecsi`, `Fernor` and `Chandler` it was low and varied from 0.1 to 0.03 %. (Table 2).

The investigated walnut cultivars are not attacked equally regarding the bacterial agent, *Xanthomonas arboricola* pv. *juglandis* (Pierce) Dye, which is very well illustrated by the data in Table 3. Apical fruit-bearing cultivars, as most of Bulgarian cultivars are, demonstrate high susceptibility to anthracnose. Regarding the bacterial blight, they show some tolerance and are not so intensely attacked by this disease as lateral fruit bearing cultivars.

Tab. 3. Response of walnut leaves to *X. arboricola* pv. *juglandis* attacks in the period 2006-2010, Fruit Growing Institute – Plovdiv
Reakcija lišća oraha na patogena X. arboricola pv. juglandis u periodu 2006-2010, Voćarski institut - Plovdiv

Cultivar *Sorta*	Leaf infestation index, by McKinney *Indeks bolesti lista prema McKinney-u*						Fruit infestation index, by McKinney *Indeks bolesti ploda prema McKinney-u*			
	2006	2007	2008	2009	2010	Average *Prosjek*	2008	2009	2010	Average *Prosjek*
Serr	5.1	7.0	14.7	0.5	1.0	5.66 bc(2)	0.5	1.0	1.0	0.83 e(3)
Slivenski	3.9	5.3	20.1	4.5	2.0	7.16 bc(2)	4.0	4.5	2.0	3.50 bc(5)
Izvor 10	4.0	8.2	27.8	1.8	2.0	8.76 bc(2)	1.8	1.0	2.0	1.60 cde(4)
Sheynovo	1.1	4.9	18.6	1.3	1.0	5.38 bc(2)	1.3	1.0	1.0	1.10 de(3)
Kuklenski	5.3	7.8	23.0	3.8	5.0	8.98 bc(3)	4.6	3.8	5.0	4.47 ab(5)
Silistrenski	2.3	7.8	14.8	0.6	1.5	5.40 bc(2)	3.7	0.3	1.0	1.67 cde(4)
Hartley	15.8	21.9	22.2	7.6	13.4	16.18 a(3)	7.6	4.0	6.5	6.03 a(5)
Lara	4.3	7.8	10.4	3.0	5.0	7.50 bc(2)	2.5	1.0	1.3	1.60 cde(4)
Milotai 10	3.6	4.1	9.1	6.0	10.0	6.56 bc(2)	1.8	6.0	10.0	5.93 a(5)
Tiszacsecsi	2.0	6.4	15.3	5.8	8.0	7.50 bc(2)	3.1	1.2	3.0	2.43 bcd(4)
Fernette	3.6	2.8	10.2	0.9	2.5	4.00 c(2)	0.9	0.1	1.0	0.67 e(3)
Fernor	0.7	1.3	8.1	2.8	4.0	3.38 c(2)	1.6	0.3	1.2	1.03 de(3)
Chandler	3.7	4.6	3.5	2.5	7.0	3.66 c(2)	1.4	0.5	1.3	1.07 de(3)

The means followed by the same letter do not differ significantly from one another ($p = 0.05$).
Označene vrijednosti se ne razlikuju značajno jedna od druge (p = 0.05).
Leaf cultivar susceptibility: (1) Highly resistant (0 - 3 % infected area); (2) Resistant (3 - 10 % infected area); (3) Slightly susceptible (10 - 25 % infected area); (4) Susceptible (25 - 50 % infected area); (5) Highly susceptible (50 - 75 % infected area), (6) Very highly susceptible (75 - 100 % infected area).
Osjetljivost lista kod sorte: *(1) Veoma otporan (0 - 3 % zaraženog područja); (2) Otporan (3 - 10 % zaraženog područja); (3) Neznatno osjetljiv (10 - 25 % zaraženog područja); (4) Osjetljiv (25 - 50 % zaraženog područja); (5) Veoma osjetljiv (50 - 75 % zaraženog područja), (6) Izuzetno osjetljiv (75 - 100 % zaraženog područja).*
Fruit cultivar susceptibility: (1) Highly resistant (up to 0.25% % infected area; (2) Resistant (0.25 – 0.5% infected area); (3) Slightly susceptible (0.5 – 1.5% infected area); (4) Susceptible (1.5 – 3.5% infected area); (5) Highly susceptible (3.5 – 5% infected area); (6) Very highly susceptible (> 5% infected area).
Osjetljivost ploda kod sorte*: (1) Veoma otporan (do 0.25% % zaraženog područja; (2) Otporan (0.25 – 0.5% zaraženog područja); (3) Neznatno osjetljiv (0.5 – 1.5% zaraženog područja); (4) Osjetljiv (1.5 – 3.5% zaraženog područja); (5) Veoma osjetljiv (3.5 – 5% zaraženog područja); (6) Izuzetno osjetljiv (> 5% infected area).*

In the group of apical fruit-bearing cultivars on leaf level, the highest infestation index was reported in cultivars `Kuklenski`(9.0%), `Izvor` 10`(8.8%) and `Slivenski`(7.2%), and considerably lower in the rest of the cultivars like `Sheinovo`(5.4%), `Silistrenski` (5.4%) and `Silistrenski` (5.7%), (Table 3).

In the group of lateral fruit-bearing cultivars, the highest level of attack was reported in `Hartley`(16.2%) and `Lara`(11.0%), middle – in `Tiszacsecsi` (7,5 %) and `Millotay`(5.6 %) and low – in `Chandler`(4.4%), `Fernette`(4.0%) and `Fernor`(3.4%) (Table 3).

The results at level fruit were similar. In apical fruit-bearing cultivars, the average level of attack is reported for cultivars `Kuklenski`(4.5%) and `Slivenski` (3.5%), and low level of attack for `Silistrenski`, `Izvor` 10, `Sheinovo` and `Seer`, varying from 1,7% to 0.8%. For cultivars of lateral fruit-bearing the highest level was reported for `Hartley` (6.0%), and `Millotay` (5.9%), middle for `Tiszacsecsi`(2.4%) and `Lara` (1.6%) and the lowest for `Chandler` (1.1%), `Fernor`(1.0%) and `Fernette` (0.7%) (Table 3).

Conclusion

Summarizing the results of the research, we can make the conclusion that all investigated cultivars are susceptible to attack of walnut anthracnose and walnut bacterial blight agents to some extent.

Cultivars of apical fruit-bearing are more susceptible to anthracnose attack compare to cultivars of lateral fruit-bearing. The cultivars of apical fruit-bearing and earlier leafing are more susceptible to anthracnose attack compare to those of the same type of fruit-bearing and later leafing. From the group of apical fruit-bearing cultivars the most sensitive to anthracnose are `Seer`, `Slivenski` and `Izvor` 10, and the less sensitive - `Silistrenski` and `Sheinovo`. The cultivar `Kuklenski` takes a middle position. For lateral fruit-bearing walnut cultivars a more intense attack of anthracnose is observed in cultivars with earlier leafing compare to those of the same type of fruit-bearing but with later development. The most susceptible of this group are cultivars `Hartley`, `Lara`, `Tiszacsecsi` and `Millotay`, and the least susceptible are `Chandler` `Fernor` and `Fernette`.

The cultivars of lateral type of fruit-bearing are more susceptible to bacterial blight attack compare to those of apical fruit-bearing. From the apical fruit-bearing cultivars more susceptible to bacterial blight at level leaves and fruits are cultivars `Kuklenski`, `Slivenski` and `Izvor 10`, while

`Silistrenski` and `Sheinovo` are with low degree of sensitivity. The cultivars of lateral type of fruit-bearing and earlier leafing are more susceptible to bacterial blight attack compare to those of the same type of fruit-bearing and later development. In this group the most sensitive at leaf level is are cultivar `Hartley`, followed by cultivars `Lara`,`Tiszacsecsi`, and `Millotay`, and the least sensitive - `Chandler`, `Fernor` and `Fernette`.

At fruit level the most sensitive to this disease are cultivars `Hartley` and `Millotay`, followed by cultivars `Tiszacsecsi`, and `Lara`, and the least sensitive - `Chandler`, `Fernor` and `Fernette`.

In conclusion we must note the fact that in conditions of Bulgaria, respectively the region of Plovdiv, anthracnose occurs more often. It is observed every year and causes serious damages on the green organs of walnut trees (Arnaoudov & Gandev, 2009). The cultivars of earlier development and apical fruit-bearing, to which almost all Bulgarian cultivars belong to, are more susceptible to anthracnose compare to those of lateral type of fruit-bearing and later development.

Bacterial blight on walnuts in Bulgaria is spread on a smaller scale. Most probably, on one hand, this is due to the lower sensitivity of the popular walnut cultivars and genotypes and on the other hand – the geographical position and climatic conditions of the region. From the point of view of the local walnut cultivars, this disease could cause big damage only in regions and years with higher humidity. Regarding the introduced walnut cultivars of lateral fruit-bearing type, the situation is different. For some of them it has been ascertained in this, as well as in previous our research (Arnaoudov at al., 2009), that they are highly sensitive to bacterial blight attack. This makes it necessary when planting new orchards in future to make the right choice, assuming not only the economic characteristics of the cultivar but its sensitivity to economically important diseases, as well.

References

Arnaoudov, V. & Gandev, S. (2009). Susceptibility of some cultivars to *Gnomonia leptostilla* (Fr.) Ces. et de Not. The First Balkan Symposium on Fruit Growing, *Plovdiv, 15-17 November 2007. Acta Horticulturae,* (825), 407-412.

Arnaoudov, V., Gandev, S. & Dimova, M. (2009). *Susceptibility of some walnut varieties to walnut blight (Xanthomonas arboricola pv.*

juglandis (pierce die). Paper presented at 3rd International Scientific Horticulture Conference. Nitra. Slovaka.

Balaž, J., Korać, M. i Cerović, S. (1991). Osetljivost genotipova oraha prema Gnomonia leptostyla (Fr) Ces et Not. prouzrokovaču lisne pegavosti. Jugoslovensko voćarstvo, *95-96,* 91-94.

Belisario, A. & Zoina, A. (1995). Occurrence of Persian walnut bacterial blight and control in the nursery. *Europ. J. for Path., 25*(4), 224-237.

Belisario, A., Zoina, A., Pezza, L., Caboni, E., Damiano, C. & Corazza, L., (1997). *Preliminary investigations on population dynamics of Xanthomonas campestris* pv. *juglandis and* other *Xanthomonas in English (Persian) walnut in vitro plants.* Paper presented 10th Congress of the Mediterranean Phytopathological Union, Montpellier (France), 1-5 June 1997.

Gardan, L., Luisetti, J., Gaignard, J.L. (1986). La bactériose du noyer. *Phytoma, La Défense des Végétaux,* (11) 35-41.

Germain, E. (1990). *I portinnesti del noce. Rivista di Frutticoltura, 52*(12), 29-32.

Germain, E. (1990a). Inheritance of late leafing and lateral bud fruitfulness in walnut (*Juglans regia* L.), phenotypic correlations among some traits of the trees. First Intern. Symp. on Walnut Production, Budapest (Hungary), 25-29 Sept. 1989. *Acta Horticulturae,* 284, 125-134.

Germain, E. (2004). *Inventory of walnut research, germplasm and references.* Rome: Food and Agriculture Organization of the United Nations. FAO Technical Series 66.

Hristov, A. (1956). *Bolesti po kulturnite rasteniya v Bulgaria.* Sofia: Zemizdat.

Hristov, A. (1972). *Opredelitel na bolestite po rasteniyata.* Sofia: Zemizdat.

Josifović, M. (1956). Poljoprivredna fitopatologija. Beograd: Naučna knjiga.

Malkov, K. (1905). Die schadlichsten Insekten und Pflanzenkrankheiten, welche an der Kulturpflanzen in Bulgarien wahrend des Jahres 1903 geschadigt haben. *Zeitschrift fur Pflanzenkrankheiten, 15*(1,) 50-53.

Malkov, K. (1906). Contribution to the parasitic fungi in Bulgaria. *Travaux de la Societe Bulgare des Sciences Naturelles,*(3) 14-25.

Martins, J.M.S. (1996). A method for measuring the intensity of walnut bacterial blight on fruits. *Nucis,* (5),15-17.

Miller, P.W. & Bollen, W.B. (1946). Walnut bacteriosis and its control. *Tech. Bull. Ore. agric. Exp. Sta.*, (9), 107.

Mulerian, E. N. & Schroth, M. N. (1982). Ecology of *Xanthomonas campestris* pv. *juglandis* on Persian (English) walnut. *Phytopathology*, (72), 434-438.

Nedev, N., Serafimov, S., Anadoliev, G., Kavardjikov, L., Krinkov, H., Radev, R., Dochev, D., Stamatov, I., Slavov, N.,Vishanska, Y., Rusalimov, J., Iovchev, I., Djeneva, A., Lalev, N., Iliev, I. & Slavcheva, R.(1983). *Orehoplodni culturi*. Plovdiv: Christo G. Danov.

Nedev, N., Vasilev, V., Kavardjikov, L. & Zdravkov, K. (1976). *Orehoplodni culturi*. Plovdiv: Christo G. Danov.

Ninot, A., Moragrega, C., Montesinos, E. & Aletà, N., (1997). El control filosanitari de la bacteriosi al noguer. Calendari d'aplicacions amb coure. *2a Jornada de Protecció Vegetal. ICEA. 21-26.*

Olson, W. H., Buchner, R .P., Adaskaveg, J. E. & Lindow S. E. (1997). Walnut blight control in California. *Acta Horticulture (ISHS),* (442), 361-365.

Pastore, M., Consoli, D. & Cristinzio, G. (1997). Susceptibility of 32 walnut varieties to *Gnomonia leptostyla* and *Xanthomonas campestris pv juglandis*. *Acta Hort.*, (442), 379–384.

Penev, S. & Nedev, N. (1964). Ovoshtarstvo. Tsenni orekhovi semenacheta - nasha selektsiya. *Fruit Growing*, (11), 16-19.

Petrova-Dimova, M. (2003). *Antraknosa po oreha* (Doctoral dissertation). Agrarian University, Plovdiv, Bulgaria.

Rosnev, B. & Tsanova, P. (1980). Vŭrkhu razprostranenieto na antraknosata i borbata za namalyavane povredite prichineni ot neya po orehite (Juglans regiya L .) v naschata strana. *Forestry Science, 17*, 44-56.

Savov, C. (1923). Razprostranenie na gŭbnata, bakterialna i fanerogamna flora po kulturnite i divi rasteniya v Shumenska okoliya In *Scientific works of Agricultural Institute of Bulgaria*, *1924.*Sofia.

Steele, R. & Torrie, J. (1980). *Principles and procedures of statistics*. New York: McGraw-Hill.

Stefanov, N. (1964). A pomological study of the Silistrenski walnut variety (In Bulgarian). *Grad. lozar. Nauka, 1*(7), 25-28.

Teviotdale, B.L., Schroth, M.N. & Mulrean, E.N. (1985). Bark, fruit and foliage diseases. In Ramos, D. (Ed.)*, Walnut orchard management* (pp. 153-157). The Regents of the Univ. of California, Div. of Agricultural and Natural Resources, Oakland, Publ. 21410.

Trifonov, D. (1962). Antraknosa po oreha *Gnomonia leptospila* (Fr.) Ces et de Not. *Plant protection*, (6), 10-14.

Veghelyi, K & Penzes-Toth, T. (1990). Life cycle, forecast and control of Gnomonia leptostyla Fr. Ces et de Not. *Acta horticulturae,* (284), 303.

Received: March 28, 2014
Accepted: June 3, 2014

Osjetljivost nekih sorti oraha na patogene *Gnomonia leptostyla* i *Xanthomonas arboricola* pv. *juglandis* u Bugarskoj

Veselin Arnaudov[1], Stefan Gandev[1], Milena Dimova[2]

[1]*Voćarski institut, Plovdiv, Bugarska*
[2]*Poljoprivredni univerzitet, Plovdiv, Bugarska*

Sažetak

Cilj ovog istraživanja bio je da se prouči i uporedi osjetljivost 13 sorti oraha – 5 bugarskih (B), 3 francuske (F), 2 mađarske (H), and 3 američke (A) – na *Gnomonia leptostyla* (Fr.) i *Xanthomonas arboricola* pv. *juglandis* (Pierce) Dye, patogene koji prouzrokuju antraknozu oraha i bakterioznu pjegavost oraha. Ispitivanje je sprovedeno u prirodnim uslovima okruženja na kolekcionom zasadu starom od 5 do 8 godina u Voćarskom institutu u Plovdivu tokom perioda 2006-2010. Evaluacija napada kojeg su prouzrokovali ovi patogeni sprovedena je na 6 različitih nivoa osjetljivosti na dati patogen, a baziraju se na stepenu napada. Članak prezentuje podatke o osjetljivosti ispitivanih sorti na patogene *G. leptostyla* (Fr.) i X. *arboricola* pv. *juglandis* (Pierce) Dye, kao i diskusiju u vezi sa dobijenim rezultatima.

Ključne riječi: Juglans regija, sorte, antraknoza oraha, bakteriozna pjegavost oraha, infekcija

Veselin Arnaudov
E-mail address:vaarnaudov@abv.bg

Primljeno: 28. marta 2014.
Odobreno: 3. juna 2014.

Original scientific paper
Originalan naučni rad
UDK: 634.63(497.16)
DOI: 10.7251/AGREN1401055L

University of Banjaluka, Faculty of Agriculture
Agro-knowledge Journal

Variability of Oil Content in Fruit of Olive Variety Žutica on Montenegrin Coast

Biljana Lazović [1], Mirjana Adakalić [1], Stoja Ljutica [1], Tatjana Perović[1], Miroslav Čizmović[1]

[1]*University of Montenegro, Biotechnical faculty-Podgorica, Centre for Subtropical Cultures-Bar, Montenegro*

Abstract

Žutica, the major variety on Montenegrin Coast, belongs to the group of olive varieties for oil production, with oil content in average above 21%. During the research of the properties of Žutica variety, the existence of variability in the oil content was recorded. In order to determine the degree of the variability of oil content within this variety, the fruits of 42 accessions were analyzed. The results confirmed high content of oil as well as the existence of variability of this parameter between the studied accessions. Twenty two accessions had the content of oil of over 20%, while 13 accessions had the oil content greater than 22% in fresh matter. The highest oil content was in fruit of VAL2 (24.3%) and in dry matter in DUB (63.77%). The results suggest Žutica accessions (clones) with higher oil content promising for spread in the new plantations.

Key words: olive accessions, Montenegro, olive oil

Introduction

Olives have been grown on the Montenegrin Coast for more than 2000 years, as evidenced by two exemplars situated in Bar and Budva. The main cultivar that dominates in the olive assortments of Montenegro is Žutica. This cultivar is present with 98% in the southern coastal area or with 65% in relation to other cultivars. During the long period of cultivation and influences of different ecological conditions along the coast, many differences have evolved in the frame of this variety recognizable on the phenotype (Lazović et al., 2002). In general, Žutica is characterized as a variety for oil production, with a small to medium-sized fruit and a high content of oil of more than 21% (Miranović, 1994; Lazović, 2001). This variety is also used for table consumption, prepared in local ways as green and black.

During the research related to morphological and chemical properties of this variety, the existence of variability in the oil content was recorded. With recording of the phenotype differences among individuals of this variety, we considered the possibility to find clones with the valuable morphological traits that can be used in production and/or in breeding programs. In spite of overall opinion that clone selection has not produced much innovation in terms of better genotypes (Bellini et al., 2008), the clones with high oil content can be used to improve olive oil production. The aim of this work was to analyze the range of olive oil content among Žutica individuals/clones and the capacities represented with the most prominent clones for the olive oil production.

Material and Methods

During the three-year period (2009-2011) the study was conducted on 42 individuals /clones of cultivar Žutica. Individual trees /clones were marked according to their original location along the coast of Montenegro (Bar: DAB1, DAB2, DAB3, DAB4, SUS1, SUS2, CSV1, CSV2, DM5, STM1, STM2, KAP1, KAP2, BRI1, BRI2, KUR, ZAVG; Ulcinj: VAL1, VAL2, VALD, VALL, STUL, VALVO; Budva: REZ, PET1, PET2, PET3, PET4, MAES, DIVA, MIRI2; Tivat: GRAB1, GRAB2, GRAB3, KRST; Kotor: KAV1, KAV2, DUB; Lustica: LUS14, LUS15, LUS2, LUS3). Phenological phases (here presented with the end of flowering and beginning of ripening, respectively) were observed and the period of development of fruit was calculated (Baranco et al., 2000). The fruit samples collected in quantity of 1kg per tree were used for the analyses of

moisture and dry matter at 105ºC (drier Memmert UFB400) and olive oil content (Soxtec apparatus with diethyl ether), as well. The data obtained were statistically processed with STATISTIX 7.0 program. The $LSD_{0.05}$ test was used to define the significance of the differences among Žutica individuals/clones. The data were standardized and a dendrogram was constructed using Unweighted pair-group average (UPGMA) method with Squared Euclidean distance in the program STATISTICA 5.0.

Results and Discussion

Flowering in Žutica clones (Table 1) occurred in the last decade of May and the beginning of June. Flowering ended with 9 days of difference among the clones. Flowering intensity was not significantly different. No influence of the location on the clone flowering was noticed.

