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SURVIVAL AND VEGETATIVE GROWTH OF NURSERY GRAFTED WALNUT PLANTS

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SUMMARY: The survival and vegetative growth of nursery grafted walnut plants were observed in cv. Šeinovo, Ovčar, G-286, G-139 and Elit. The highest survival (74.2%) and the highest percentage of class I plants (63.4%) were obtained in Seinovo, and the lowest (63.3% and 50.9% respectively) in Elit. Vegetative growth in the first year was the highest in G-286 (15.5 cm) and the lowest in Elit (13.9 cm) on average. In the second year, Seinovo had the highest growth (178.0 cm) and Elit the lowest (165.7 cm).

Key words: *vegetative growth, walnut plants, nursery, cultivar.*

INTRODUCTION

The technology employed in grafted walnut production is rather complex. Particular attention should be given to grafting and stratification methods as well as to proper care of grafted walnut plants in the nursery in order to obtain quality planting material. The survival and growth of nursery walnut plants are much dependent upon the effect of climatic factors, primarily air temperature and rainfall. Paunović (2010) reported that temperature and rainfall directly affect survival and growth of nursery walnut plants, their winter frost resistance, lignification, apical bud development and root system growth. Korać (1987) and Korać et al. (1997) emphasised the suitability of vine growing regions for walnut production due to the higher temperature sum and the requirement for considerably higher air temperatures during foliation than in most other fruit species. Moreover, the same authors observed that walnut remains underdeveloped under soil water deficiency, becoming susceptible to parasite attacks and winter frosts. Similar results were obtained by Šoškić (2007) who underlined the importance of favourable rainfall distribution during the growing season, particularly in July, given the fact that early droughts reduce vegetative growth.

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The objective of this study was to evaluate the survival and vegetative growth of nursery walnut plants under natural temperate continental climate conditions in Serbia.

MATERIAL AND METHODS

The experiment was conducted during 2003-2005 in the nursery of the Fruit Research Institute, Cacak, Serbia, located in the Zapadna Morava river valley at an altitude of 242 m (43°53'17''N, 20°20'35''E). One cultivar (Seinovo-control) and four walnut selections, including Ovcar, G-286, Elit and G-139, were studied.

Walnut planting was conducted in the nursery on 20 May 2003 and 25 May 2004 following a randomised block design (5 cultivars x 4 replications), 34 grafted plants of each cultivar were included in replications, totalling 680 plants. According to its physical and chemical properties, the soil used in the study was a mildly acid (pH 6.35) loamy alluvial deposit that had a good supply of humus in the 0-20 cm layer (2.76%), a low humus content in deeper layers (1.50%), a moderate supply of N (0.13%), an abundant supply of P_2O_5 (17.80 mg/100 g air dry soil) and K_2O (28.25 mg/100 g air dry soil), and no content of $CaCO_3$.

At the end of the first and second growing seasons, the percentage of survived plants was visually determined. During both growing seasons, at 20-day intervals upon shoot emergence, plant height was measured from the graft union upwards.

The obtained results are presented in percentages. The results were subjected to Fisher's model of analysis of variance - ANOVA (Fisher, 1953). The significance of differences between the means of the control cultivar and the selections at $P \leq 0.01$ and $P \leq 0.05$ significance levels was determined using Dunnett's one-sided and two-sided comparison test (Dunnett, 1955). The significance of differences between particular seasons, and interaction means were tested using the LSD test at $P \leq 0.05$. The results are presented in tabular form.

RESULTS AND DISCUSSION

Cacak has a temperate continental climate. The mean annual air temperature in Čačak (Table 1) during 1992-2002 was 11.9°C. The average air temperature during the growing season (April-October) was 17.9°C. The coldest months were January and December, as evidenced by the mean monthly temperature of 0.5°C and 0.8°C, respectively, whereas the warmest months were July (22.6°C) and August (23.0°C). The average annual rainfall was 714.5 mm. Total rainfall was highest in June (88.4 mm) and lowest in January (30.7 mm). The amount of rainfall during the growing season was 462.7 mm, accounting for 66.6% of the total annual rainfall.