Tab. 1. Flowering and maturation of 42 clones of cv. Žutica (2009-2011)
Cvjetanje i zrenje 42 klona sorte Žutica (2009-2011)

No. *Br.*	Clone *Klon*	End of flowering *Kraj cvjetanja*	Degree of flowering *Stepen cvjetanja*	Beginning of maturation *Početak zrenja*	Days from the end of flowering to the beginning of maturation *Broj dana od kraja cvjetanja do početka zrenja*
1	DAB1	28th May	1	6th October	130
2	DAB2	27th May	1	6thOctober	131
3	DAB3	30th May	1	16th October	139
4	DAB4	29th May	1.5	16th October	140
5	SUS1	29th May	3	17thOctober	141
6	SUS2	29th May	1	16th October	140
7	CSV1	25th May	1.5	18thOctober	146
8	CSV2	26th May	2.5	12thOctober	139
9	REZ	28th May	3	21th October	146
10	LUS14	2nd June	1.5	15thOctober	135
11	LUS15	2nd June	1.5	15th October	135
12	DM5	23th May	3	14th October	143
13	VAL1	29th May	3	17th October	141
14	VAL2	27th May	4	15th October	141
15	VALD	30th May	3	15th October	138
16	VALL	31st May	2	17th October	139
17	STUL	29th May	2.5	9th October	131
18	VALVO	28th May	3	17th October	142
19	STM1	27th May	1	11th October	137
20	STM2	26th May	2	11th October	138
21	KAP1	25th May	1	8thOctober	136
22	KAP2	25th May	0.5	8th October	136
23	PET1	20th May	2.5	17th October	149
24	PET2	20th May	3	16th October	148

No. *Br.*	Clone *Klon*	End of flowering *Kraj cvjetanja*	Degree of flowering *Stepen cvjetanja*	Beginning of maturation *Početak zrenja*	Days from the end of flowering to the beginning of maturation *Broj dana od kraja cvjetanja do početka zrenja*
25	PET3	20th May	2.5	17thOctober	149
26	PER4	21st May	1	14th October	145
27	BRI1	3rd June	2	13thOctober	132
28	BRI2	2nd June	1.5	13th October	133
29	MAES	26th May	0.5	21st October	148
30	DIVA	25th May	0.5	15th October	143
31	KAV1	27th May	2.0	09th October	135
32	KAV2	27th May	1	10th October	136
33	KRST	28th May	3	10th October	135
34	GRAB1	30th May	2	8th October	131
35	GRAB2	29th May	2.5	8th October	132
36	GRAB3	30th May	3	9th October	131
37	LUS2	30th May	1	13th October	136
38	MIRI2	24th May	5	23th October	152
39	LUS3	29th May	2	10th October	134
40	KUR	29th May	4	17th October	141
41	ZAVG	30th May	1	15th October	138
42	DUB	30th May	3	7th October	130
P-value		0.0002**	0.0941ns	1.0000ns	0.8189ns
$LSD_{0,05}$		5.2062	1.9217	29.848	18.569

Maturation, presented with the beginning of this phase, started in October with a difference of 17 days between the earliest (DAB1 and 2) and the latest (MIR2). Regarding the olive descriptor (Baranco et al., 2000), the early ripening occurred in late October.

The period for fruit to develop and start ripening was differed in 22 days among Žutica clones and it was not significant. The shortest period for fruits to start maturation was 130 days (DAB1 and DUB) and the longest was of 152 days in MIR2. The amount of yield did not influence the maturation beginning. This period is very important for the development of the fruit and in regard of the accumulation of olive oil. It is also in accordance with the previous results (Lazović et al., 2006; Hamidoghli et al., 2008).

The harvesting period is very important since the oil content (in dry and fresh matter) and olive oil quality parameters decreased during ripening (Hamidoghli et al., 2008). Therefore, the data presented in Table 1 are of importance in relation to the oil content and chemical properties of the fruits (Table 2). The chemical properties obtained were significantly different among Žutica clones.

The oil content in fruit of 22 examined clones was over 20% on fresh matter. The range was from the lowest 14.63% (LUS2) up to 24.28% (VAL2). The moisture content in the fruit influenced the oil content which

calculated on dry matter was in range from 33.42% (PET4) to 63.44% (DUB) and it was above 50% in 13 clones, respectively. Similar olive oil values in dry matter were obtained for Turkish varieties (Arslan, 2012), mentioning the conclusion of Tous and Romero (1994) that olive varieties with more than 46% total oil in dry matter are classified as high oil containing varieties. Thus, our results confirm Žutica as high oil containing variety with average of 46.77% oil in dry matter. From the other hand, a high level of variability in olive oil content suggests the presence of even more oily accessions of Žutica.

The influence of ecological conditions of the site cannot be recognized as a rule (Sladonja et al., 2006) since the clones from the same area showed very different oil content. More likely is that differences in oil content is the potential within this variety that should be subject of the deeper research considering the oil qualitative standards (Cantini et al., 1999) to insure more flavoring olive oil production.

The influence of the period end of flowering - beginning of maturation (Table 1) on oil accumulation was not confirmed.

Tab. 2. Chemical properties of fruit in 42 individuals/clones of cv. Žutica
Hemijske osobine ploda 42 individue/klona sorte Žutica

No. *Br.*	Clone *Klon*	Moisture *Vlaga* (%)	Dry matter *Suva materija* (%)	Oil content in fresh matter *Sadržaj ulja na svježu mat.* (%)	Oil content in dry matter *Sadržaj ulja na suvu mat.* (%)
1	DAB1	57.92	42.08	23.90	56.80
2	DAB2	55.06	44.94	22.99	51.15
3	DAB3	55.93	44.07	21.65	49.13
4	DAB4	59.58	40.43	20.31	50.23
5	SUS1	57.69	42.31	17.00	40.17
6	SUS2	55.69	44.32	22.27	50.25
7	CSV1	55.41	44.59	17.96	40.27
8	CSV2	57.62	42.39	19.49	45.97
9	REZ	61.66	38.34	18.46	48.15
10	LUS14	57.41	42.59	17.73	41.62
11	LUS15	55.55	44.45	17.88	40.22
12	DM5	58.44	41.56	20.08	48.32
13	VAL1	56.66	43.34	22.36	51.60
14	VAL2	57.08	42.92	24.28	56.57
15	VALD	58.59	41.41	19.46	47.01
16	VALL	55.23	44.77	21.77	48.63

No. *Br.*	Clone *Klon*	Moisture *Vlaga* (%)	Dry matter *Suva materija* (%)	Oil content in fresh matter *Sadržaj ulja na svježu mat.* (%)	Oil content in dry matter *Sadržaj ulja na suvu mat.* (%)
17	STUL	56.78	43.22	22.40	51.83
18	VALVO	59.33	40.67	18.36	45.14
19	STM1	59.12	40.88	18.67	45.67
20	STM2	61.31	38.69	17.96	46.42
21	KAP1	58.95	41.05	18.14	44.17
22	KAP2	55.50	44.50	20.28	45.57
23	PET1	63.55	36.45	19.46	53.40
24	PET2	63.05	36.95	22.01	59.56
25	PET3	56.44	43.56	21.15	48.57
26	PET4	51.62	48.38	16.17	33.42
27	BRI1	49.72	50.29	23.08	45.90
28	BRI2	53.77	46.23	23.73	51.33
29	MAES	59.75	40.25	19.77	49.11
30	DIVA	53.71	46.29	21.86	47.23
31	KAV1	56.91	43.10	21.99	51.02
32	KAV2	50.16	49.85	23.24	46.61
33	KRST	48.13	51.88	22.00	42.40
34	GRAB1	46.95	53.05	19.90	37.51
35	GRAB2	46.85	53.15	24.20	45.52
36	GRAB3	47.11	52.90	22.04	41.66
37	LUS2	64.33	35.67	14.63	41.01
38	MIRI2	54.65	45.35	19.39	42.76
39	LUS3	58.36	41.64	14.68	35.25
40	KUR	61.11	38.89	20.41	52.47
41	ZAVG	56.09	43.91	19.50	44.41
42	DUB	68.87	31.13	19.75	63.44
Average		56.61	43.39	20.29	46.77
P-value		0.0000**	0.0000**	0.0000**	0.0001**
$LSD_{0,05}$		5.1165	5.1165	3.7196	9.4790

To elaborate further the differences in chemical parameters, the dendrogram was constructed (Fig. 1) dividing Žutica clones into 4 groups. The first group is composed of two subgroups with 12 and 18 individuals. The clones linked in first subgroup have high oil content in fresh and in dry matter. The second group is with the highest dry matter content (51.52%); the third group has the lowest oil content in fresh matter

(15.16%), while the three clones in the fourth group have the highest moisture and oil in dry matter content (65.16% and 56.8%, respectively).

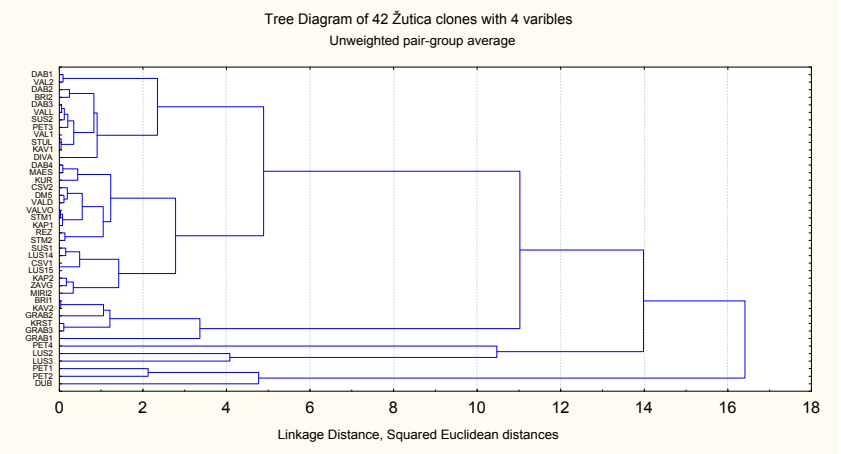


Fig. 1. Dendrogram of 42 Žutica clones derived from UPGMA analysis of chemical properties
Dendrogram za 42 klona sorte Žutica dobijen UPGMA analizom hemijskih osobina

Conclusion

The study of 8 parameters in 42 individuals/clones showed the high level of variability among Žutica variety regarding the olive oil content. The results showed the presence of the clones with high oil content in the fruit, 22 clones with more than 20% and in two clones of over 24% (GRAB2 and VAL2). The clones should be further studied for olive oil quality, while the expressed variability should be confirmed by DNA analysis. The clones with higher oil content are potential for multiplication and growing in new plantations.

Acknowledgements

The research project was funded by the Ministry of Science of Montenegro.

References

Arslan, D. (2012). Physico-chemical characteristics of olive fruits of Turkish varieties from the province of Hatay. *Grasas y Aceites, 63(2),* 158-166.

Barranco, D., Cimato, A., Fiorino, P., Rallo, L., Touzani, A., Castañeda, C., Serafini, F. & Trujillo, I. (2000). *World Catalogue of Olive Varieties.* Madrid: Consejo Oleícola Internacional.

Benito, M., Oria, R. & Sanchez-Gimeno, A.C. (2010). Characterization of the Olive Oil from Three Potentially Interesting Varieties from Aragon (Spain). *Food Sci Tech Int 2010, 16(*6), 523-530.

Cantini, C., Cimato, A. & Sani, G. (1999). Morphological evaluation of olive germplasm present in Tuscany region. *Euphytica*, *109*, 173-181.

Hamidoghli, Y., Jamalizadeh, S. & Malakroudi, M.R. (2008). Determination of harvesting time effect on quality and quantity of olive (Olea europea L.) oil in Roudbar regions. *Journal of Food, Agriculture & Environment, 6*(2), 238-241.

Lazović, Biljana, Bošković, R., Gašić, Ksenija, James, Celia & Tobutt, K. (2002). Genetic diversity of olives grown along the coast of Montenegro. *Acta Hort. (ISHS), 2*(586),167-170.

Lazović, B., Adakalić, M., Perović, T., Hrnčić, S., Pucci, C., Terrosi, A. & Spanedda, A.F. (2006). Increased olive oil yield and quality in Montenegrin cv. Žutica by *Bactrocera oleae* Gmel. (Diptera Tephritidae) control and improved harvest techniques. *IOBC wprs Bulletin, 30* (9), 337-342.

Lazović, B. (2001). Osobine ploda nekih sorti masline (*Olea europaea* L.). *Poljoprivreda i šumarstvo,47*(3-4), 15-25.

Miranović, K. (1994):. Investigation of Elayographic Properties of the Olive Cultivar Žutica (*Olea europaea* L.). *Acta Horticulturae (ISHS), 1*(356), 74-77.

Sladonja, B., Brkić, K., Radulović, M., Lukić, I., Šetić, E. & Krapac, M. (2006): Oil content in fruits of leading autochthonous olive varieties in Istria. *Pomologia Croatica 12*(2), 153-158.

Received: May 7, 2014
Accepted: June 11, 2014

Varijabilnost sadržaja ulja u plodu masline sorte Žutica na Crnogorskom primorju

Biljana Lazović[1], Mirjana Adakalić[1], Stoja Ljutica[1], Tatjana Perović[1], Miroslav Čizmović[1]

[1]*Univerzitet Crne Gore, Biotehnički fakultet-Podgorica, Centar za suptropske kulture-Bar, Crna Gora*

Sažetak

Žutica je najvažnija sorta masline na Crnogorskom primorju za proizvodnju ulja, čiji je sadržaj u plodu u prosjeku iznad 21%. Tokom istraživanja osobina ove sorte zapažena je varijabilnost u sadržaju ulja. Za utvrđivanje stepena varijabilnosti sadržaja ulja u plodu analizirano je 42 aksešena (klona) ove sorte. Rezultati su potvrdili visok sadržaj ulja kao i postojanje varijabilnosti ovog parametra između analiziranih aksešena sorte Žutica. Od ukupnog broja ispitivanih, kod 22 aksešena sadržaj ulja u plodu bio je preko 20%, dok je sadržaj ulja veći od 22% u svježoj materiji imalo 13 aksešena/klonova. Najveći sadržaj ulja u svježem plodu bio je kod VAL2 (24,3%), a u suvoj materiji kod DUB (63,44%). Rezultati ukazuju da aksešeni (klonovi) Žutice sa većim sadržajem ulja u plodu predstavljaju potencijal za širenja u novim zasadima.

Ključne riječi: aksešeni, Crna Gora, maslinovo ulje

Biljana Lazović
E-mail address: biljanal@t-com.me

Primljeno: 7. maja 2014.
Odobreno: 11. juna, 2014.

Originalan naučni rad
Original scientific paper
UDK: 645.25:581.19
DOI: 10.7251/AGRSR1401065Ć

University of Banjaluka, Faculty of Agriculture
Agro-knowledge Journal

Kvalitativne i kvantitativne osobine novih sorti crvenog luka

Josip Ćota[1], Azra Hadžić[2], Jelena Ćota[3], Milana Šilj[4]

[1]*Federalni zavod za poljoprivredu, Sarajevo, Bosna i Hercegovina*
[2]*Pedagoški fakultet, Univerzitet u Sarajevu, Bosna i Hercegovina*
[3]*Farmaceuski fakultet, Univerzitet u Beogradu, Srbija*
[4]*Poljoprivredni fakultet, Univerzitet u Istočnom Sarajevu, Bosna i Hercegovina*

Sažetak

Cilj rada je bio da se prikažu karakteristike novih sorti crvenog luka (Zenički i Konjički), stvorene u Federalnom zavodu za poljoprivredu Sarajevo i njihova pogodnost za uzgoj u Bosni i Hercegovini. Ispitivanja su obavljena tokom dvije godine (2012; 2013) na lokalitetu Butmir (Sarajevo). Ogledi su izvedeni po randomiziranom blok sistemu u pet ponavljanja. Ispitivane su proizvodne osobine crvenog luka: prinos i dužina vegetacije. U okviru kvalitativnih osobina utvrđen je sadržaj suhe materije, šećera i bijelančevina u lukovici. Za standard je korištena sorta Stuttgarter. Nove sorte se odlikuju dužinom vegetacije od 114 do 115 dana. Sorta Zenički je ostvarila viši prinos lukovica za 17 %, a sorta Konjički za 31 % u odnosu na Stuttgarter. U 2013. su prinosi lukovica viši za 15 % u odnosu na 2012. godinu. Ispitivane sorte odlikuje visok kvalitet, jer je sadržaj suhe materije od 13,8 do 15,88%, ukupnih šećera od 8,20 do 10,98% i bjelančevina od 1,50 do 1,70%, kao i blago ljut ukus i dobra obavijenost lukovice.

Ključne riječi: Zenički luk, Konjički luk, prinos, kvalitet

Uvod

Najveći prinosi crnog luka su u zemljama gde se on uzgaja direktno iz sjemena uz potpunu primjenu savremene tehnologije i odgovarajućeg sortimenta, a najmanji gdje se proizvodi iz arpadžika, što je inače tipično za zemlje jugoistočne Evrope. U uslovima BiH, proizvodnja se najčešće odvija na manjim površinama, bez sistema za zalivanje te zato dominira proizvodnja iz arpadžika, gdje se ostvaruju vrlo niski prinosi od 7,8 t/ha (http://www.fao.org). U 2012. pod crvenim lukom je bilo zasijano 5.223 ha, a 2013. godini 4.887 ha (Agencija za statistiku BiH [AZSBiH], 2012).

Crni luk se tradicionalno koristi kao svježa, zatim termički obrađena (sastavni dio mnogih jela), a zadnjih godina i kao prerađena namirnica (kiseljenjem, sušenjem).

Svaki od ovih vidova korišćenja zahtjeva odgovarajuću tehnologiju gajenja kao i sortiment, te su i različiti ciljevi oplemenjivanja ove povrtne vrste (Gvozdanović-Varga i sar., 1996; Gvozdanović-Varga i sar., 2005)**.**

Uz visinu prinosa domaćih sorata crnog luka, dosadašnja istraživanja su ukazala i na neke nutritivne vrijednosti i potvrdila značaj ove namirnice kroz sadržaje mikro nutrijenata u lukovici (Ćota i sar., 2013). Rezultati utvrđenih količina minerala u uzorcima luka uzgojenog u našim agroekološkim uslovima, u prosjeku za sve tri sorte, ukazuju da crveni luk sadrži najviše cinka (1.3126 mg/kg), pa željeza (0,7196 mg/kg), mangana (0,3243 mg/kg), bakra (0,2210 mg/kg) i kadmija (0,01467 mg/kg). Prisustvo i količine nekih minerala u luku se mogu vezati za lokalitet uzgoja kroz načine i mogućnosti dospijevanja iz tla u biljku. Dobijeni rezultati istraživanja ukazuju da sa 100 g luka ispitivanih sorata uzgojenih na našem području možemo zadovoljiti dnevne potrebe sa 55,25% bakra, željeza sa čak 126,21%, cinka sa 82,06 % i mangana sa 83,15% u odnosu na propisane po USDA (USDA, 2003).

Krupnoća lukovice je sortna oznaka, ali na krupnoću u velikoj mjeri utiču i uslovi uzgoja. Prema masi razlikujemo sitne lukovice koje su lakše od 60 g, srednje 60-100 g i krupne iznad 100 g (Lazić i sar., 2001). Isti autori navode da je oblik lukovice sortna oznaka koja u mnogome varira u zavisnosti od tipa i strukture zemljišta (na zbijenim zemljištima formira se pljosnatija lukovica), i dubine sjetve (ako je sjetva dublja, lukovica se izdužuje).

Cilj ovog rada je prikaz rezultata istraživanja novih sorata crvenog luka kreiranih u Federalnom zavodu za poljoprivredu u Sarajevu i njihova pogodnost za uzgoj u Bosni i Hercegovini. Priznavanjem, uzgojem i

kontrolisanom proizvodnjom arpadžika novih sorata crvenog luka, povećala bi se proizvodnja domaćeg crvenog luka i smanjio uvoz.

Materijal i metode rada

Na lokalitetu Butmir (Sarajevo) je postavljen ogled tokom dvije godine (2012. i 2013.) sa novim sortama crvenog luka, pod oznakom Zenički i Konjički. Za standard je korištena sorta Stuttgarter, koja se proizvodi iz arpadžika i raširena je u proizvodnji. Ogledi su postavljeni po randomiziranom blok sistemu u pet ponavljanja. Veličina osnovne parcele je 4,5 m^2 (5 x 0,9 m), sa tri reda na parceli (30 x 10 cm), odnosno 150 biljaka na parceli (330 hiljada biljaka/ha).

Sadnja crnog luka je obavljena ručno, 18.3.2012. i 06.03.2013. godine. U toku vegetacije primjenjene su sve potrebne mjere njege u proizvodnji crvenog luka. Prilikom đubrenja vodilo se računa o predusjevu i tipu tla. Nastojalo se biljkama obezbjediti takve uvjete koji će omogućiti ispoljavanje maksimalnog kapaciteta rodnosti sorte. U tlo su unesena mineralna đubriva u slijedećim količinama čistih hraniva: 56 kg/ha N, 112 kg/ha P_2O_5 i 294 kg/ha K_2O. U rano proljeće su unesena NPK gnojiva. Prihrana je obavljena prije prvog okopavanja. Evidentiran je datum tehnološke zrelosti, odnosno dužine vegetacije za ispitivane sorte. Nakon vađenja i sušenja lukovica određivani su prinosi crnog luka, a od hemijskih analiza:

- udio suhe materije (sušenjem na temperaturi od 102-105^{0}C);
- sadržaj ukupnih proteina metodom po Kjeldahl-u;
- sadržaj ukupnih šećera po Luff-Schoorl-u (gravimetrijski).

Prinosi su obrađeni analizom varijanse. Testiranje razlika obavljeno je LSD-testom za nivo značajnosti P=0,05 i P=0,01.

Agroekološki uslovi u toku izvođenja ogleda

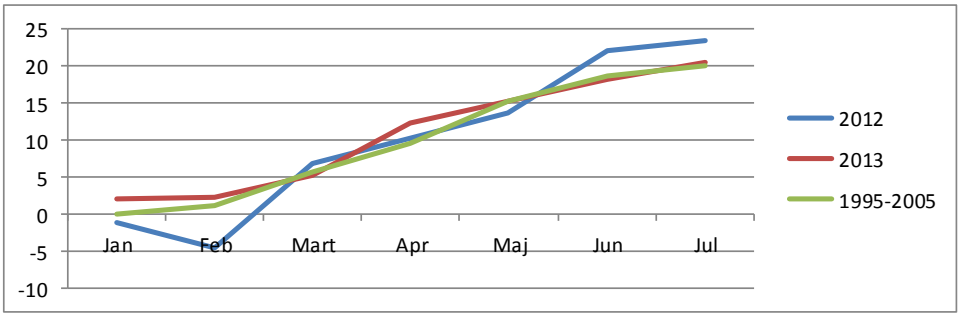
Prije postavljanja ogleda uzeti su prosječni uzorci zemljišta i izvršena je hemijska analiza (Tab.1). Na lokalitetu Butmir je smeđe dolinsko tlo, a po sastavu hraniva tlo je umjereno opskrbljeno fosforom i kalijmom.

Za prikaz klimatskih uslova u vegetacionom periodu korišteni su podaci sa meteorološke stanice Sarajevo (lokalitet Butmir). Prikazane su srednje mjesečne temperature i sume padavina za vegetacioni period crnog luka (Graf. 1, 2, 3, i 4).

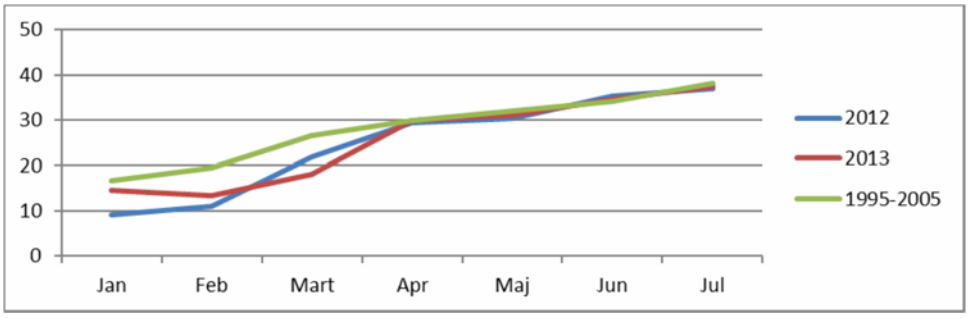
Tab. 1. Hemijske osobine tla
Chemical properties of soil

Godina *Year*	Reakcija pH u *Reaction pH*		Sadržaj u % *Content %*			mg u 100g tla sadrži fiziološki aktivnog *mg in 100g of soil contains phisiologially active*	
	H_2O	KCl	Ukupan N *Total N*	$CaCO_3$	Humus	P_2O_5	K_2O
2012.	5,89	-	0,09	-	1,80	12,50	10,9
2013.	6,02	-	0,08	-	1,80	8,45	14,20

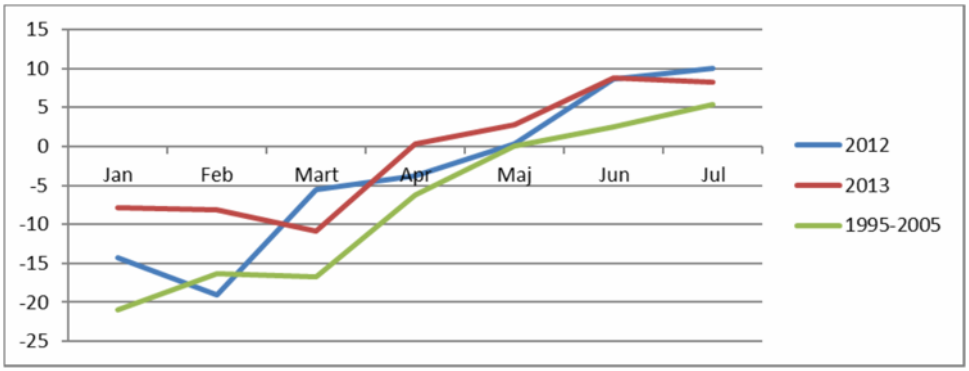
Klimatski uslovi variraju od godine do godine. U Butmiru su oštre zime i umjereno topla ljeta. U godinama ispitivanja temperature zraka su se kretale u okviru višegodišnjeg prosjeka.



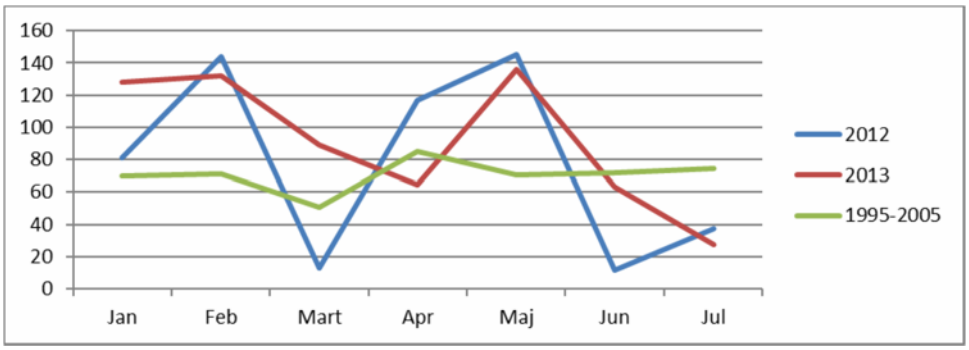
Graf. 1 Srednje mjesečne temperature zraka (Cº) /
Mean monthly air temperatures (Cº)



Graf. 2 Maksimalne mjesečne temperature zraka (Cº)
Maximum monthly air temperatures (Cº)



Graf. 3 Minimalne mjesečne temperature zraka (Cº)
Minimum monthly air temperatures (Cº)



Graf. 4 Mjesečne količine padavina (l/m^2)
Monthly precipitation (l/m^2)

Ako se analiziraju podaci temperatura, može se uočiti da su temperature u periodu izvođenja ogleda sa sortama crnog luka (2012. i 2013.) bile zadovoljavajuće u odnosu na višegodišnji prosjek. Više srednje mjesečne temperature su bile u III, IV, VI i VIII mjesecu (2012.), a u II, IV i VII mjesecu (2013.) u odnosu na višegodišnji prosjek. Maksimalne temperature su bile više u VI mjesecu (2012.) i IV i VI mjesecu (2013.), dok su minimalne temperature bile nešto više, osim V mjeseca (2012.) u odnosu na višegodišnji prosjek. U toku vegetacije manjak oborina je bio u III, VI i VII mjesecu (2012.) i u IV, VI i VII mjesecu (2013.), što nije značajno uticalo na nicanje luka jer je zemljište imalo dovoljno akumulirane vlage.

Rezultati i diskusija

Ispitivane osobine novih sorata crvenog luka prikazane su u poređenju sa sortom Stuttgarter, koja se proizvodi iz arpadžika i ima veoma dugu tradiciju gajenja na ovim prostorima. Nove sorte su srednje kasne vegetacije, kao i standard, dužine vegetacije od 122 do 142 dana. Biljke su dobro razvijene sa uspravnim položajem listova, tamno zelene boje sa izraženom voštanom prevlakom (Ćota i sar., 2013).

Tab. 2. Prinos crvenog luka po sortama i godinama u t/ha
Onion yield by the varieties and years in t/ha

Sorta *Variety*	Prinos u t/ha *Yield in t/ha*			
	2012.		2013.	
	t/ha	%	t/ha	%
Stuttgarter	25,4	100	27,9	100
Konjički	34,0**	134	36,3**	130
Zenički	27,0	106	35,7**	127
LSD P= 5 %	3,63		2,13	
LSD P= 1%	5,23		3,12	

Rezultati prinosa crvenog luka ukazuju na signifikantnu varjabilnost sorta u 2012. i 2013. godini. Prinosi crnog luka su bili visoko značajno viši 2012. godine, kod Konjičkog za 34%, a za 27 % kod Zeničkog i 30% Konjičkog u 2013. godini u odnosu na standardnu sortu Stuttgarter (Tab. 2).

Sorta Zenički je ostvarila viši prinos lukovica za 17%, a Konjički za 31% u odnosu na Stuttgarter, ali rezultati nisu statistički značajni (Tab. 3).

Tab. 3. Utjecaj faktora sorte
The impact of factors of sorts

Sorta/*Variety*	Prinos t/ha */Yield t/ha*	%
Stuttgarter	26,65	100
Konjički	35,5	131
Zenički	31,35	117
LSD P = 5%	11,05	
LSD P= 1 %	25,49	

Tab. 4. Utjecaj faktora godine
The impact of factors of years

Godina/*Year*	Prinos t/ha */Yield in t/ha*	%
2012.	28,8	100
2013.	33,3	115
$LSD_{P=5\%}$	9,3	
$LSD_{P=1\%}$	20,82	

Uočavaju se razlike u prinosu lukovica po godinama. U 2013. su prinosi lukovica viši za 15 % u odnosu na 2012. Godinu (Tab. 4).

Tab.5. Hemijski sastav lukovica ispitivanih sorata crnog luka
Chemical composition of the examined onion varieties

Parametar *Parameter*	Konjički		Zenički		Stuttgarter	
	2012.	2013.	2012.	2013.	2012.	2013.
Suha materija %/ *Dry content %*	14,04	14,15	15,88	15,23	14,29	13,80
Ukupni šećeri %/ *Total sugars %*	8,20	10,98	10,05	10,98	8,60	10,58
Ukupne bjelančevine %/ *Total proteins %*	1,55	1,54	1,50	1,58	1,70	1,51

Sadržaja suhe materije, uz ostale pokazatelje (sadržaj šećera i eteričnog ulja) svrstava sorte crnog luka u tri grupe: ljute sorte koje se odlikuju visokim sadržajem suhe materije preko 14%, poluljute sorte sadrže od 10-14% suhe materije i slatke sorte sadrže do 10% suhe materije (Lazić i sar., 2001). Prema dobijenim podacima, sadržaj suhe materije u uzorcima lukovica ispitivanih sorata se kreće od 14,04 do 15,88 %, te se može reći da spadaju u grupu ljutih sorti. Prema podacima Nacionalnog Instituta za javno zdravlje Finske (National Public Health Institute of Finland) ukupnih proteina u crnom luku ima oko 19% ili 1,3 g/100 g svježe sirovine (http://www.fine.fi), odnosno prema podacima FAO-a iz 2009 1,5 g/100 g (http://www.fao.org). U odnosu na navedene podatke, ispitivane sorte u ovim istraživanjima su sa uočljivo nižim sadržajima bjelančevina koje se kreću se od 1,50 do 1,70 %. Prema istim izvorima, količina ugljenih hidrata u luku kreće se oko 72% ili 12,7 g/100 g svježe sirovine, od čega šećera ima oko 30% ili 4,8 g/100 g. I po sadržaju ukupnih šećera, ispitivane sorte crnog luka u uslovima uzgoja u Bosni i

Hercegovini su sa izrazito niskim sadržajem ovih nutrijenata (od 8,20 do 10,98 %) (Tab. 5).

Dobijeni podaci ukazuju na potrebu detaljnijih istraživanja, a posebno agroekoloških uslova uzgoja. Poznato je da padavine utiču na obezbijeđenost biljaka vodom, i mogu utjecati na sastav ubranih biljnih plodova. Zbog relativno slabo razvijenog korjenovog sistema, koji je rasprostranjen plitko, crni luk zahtijeva dobru vlažnost površinskog sloja zemljišta. Nedostatak vode u periodu intenzivnog porasta biljke dovodi do zaostajanja rasta i smanjenja kvaliteta lukovice. U uslovima navodnjavanja biljna tkiva su hidratisanija. Potrebe luka za vodom razlikuju se tokom vegetacije. Najveće zahtjeve luk ima u periodu nicanja do faze intenzivnog obrazovanja listova, dok se njegovi zahtjevi smanjuju ka fazi zrenja. U fazi zrenja nedostatak vlage povoljno utiče na kvalitet lukovice. Suvišak vode dovodi do formiranja krupnijih, sočnijih, manje kvalitetnih lukovica, a veoma često i usporava dozrijevanje lukovice (Lazić i sar., 2001; http://tehnologijahrane.com).

Zaključak

Nove sorte crvenog luka (Zenički i Konjički), stvorene su u Federalnom zavodu za poljoprivredu u Sarajevu. Postignuti kvantitativni i kvalitativni rezultati ukazuju da ove sorte imaju potencijale za gajenje u agroklimatskim uslovima Bosne i Hercegovine i po nekim parametrima su bolje u odnosu na standarnu sortu Stuttgarter.

- Prinosi crnog luka su bili visoko značajno viši 2012. godine i to kod sorte Konjički za 34%, a za 27% kod Zeničkog i za 30 % kod Konjičkog u 2013. godini u odnosu na standardnu sortu Stuttgarter.
- U 2013. godini su prinosi lukovica bili viši za 15 % u odnosu na 2012. godinu.
- Sadržaja suhe materije u uzorcima lukovica ispitivanih sorata se kretao od 14,04 do 15,88 %.
- Ispitivane sorte u ovim istraživanjima su sa uočljivo nižim sadržajem bjelančevina (oko 1,50%) u odnosu na standard (oko 1,60%).
- Po sadržaju ukupnih šećera, sve ispitivane sorte crnog luka, u uslovima uzgoja u Bosni i Hercegovini, su sa izrazito niskim sadržajem ovih nutrijenata (8,20 do 10,98 %).

Literatura

Agencija za statistiku Bosne i Hercegovine. (2012). *Zasijana površina, požnjevena površina i proizvodnja po usjevima* (Godina VII, Broj 3, strana 2). Sarajevo: Agencija za statistiku Bosne i Hercegovine.

Cota, J., Gvozdanovic-Varga, Jelica, Hadžic, Azra, Petrovic, Anamarija, Saric, Edita, Savic, Aleksandra & Cota, Jelena (2013). *Yield and mineral composition of two new onion varieties from Bosnia and Herzegovina*. IV International Symposium „Agrosym 2013. (pp. 251-256). DOI: 10.7251/AGSY1303251C.

Gvozdanović-Varga, Jelica, Takač, A., Vasić, Mirjana, Panajotović, J. & Červenski, J. (1996). Characters of bulbs of diferent onion populations (*Allium cepa* L.). *Genetika, 28*(2), 85-89.

Gvozdanović-Varga, J., Lazić, B., Vasić, M. & Červenski, J. (2005). Evaluation of onion (Allium cepa L.) genotypes. *Natura Monte-negrina,* (4), 113-120.

Lazić, B., Urovka, M., Marković, V. i Ilin, Ž. (2001). *Povrtarstvo (Drugo izdanje).* Poljoprivredni fakultet u Novom Sadu.

USDA (July 2003). *National Nutrient Database for Standard Reference, Release* 16. USDA

Primljeno: 21. marta 2014.
Odobreno: 5. juna 2014.

Quantitative and Qualitative Characteristics of New Onion Varieties

Josip Ćota[1], Azra Hadžić[2], Jelena Ćota[3], Milana Šilj[4]

[1]*Federal Institute for Agriculture, Sarajevo, Bosnia and Herzegovina*
[2]*Faculty of Educational Sciences*, *University of Sarajevo*, *Bosnia and Herzegovina*
[3]*Faculty of Pharmacy, University of Belgrade, Serbia*
[4]*Faculty of Agriculture, University of East Sarajevo, Bosnia and Herzegovina*

Abstract

The aim of this paper is to present the characteristics of new varieties of the onion (Zenički and Konjički), created in the Federal Institute for Agriculture Sarajevo and their suitability for cultivation in Bosnia and Herzegovina. The tests were carried out in two years (2012 and 2013) at the site Butmir (Sarajevo). The experiments were conducted in a randomized block system in five repetitions. The examination included the following productive traits of the onion: yield and length of the growing season. Within the qualitative characteristics, the contents of dry matters, sugars and proteins were determined in the bulb. The variety Stuttgarter was used as a standard. The new varieties are distinguished by the length of the growing period of 114-115 days. The variety Zenički has achieved a higher yield of bulbs for 17%, while Konjički for 31%, comparing to Stuttgarter. The yields of bulbs in 2013 were higher by 15% comparing to 2012. These varieties are characterized by high quality, because the dry matter content is from 13.8 to 15.88%, total sugars from 8.20 to 10.98%, and proteins from 1.50 to 1.70%, with slightly spicy taste and well wrapped bulb.

Key words: Zenički, Konjički, yield, quality

Josip Ćota
E-mail address:j.cota@fzzp.com.ba

Received: March 21, 2014
Accepted: June 5, 2014

Originalan naučni rad
Original scientific paper
UDK: 635.262:[631.54:582.573.16]
DOI: 10.7251/AGRSR1401075M

University of Banjaluka, Faculty of Agriculture
Agro-knowledge Journal

Uticaj gustine useva na produktivnost fotosinteze i prinos belog luka proletnjaka

Đorđe Moravčević[1], Jelica Gvozdanović Varga[2], Anamarija Stojanović[2], Damir Beatović[1], Vida Todorović[3], Nenad Pavlović[4]

[1]*Poljoprivredni fakultet, Univerzitet u Beogradu, Republika Srbija*
[2]*Institut za ratarstvo i povrtarstvo, Novi Sad, Republika Srbija*
[3]*Poljoprivredni fakultet, Univerzitet u Banjoj Luci, Bosna i Hercegovina*
[4]*Institut za povrtarstvo, Smederevska Palanka, Republika Srbija*

Sažetak

Beli luk je ispitan u poljskim ogledima koji su izvedeni u centralnom delu Srbije (Beograd). Ispitan je beli luk proletnjak. Postavljen je cilj da se ispita uticaj gustine useva na produktivnost fotosinteze (LAR-Leaf Area Ratio, NAR- Net Assimilation Rate) i prinos belog luka. Ispitivanjima su bile obuhvaćene sledeće gustine useva: 300 (G1), 450 (G2), 600 (G3), 750 (G4) i 900 (G5) hiljada biljaka ha^{-1}. Beli luk je ostvarivao bolje rezultate u gušćim usevima. Na to jasno ukazuje prinos koji je beli luk ostvarivao u ogledima. Prosečne vrednosti prinosa kreću se u rasponu od 5,6 (G1) do 12,5 t ha^{-1} (G5). Rezultati pokazuju da beli luk treba gajiti u usevima veće gustine.

Ključne reči: Allium sativum, gustina useva, LAR, NAR, prinos

Uvod

Fotosinteza je biohemijski proces u kome nastaju složena organska jedinjenja (šećeri, skrob, vitamini). Karakteristike fotosinteze zavise od raznih faktora biotičke i abiotičke prirode. Najvažniji abiotički faktori su svetlost, temperatura, voda i CO_2. Za fotosintezu je neophodna i mineralna

ishrana. Od biotičkih faktora treba istaći koncentraciju hlorofila, veličinu lisne površine, te starost i položaj listova na biljci. Veliki značaj ima i genotip. Fotosinteza se određuje na razne načine. Najlakše se određuje tako da se na kraju vegetacije nekog useva izmeri (odredi) prinos suve materije. Međutim, mnogo je realnije da se određuje preko priraštaja suve materije po jedinici lisne površine u jedinici vremena (Net Assimilation Rate ili NAR). Fotosinteza se može određivati i preko odnosa koji postoji između površine lista jedne biljke i mase suve materije cele biljke (Leaf Area Ratio ili LAR), kao i na druge načine. Na fotosintezu treba uticati, a cilj je da ona ostvaruje visoke vrednosti. Time se utiče i na prinos, koji se formira od produkata fotosinteze. U prinos se ugrađuje i do 90% fotosintetskih produkata. Produktivnost fotosinteze belog luka maksimalne vrednosti dostiže 90 dana posle sadnje čenova (Kastori, 1989; Halan et al., 1990; Ledesma et al., 1997).

Gustina useva je veoma važan faktor u biljnoj proizvodnji. Biljke se normalno razvijaju samo u usevima odgovarajuće gustine. Smanjivanje gustine useva pozitivno utiče na veličinu i kvalitet lukovica, a negativno utiče na prinos belog luka (Moravčević et al., 2011). Različiti autori navode kod belog luka kao optimalne gustine one od 300 hiljada (Lewis et al., 1995), oko 600 hiljada (Kilgori et al., 2007), pa čak i od 2 milona biljaka ha^{-1} (Ahmad & Iqubal, 2002).

Cilj ovih ispitivanja je da se prošire naučna saznanja o uticaju gustine useva na fotosintezu i prinos belog luka u uslovima kontinentalne klime gde su prosečni prinosi belog luka proletnjaka jako niski (2-4 t ha^{-1}).

Materijal i metode rada

Beli luk (*Allium sativum*) je ispitivan na oglednom dobru Poljoprivrednog fakulteta Univerziteta u Beogradu (Radmilovac, Srbija). Korišćen je metod poljskih ogleda. Ispitivanja su trajala dve godine (2007. i 2008). Ogledi su postavljeni po slučajnom blok-sistemu u četiri ponavljanja. Veličina elementarne parcelice iznosila je 4 m^2 (2x2 m).

Zemljište, na kojem je beli luk ispitivan, je u tipu gajnjače, sledećih hemijskih osobina: pH-5.60 (KCl), sadržaj humusa 2,51 %, ukupnog azota – 0,11 %, fosfora 11,9 mg i kalijuma - 21,2 mg u 100 g zemljišta. Osnovna, jesenja, obrada zemljišta (oranje) izvođena je na dubinu od 30cm. Neposredno pred postavljanje ogleda (sredina marta) izvršena je predsetvena obrada zemljišta i startno đubrenje (400 kg ha^{-1}, 15:15:15). Sadnja belog luka izvođena je tokom marta, u obe ispitivane godine (24. i

23). Luk je sađen na međuredni razmak koji je bio konstantan (25 cm), dok je razmak između čenova (biljaka) varirao i kretao se od 4,4 do 13,3 cm. Tako su dobijene gustine useva od: 300 (G1), 450 (G2), 600 (G3), 750 (G4) i 900 (G5) hiljada biljaka ha^{-1}. Korišćena je sorta belog luka proletnjaka „piros“ (Institut za povrtarstvo, Smederevska Palanka). Svi radovi oko ogleda izvođeni su ručno.

Merenje belog luka započeto je 40 dana posle sadnje i vršeno je svakog desetog dana (dekadno). Luk je meren 8 puta u toku ispitivanja. Određivani su sledeći parametri: LAR (relativna lisna površina), NAR (neto produktivnost fotosinteze) i prinos lukovica.

Za određivanje LAR i NAR korišćeni su sledeći postupci (Kastori, 1989): LAR=A/W, [cm^2 g^{-1}]; A- površina lista po biljci [cm^2], W – masa suve materije po biljci (bez korena), [g]; NAR=1/A x (W_2-W_1)/T_2-T_1, [g m^{-2} d^{-1}]; A - površina lista po biljci [m^2], W_1 - ukupna suva masa biljke u vremenu T_1 [g], W_2 - ukupna suva masa biljke u vremenu T_2 [g], T (T_2-T_1) - interval između dva merenja [dan].

Berba belog luka, u obe ispitivane godine, obavljana je u julu (22. i 29), kada je zapaženo da su lažna stabla potpuno omekšala, a biljke još nisu počele masovno da polažu. Nakon sušenja lukovice su odvajane od nadzemnog dela biljke i merene. Prinos je izražen u t ha^{-1}. Padavine i temperature za vreme izvođenja ogleda prikazane su u Tabeli 1.

Tab. 1. Srednje mesečne temperature i padavine
Mean monthly temperature and monthly rainfall

Mesec *Month*	Temperatura [ºC], *Temperature*			Padavine [mm], *Rainfall*		
	2007	2008	1982-2011	2007	2008	1982-2011
Mart *(March)*	9,3	9,1	6,8	93,3	75,5	43,9
April *(April)*	12,8	13,5	12,3	1,0	27,3	50,0
Maj *(May)*	18,3	18,3	17,3	96,1	14,8	59,7
Jun *(June)*	22,2	22,3	20,2	114,7	62,5	90,8
Jul *(July)*	23,5	22,4	22,0	17,2	56,8	68,4
Prosek/Suma *Mean/Sum*	17,2	17,1	15,7	64,5 / 322,3	47,4 / 236,9	62,6 / 312,8

Rezultati su statistički obrađeni po modelu jedno i dvofaktorijalne analize varijanse (ANOVA) i LSD testa na dva nivoa značajnosti ($p<0.05$ i $p<0.01$). Jednogodišnji rezultati su prikazani tabelarno, a dvogodišnji grafički (Excel 2007, DSAASTAT).

Rezultati i diskusija

Relativna lisna površina (LAR)

Najveće prosečne vrednosti LAR je ostvarivao u periodu od I do III merenja belog luka, kada su one bile i veoma ujednačene (Graf. 1). Navedene vrednosti variraju od 55,4 do 56,6 $cm^2 g^{-1}$. U narednih 20 dana (III-V merenja) usledilo je naglo smanjivanje LAR, kada se on smanjio na 30,3 $cm^2 g^{-1}$. U periodu koji je trajao od VI do VIII merenja LAR se i dalje smanjivao, ali znatno sporije. Na kraju je dostigao prosečnu vrednost na svim gustinama koja iznosi 15,3 $cm^2 g^{-1}$.

Tab. 2. Relativna lisna površina u 2007. godini [$cm^2 g^{-1}$]
Leaf Area Ratio in 2007[$cm^2 g^{-1}$]

Gustina (A) [biljaka ha^{-1}] *Density*	Merenje (B) *Measurement*								Prosek *Average*
	I	II	III	IV	V	VI	VII	VIII	
300.000 (G1)	59,0	53,7	38,1	31,4	14,4	14,7	12,7	5,9	28,7
450.000 (G2)	74,0	44,9	47,3	34,0	22,7	17,5	11,4	6,2	32,2
600.000 (G3)	80,8	59,9	50,2	39,6	23,7	18,4	12,2	6,7	36,4
750.000 (G4)	66,8	66,9	50,7	36,3	21,7	16,2	10,7	5,2	34,3
900.000 (G5)	69,5	65,4	72,2	37,3	21,1	17,2	11,0	6,2	37,5
Prosek / *Average*	70,0	58,2	51,7	35,7	20,7	16,8	11,6	6,0	33,8

LSD	A	B	A x B
0.05	3,9	5,0	11,1
0,01	5,2	6,6	14,8

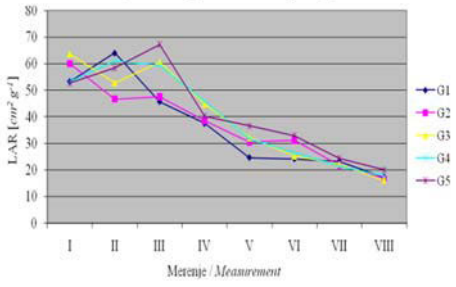
LAR se ovako ponašao i po godinama ispitivanja, ali su postojale i određene specifičnosti (Tabela 2 i 3). U 2007. godini LAR se intenzivnije smanjivao u toku vegetacije belog luka. Specifičnost je i to da je gustina useva različito uticala na ponašanje LAR. U 2007. godini uticaj gustine na LAR ispoljavao se do VI merenja, dok se u 2008. godini ispoljavao do kraja vegetacije. Gušći usevi su u celini pokazivali stimulativniji uticaj na posmatrani parametar.

Tab. 3. Relativna lisna površina u 2008. godini [$cm^2\ g^{-1}$]
Leaf Area Ratio in 2008 [$cm^2\ g^{-1}$]

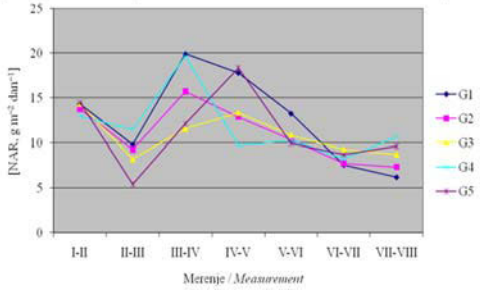
Gustina (A) [biljaka ha^{-1}] *Density*	Merenje (B) *Measurement*								Prosek *Average*
	I	II	III	IV	V	VI	VII	VIII	
300.000 (G1)	47,8	67,5	53,4	43,6	33,6	30,2	28,8	23,8	41,1
450.000 (G2)	46,1	46,2	45,2	42,9	36,4	42,8	31,8	23,5	39,4
600.000 (G3)	46,8	45,8	71,0	47,3	38,7	32,0	31,7	20,1	41,6
750.000 (G4)	39,8	55,4	68,3	55,5	37,8	34,9	29,7	23,9	43,2
900.000 (G5)	35,9	48,5	62,2	43,3	51,8	48,8	37,1	31,8	44,9
Prosek / *Average*	43,2	52,7	60,0	46,5	39,6	37,7	31,8	24,6	42,0

LSD	A	B	A x B
0.05	5,9	7,4	16,6
0,01	7,7	9,8	21,9

LAR je dostizao veće vrednosti u periodu koji je prethodio formiranju lukovice, a koji je obeležen intenzivnim formiranjem lisnog aparata (površina lista). Sa pojavom lukovice započeto je brzo nagomilavanje suve materije u belom luku, što je uticalo da vrednosti LAR postanu manje. LAR se objektivnije pokazao u 2007. godini, koja se odlikovala veoma povoljnim uslovima za razvoj belog luka, naročito u pogledu padavina. U 2008. godini vladali su sušni uslovi i visoke temperature vazduha, pa se beli luk nije prirodno ponašao kao u prethodnoj godini. To je doprinelo da LAR ostvaruje ujednačene vrednosti tokom cele vegetacije, što se razlikuje od opšte tendencije za ponašanje posmatranog parametra (Stahlschmidt et al., 1997).



Graf. 1 LAR (2-godišnji prosek)
Leaf Area Ratio (two-year means)



Graf. 2 NAR (2-godišnji prosek)
Net Assimilation Rate (two-year means)

Neto produktivnost fotosinteze (NAR)

Najveće vrednosti NAR je ostvarivao u intervalima III-IV, IV-V i I-II. Karakterističan je interval II-III kada je NAR dostizao relativno male

vrednosti. Posebno je karakterističan interval V-VI u kome je NAR počeo trajno da se smanjuje (Graf. 2).

Tab. 4. Neto produktivnost fotosinteze u 2007. godini [g m^{-2} dan^{-1}]
Net Assimilation Rate in 2007 [g m^{-2} dan^{-1}]

Gustina (A) [biljaka ha^{-1}] *Density*	Merenje (B) *Measurement*							Prosek *Average*
	I-II	II-III	III-IV	IV-V	V-VI	VI-VII	VII-VIII	
300.000 (G1)	20,1	12,7	27,3	24,6	21,0	9,8	9,5	17,8
450.000 (G2)	17,5	14,2	21,7	14,9	15,0	11,4	8,4	14,7
600.000 (G3)	19,2	10,5	15,1	19,6	15,3	15,3	9,5	14,9
750.000 (G4)	14,9	15,2	30,4	12,3	16,6	14,5	15,7	17,1
900.000 (G5)	16,9	6,9	12,4	30,0	16,6	14,7	15,6	16,2
Prosek / *Average*	17,7	11,9	21,4	20,3	16,9	13,1	11,7	16,1

LSD	A	B	A x B
0.05	5,7	6,8	15,2
0,01	7,6	9,0	20,1

To se naročito ispoljilo u 2007. godini, dok je u 2008. godini pokazao određeno kolebanje (Tabela 4 i 5). NAR je izrazito veće vrednosti ostvarivao u 2007. godini, u kojoj je stizao do 21,4 g m^{-2} dan^{-1} (interval III-IV). U 2008. godini nije prelazio 10,3 g m^{-2} dan^{-1} (interval I-II). Gustina useva je ograničeno uticala na NAR. U stvari, uticaj gustine javljao se samo u 2007. godini i to u određenom delu vegetacije belog luka (intervali II-III i III-IV). Gušći usevi su u proseku povoljnije uticali na NAR.

Tab. 5. Neto produktivnost fotosinteze u 2008. godini [g m^{-2} dan^{-1}]
Net Assimilation Rate in 2008 [g m^{-2} dan^{-1}]

Gustina (A) [biljaka ha^{-1}] *Density*	Merenje (B) *Measurement*							Prosek *Average*
	I-II	II-III	III-IV	IV-V	V-VI	VI-VII	VII-VIII	
300.000 (G1)	8,6	6,9	12,6	11,1	5,6	5,4	3,0	7,6
450.000 (G2)	10,0	4,3	9,7	10,8	5,7	4,1	6,2	7,3
600.000 (G3)	9,5	5,9	8,1	7,1	6,4	3,2	7,9	6,9
750.000 (G4)	11,1	7,8	9,0	7,1	4,0	2,0	5,6	6,7
900.000 (G5)	12,1	3,8	11,8	6,8	3,2	2,6	3,6	6,3
Prosek / *Average*	10,3	5,7	10,2	8,6	5,0	3,5	5,3	6,9

LSD	A	B	A x B
0,05	3,1	3,7	8,3
0,01	4,2	4,9	11,0

Za beli luk je karakteristično da NAR najveće vrednosti dostiže oko tri meseca posle zasnivanja useva (Halan et al., 1990; Ledesma et al., 1997). U našim ispitivanjima to se ispoljilo nešto ranije, čemu je doprinela sorta (domaća) i lokalni ekološki uslovi. Slabije ispoljavanje NAR u intervalu II-III je normalna reakcija belog luka, koji u tom delu vegetacije pokazuje velike vrednosti za površinu lista, a za suvu materiju je obrnuto (parametri od kojih zavisi NAR). Beli luk je imao povoljnije uslove za svoj razvoj u 2007. godini, što je uticalo da se NAR jače ispolji u toj godini. Takvi uslovi su doprineli da se ispolji određeni uticaj gustine useva na beli luk, što nije došlo do izražaja u 2008. godini.

Prinos lukovica

Najveća prosečna vrednost za prinos iznosi 12,5 t ha^{-1}. Navedenu vrednost prinos je ostvario u najgušćem usevu (G5). U najređem usevu (G1) prinos je dostigao samo 5,6 t ha^{-1}. Ostale vrednosti za prinos kreću se od 7,4 t ha^{-1} (G2) do 10,4 t ha^{-1} (G4). Posmatrani parametar dostizao je znatno veće vrednosti u 2007. godini, u kojoj je ostvaren apsolutni maksimum u ovim ispitivanjima. Radi se o maksimumu koji iznosi 15,5 t ha^{-1}, a ostvaren je u najgušćem usevu. Najmanji prinos ima vrednost koja iznosi 6,6 t ha^{-1} i dobijena je u najređem usevu. Prinos se tako ispoljio i u 2008. godini, ali je dostizao znatno manje vrednosti. Gustina useva je značajno uticala na visinu prinosa, a karakter tog uticaja je bio isti u obe godine ispitivanja. U stvari, povećanje gustine za po 300 hiljada biljaka ha^{-1} uvek je ostvarivalo značajan ili vrlo značajan uticaj na prinos, što nije slučaj sa povećanjem gustine za po 150 hiljada biljaka ha^{-1} (susedne varijante). Ukupni prosek za prinos iznosi 9 t ha^{-1}.

Tab. 6. Prinos lukovica [t ha^{-1}]
Bulb yield [t ha^{-1}]

Gustina (A) [biljaka ha^{-1}] *Density*		2007	2008	Prosek *Average*
300.000 (G1)		6,6	4,6	5,6
450.000 (G2)		8,3	6,5	7,4
600.000 (G3)		10,8	7,7	9,2
750.000 (G4)		12,5	8,3	10,4
900.000 (G5)		15,5	9,4	12,5
Prosek / *Average*		10,7	7,3	9,0
LSD	0,05	1,9	1,6	1,2
	0,01	2,6	2,3	1,6

Beli luk nije izrazito reagovao na povećavanje gustine za po 150 hiljada biljaka ha^{-1} (kako je to bilo u ogledu), pa se može konstatovati da ova vrsta povrća ne ispoljava veliku osetljivost na gustinu useva. To je u najužoj vezi sa morfološkim karakteristikama belog luka (uski i uspravni listovi, niske biljke). Navedene karakteristike pružaju mogućnost da beli luk dobro podnosi uslove koji vladaju u gustim usevima, što se pozitivno projektuje na prinos. Ne postoji univerzalna gustina za proizvodnju posmatranog luka, jer ona ne utiče samostalno na razvoj useva, već utiče interaktivno sa drugim faktorima (zemljište, klima, agrotehnika). Ovakve konstatacije za gustinu useva ističu i drugi autori (Haque et al., 2002; Cortes et al., 2003; Gvozdanović-Varga, 2005).

Zaključak

U konkretnim uslovima (centralna Srbija) beli luk proletnjak treba proizvoditi u gustim usevima. U gustinama većim od 600 hiljada biljaka ha^{-1} ostvaruju se značajno veći prinosi po jedinici površine. Ukoliko je beli luk namenjen industrijskoj preradi ili farmaciji, takve gustine su za preporuku. Beli luk za svežu potrošnju, gde se zahteva krupnija lukovica, treba gajiti u gustinama manjim od gore pomenute.

Napomena

Rad predstavlja deo istraživanja na projektu pod nazivom "Stvaranje sorata i hibrida povrća za gajenje na otvorenom polju i u zaštićenom prostoru" (Ministarstvo prosvete i nauke Republike Srbije, TR 31030).

Literatura

Ahmad, S. & Iqbal, J. (2002). Optimizing Plant Density Cum Weed Control Method For Puccinial Rust Management and Yield in Garlic. *Asian Journal of Plant Sciences*, *1*(2), 97-198.

Cortes, C.F., Olalla, F.M.S. & Urrea, R.L. (2003). Production of garlic (*Allium sativum* L.) under controlled deficit irrigation in a semi-arid climate. *Agricultural Water Management, 59*, 155-167.

Gvozdanović-Varga Jelica (2005). *Analiza stabilnosti komponenata prinosa prolećnog belog luka (Allium sativum* L.*)* (Doktorska diser-

tacija). Poljoprivredni fakultet Univerziteta u Novom Sadu, Novi Sad, Srbija.

Halan Shoba, Arumugam, R. & Halan, S. (1990). Physiology of growth and development of garlic (*Allium sativum* L.). *South-Indian-Horticulture 38*(6), 323-328.

Haque, S., Sattar, A. & Pramanik, H.R. (2002). Land Configuration and Varietal Effect on Yield Contributing Traits and Yield of Garlic. *Pak J Biol Sci, 5*(10), 1024-1027.

Kastori, R. (1989). *Fiziologija biljaka*. Novi Sad: Matica srpska.

Kilgori, M.J., Magaji, M.D. & Yakubu, A.I. (2007). Effect of Plant Spacing and Date of Planting on Yield of Two Garlic (*Allium sativum* L.) Cultivars in Sokoto, Nigeria. *American-Eurasian J. Agric.& Environ. Sci., 2*(2), 153-157.

Ledesma, A., Nunez, S.B., Arguello, J.A., Burba, J.L. & Galmarini, C.R. (1997). Bulbing physiology in garlic (*Allium sativum* L.) cv. Rosado Paraguayo. Characterization of ontogenic stages by shoot growth dynamics and its relation to bulbing. *Acta Horticulturae, 433,* 405-416.

Lewis, L.A., Ojeda, D.L., Salazar, M.O. & Campbell, R.J. (1995). Effect of population density on growth, development and yield of garlic (*Allium sativum* L.) cv. *Vietnamita*. *Proceedings of the Interamerican Society for Tropical Horticulture*, *39*(6), 23-26.

Moravčević, Đ., Bjelić, V., Moravčević, M., Gvozdanović Varga, J., Beatović, D. & Jelačić, S. (2011). Effect of plant density on the bulb quality and spring garlic yield (A. *sativum* L.). *Proceedings of the Interamerican Society for Tropical Horticulture, 39*(6), 23-26.

Stahlschmidt, O., Cavagnaro, J.B., Borgo, R., Burba, J.L. & Galmarini, C.R. (1997). Growth analysis of three garlic (*A. sativum* L.) cultivars with differences in yield. *Acta Horticulturae, 433*, 27-434.

Primljeno: 23. aprila 2014.
Odobreno: 1. jula 2014.

Effect of Plant Density on Photosynthesis Productivity and Yield of Spring Garlic

Đorđe Moravčević[1], Jelica Gvozdanović Varga[2], Anamarija Stojanović[2], Damir Beatović[1], Vida Todorović[3], Nenad Pavlović[4]

[1] Faculty of Agriculture, University of Belgrade, Republic of Serbia
[2]Institute of Field and Vegetable Crops, Novi Sad, Republic of Serbia
[3]Faculty of Agriculture, University of Banja Luka, Republic of Srpska
[4]Institute of Vegetable Crops, Smederevska Palanka, Republic of Serbia

Abstract

Garlic was examined in field experiments conducted in central Serbia (Belgrade). Spring garlic was examined. The objective was to examine the effect of plant density on photosynthesis productivity (LAR-Leaf Area Ratio, NAR- Net Assimilation Rate) and the yield of garlic. The analysis involved the following plant densities: 300 (G1), 450 (G2), 600 (G3), 750 (G4) and 900 (G5) thousand plants ha^{-1}. The garlic exhibited better results in denser crop establishment. It is clearly indicated by the yield of garlic attained in the experiments. Average yield rates range from 5.6 (G1) to 12.5 t ha^{-1} (G5). The results demonstrate that the garlic should be grown in high density establishment.

Key words: Allium sativum, plant density, LAR, NAR, yield

Đorđe Moravčević
E-mail address:djordjemor@agrif.bg.ac.rs

Received: April 23, 2014
Accepted: July 1, 2014

Originalan naučni rad
Original scientific paper
UDK: 633.31:631.52
DOI: 10.7251/AGRSR1401085B

University of Banjaluka, Faculty of Agriculture
Agro-knowledge Journal

Uticaj međurednog rastojanja na prinos, komponente prinosa i kvalitet semena lucerke

Dragoljub Beković[1], Rade Stanisavljević[2], Milan Biberdžić[1], Slaviša Stojković[1], Jasmina Knežević[1]

[1]*Poljoprivredni fakultet – Kosovska Mitrovica – Lešak, Univerzitet u Prištini, Srbija*
[2]*Institut za zaštitu bilja i životnu sredinu, Beograd, Srbija*

Sažetak

U agroekološkim uslovima južne Srbije izvršena su istraživanja radi utvrđivanja uticaja međurednog rastojanja na prinos, komponente prinosa i kvalitet semena lucerke sorte K-23. Najviši prosečan prinos semena ostvaren je na međurednom rastojanju od 40 cm (271,7 kg ha^{-1}), zatim pri rastojanju od 20 cm (249,4 kg ha^{-1}), a najniži pri rastojanju od 60 cm (244,0 kg ha^{-1}). Najviše cvasti ostvareno je setvom na rastojanju od 60 cm (13,37 cvasti/stabljici), a najmanje pri rastojanju od 20 cm (8,57 cvasti/stabljici). Međuredno rastojanje od 60 cm uslovilo je najviše mahuna po cvasti (7,15), dok je najmanje mahuna (5,50) bilo pri rastojanju od 20 cm. Broj zrna po mahuni se kretao od 3,55 (rastojanje od 20 cm) do 4,05 (međuredno rastojanje od 60 cm). Najbolji kvalitet semena ostvaren je setvom na međurednom rastojanju od 60 cm. Najviša masa 1000 semena ostvarena je pri setvi na rastojanju od 60 cm, a najniža na 20 cm (2,07, odnosno 1,97 g). Najviša klijavost semena ostvarena je pri rastojanju od 60 cm (88,00%), a najniža pri rastojanju od 20 cm (85,76 %).

Ključne reči: cvasti, mahune, masa 1000 semena, klijavost

Uvod

Lucerka je vrsta koja se odlikuje visokim genetskim potencijalom za prinos krme, što je često u negativnoj korelaciji sa prinosom semena. Odlikuje se bujnim vegetativnim rastom, visokim udelom lista u prinosu nadzemne biomase i tankim nežnim stabljikama koje lako poležu. Zbog ovih osobina, prinos semena lucerke je pod velikim uticajem ekoloških činilaca i značajno varira u zavisnosti od vremenskih uslova u toku godine, više nego kod drugih biljnih vrsta. Osnovna karakteristika proizvodnje semena lucerke u Srbiji je izuzetno veliko variranje visine prinosa u zavisnosti od vremenskih uslova godine. Tako prinos semena u nepovoljnoj godini može biti i 10 puta manji nego u povoljnoj. Upravo zbog izraženog variranja visine prinosa semena u Srbiji ne postoje specijalizovani usevi za proizvodnju semena jer je rizik od gubitka prihoda u nepovoljnim godinama vrlo veliki. Umesto toga, proizvodnja semena se odvija na usevima kombinovane namene (proizvodnja krme i semena). Na ovakvim usevima prvi i treći otkos se koriste za proizvodnju krme, dok se seme proizvodi iz drugog otkosa. U godinama sa većom količinom padavina, proizvođači odustaju od proizvodnje semena, i prihod ostvaruju samo proizvodnjom krme i na taj način smanjuju rizik proizvodnje (Karagić i Katić, 2012).

Značajan uticaj na visinu prinosa semena, pored klimatskih činilaca ima međuredno rastojanje, odnosno optimalan broj biljaka po jedinici površine. Prema brojnim istraživanjima visoki prinosi i kvalitet semena lucerke dobija se setvom lucerke u šire redove i sa manjim količinama semena (Erić, 1988; Lukić, 2000; Beković, 2005; Stanisavljević, 2006 i drugi). Međutim, širokoredni usev sa manjom količinom semena ne obezbeđuje uvek viši prinos semena u odnosu na uskoredni usev sa međurednim rastojanjem manjim od 25 cm i većim količinama semena, kao što se koristi za proizvodnju kabaste stočne hrane (Lovato and Montanari, 1991; Vučković, 1994 i drugi).

Kvalitet semena lucerke uslovljen je prvenstveno biologijom ove vrste, ali i nizom drugih faktora, prvenstveno spoljašnjih. Način i gustina setve utiču na kvalitet semena lucerke više nego što je to slučaj kod drugih biljaka. Postoji veliko variranje u pogledu kvaliteta semena lucerke u zavisnosti od izbora otkosa za seme, načina setve, količine semena i godine proizvodnje. Setvom lucerke na većim međurednim rastojanjima redovno se dobija seme boljeg kvaliteta, prvenstveno sa većom masom 1000 semena i klijavošću (Erić,1988; Vučković, 1994; Stanisavljević, 2006). Ekološki uslovi značajno utiču na kvalitet semena lucerke pa je klijavost

semena znatno niža u godini sa više padavina u odnosu na suvu, toplu i sunčanu godinu (Vučković, 1994; Karagić, 2004).

Imajući u vidu značaj proizvodnje kvalitetnog semena lucerke, cilj ovih istraživanja je bio da se u agroekološkim uslovima niškog regiona ispita uticaj međurednog rastojanja i uslova uspevanja na prinos, komponente prinosa i kvalitet semena lucerke što bi predstavljalo značajan doprinos unapređenju gajenja ove krmne biljke.

Materijal i metode rada

Radi ostvarivanja postavljenih ciljeva izvršena su trogodišnja eksprimentalna istraživanja na lokaciji „Ledena stena“ u predgrađu Niša. Kao materijal je poslužila sorta lucerke K-23 nastala u Institutu za krmno bilje u Kruševcu. Odlikuje se razgranatim stabljikama dobro obraslim lišćem i brzom regeneracijom nakon košenja. Otporna je na poleganje i prema važnijim bolestima. Visokoprinosna je sorta; sa 4-5 košenja daje godišnje do 20 t ha^{-1} suve materije. Prosečan sadržaj sirovih proteina u suvoj materiji kreće se od 18 % do 20 %. Lucerka je sejana polovinom aprila, na tri međuredna rastojanja, i to 20 cm, 40 cm i 60 cm. Ogled je postavljen po slučajnom blok sistemu u 4 ponavljanja.Veličina osnovne parcele za rastojanje od 20 cm bila je 5 m^2, za rastojanje od 40 cm 6 m^2, a za međuredno rastojanje od 60 cm 9 m^2. Zemljište na kome su obavljena istraživanja pripada tipu aluvijum. U godini zasnivanja useva za ispitivanje prinosa i komponenti prinosa semena lucerke korišćen je prvi porast, a u drugoj i trećoj godini drugi porast.

Na osnovu višegodišnjih podataka, područje Niša se odlikuje dugim sušnim letnjim periodom, koji se proteže kroz sve letnje mesece. Međutim, tokom 2005. godine veća količina i povoljniji raspored padavina uslovili su ravnomerno i ujednačeno klijanje i nicanje useva lucerke (tab. 1). U toku 2006. godine zabeležena je nešto veća količina padavina posebno tokomu avgusta, što je uticalo na sazrevanje semena lucerke, otežanu žetvu pa i gubitke prinosa semena. Najpovoljniji uslovi za proizvodnju semena lucerke bili su tokom 2007. godine koju je karakterisao duži sušni period u toku celog leta (tab.1).

Tab.1. Srednje mesečne temperature (°C) i mesečne sume padavina (mm) – Niš 2005-2007.
Mean monthly temperatures (°C) and total precipitation (mm)- Niš 2005-2007

Godina *Year*	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	I-XII Prosek/ suma *Aver./ Amount*
Temperature – (°C) –*Temperatures*													
2005	0,8	-1,7	5,1	11,8	16,8	19,0	22,3	20,5	17,9	12,3	5,7	3,5	10,9
2006	-1,5	1,2	6,3	13,3	17,0	20,0	22,9	21,2	18,3	14,0	6,7	2,4	11,8
2007	5,4	6,6	10,0	13,3	18,8	23,6	26,2	24,6	16,1	11,6	4,6	0,8	13,5
Količina padavina-(mm)- *Amount of precipitation*													
2005	49,2	60,8	69,5	89,0	103,6	50,8	44,8	85,0	21,1	38,3	42,5	76,4	731
2006	34,0	56,6	85,7	62,6	39,2	67,8	30,9	111,7	15,7	37,2	27,8	51,2	620
2007	29,0	35,9	26,2	16,4	66,5	13,9	7,7	32,2	58,6	131,7	117,3	24,8	550,2

Prinos semena lucerke utvrđivan je u fazi kada je 70- 80% mahuna bilo mrke boje. Broj cvasti po stabljici je utvrđen nakon uzimanja uzorka od 30 stabljika po ponavljanju. Broj cvetova po cvasti i mahuna/cvasti je utvđivan na uzorku od po 30 dobro razvijenih cvasti ravnomerno sa vršnih, središnih i donjih delova stabljike sa svakog ponavljanja. Broj semena po mahuni utvrđen je brojanjem 30 slučajno odabranih mahuna sa svakog ponavljanja. Masa 1000 semena (g) određivana je brojanjem i merenjem 8 puta po 100 semena za svaku varijantu. Klijavost semena (%) je utvrđivana u laboratorijskim uslovima naklijavanjem u petri kutijama na filter papiru pri temperaturi od 20°C, brojanjem klijavih semena nakon 10 dana. Dobijeni rezultati su obrađeni metodom analize varijanse (ANOVA), a značajnosti između dobijenih vrednosti utvrđene su LSD testom.

Rezultati i diskusija

Na osnovu trogodišnjih rezultata u ovim istraživanjima, najviši prinos semena lucerke je ostvaren pri međurednom rastojanju od 40 cm (271,7 kg ha^{-1}), a najniži pri rastojanju od 60 cm (244,0 kg ha^{-1}), dok je setvom na rastojanju od 20 cm ostvaren prinos od 249,4 kg ha^{-1} (tab. 2).

Tab. 2. Prinos semena, komponente prinosa i kvalitet semena lucerke
Seed yield, yield components and seed quality of alfalfa

Godina *Year*	Međur. rastoj. *Row spacing*	Prinos semena kg ha^{-1} *Seed yield kg ha^{-1}*	Komponente prinosa *Yield components*			Kvalitet semena *Seed quality*	
			Cvasti/stabljici *Inflor. per stem*	Mahuna/ cvasti *Pods per inflores-cence*	Sem./ mahuni *Grains per pod*	Masa 1000 sem. *1000-seed weight* (g)	Klijav. *Shoot. potential* %
2005 (A_0)	20 cm	147,8	7,16	4,25	3,36	2,01	90,55
	40 cm	133,1	8,47	6,05	3,60	2,13	92,25
	60 cm	140,4	9,12	5,75	3,55	2,15	92,50
Pros-*Aver.*		140,1	8,25	5,35	3,59	2,09	91,77
LSD 0.05		17,78	0,56	0,32	0,19	0,038	1,56
0.01		23,65	0,75	0,42	0,25	0,050	2,07
2006 (A_1)	20 cm	210,7	9,34	5,40	3,45	2,01	86,75
	40 cm	245,8	16,27	6,12	3,80	2,05	89,25
	60 cm	239,7	16,75	6,35	4,05	2,08	90,25
Pros-*Aver.*		232,1	14,12	5,78	3,76	2,05	88,75
LSD 0.05		21,15	1,18	0,34	0,25	0,036	1,44
0.01		28,13	1,57	0,46	0,33	0,048	1,90
2007 (A_2)	20 cm	389,7	9,22	6,86	3,85	1,90	80,00
	40 cm	436,2	13,61	8,58	4,25	1,94	80,25
	60 cm	351,8	14,25	9,35	4,55	1,98	81,25
Pros-*Aver.*		392,6	12,36	8,26	4,22	1,94	80,50
LSD 0.05		26,33	0,94	0,55	0,29	0,030	1,66
0.01		35,02	1,25	0,73	0,38	0,039	2,21
Prosek	20 cm	249,4	8,57	5,50	3,55	1,97	85,76
Average	40 cm	271,7	12,78	6,92	3,88	2,00	87,25
2005-2007	60 cm	244,0	13,37	7,15	4,05	2,07	88,00

Posmatrano po godinama, zapaža se da je u 2005. godini, tj. u godini zasnivanja lucerišta (A_0) ostvaren prosečan prinos od 140,5 kg ha^{-1}, koji se može smatrati zadovoljavajućim. U drugoj godini istraživanja odnosno u prvoj godini punog iskorišćavanja (A_1) prosečan prinos je bio 230,8 kg ha^{-1} što je na nivou republičkog proseka, dok je najviši prinos ostvaren u trećoj godini istraživanja tj. u drugoj godini punog iskorišćavanja (A_2) i iznosio je prosečno 403,7 kg ha^{-1}. Rezultate slične ovima navodi Erić (1988) koji ističe da se najviši prinosi semena ostvaruju pri setvi na rastojanju od 30 cm i 40 cm (251,4 kg ha^{-1}, odnosno 221,2 kg ha^{-1}), dok je niži prinos semena ostvaren sa daljim povećanjem međurednog rastojanja na 50 cm (194,6 kg ha^{-1}). Askarian et *al.* (1995) navode da se najviši prinos semena dobija pri setvi na rastojanju od 45 cm (177,0 kg ha^{-1}), te da prinos opada sa povećanjem međurednog rastojanja na 60 cm (149,0 kg ha^{-1}), ali i sa smanjenjem rastojanja na 30 cm, odnosno 15cm

(166,0 kg ha^{-1} odnosno 136,0 kg ha^{-1}). Slično ovome, Stanisavljević i saradnici (2007) u uslovima istočne Srbije su najviše prinose semena ostvarili pri srednjoj gustini useva (343,6 kg ha^{1}) dok je sa smanjenjem i povećanjem međurednog rastojanja prinos opadao.

Najviše cvasti/stabljici ostvareno je pri najvećem međurednom rastojanju (13,37 cvasti/stabljici) a najmanje na rastojanju od 20 cm (8,57 cvasti/stabljici). Posmatrano po godinama, najviše cvasti/stabljici bilo je 2006 godine (14,12 cvasti/stabljici), najmanje u godini zasnivanja (8,25 cvasti/stabljici), dok je u 2007. godini ostvareno prosečno 12,36 cvasti/stabljici (tab.2). Broj mahuna/cvasti se kretao od 5,50 koliko je bilo pri setvi na međurednom rastojanju od 20 cm, do 7,15 mahuna/cvasti (međuredno rastojanje od 60 cm). Posmatrano po godinama, najveći broj mahuna/cvasti zabeležen je u 2007. godini (8,26 mahuna/cvasti), koja je okarakterisana kao najpogodnija za proizvodnju semena, a najmanji u 2005. godini (5,35 mahuna/cvasti). Najviše semena/mahuni ostvareno je setvom na međurednom rastojanju od 60 cm (4,05 semena/mahuni), a najmanje na rastojanju od 20 cm (3,55 semena/mahuni). U 2007. godini je ostvareno najviše semena/mahuni (4,22 semena/mahuni), dok je najmanje semena/mahuni bilo 2005. godine (3,50 semena/mahuni). Karagić (2004) navodi da je u drugoj i trećoj godini života lucerke bilo prosečno 9,66 cvasti po izdanku, 9,03 mahuna/cvasti i 5,47 semena/mahuni. Prema Ilićevoj (2005) broj cvetova/cvasti za 17 ispitivanih genotipova je bio prosečno 14,0 cvasti/stabljici, dok Đurović i sar. (2007) za 5 ispitivanih genotipova navode prosek od 9,37 cvasti/stabljici, 7,31 mahuna/cvasti i 5,53 semena/mahuni.

Masa 1000 semena je značajna komponenta kvaliteta semena, jer ukazuje na krupnoću i nalivenost semena. Najviša prosečna masa 1000 semena ostvarena je pri međurednom rastojanju od 60 cm (2,07g), a najniža (1,97 g) pri rastojanju od 20 cm (tab. 2) U prvoj godini istraživanja ostvarena je najviša masa 1000 semena (2,09 g), a najniža u trećoj godini (1,94 g). Da se pri većim međurednim rastojanjima dobija seme sa većom masom potvrđuju i rezultati koje su dobili Erić (1988), Lovato i Montanari (1991), Vučković (1994), Askarian et al. (1995) i drugi.

Najviša prosečna klijavost semena ostvarena je pri međurednom rastojanju od 60 cm (90,5%) a najniža pri rastojanju od 20 cm (88,0%). Posmatrano po godinama najviša klijavost je ostvarena je u 2005. godini (91,77 %), a najniža u 2007. godini (80,5%). Na variranje klijavosti semena usled ekoloških uslova ukazuju i rezultati koje iznose Kostić (1996), Katić i sar. (1999), Jevtić (2001), Karagić (2004) i drugi.

Zaključak

Na osnovu izvršenih trogodišnjih istraživanja može se zaključiti sledeće:

Međuredno rastojanje je značajno uslovilo visinu prinosa semena koja se kretala od 244,0 kg ha^{-1} (međuredno rastojanje od 60cm) do 271,7 kg ha^{-1} (međuredno rastojanje od 60cm). Posmatrano po godinama prinos semena se kretao od 140,5 kg ha^{-1} u godini zasnivanja do 392,6 kg ha^{-1} u trećoj godini istraživanja.

Najveći broj cvasti po stabljici (13,37) ostvaren je pri međurednom rastojanju od 60 cm, a najniži (8,57) pri rastojanju od 20 cm.

Najviše mahuna po cvasti i zrna po mahuni ostvareno je takođe pri rastojanju od 60 cm (7,15 odnosno 4,05), a najmanje pri rastojanju od 20 cm (5,50 odnosno 3,55).

Najveća prosečna masa 1000 semena ostvarena je pri međurednom rastojanju od 60 cm (2,07 g), a najniža (1,97 g) pri rastojanju od 20 cm. Ekološki uslovi uticali da se masa 1000 semena kretala od 1,94 g u trećoj do 2,09 g u godini zasnivanja.

Prosečna klijavost semena se kretala od 91,77 % u prvoj do 80,50 % u trećoj godini istraživanja. Pri međurednom rastojanju od 60 cm, prosečna klijavost semena je bila 88,00% dok je sa smanjenjem međurednog rastojanja klijavost semena opadala do 85,76% (međuredno rastojanje od 20cm), što ukazuje na značajan uticaj ovog faktora na klijavost semena.

Napomena

Ova istraživanja obavljena su kao deo projekta TR 31016 „Unapređenje tehnologije gajenja krmnih biljaka na oranicama i travnjacima“ koje finansira Ministarstvo prosvete i nauke Republike Srbije.

Literatura

Ascarian, M., Hempton, J.G., & Hill, M. J. (1995). Effect of row spacing and sowing rate on seed production of lucerne (*Medicago sativa* L.) cv Grasslands Oranga. *New Zealand Journal of Agricultural Research*, *38*, 289-296.

Beković, D. (2005). *Uticaj ekoloških uslova i načina setve na prinos i kvalitet semena i krme lucerke (Medicago sativa* L.*)* (Doktorska disertacija). Poljoprivredni fakultet Lešak, Univerzitet u Prištini.

Đurović, D., Stevović, V., Đukić, D., Petkova, D. i Madić, M. (2007). Prinos i komponente prinosa semena genotipova lucerke. *Zbornik radova Instituta za ratarsvo i povrtarstvo Novi Sad*, *44*(1), 151-157.

Erić, P. (1988). *Uticaj načina i gustine setve na prinos i kvalitet semena lucerke (Medicago sativa* (L) *em Wass.) sorte "NS Banat ZMS II" na zemljištu tipa cernozem* (Doktorska disertacija). Poljoprivredni fakultet Univerziteta u Novom Sadu.

Ilić, O. (2005). *Geneticka varijabilnost fertilnosti lucerke u uslovima slobodne oplodnje* (Magistarska teza). Poljoprivredni fakultet Univerziteta u Novom Sadu.

Jevtić, G., Radović Jasmina i Lugić, Z. (2001). Uticaj medonosne pčele (*Apis mellifera* L.) na prinos i komponente prinosa semena. *Arhiv za poljoprivredne nauke, 62*(220), 45-52.

Karagić, Đ. (2004). *Komponente prinosa, prinos i kvalitet semena u zavisnosti od sistema kosidbe* (Doktorska disertacija). Poljoprivredni fakultet Univerziteta u Novom Sadu.

Karagić, Đ. i Katić, S. (2012). Proizvodnja semena višegodišnjih krmnih mahunarki. U: Đukić D. i Stevović V. (ur.), *Oplemenjivanje krmnih biljaka i proizvodnja stočne hrane na oranicama.* Univerzitet u Kragujevcu, Agronomski fakultet Čačak, 109-138.

Katić, S., Mihajlović, V., Karagić Đ.,Vujaković, M. i Pataki, I. (1999). Biološke i tehnološke
osobine semena lucerke. *Selekcija i semenarstvo, 6*(3-4*)*, 45-50.

Kostić, Ž. (1996). Uticaj ekoloških uslova na prinos i kvalitet semena ucerke. *Selekcija i Semenarstvo,* (1-2), 84-86.

Lovato, A., & Montanari, M. (1991). Influence of Row Spacing and Sowing Rates on Lucerne (*Medicago sativa* L.) Seed Production. *Rivista di agronomia*, *25*(4), 78-81.

Lukić, D. (2000). *Lucerka*. Naučni institut za ratarstvo i povrtarstvo Novi Sad.

Stanisavljević, R. (2006). *Uticaj gustine useva na prinos i kvalitet krme i semena lucerke* (*Medicago sativa* L.*)* (Doktorska disertacija). Poljoprivredni fakultet Univerziteta u Novom Sadu.

Stanisavljević, R., Djukić, D., Milenković, J., Jevtić, G., Beković, D. i Terzić, D. (2007). Prinos i komponente prinosa semena u zavisnosti od gustine useva. *Zbornik radova Instituta za ratarsvo i povrtarstvo Novi Sad, 44*(1), 107-114.

Vučković, S. (1994). *Uticaj načina setve i đubrenja borom i cinkom na prinos i kvalitet semena* (Doktorska disertacija). Poljoprivredni fakultet Univerziteta u Beogradu.

Primljeno: 23. marta 2014.
Odobreno: 9. jula 2014.

Effect of Row Spacing on Seed Yield, Yield Components and Seed Quality of Alfalfa

Dragoljub Beković[1], Rade Stanisavljević[2], Milan Biberdžić[1], Slaviša Stojković[1], Jasmina Knežević[1]

[1]Faculty of Agriculture - Kosovska Mitrovica - Lešak, University of Priština, Serbia
[2] Institute for Plant Protection and Environment, Belgrade, Serbia

Abstract

Under agro-environmental conditions of Southern Serbia, the research was conducted over a three-year period to evaluate the effect of row spacing on seed yield, yield components and seed quality of alfalfa *cv.* 'K-23'. The average seed yield of alfalfa was highest at a row spacing of 40 cm (271.7 kg ha^{-1}), followed by row spacing of 20 cm (249.4 kg ha^{-1}) and 60 cm (244.0 kg ha^{-1}). The highest and lowest number of inflorescences per stem were obtained in rows spaced 60 cm (13.37 inflorescences/stem) and 20 cm apart (8.57 inflorescences/stem), respectively. The widest row spacing of 60 cm (7.15 pods / inflorescence) resulted in the highest number of pods per inflorescence, whereas the lowest number was produced at 20 cm spacing (5.50 pods / inflorescence). Grain number per

pod ranged from 3.55 (at 20 cm row spacing) to 4.05 (at 60 cm). The highest quality of alfalfa seed during the three years of the research was obtained at the widest row spacing (60 cm). Thousand-seed weight was highest at 60 cm and lowest at 20 cm (1.97 g and 2.07 g, respectively). The highest average values for seed germination rate were reported for 60 cm row spacing (88.00%) and the lowest for 20 cm row spacing (85.76 %).

Key words: inflorescences, pods, 1000 seed weight, germination rate

Dragoljub Beković
E-mail address: dragoljub_bekovic@yahoo.com

Received: March 23, 2014
Accepted: July 9, 2014

Professional paper
Stručni rad
UDK: 634.5-154.1
DOI: 10.7251/AGREN1401095G

University of Banjaluka, Faculty of Agriculture
Agro-knowledge Journal

State-of-the-art and Problems of Walnut Propagation Methods

Stefan Gandev[1]

[1]*Fruit-Growing Institute, Plovdiv, Bulgaria*

Abstract

At present budding and grafting are the most widely used approaches in the production of grafted walnut trees. Poor callus formation in walnut makes it difficult to propagate. Walnut propagation by cuttings is a method difficult to be realized. The presence of high concentration of phenolic compounds in its tissue and their oxidation, is the major reason of using micropropagation as a suitable method. The most commonly used technique is patch budding. Other used methods are bench grafting and hot callus. In the last years hot callus as a technique has been successfully used for propagation of walnut cultivars, but the height of the trees is not enough at the end of the season. A new walnut propagation method is called epicotyl grafting. All the methods of walnut propagation are discussed in the present paper.

Key words: Juglans regia L., budding, scion grafting

Introduction

The high protein and fat content in walnut kernels makes them an essential food for the people. That is why walnut is a strategic species for human nutrition and it was included in the list of FAO as a priority crop to be grown (Gandev, 2007). That necessitates the propagation of only those cultivars that possess good biological and economic properties. Due to heterozygosity of walnut, its propagation by seeds does not result in the inheritance of the characteristics of the chosen cultivar (Sharma et al.,

2003). What is more, seed-propagated trees start bearing fruit later. Those disadvantages could be overcome by vegetative propagation, which, unfortunately, is a difficult process due to the poor callus formation in that fruit species (Kuniyuki and Forde, 1985; Coggeshall and Beineke, 1997).

Analysis

Propagation by budding and scion grafting

At present ***budding*** and ***scion grafting*** are the most popular grafting methods in the production of walnut trees. In walnut, budding is basically carried out by the method of **patch *budding***. That is among the oldest and the most popular techniques of walnut propagation in a nursery in the open (Kuniyuki and Forde, 1985), adapted in our country (Nedev, 1967). The efficiency of that grafting method is different in the separate countries (Nedev et al., 1976; Ozkan et al., 2001). Solar et al. (2001) announced that in Slovenia the success rate of the *patch budding* method applied in walnut propagation is only 16%. In Turkey it is 88.3%, 72.5% in the spring of the following year and 41.25% before taking out the trees from the nursery (Ozkan et al., 2001). Probably the success in that case depends on the climatic conditions in the countries where applied. Winter frosts and spring late frosts reduce the percentage of the tree survival rate, but they are not the only limiting factors. Air temperature after grafting is also important. According to Lagerstedt and Roberts (1972) grafting in the open could be unsuccessful due to low temperatures after grafting, which make difficult or compromise good callus formation. Gandev and Dzhuvinov (2006) established that when growing walnut in the open under the conditions of South Bulgaria, temperature variation during days and nights decreases the percentage of the survival rate. That is the reason why the great difference between the day and night temperatures in the West European countries makes the survival of grafted tree difficult in the open.

The major walnut grafting method in Bulgaria is ***patch budding***. Non-stratified seeds are sown at a depth of 8-12 cm from the middle of November to the first decade of December. During vegetation soil is maintained free of weeds by applying herbicides and by tilling and earthing up the plants in order to form a thinner and tender soil crust at the grafting place. The aim is that the rootstocks reach a minimum thickness of 12 mm at the place of grafting. Hardwood cuttings are used, not less

than 12-14 mm thick. The best time for grafting in the climatic conditions of Bulgaria is from 20 August to 5 September. Grafting is performed at 5-10 cm above the soil surface, using a double knife. One month later the bandage is removed. In the second half of November the patch is covered with 20-30 cm of soil in order to protect the buds from winter cold. In spring (in March) the rootstocks are uncovered and the rootstock is cut off above the grafted bud. Soil is maintained free of weeds to enable the rapid growth of the grafted buds. The ready planting material is taken out after leaf fall.

The disadvantages of that method are: the short period suitable for carrying out the grafting and the dependence on the climatic conditions. In some years the winter cold, the excessive soil moisture during the stage of winter dormancy and the early autumn and late spring frosts could compromise the production of grafted planting material to 100%.

Chip budding is another method of walnut propagation in the open. In the climatic conditions of the high himalaya, chandel et al. (2006) announced that the optimal time for grafting is the middle of may till the first week of june and for patch budding – from the middle till the end of june. Grafting is carried out on annual rootstocks (*j. Regia* l.) With buds collected in the same season. In the time mentioned the survival rate is 89.0% for chip budding and about 50.0% for patch budding. Data about the conditions in turkey are controversial. A survival rate of only 13% was reported for chip buding and 43% for patch budding (polat and ördek, 2006).

According to achim and botu (2001), under the climatic conditions of the carpathian region in romania, chip budding could be performed in the open from 15 may till 15 june, using buds collected during the winter dormancy stage of the trees and stored in a refrigerator at a temperature of 1-4°c. Rootstock age and the time of their cutting off after grafting exert an effect on the survival rate. Using common walnut rootstocks (*j. Regia* l.), planted early in spring, forced and grafted in the same year in the period mentioned above, results in a survival rate of 78.0%. When using rootstocks planted in the previous year and grafted in the period mentioned, the survival rate decreases to 40.0%. In both cases, cutting off the rootstocks immediately after grafting leads to a decreased percentage of survival. That is why the rootstocks should be cut off 15 days after grafting. In Romania that method should be applied under controlled temperature in winter months.

Under the climatic conditions of Poland, Porebski (1994) also found out that summer chip budding is risky and it is possible to be used only in seasons when the average daily temperature is not lower than 18ºC.

Chip budding could be performed not only during vegetation, but also in winter months during tree dormancy, however the grafted plants should be kept under controlled temperature. In such cases the patch budding method is not very suitable due to the difficult separating of the bud from the scion (Bayazit et al., 2005). That problem does not exist in the chip budding method. Özkan and Gümüs (2001) applied chip budding to one-year old rootstocks in January, February and March. The grafted plants were put in wooden containers and covered with wet sawdust at a temperature of 27°C for 25 days. In that trial the highest survival rate percentage was obtained in Tokat cultivar in March – 53.0% versus the survival rate of 50.0% in September. The careful analysis shows that the authors calculated the percentage of the survived plants in September on the basis of the successfully propagated plants in March. We think that a clearer picture of the efficiency of that method would be obtained if calculation is done by taking into consideration all the grafted plants. After re-calculating, the method shows an efficiency from 16.0% to 26.0% for the studied cultivars and grafting time, which, in our opinion, is not an efficient method to use. A similar survival rate (26.9%) was reported by Porebski et al. (2002) after winter application of the chip budding method. According to them, the percentage of the plant survival rate could be increased if the rootstocks are forced and if they are in full vegetation at the time of winter grafting. Applying that practice, the authors obtained 81.9% of successfully propagated plants in March.

In Bulgaria the chip budding method is not recommended neither during the dormancy period under controlled temperature, nor during vegetation under natural conditions, due to the unsatisfactory results (Gandev, unpublished data).

Scion grafting of walnut under natural climatic conditions resulted in a worse result compared to most fruit species. In Turkey Demiroren and Buyukyilmaz (1988) obtained 20% of successfully propagated plants after ***cleft grafting*** and improved copulation. The results of Barut (2001) after ***splice grafting*** were similar, i.e. – from 20% to 33% survival rate.

Bark grafting is another approach for walnut propagation by scion grafting. 80% of successfully propagated plants were obtained under the warm conditions of South Africa (Rotondo Walnuts, 2004). The method is

not recommended for industrial-scale production, because rootstocks need to be grown for about 3-4 years before reaching the necessary thickness of 30 mm to 100 mm (Reil et al., 1998; Hartmann et al., 2002).

Due to the above mentioned disadvantages, *scion grafting* is applied in practice basically when walnut is propagated *indoors* (under controlled temperature). According to the different technologies, temperature, humidity, the grafting method and time of grafting are controlled, to provide permanent temperature necessary for the callus formation process.

It is well known that temperature has a definite effect on callus formation in fruit plants, the temperature values varying for the different species (Hartmann et al., 2002). As early as the beginning of the 30s last century, Sitton (1931) established that the optimal temperature for callus formation in walnut is 27°C. Later studies of Rongting and Pinghai (1993) and Reil et al. (1998) showed that the optimal temperature is from 26°C to 27°C, however 22°C is also favourable for the process (Rongting and Pinghai, 1993), while callus formation in walnut is unsatisfactory at temperatures below 20°C (Reil et al., 1998; Hartmann et al., 2002).

Temperatures have an effect on the amount of the callus tissue, as well as on the speed of callus formation. At a temperature of 22°C callus formation begins on the 6th day after grafting, while at 27°C the process starts on the 5th day. When the temperature increases up to 32°C, callus formation begins in 4 days only but at that temperature, less callus tissue is produced (Rongting and Pinghai, 1993).

The temperature of 27°C (± 2°C) has been adopted as a standard used by a large number of researchers and producers of planting material from around the world in their trials to carry out successful walnut grafting under controlled temperature (Zachej, 1976; Lagerstedt, 1981b; Millikan, 1984; Avanzato and Tamponi, 1988; Tsurkan, 1990; Avanzato and Atefi, 1997; Stanisavljević and Mitrović, 1997; Achim and Botu, 2001; Solar et al., 2001; Porebski et al., 2002; Avanzato et al, 2006; Erdogan, 2006; Vahdati & Zareie, 2006).

There is not a common opinion worldwide on the choice of a certain grafting method. *Improved copulation* (Radicati and Me, 1986; Lantos, 1990; Stanisavljević and Mitrović, 1997; Achim and Botu, 2001; Erdogan, 2006; Muzaffar and Kumar, 2011), *cleft grafting* (Pathak and Srivastava, 1975; Gautam, 1990; Atefi, 1997; Qian and Qian, 2000; Achim and Botu, 2001), *omega type grafting* (Lagerstedt, 1982; Ferhatoğlu, 1997; Solar et al., 2001; Dehgan et al., 2010) and *side grafting* (Germain et al., 1999) are all used. In previous studies of Gandev (2007,

2008 and 2009) it was found out that *cleft grafting* results in obtaining a high percentage of successfully propagated plants.

Along with the method chosen, the heating period is also important for the grafting success. There are announcements (Pieniazek, 1972; Avanzato and Atefi, 1997; Özkan and Gümüs, 2001; Karadeniz, 2003, Vahdati and Zareie, 2006; Erdogan, 2006), that the period of heating necessary for good callus production varies from 21 to 33 days. According to Cerny (1965), when the period is shorter than 14 days, the produced callus is insufficient for the good development of the propagated plants.

Studying the phenolic content of walnut, Pinghai and Rongting (1993b) mentioned that the amount of yuglon is different in the studied cultivars and according to Solar et al. (2006) it varies in the different seasons. They admitted that the high content of yuglon is the reason for poorer callus formation. In later studies, Karadeniz and Kazankaya (1997) confirmed those results and they established a reverse correlation between the callus formation process and the content of phenols in nine walnut cultivars. Lantos (1990) reported from 56% to 71% of survival rate after grafting of three cultivars; Stanisavljević and Mitrović (1997) – from 55% to 93% in a study with seven cultivars, while the results of Erdogan (2006) varied for the same cultivars, tested in two consecutive years. According to a number of authors (Pieniazek, 1972; Farmer, 1973; Lagerstedt, 1979; Atefi, 1997; Erdogan, 2006) callus formation in the grafted plants is cultivar specific, however it also depends on air humidity, which should be about 80% (Ferhatoğlu, 1997; Stansavljević and Mitrović, 1997; Germain et al., 1999; Achim and Botu, 2001; Özkan and Gümüs, 2001; Solar et al., 2001). Optimal time for ***scion budding*** is during winter dormancy of both the rootstock and the scion (Lagerstedt, 1979, 1982; Hartmann et al., 2002) and grafting could be carried out at the beginning, in the middle or at the end of the dormancy period. The results of the conducted investigations are controversial. In the US Lagerstedt (1982) recommended to carry out scion budding in the middle of the winter dormancy, i.e. from the middle of December to the middle of January and not in February and March. In the climatic conditions of Israel, Ebadi et al. (2002) obtained a significantly higher percentage of survival when grafting was conducted in December, not in January. Also in Iran, Vahdati and Zareie (2006) preferred to carry out grafting in March, i.e. at the end of the dormancy period, just like Ferhatoğlu (1997) and Erdogan (2006) in Turkey. Our data (FAO project, 2002-2004) showed that *scion budding* in March resulted in successful walnut propagation during the period of winter dormancy.

Various scion budding technologies have been applied indoors in many parts of the world. The most popular and widely used technology for callus formation in walnut is putting the grafted plants in wooden containers and placing them in a room with controlled temperature (Nedev et al., 1983). Throughout the world that propagation method is known as ***bench grafting***. The authors Sen (1986), Kantarci (1989), Tsurkan (1990), Flores et al. (1995) underlined the following advantages of *bench grafting* over *patch* and *chip budding:*

- The period suitable for grafting is extended and a larger number of plants could be produced;
- Grafting is carried out in winter, i.e. in a season of less agricultural work;
- Bench grafting could be mechanized, thus the amount will be increased and the production costs will be reduced.

In Bulgaria *bench grafting* was studied by Anadoliev (1983). One-year old seedlings grown in the open should be used as rootstocks. Scions are collected during the winter dormancy of the mother plants. Grafting is performed by the method of improved copulation from the first decade of February till the middle of March. After grafting the scions are dipped in paraffin at the place of grafting and put in containers. The plant roots are covered with sawdust mixed with perlite at equal amounts. The ready containers are put in a room where the temperature of 26-27°C is maintained for 3-4 weeks. The successfully grafted plants are adapted and planted in the open, in the fields.

Tsurkan (1990) reported that following that technology, he obtained a considerably lower percentage of successfully propagated plants – from 5% to 45% – explaining that the variation in the survival rate depended on the method of grafting. According to Özkan and Gümüs (2001) the percentage varied within 33% – 53% for the separate cultivars. Terziev (personal correspondence) obtained about 40% plants with callus formation in three consecutive years.

Another method of walnut propagation is ***hipocotyl grafting*** (Frutos, 1995; Avanzato, 2001). In the recent years the method gained greater importance (Vahdati and Zareie, 2006; Gandev and Dzhuvinov, 2006; Gandev, 2008). Potted seedling rootstocks are used in that method. Grafting is carried out during the vegetation period. The growing tip of the rootstock is cut off and a growing tip from the propagated cultivar is grafted. The pot is firmly covered with a plastic bag in order to provide high air humidity, necessary for callus formation. Then the plant is placed

for 4 weeks in a greenhouse at a temperature of 26°C (± 1°C). The successfully propagated plants are put for adaptation in a shaded place for 2-3 weeks, after which are taken in the open. Gandev and Dzhuvinov (2006) reported that they obtained 83% of survival rate by that grafting method.

The ***hot callus*** method was described in details by Lagerstedt (1981a, 1981b, 1982, 1983, 1984). Using a heating cable, a temperature of 26°C (± 2°C) is maintained at the place of grafting. The one-year old rootstocks are taken out of the soil, grafted on and put horizontally over the heating source, covering their roots with sawdust. The positive results obtained by Erdogan (2006) who used electric heating cable, confirmed the method efficiency. Avanzato and Atefi (1997) and Avanzato (1999) developed an alternative approach for heating the place of grafting without taking the rootstocks out of soil, using also an electric cable. In that way the stress of the rootstocks is avoided as they are not taken out of soil and the growth of the graftage after the grafting process is favoured.

In Bulgaria the method with electric heating was successfully tested and adapted by Gandev (2007, 2008, 2009). In that case a simple appliance is used in a steel-and-glass greenhouse, placing the electric cable in a groove, covering it with peat. The thermal regulator maintains the necessary temperature. The cleft grafted plants are placed horizontally, perpendicular to the groove, at a distance 10-15 cm from one another and their roots are covered with sand. The place of grafting should be just above the heating cable. The place of grafting is covered with wet foam, firmly fixed above the groove and the grafted plant in order to provide high air humidity. The scions are 12-15 cm long, with 2-3 buds. For 4 weeks high air humidity is maintained at the place of grafting and the temperature should be about 27°C (± 1°C). The plants that have formed callus are adapted and in spring they are planted in the fields. Using radioisotopes, Nacheva and Gandev (2009) studied the transport and distribution of ^{14}C-photoassimilates in walnut plants propagated by the hot callus method. It was established that there was not any negative effect on the movement of photoassimilates in the grafted plants in result of the method applied. The adapted hot callus method of walnut propagation by using an electric cable, described above, has some disadvantages, such as the big energy consumption and the risk of using electricity in humid environment.

Suk-In et al. (2006) announced that along ***hipocotyl grafting***, ***epicotyl grafting*** could also be used for walnut propagation. Taking into con-

sideration the advantages of epicotyl grafting, Gandev and Arnaudov (2011) started the first investigations on the method at the Fruit-Growing Institute – Plovdiv. Similar to the other techniques for winter scion grafting, the parameters in that method are the same: providing a temperature of about 27°C (± 1°C) and high air humidity at the place of grafting for 3-4 weeks. Some elements of the technological process, such as reaching the necessary thickness of the rootstocks before grafting and the types of scions suitable to be grafted, are still understudied.

According to Rodriquez et al. (1989) and Preece et al. (1989) walnut belongs to the group of species, difficult to be cultivated *in vitro*. Rongting and Pinghai (1993a) think that this is due to the high content of phenolic components in the plant tissue and their oxidizing after the injury. The major difficulties in walnut micropropagation are related to setting and stabilizing the tips from matured plants in *in vitro* culture, the low coefficient of multiplication, difficult root-formation, as well as the great losses during plant adaptation. The first announcements about successes in setting and stabilizing in culture are from the beginning of 90s last century (Rodriguez, 1982a,b). Later, a number of studies have been carried out, most of them being based on the nutrient medium for *in vitro* cultivation of *Juglans* spp., developed by Driver and Kuniyuki (1984). It is well known that the genetic type plays an important role at all the stages of vegetative propagation, especially at the rooting stage. In the recent years, successful examples for rooting and acclimatization of different walnut cultivars were announced (Ripetti et al., 1994 and Nacheva, 2012). Unfortunately, there are still unsolved problems in walnut micropropagation and it has not yet found industrial application in the production of walnut planting material.

Conclusion

In many countries the most commonly used technique is ***patch budding***. Other popular methods are ***bench grafting*** and ***hot callus***. In the last years hot callus method has been successfully used for propagation of walnut cultivars, but the tree height at the end of the season is unsatisfactory. The new walnut propagation method is called ***epicotyl grafting***. Depending on the climatic conditions and equipment, each of the methods could be used successfully.

References

Anadoliev, G. (1983). Razmnojavane na oreha v stratifikalnia. In Nedev, N. (Ed.), *Orehoplodni* (pp. 81-100). Plovdiv: 'Hristo G. Danov'.

Nacheva, L. (2012). *Godishen doklad na Instituta po ovoshtarstvo-Plovdiv za 2012 godina.* Instituta po ovoshtarstvo-Plovdiv

Nacheva, L. & Gandev, S (2009). Transport and distribution of ^{14}C-photo-assimilates in walnut plants grafted by the hot callus method. *Plant Science, 46*, 210-213

Nedev, N., Serafimov, S., Anadoliev, G., Kavardzhikov, L., Krinkov, H. , Radev, R., Dochev, D., Stamatov, I., Slavov, N., Vishanska, Y., Rusalimov, Z., Yovchev, I., Dzheneva, A., Lalev, N., Iliev, I. & Slavcheva, R. (1983). *Orehoplodni*. Plovdiv: 'Hristo G. Danov'.

Achim, G. & Botu, I. (2001). Results in walnut propagation by using different methods. *Acta Horticulturae, 544*, 503-509.

Atefi, J. (1997). Comparison of hypocotyl and hot callus cable graft with traditional grafting method. *Acta Horticulturae*, *442*, 309-312.

Avanzato, D. (1999). Un sistema mobile di riscaldamento locallizzato del punto d'innesto applicato in situ su semenzali di noce. *Riv. Fruttic. Ortofloric., 61*(11), 74-76.

Avanzato, D. (2001). Effect of different hygro-thermic environments on growth of potted grafted seedlinds. *Acta Horticulturae, 544*, 546-464.

Avanzato, D. & Tamponi, G. (1988). The effect of heating of walnut graft unions on graft success. *Acta Horticulturae, 277*, 79-83.

Avanzato, D. & Atefi, J. (1997). Walnut grafting by heating the graft point directly in the field. *Acta Horticulturae 442*, 291-294.

Avanzato, D., Ducci, D., Gorian, F., Gui, L., Major, A., Malvolti, E., Mezzalira, G., Pollegioni, P. & Proietti, R. (2006). Propagation ability of selected walnut hybrids (*Juglans regia* L. x *J. nigra* L.). *Acta Horticulturae, 705*, 359-364.

Barut, E. (2001). Different whip grafting methods of walnut. *Acta Horticulturae, 544*, 511-513.

Bayazit, S., Imrak, B. & Küden, A. (2005). Determination of grafting times and methods of walnut under Adana ecological conditions. *Bançe Ceviz, 34*(1), 231-234.

Cerny, L. (1965). Veredelung der walnuss und anderer holzarten in der zeit der echten winterruhe. *Biol. Plant. 7*, 226-237.

Chandel, J.S., Gautam, D.R. & Sharma, N.C. (2006). Chip budding: an excellent method of propagation of walnut (*Juglans regia L.)*. *Acta Horticulturae, 705*, 335-339.

Coggeshall, M.V. & Beineke, W.F. (1997). *Black walnut vegetative propagation: the challenge continues.* Paper presented at Proc., 5-th Black Walnut Symposium, U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. United States.

Dehgan, B., Vahdati, K., Rezaee, R. & Hassani, D. (2010). Walnut grafting success as affected by different grafting methods, cultivars and forcing treatmens. *Acta Horticulturae, 861*, 345-352.

Demiroren, S. & Buyukyilmaz, M. (1988). *Studies on propagation methods of walnut.* Paper presented at International conference of walnuts. 19-23 September 1988, Ataturk Central Horticultural Research Institute, Yalova, Turkey.

Driver, J.A. & Kuniyuki, A.H. (1984). In vitro propagation of Paradox walnut rootstock. *HortScience 19*, 507–509.

Ebadi, A., Solgi, M. & Zamani, Z. (2002). Effects of date of grafting and kind of callusing bed on grafting success of side and saddle grafting in Persian walnut (*Juglans regia* L.). *Seed Plant 18*(3), 294-305.

Erdogan, V. (2006). Use of hot callusing cable in walnut propagation. *Acta Horticulturae, 705*, 313-317.

Farmer, R.E. (1973). *Vegetative propagation: problems and prospects.* Paper presented at Black walnut symposium, 14-15 August 1973, Carbondale, Illinois.

Ferhatoğlu, Y. (1997). The studies on the effect of potting and omega grafting in relation to different time on graft taking percents of some standard walnut varieties. *Acta Horticulturae, 442*, 303-308.

Flores, P., Moyano, M. & Seta, S. (1995). Selection of the most suitable management techniques for walnut grafts in Zavalla. *Horticulturae Argentina, 14*(37), 52-54.

Frutos, D. (1995). *Walnut propagation research: Hypocotyl grafting*. FAO Report, Rome.

Gandev, S. (2007). Budding and grafting of the walnut (*Juglans regia* L.) and their effectiveness in Bulgaria. *Bulgarian Journal of Agricultural Science, 13*, 683-689.

Gandev, S. (2008). Extending the period for propagation of walnut (*Juglans regia* L.) by combining hot callusing, hypocotyl grafting and patch budding methods. *Voćarstvo, 42*, 49-53.

Gandev, S. (2009). Propagation of walnut under controlled temperature by the mehods of omega bench grafting, hot callus and epicotyl grafting. *Bulgarian Journal of Agricultural Science, 15*, 105-108.

Gandev, S. & Arnaudov, V. (2011). Propagation method of epicotyl grafting in walnut (*Juglans regia* L.) under Production Condition. *Bulgarian Journal of Agricultural Science, 17*, 173-176.

Gandev, S. & Dzhuvinov, V. (2006). Performance of hypocotyl grafting of walnut under uncontrolled temperature conditions. *Acta Horticulturae, 705*, 351-353.

Gautam, D.R. (1990). Studies on the winter and summer vegetative propagation techniques of walnut (*J. regia* L.). *Acta Horticulturae, 284*, 27-31.

Germain, E., Prunet, E.J. & Garcin, A. (1999). *Le Noyer*. Paris: Centre Technique Interprofessionnel des Fruits et Légumes Publication.

Hartmann, H.T., Kester, D.E., Davies, F.T. & Geneve, R.L. (2002). *Plant propagation: principles and practices*. New Jersey: Prentice Hall Inc.

Kantarci, M. (1989). The effect of different conditions and methods on the grafting of walnuts. *Doga Türk Tarim ve Ormancilik Dergisi, 13*(36), 1089-1095.

Karadeniz, T. (2003). Flavan content of annual shoots affects graft take success in walnut (*Juglans regia* L.). *S. Afr. J. Bot. 69*(3), 292-294.

Karadeniz, T. & Kazankaya, A. (1997). Relations between phenolic compounds and graft success in walnut. *Acta Horticulturae, 442*, 193-196.

Kuniyuki, A. & Forde, H. (1985). Walnut propagation. In Ramos, D. (Ed.), *Walnut orchard management* (pp. 38-46). Publication 21410, University of California, USA.

Lagerstedt, H.B. (1979). Propagation-Seed, Grafting, Budding. In Jaynes, R.A. (ed.), *Nut Tree Culture in North America,* (pp.240-271). USA: NNGA Broken Arrow., Road Hamden, Conn.,

Lagerstedt, H.B. (1981). A new device for hot callusing graft unions. *HortScience, 16*, 529-530.

Lagerstedt, H.B. (1982). A device for hot callusing graft unions of fruit and nut trees. *Proc. Inter. Plant. Propag. Soc.,* 31, 151-159.

Lagerstedt, H.B. (1984). Hot callusing pipe speeds up grafting. *Am. Nurseryman, 15*, 113-117.

Lagerstedt, H. B. and W. W. Roberts (1972). Walnut grafting in Oregon-problem and solutions. *Ann. Rep. NNGA,* Iova State University.

Lantos, A. (1990). Bench Grafting of walnut. *Acta Horticulturae, 284*, 53-57.

Millikan, D.F. (1984). Propagation of Juglans Species by Fall Grafting. *Ann. Report North Nut Grow Ass.,* 61, 41-44.

Muzaffar, M. & Kumar, A. (2011). Effect of different methods, time and environmental condition on grafting in walnut. *International Journal of Farm Sciences 1*(2), 17-22.

Nedev, N., Vasilev, V., Kavardzhikov, L. & Zdravkov, K. (1976). *Oreh*. Plovdiv: 'Hristo G. Danov'.

Özkan, Y., Edizer, Y. & Auca, Y. (2001). A study on propagation with patch budding of some walnut cultivars (*Juglans regia* L.). *Acta Horticulturae, 544*, 521-525.

Özkan, Y. & Gümüs, A. (2001). Effects of different applications on grafting under controlled conditions of walnut (*Juglans regia* L.). *Acta Horticulturae, 544*, 515-520.

Pathak, K. & Srivastava, R. (1975). Walnut propagation by vegetative method. *Indian Horticulture, 19*(4), 13-16.

Pinghai, D. & Rongting, Xi. (1993). Effect of phenols on the survival of walnut grafting. *Acta Horticulturae, 311*, 134-140.

Polat, A. & Ördek, G. (2006). Increasing of grafting success rate on walnut. *Acta Horticulturae, 722*, 253-256.

Porebski, S. (1994). Szczepienie orzechow wloskich. *Szkolkarstwo, 4*, 14-15.

Porebski, S., Rzeźnicka, B. & Poniedzialek, W. (2002). Comparison of two methods of walnut grafting. *J. Fruit Orn. Pl. Res. 10*, 55-62.

Preece, J.E., Van Sambeek, J.W., Huetteman, C.A. & Gaffney, G. R. (1989). *Biotechnology: in vitro studies with walnut (Juglans) species: the continuing quest for quality.* Paper presented at Proceedings of the 4th Black Walnut Symposium, Carbondale, Illinois, Walnut Council, Indianapolis.

Qian-Chun & Qian, C. (2000). Study on walnut seedling grafting techniques. *South China Fruit, 29*(6), 41-45.

Radicati, L. & Me, G. (1986). Further experiments on different grafting and budding methods of walnut in the Northern Italy. *HortScience. 21*(3), 768-772.

Reil, W.O., Leslie, C.A., Forde, H.I. & Mckenna, J.R. (1998). Propagation. In Ramos, D.E. (ed.). *Walnut production manual*. Publication 3373. University of California, Division of Agricultural and Natural Resources.

Ripetti, V., Kevers, C.L. & T. Gaspar, T. (1994). Two successive media for the rooting of walnut shoots in vitro. Changes in peroxidases activity and in ethylene production. *Adv. Hort.Sci. 8*, 29-32.

Rodriguez, R. (1982a). Callus initiation and root formation from in vitro culture of walnut cotyledons. *HortScience, 17*,195–196.
Rodriguez, R. (1982b). Stimulation of multiple shoot-bud formation in walnut seeds. *HortScience, 17*, 587-592.
Rongting, Xi & Pinghai, D. (1993). A study on the uniting processes of walnut grafting and the factor affecting. *Acta Horticulturae, 311,* 160-170.
Rotondo Walnuts (2004). *Progress report for the period June to October 2004.* Paper presented at IDC Board meeting, 25 November 2004. Rotondo Farm, Aliwal North, South Africa.
Sharma, A., Singh, S. & Srivastava, K. & Sounduri, A. (2003). Studies on success of walnut grafting as affected by time and environment. *Indian Journal of Ecology, 18*, 123-125.
Sitton, B.G. (1931). Vegetative propagation of the black walnut. *Mich. Agric. Exp. Stn. Tech. Bull.,* (119)*,* 45.
Solar, A., Colariac, M., Usenik, V. & Stampar, F. (2006). Seasonal variations of selected flavonoids, phenolic acids and quinones in annual shoots of common walnut. *Plant Science, 170*, 453–461.
Solar, A., Stampar, F., Trost, M., Barbo, J. & Avsec, S. (2001). Comparison of different propagation methods in walnut (*Juglans regia* L.) made in Slovenia. *Acta Horticulturae, 544*, 527-530.
Stanisavljević, M. & Mitrović, M. (1997). Effect of variety on successful grafting and development of nursery trees of walnut (*Juglans regia* L.). *Acta Horticulturae, 442*, 281-283.
Suk-In, H., Moon-Ho, L. & Yong-Seok, J. (2006). Study on new vegetative propagation method 'Epicotyl grafting' in walnut trees (*Juglans* Spp.). *Acta Horticulturae, 705*, 371-374.
Tsurkan, L.P. (1990). Production technology of English walnut planting materialising winter table grafting. *Acta Horticulturae, 284*, 65-68.
Vahdati, K. & Zareie, N. (2006). Evaluation of side-stub and hypocotyle grafting efficiency for walnut propagation in Iran. *Acta Horticulturae, 705*, 347-350.
Zachej, S. (1976). Determination of the optimum time for grafting walnuts with the use of heat. *Hort. Abstr,. 46*(10), 780-786.

Received: March 28, 2014
Accepted: June 23, 2014

Stanje i problemi u proizvodnji sadnog materijala oraha

Stefan Gandev[1]

[1]*Voćarski institut, Plovdiv, Bugarska*

Sažetak

Danas su okuliranje i kalemljenje kalem grančicom najčešće korišćeni pristupi u proizvodnji kalemljenog oraha. Slabo formiranje kalusa otežava razmnožavanje. Razmnožavanje reznicama je metod koji nije lako realizovati. Prisustvo visokih koncentracija fenolnih jedinjenja u tkivu i njihova oksidacija su glavni razlog za korišćenje mikropropagacije kao odgovarajuće metode. Najčešće korištena tehnika je okuliranje na prozorče. Ostale tehnike koje se koriste su kalemljenje iz ruke i stratifikovanje. Posljednjih godina se stratifikovanje kao tehnika uspješno koristi za razmnožavanje, ali visina stabla ne bude dovoljna na kraju sezone. Nova metoda razmnožavanja oraha je kalemljenje epikotila. U ovom radu se diskutuje o svim metodama razmnožavanja oraha.

Ključne riječi: Juglans regia L., okuliranje, kalemljenje na zrelo

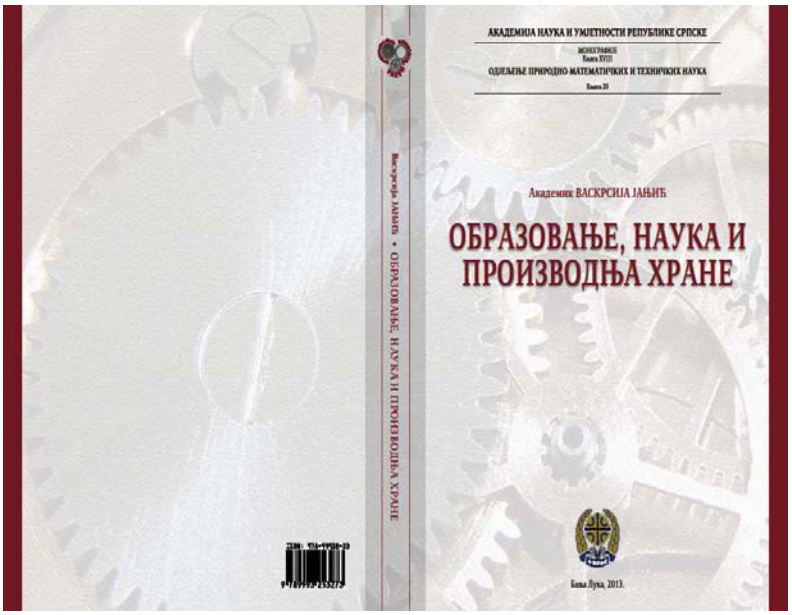
Stefan Gandev
E-mail address:s.gandev@abv.bg

Primljeno: 28. marta 2014.
Odobreno: 23. juna 2014.

Vaskrsija Janjić

Obrazovanje, nauka i proizvodnja hrane

Akademija nauka i umjetnosti Republike Srpske
Odeljenje prirodno-matematičkih i tehničkih nauka, Banja Luka, 2013, 678 str.



Ovo izuzetno monografsko delo autor je posvetio Akademiji nauka i umjetnosti Republike Srpske čiji je član, povodom obeležavanja 20 godina njenog postojanja i rada, u znak zahvalnosti za sve što je uradila za svoj narod.

Monografija je po svojoj koncepciji i sadržaju neobična, pošto se u njoj razmatraju problemi na prvi pogled tri različite oblasti: obrazovanja, nauke i proizvodnje hrane. U stvarnosti ove oblasti su usko povezane. Bez dobrog obrazovanja nema vrhunske nauke, a bez nauke uspešne proizvodnje hrane. Tako posmatrano, dolazi se do zaključka da publikacija predstavlja znalački dobro komponovanu celinu, pošto obrazovanje, nauka i proizvodnja hrane predstavljaju najznačajniji oslonac opstanka i prosperiteta svakog društva. Zahvaljujući višegodišnjem, istrajnom i uspešnom naučnoistraživačkom i pedagoškom radu kao i svestranom uvidu u najnovija zbivanja u pomenute tri oblasti, iz pera akademika V. Janjića nastalo je izuzetno delo, velike vrednosti.

Knjiga je napisana na 678 stranica komjuterski pripremljenog teksta, ima 435 tabela, 314 grafikona, 29 shema, 8 mapa i 75 slika. Posle svakog poglavlja naveden je spisak literature koji ukupno obuhvata 778 literaturnih navoda. Na kraju knjige dat je izvod publikacije na engleskom jeziku i izveštaj recenzenata. Pored autorskih publikacija, autor je obimno koristio i najnoviju statističku građu OECD, FAO, UNESCO, naših statističkih zavoda i Narodne biblioteke Srbije. Knjiga je napisana jasnim jezikom i stilom. Posebno treba istaći da je tehnička izvedba knjige na izuzetno zavidnom nivou.

Publikacija je podeljena na tri velika poglavlja. Prvo poglavlje posvećeno je obrazovanju i obuhvata osam podnaslova: Uloga i značaj obrazovanja; Kratak istorijski pregled visokog obrazovanja; Obrazovanje u Bosni i Hercegovini i Republici Srpskoj; Akademske studije u Srbiji; Ekspanzija i kvalitet visokog obrazovanja; Obrazovanje u svetu; Broj stanovnika u svetu; Metode i kriterijumi za rangiranje univerziteta u svetu; Literatura.

Zahvaljujući višegodišnjem ličnom iskustvu u obrazovanju na redovnim i poslediplomskim studijama, kao i znalačkom i sistematskom prikupljanju, proučavanju i obradi najnovijih raspoloživih podataka, autor je sa velikim uspehom svestrano pikazao i analizirao obrazovanje na različitim stupnjevima na našem prostoru i u svetu i ukazao na pravce razvoja i uticaj globalizacije na obrazovni sistem. Ovo poglavlje istovremeno predstavlja vrednu istorijsku građu obrazovnog sistema u nas.

Poglavlje koje se odnosi na nauku ima deset podnaslova: Stanje, problemi i perspektive naučnoistraživačkog rada; Stanje infrastrukture ustanova u oblasti nauke u Bosni i Hercegovini i Republici Srpskoj; Stanje i izdvajanja za nauku u Republici Srbiji; Programi za stvaranje evropskog istraživačkog prostora; Stanje istraživanja u svetu; Patenti i licence u svetu; Patenti, industrijski dizajni i žigovi u Srbiji; Vrednovanje naučnog rada; Naučni radovi i časopisi u Srbiji i zemljama u okruženju; Vrednovanje naučnih radova i časopisa u svetu iz različitih oblasti nauka; Literatura.

Nauka je veoma dinamična oblast ljudskog stvaralaštva, stoga poznavanje pravaca razvoja i prioriteta u toj oblasti je važan preduslov za uspešan, plodotvoran naučnoistraživački rad. U ovom poglavlju autor svestrano razmatra problematiku naučnog rada na našem prostoru i šire, počev od materijalnih uslova i ljudskog resursa, izbora mladih saradnika, uloge rokovodioca, planiranje u nauci, zahteve svetske nauke, perspektive daljeg razvoja nauke, svetske kriterijume vrednovanja naučnog rada i časopisa i dr. Čitajući ovo poglavlje, dolazi se do saznanja da je baviti se naukom privilegija, ali je istovremeno veoma zahtevno. Potrebna su veća

ulaganja, više truda, znalačko trasiranje razvoja nauke da bi u toj oblasti u nekom doglednom vremenu ostvarili priključak nauci razvijenog sveta.

Proizvodnja dovoljne količine zdravstveno bezbedne hrane je u globalnim razmerana najveći izazov čovečanstva. Poglavlje o proizvodnji hrane je najobimnije i obuhvata 10 podnaslova: Osnovni problemi u proizvodnji hrane u svetu; Osnovni problemi u proizvodnji hrane u Republici Srpskoj i Srbiji; Globalni značaj biljaka; Genetički modifikovane biljke; Genetički modifikovane životinje; Genetički modifikovana hrana; Osnovne karakteristike najvažnijih genetički modifikovanih biljaka; Površine na kojima se gaje genetički modifikovane biljke u svetu; Osnovne karakteristike herbicida koji se primenjuju u genetički modifikovanim usevima; Programi stvaranja i korišćenja genetski modifikovanih biljaka; Literatura.

U ovom poglavlju u uvodnom delu razmatrani su osnovni problemi proizvodnje hrane u svetu i na našem prostoru, kao i značaj biljnog sveta i čoveka u tom procesu. Najveći prostor posvećen je problematici genetički modifikovanim biljkama, njihovom stvaranju, osnovnim karakteristikama, prednostima i rizicima gajenja i rasprostranjenja. Autor ukazuje na kompleksnost ove problematike, ona je podjednako značajna kako iz zdravstveno bezbednih, tako i ekonomskih razloga. Mišljenje među naučnicima o opravdanosti gajenja genetički modifikovanih organizama su podeljenja, što ovu problematiku čini još aktuelnijom. Zahvaljujući veoma svestranom, detaljnom i znalačkom razmatranju ove problematike, čitalac može da se informiše o najnovijem stanju u ovoj oblasti i da stvori svoje sopstveno mišljenje. Genetički modifikovane biljke su stvorene pre svega zbog primene herbicida, ali ne samo zbog toga. U toj oblasti autor ove knjige ima zavidne naučne rezultate i objavljena izuzetno vredna dela.

Ova publikacija je od izuzetnog značaja ne samo za istraživače već istovremeno i za stručnjake koji se bave planiranjem, organizacijom i vrednovanjem obrazovnog i naučnog rada i regulativima u proizvodnji hrane. Za pisanje ovako obimnog, kompleksnog i multidisciplinarnog teksta potrebna je istrajnost, znanje, iskustvo i dar što krasi autora, što je i omogućilo nastajanje ove publikacije. Imajući u vidu značaj i aktuelnost problematike, sadržaj, karakter i visok naučni nivo, za očekivati je da će ovo izuzetno delo trajne vrednosti pobuditi veliko intresovanje i obogatiti naš naučni i duhovni prostor i popuniti prazninu u toj oblasti.

Akademik Rudolf Kastori

Упутство ауторима

Часопис "Агрознање" је научно-стручни часопис који објављује научне и стручне радове, који нису штампани у другим часописима. Сажеци, синопсиси, магистарски и докторски радови се не сматрају објављеним радовима, у смислу могућности штампања у часопису "Агрознање".

Категоризација радова

"Агрознање" објављује рецензиране радове сврстане у сљедеће категорије: прегледни рад, оригинални научни рад, претходно саопштење, излагање на научном или стручном скупу и стручни рад.

Прегледни рад је највиша категорија научног рада. Пишу их аутори који имају најмање десет публикованих научних радова са рецензијом у међународним или националним часописима из домена научног питања које обрађује прегледни рад, што истовремено подразумијева да су ови радови цитирани (аутоцитати) у самом раду.

Оригинални научни рад садржи необјављене научне резултате изворних научних истраживања.

Претходно саопштење садржи нове научне резултате које треба претходно објавити.

Излагање на научном и стручном скупу је изворни научни и стручни прилог необјављен у зборницима, који се може прихватити као прегледни, научни или стручни рад са обавезном назнаком на ком скупу је саопштен.

Стручни рад је прилог значајан за струку о теми коју аутор није досад објавио.

Аутор предлаже категорију рада, али коначну одлуку доноси редакција часописа на приједлог рецензената.

Припрема радова за штампање

Рад може бити написан на српском језику (ћирилично и латинично писмо) и на енглеском језику.

Обим радова треба бити ограничен на 12 страница A_4 формата за прегледни рад, а 8 страница A_4 формата за остале категорије радова. Овај број страница подразумијева и све табеле, графиконе, слике и друге прилоге, уз основни фонт текста Times New Roman, величину фонта 12 pt и проредом 1,5. Све маргине морају бити најмање 2,5 cm.

Текст прегледног рада треба да садржи поглавља: Сажетак, Увод (са прегледом литературе), Дискусија или Анализа рада, Закључак, Литература, Сажетак (преведен на српски ако је написан на енглеском и обрнуто).

Текст оригиналног научног рада треба да садржи сљедећа поглавља: Сажетак, Увод (са прегледом литературе), Материјал и методе рада, Резултати и дискусија, Закључак, Литература, Abstract (прјевод Сажетка).

Наслов рада треба бити што краћи, информативан и писан малим словима величине 14 pt, без наглашавања текста (bold, italic, underline), на средини странице. Испод наслова рада и једног празног реда писати пуно име и презиме аутора без титуле, величина 12 pt. Испод имена аутора у фонту *italic* писати назив институције-организације у којој је аутор запослен, град и земљу у којој се институција-организација налази. У овом дијелу није потребно наводити тачне адресе и поштанске бројеве.

Сажетак представља сажет приказ рада који треба да има између 50 и 150 ријечи, а пише се на језику рада. Елементи које сажетак треба да садржи у кратким цртама су: предмет истраживања, метод рада, резултати рада, идеја за ново истраживање и кратак закључак/пресјек доприноса рада.

Након сажетка, са размаком од једног реда се дају кључне ријечи (до пет укупно) у сљедећем формату: *Кључне ријечи:* кључна ријеч 1, кључна ријеч 2, ..., кључна ријеч 5. Ријечи из наслова не смију да се понављају у Кључним ријечима.

Наслови и поднаслови рада. Главни наслови у раду (наслови поглавља: Увод, Материјал и метод рада, итд.) се пишу величином фонта 13 pt, на средини странице. Између кључних ријечи и Увода су два празна реда. Поднаслови у поглављима се пишу величином фонта 12 pt, поравнати према лијевој маргини. Између наслова поглавља и текста претходног поглавља оставља се један празан ред. Сваки наслов/поднаслов и текст који га прати, између себе имају по један празан ред.

Литература се пише азбучним, односно абецедним редом (у зависности од језика и писма) са пуним подацима према АПА стандарду (види табеле иза Упутства на енглеском језику).

Abstract (пријевод Сажетка) писати на енглеском језику ако је рад на српском, и обрнуто. *Abstract,* такође, мора да садржи наслов рада, имена аутора, назив и сједиште установе-организације у којој је аутор запослен, град и земљу у којој се институција-организација налази и кључне ријечи (*све на истом језику*), а у формату који је наведен раније. Испод кључних ријечи навести име и презиме аутора задуженог за кореспонденцију и његову/њену е-маил адресу.

Табеле, графикони и слике морају бити означени бројем и да имају одговарајући назив (нпр. Таб. 1. / Граф. 1. / Сл. 1. Приказ резултата истраживања у 2011. години). Називи табела се наводе изнад табеле са лијевим поравнањем и једним празним редом између, док се називи графикона и слика наводе испод, на средини странице и једним празним редом између. Табеле, графикони и слике *не смију* излазити изван задатих маргина. У табелама избјегавати сувишне линије, бојење ћелија, подебљавање слова и сл. Графикони и слике се приказују без оквира. Сви текстуални елементи

морају бити наведени на српском и енглеском језику, са величином фонта 8 pt до 12 pt и обичним словима. Слике, шеме и сл., које се налазе у раду, морају имати резолуцију од најмање 300 dpi, а шаљу се као посебни прилози, с тим да се у самом раду поставља слика мање резолуције, како би се знао њен жељени положај и димензије.

Номенклатура и систем јединица - користите међународни систем јединица (SI). Ако се помињу и друге јединице, молим вас дајте свој еквивалент у SI. Аутори и уредник су обавезни да прихвате правила која регулишу биолошку номенклатуру, како је наведено у Међународном кодексу ботаничке номенклатуре, Међународном кодексу номенклатуре бактерија, и Међународном кодексу зоолошке номенклатуре.

Часопис "Агрознање" користи "Приручник за објављивање Америчке писихолошке асоцијације" - (APA) стил и упутства за цитирање и навођење референци.

Цитати у тексту се појављују у загради и садрже презиме аутора и годину издања, одвојене зарезом. Иза године издавања се може позвати и на број странице, а он се такође одваја зарезом.

Скраћенице је најбоље избјегавати, осим општепознатих. Сваку скраћеницу је, приликом првог навођења, потребно објаснити, тј. навести пуни назив. Скраћенице у табелама, графиконима и на сликама је потребно објаснити.

Фусноте треба избјегавати и користити их само у случају да је неопходно додатно објашњење за неки дио текста.

Напомене се наводе на крају рада, иза поглавља Закључак и обично садрже забиљешке о подршци истраживању, пројектима, и сл.

Литература се пописује на крају рада и мора да садржи све изворе који су коришћени у раду. У попис литературе се не уносе персонални документи, писма, меморандуми и неформална електронска комуникација. Навођење имена града у ком је дјело издато се изоставља уколико је име града садржано у називу издавача (нпр. Универзитет у Бањој Луци). Попис литературе се изводи азбучним, односно абецедним редослиједом у зависности од језика и писма на ком је рад написан. Уколико наводимо више радова од истог аутора, прво се наводе раније издати радови, а затим новији. Референце једног аутора које су објављене у истој години треба писати абецедним редом према насловима, нпр., (1995а), (1995б). Уколико рад нема аутора, наслов дјела или институција заузима мјесто аутора. Позивање на секундарну литературу треба избјегавати и користити само за изворе који нису доступни на уобичајени начин или нису доступни на неком од уобичајених свјетских језика. У списку референци наводи се само секундарни извор.

Примјери цитирања извора у тексту и навођења извора у попису литературе

Ови примјери имају за циљ да аутору пруже преглед система цитирања и навођња извора који се примјењује у часопису. Примјери су дати у Табели 1 (након текста Guide for Authors).

Све радове након пријема прегледају главни и технички уредник и, уколико за то постоји потреба, враћају их ауторима на корекцију. Радови који нису припремљени према Упутству за ауторе неће бити узети у даље разматрање. Након исправки, главни уредник шаље радове на рецензију, а по завршеној рецензији, ако има одређених примједби и сугестија рецензената, радови се враћају ауторима на исправку. Након урађених исправки рад се поново шаље на рецензију. Сваки рад пролази кроз двије анонимне рецензије.

Радови се достављају у електронској верзији на имејл адресу: *agroznanje@gmail.com* или путем поште на CD-у или USB-у, на адресу Пољопривредног факултета, Универзитета у Бањој Луци са назнаком: *За редакцију часописа "Агрознање"*. Радови се достављају као отворени документ сачињен у *Microsoft Word*-у (в. 97-2003 или в. 2007), у формату који је дат у Упутству ауторима и у предвиђеном року. Радови који не стигну до предвиђеног датума неће бити предати на рецензију.

Сви радови добијају УДК класификациони број и DOI број.

Сви радови подлијежу језичној лектури и техничкој коректури, те праву техничког уредника на евентуалне мање корекције у договору са аутором.

Након штампања часописа и објаве радова, сви аутори добијају рад у PDF формату путем електронске поште.

Контакт адреса редакције часописа:
Универзитет у Бањој Луци
Пољопривредни факултет (за редакцију часописа "Агрознање")
Булевар војводе Петра Бојовића 1А
78000 Бањалука
Република Српска
Босна и Херцеговина

E-mail: *agroznanje@gmail.com*

Guide for Authors

Agro-knowledge Journal is a scientific journal publishing scientific and professional papers that have not been previously published in other journals. As abstracts, synopses, masters and PhD thesis are not considered as published papers, they can be published in *Agro-knowledge Journal.*

Types (category) of papers

Agro-knowledge Journal publishes reviewed papers according to the following categories: review papers, original scientific papers, preliminary communication, scientific and expert conference papers as well as professional papers.

Review papers are written by the authors who have at least ten scientific papers published and reviewed in international and national journals dealing with the subject related to the review paper. At the same time this implies that the ten scientific papers mentioned above have to be cited in review papers.

Original scientific papers include the unpublished scientific results of an original scientific research.

Preliminary communications include new scientific results that need to be published previously.

Scientific and experts conferences papers are considered as review papers, scientific or professional papers with a special emphasis on the conference they have been expounded.

Professional papers are a significant contribution to the profession on the subject that the author has not previously published.

The author suggests the type (category) of his paper, while the final decision is made by the editorial board on the proposal of the reviewers.

Preparing papers for printing

Papers can be written in Serbian (Cyrillic and Latin alphabet) and English.

Paper length is limited to 12 pages in A4 paper for review papers. For all the other categories it is limited to 8 pages in A4 paper. This paper length includes all the tables, graphs, figures, schemes, etc. The paper should be written in 12pt, Times New Roman, 1.5 lines spacing. All the margins should be less than 2.5 cm.

Review papers should consist of the following sections: Abstract, Introduction (with Literature Review), Discussion or Analysis, Conclusion, References and Abstract (translated into Serbian if it is written in English or vice versa)

Original scientific papers should consist of the following sections: Abstract, Introduction (with Literature Review), Material and Methods, Results and Discussion, Conclusion, References and Abstract (translated into Serbian if the papers are written in English or vice versa).

The paper title should be concise, informative and written in small letters, font size 14 pt, without highlighting the text (bold, italic, underline), centered. The name and surname of the authors should be written without title of rank, in font size 12pt, centered, one empty line below the paper title. The name and address of the institution (organization) in which the respective authors are employed should be below the name of the authors, followed by the name of the city and country where the institution is placed (in *italics*). The correct address and zip code are not necessary to be given.

Abstract provides a brief description (summary) of the paper that needs to be between 50 and 150 words, written in the language of the paper. The abstract should contain the following elements: the objective (purpose) of the research, methods, results, ideas for new research and a short conclusion.

Key words (maximum 5 words), with a single space below the Abstract, are given in the following way: *Key words*: 1st key word, 2nd key word...5th key word. The title words should not be repeated in *Key words*.

Headings and subheadings are given in the following way: the main section headings, such as Introduction, Material, etc., are written in font size 13pt, centered. There are two empty lines between Key words and Introduction. Subheadings in sections should be written in font size 12 pt, aligned to the left margin. There is one empty line between a section heading and the text of the previous section. Also, there is one empty line between each heading / subheading and the text that accompanies it.

References are written in alphabetical order with full data according to APA standard (see the tables following the text).

Abstract (translation) should be translated into English if the papers are written in Serbian, or vice versa. Following the pattern above, the Abstract (translation) should also include the paper title, author's name, the name of the institution (organization) in which the respective authors are employed, the name of the city and country where the institution (organization) is placed and Key words, as well, all in the format specified above and in the same language. Also, the name and surname of the author responsible for correspondence and his / her e-mail address should be written below Key words.

Tables, graphs and figures in the paper must be numbered and have a proper caption/title (e.g. Tab. 1 / Graph 1 / Fig. 1 / Research results in 2011). The captions of the tables are above them with left alignment and one blank line in between, while the names of graphs and figures are below them, centered, with

one blank line in between. Tables, graphs and figures should not go beyond the set margins. Redundant lines, cell staining, bold letters, and the like, should be avoided in tables. Graphs and figures are to be displayed without a frame. All text elements have to be specified in Serbian and English, the font size 8 pt to 12 pt and regular font style. Figures, schemes, etc., must be at least 300 dpi and sent as separate attachments, while the figures of the lower resolution should be actually set in the paper in order to demonstrate their desired position and dimensions.

Nomenclature and units - use the international system of units (SI). If other units are mentioned, please give their equivalent in SI. Authors and Editor(s) are, by general agreement, obliged to accept the rules governing biological nomenclature, as laid down in the International Code of Botanical Nomenclature, the International Code of Nomenclature of Bacteria, and the International Code of Zoological Nomenclature.

***Agro-knowledge Journal* applies Publication Manual of the American Psychological Association (APA) style and advice for citing and listing references.**

Citations in the text (in-text citations) are in parentheses and include the author's name and year of publication, separated by commas. The number of the cited pages can be put after the year of publication and it is also separated by commas.

It is best to avoid the *abbreviations* unless they are generally known. When it is cited for the first time, each abbreviation need to be explained, i.e., the full name has to be stated. The abbreviations in tables, graphs and figures need to be explained.

Footnotes should be avoided and only used when it is necessary to give further explanation for a part of the text.

Acknowledgements are placed at the end of the paper, after the section Conclusion and they usually includes information about the research support, projects, etc.

References are placed at the end of the paper and it must have all the sources used in the paper. Personal documents, letters, memoranda and informal electronic communication should not be placed in References. The name of the city where the work was published is omitted if the name is included in the publisher's name (e.g. University of Banjaluka). References are written in alphabetical order (if the papers are in English) or in *Cyrillic alphabetical order* in case the papers are written in Serbian. If you cite more than one paper of the same author, the earlier published ones should be cited first, then the latest, while the ones published in the same year should be cited in alphabetical order according to the titles, e.g., (1995a), (1995b). In case they have no author, the title and the name of the institution takes the place of the author's name.

Secondary sources citation should be avoided and used only for the sources not available in generally spoken languages. In the reference list, only the secondary source is included.

Examples of in-text citations and reference list

These examples are intended to provide an overview of the citation style applied in this journal. The examples are given in Table 1.

After submission all papers are read by the managing and technical editor. If it is necessary, the papers will be returned to the authors for correction. The papers which have not been done in accordance with Guide for Authors will not be taken into further consideration. As soon as they have undergone the correction, the managing editor sends them for review. After the reviews have been completed, in case there are some comments or suggestions, the papers will be returned to the authors for additional correction. When the correction is over, the papers will be sent for review again. Each paper goes through two anonymous reviews.

Submit the paper in electronic format *via* e-mail at *agroznanje@gmail.com* or *via* regular postal mail as CD or USB to the address of Faculty of Agriculture in Banjaluka with notification: for editor's office of Agro-knowledge Journal. The papers should be submitted as an open document made in Microsoft Word 97-2003 or 2007, in the format given in the Guide for Authors in due time. The papers that do not meet the deadline will not be submitted for review.

All the papers will be UDC and DOI assigned.

They will undergo technical and linguistic proofreading. The technical editor may do possible minor corrections in agreement with the author.

After the Journal has been published, all the authors will receive his/her papers in PDF file *via* e-mail.

Contact:
University of Banjaluka
Faculty of Agriculture (for editor's office of Agro-knowledge Journal)
Bulevar vojvode Petra Bojovića 1A
78000 Banjaluka
Republic of Srpska
Bosnia and Herzegovina

E-mail: *agroznanje@gmail.com*

Таб. 1. Примјери цитирања извора у тексту и навођења извора у попису литературе
Examples of in-text citations and citing reference sources

Категорија *Category*	Подкатегорија *Subcategory*	Цитирање у тексту *In-text citations*	Навођење извора у попису литературе *Citing sources*
Књиге *Books*	Један аутор *One author*	Кастори (1998) наводи ... (Кастори, 1998)	Кастори, Р. (1998). *Физиологија биљака*. Нови Сад: Фељтон.
		Hopkins (2009) presents... (Hopkins, 2009)	Hopkins, W. G. (2009). *Introduction to Plant Physiology*. New York: John Wiley & Sons.
	Два аутора *Two authors*	Мратинић и Којић (1998) наводе ... (Мратинић и Којић, 1998)	Мратинић, Евица и Којић, М. (1998). *Самоникле врсте воћака Србије*. Београд: Институт за истраживања у пољопривреди "Србија".
		Teiz and Zeiger (2002) present ... (Teiz & Zeiger, 2002)	Taiz, L., & Zeiger, E. (2002). *Plant physiology*. Sunderland: Sinauer.
	Више аутора *More authors*	Јовановић и сарадници (2012) наводе... (Jovanović i sar., 2012)	Јовановић, Р., Важић, Б. и Шарић, М. (2012). *Савремена исхрана коза за млеко*. Пољопривредни факултет Бања Лука.
		Sharp et al. (2002) presented ... (Sharp et al., 2002)	Sharp, J.A., Peters, J. & Howard, K. (2002). *The management of a student research project*. Aldershot: Gower.
	Уредник, преводилац или приређивач умјесто аутора *Editor or translator instead of the author*	(Brikel, 2006)	Brikel, K. (ur.) (2006). *Biljke i cveće: veliki ilustrovani vodič*. Beograd: Mladinska knjiga.
		(Brickell, 2004) (Royal Horticultural Society, 2004) – прво навођење/*first citation* (RHS, 2004) – сљедеће навођење/*following citation*	Brickell, C. (Ed.). (2004). *Encyclopedia of gardening*. London: Dorling Kindersley. Royal Horticultural Society. (2004). *Encyclopedia of gardening*. London: Dorling Kindersley.
	Поглавље или неки други дио књиге *Chapter or some other part of the book*	(Поповић и Маленчић, 2005)	Поповић, М., Маленчић, Ђ. (2005). Метаболизам органских азотних једињења. У Кастори, Р. (ур.), *Азот: агрохемијски, агротехнички, физиолошки и еколошки аспекти* (стр. 81-116). Пољопривредни факултет Нови Сад.

Таб. 1. Примјери цитирања извора у тексту и навођења извора у попису литературе (наставак)
Examples of in-text citations and citing reference sources (continued)

Категорија *Category*	Подкатегорија *Subcategory*	Цитирање у тексту *In-text citations*	Навођење извора у попису литературе *Citing sources*
Књиге *Books*	Поглавље или неки други дио књиге *Chapter or some other part of the book*	(Silber, 2008)	Silber, A. (2008). Chemical characteristics of soilless media. In Raviv, M., & Lieth, J.H. (Eds.), *Soilless culture: theory and practice* (pp. 209-244). London: Elsevier.
	Електронска књига *Electronic book*	(Seton, 1911)	Seton, E.T. (1991). *The Arctic prairies: A canoe-journey of 2,000 miles in search of the caribou*. Преузето 16.05.2013., sa http://www.gutenberg.org/etext/6818
		(Conoloff, 2012)	Conoloff, A. (2012). *Salvaging the suburbs*. doi: 11.8870/6001/2122.442.261
		(Gladwell, 2008)	Gladwell, M. (2008). *Outliers: The story of success*. New York: Back Bay Books. Retrieved May 16, 2013, from http://www.amazon.com
Чланци *Articles*	У штампаним часописима *In printed journals*	(Тодоровић и сар., 2012) Тодоровић и сар. (2012)	Тодоровић, В., Гаврић Рожић, А., Марковић, С., Ђуровка, М. и Васић, М. (2012). Утицај температуре на раностасност и принос салате гајене у зимском периоду. *Агрознање, 13*(3), 475-481.
		Todorović et al. (2012)	Todorović, V., Gavrić Rožić, A., Marković, S., Đurovka, M. & Vasić, M. (2012). Influence of temperature on yield and earliness of lettuce grown in the winter period. *Agroznanje, 13*(3), 475-481.

Таб. 1. Примјери цитирања извора у тексту и навођења извора у попису литературе (наставак)
Examples of in-text citations and citing reference sources (continued)

Категорија *Category*	Подкатегорија *Subcategory*	Цитирање у тексту *In-text citations*	Навођење извора у попису литературе *Citing sources*
Чланци *Articles*	У електронским (*on-line*) издањима часописа: *In electronic (on-line) journal publications:*		
	Радови са DOI бројем: *Papers with DOI assigned*	(Wieger, 2012)	Wieger, M. (2012). The agri-food sector in Poland – an analysis and assessment of CAP results in 2000-2011. *Agroznanje, 13*(4), 619-631. doi: 10.7251/ AGREN1204619W
	Радови без DOI броја: *Papers with no DOI assigned:*	(Shen et al., 2012)	Shen, G., Huhman, D., Lei, Z., & Snyder, J. (2012). Characterization of an isoflavonoid-specific prenyltransferase from *Lupinus albus*. *Plant Physiology, 159*(1), 70-80. Преузето са (Retreived from) http://www.plantphysiol.org /content/159/1/70.full.pdf+html
Остале публикације *Other publications*	Публикације различитих организација и институција *Publications of various organizations and institutions*	(Федерално министарство околиша и туризма [ФМОТ], 2009) – прво навођење/*first citation* (FMOT, 2009) – сљедеће навођење/*following citation*	Федерално министарство околиша и туризма. (2009). *Босна и Херцеговина – земља разноликости: први извјештај Босне и Херцеговине за Конвенцију о биолошкој разноликости*. Сарајево: Федерално министарство околиша и туризма.
		(U.S. Governent Accountability Office [U.S. GAO], 2010) – прво навођење/*first citation* (U.S. GAO, 2010) – сљедеће навођење/*following citation*	U.S. Government Accountability Office. (2010, March). *Information security: Concerted effort needed to consolidate and secure Internet connections at federal agencies*. Retrieved from http://www.gao.gov/assets/310/301876.pdf
	Закони, правилници и остала легислатива *Laws, regulations and other legislation*	(Закон о пољопривреди, 2006)	Закон о пољопривреди. (2006). *Службени гласник Републике Српске, 24. јул, 2006, 70/06*.
		(Law on agriculture, 2006)	Law on agriculture. (2006). *Official gazette of the Republic of Srpska, July, 24, 2006, 70/06.*

Таб. 1. Примјери цитирања извора у тексту и навођења извора у попису литературе (наставак)

Examples of in-text citations and citing reference sources (continued)

Категорија *Category*	Подкатегорија *Subcategory*	Цитирање у тексту *In-text citations*	Навођење извора у попису литературе *Citing sources*
Остале публикације *Other publications*	Докторска или магистарска теза *Doctoral dissertation or master's thesis*	Штампана верзија *Printed version*	Caprette, C. L. (2005). *Conquering the cold shudder: The origin and evolution of snake eyes* (Doctoral dissertation/ Master's thesis). Ohio State University, Columbus, OH.
		Електронска верзија *Electronic version*	Caprette, C. L. (2005). *Conquering the cold shudder: The origin and evolution of snake eyes* (Doctoral dissertation). Преузето са (Retrieved from): http://www.ohiolink.edu/etd/send-pdf.cgi?acc_num=osu1111184984
	Рад представљен на семинару,симпозијуму или конференцији *Papers presented at seminars, symposiums or conferences*	(Drinić & Savić, 2012)	Drinić, Lj., & Savić, M. (2012, March). *Problems in agriculture and rural development in Republic of Srpska*. Paper presented at the I International Symposium and XVII Scientific Conference of Agronomists of Republic of Srpska, Trebinje. Bosnia and Herzegovina.
Електронски извори *Electronic sources*	Интернет презентација *Internet presentation*	(http://www.seaturtles.org)	Уколико се позива на интернет презентацију, а не неки њен одређени дио, онда се овај извор не мора уносити у попис литературе, али се мора јасно нагласити у тексту. На примјер: *If you do not cite a specific part of an internet presentation, but the internet presentation itself, this source needn't be included in the reference list,but it must be clearly emphasized in the text e.g.:* The Sea Turtle Restoration Project homepage presents a wealth of compelling, well-researched information on the struggle to save the world's sea turtles from extinction (http://www.seaturtles.org).

Таб. 1. Примјери цитирања извора у тексту и навођења извора у попису литературе (наставак)
Examples of in-text citations and citing reference sources (continued)

Категорија *Category*	Подкатегорија *Subcategory*	Цитирање у тексту *In-text citations*	Навођење извора у попису литературе *Citing sources*
Електронски извори *Electronic sources*	Специфична страница у оквиру интернет презентације (нпр. извјештај, објашњење, чланак, и сл.) *Specific pages within the internet presentation (eg, report, explanation, article, etc.).*	(Sea Turtle Restoration Project, 2006)	Sea Turtle Restoration Project. (2006). Threats to sea turtles. Retrieved from http://seaturtles.org/section.php?id=104