Table 1. Mean monthly air temperatures and average monthly rainfall in Čačak during 1992-2002
Tabela 1. Srednje mesečne temperature vazduha i prosečne količine padavina po mesecima u Čačku (1992-2002)

Months *Meseci*	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
t (°C)	0.5	3.1	7.6	11.7	17.9	21.3	22.6	23.0	16.8	12.2	6.1	0.8
mm m^{-2}	30.7	38.9	42.5	51.2	56.4	88.4	82.6	51.6	74.9	57.6	52.8	52.7

During the 2003-2005 period, the average air temperature was 9.7°C, and the average air temperature during the growing season was 16.0°C. Mean annual air temperatures varied 0.9°C over the three-year period, being 9.3°C in 2003, 10.2°C in 2004 and 9.7°C in 2005 (Table 2). During the growing season (April-October), the same mean air temperature variation (0.9°C) was observed. Mean temperatures during the growing season from April through October were 16.2°C in 2003, 16.4°C in 2004 and 15.5°C in 2005. The mean annual sum of sunshine duration was 1,956 hours.

Table 2. Mean monthly and annual temperatures (°C) during 2003-2005
Tabela 2. Srednje mesečne i godišnje temperature (°C) za period od 2003. - 2005. godine

Month / *Mesec*	Year / *Godina*			Average, mean monthly temperatures *Prosek, srednje mesečne temperature*
	2003	2004	2005	
I	-2.5	-3.5	0.1	-1.4
II	-4.7	0.1	-1.7	-1.5
III	3.3	4.8	3.9	4.0
IV	9.3	11.4	10.5	10.4
V	18.3	16.5	15.3	16.7
VI	21.4	18.8	17.0	19.1
VII	20.7	23.5	20.6	21.6
VIII	22.2	19.3	18.7	20.1
IX	13.6	13.5	15.9	14.3
X	7.7	12.1	10.2	10.0
XI	4.7	4.4	3.8	4.3
XII	-2.0	1.6	2.0	1.6
Average I–XII / *Prosek I–XII*	9.3	10.2	9.7	9.7
Average IV-X / *Prosek IV-X*	16.2	16.4	15.5	16.0

During the study period, different amounts of rainfall were recorded, particularly during the growing season (April-October). Total rainfall in 2003, 2004 and 2005 was 590.1 mm, 707.1 mm and 474.3 mm, respectively (Table 3). The average rainfall received was 590.5 mm during the study years and 342.8 mm during the growing season. The 2003 growing season received a total of 316.4 mm rainfall. Insufficient rainfall was recorded during June (23.0 mm) and August (6.0 mm), whereas July had satisfactory rainfall (60.8 mm). During the 2004 growing season, rainfall totalled 442.5 mm, with the summer rainfall amount being satisfactory (June - 112.5 mm, July - 84.4 mm and August - 70.7 mm). The 2005 growing season was characterised by a dry period with an amount of rainfall of 269.5 mm. Notably low rainfall was recorded during intensive growth of walnut (June - 35.4 mm, July - 6.8 mm and August - 22.7 mm).

Table 3. Total monthly rainfall and average rainfall during the growing season (mm m^{-2}) for the period 2003-2005

Tabela 3. Ukupna količina padavina po mesecima i prosečna količina padavina u toku vegetacije (mm m^{-2}) (2003.- 2005)

Month / *Mesec*	Year / *Godina*			Average rainfall *Prosečna količina padavina*
	2003	2004	2005	
I	76.8	111.1	10.8	66.2
II	42.5	48.6	74.6	55.2
III	2.5	31.7	33.4	22.5
IV	20.0	68.7	67.6	52.1
V	72.7	66.0	61.8	66.8
VI	23.0	112.5	35.4	56.9
VII	60.8	84.4	6.8	50.6
VIII	6.0	70.7	22.7	33.1
IX	41.7	22.4	63.6	42.6
X	92.2	17.8	11.6	40.5
XI	66.6	59.3	58.2	61.4
XII	85.3	13.9	27.8	42.3
Average I–XII / *Prosek I–XII*	590.1	707.1	474.3	590.5
Average IV-X / *Prosek IV-X*	316.4	442.5	269.5	342.8

At the end of the first growing season, Dunnett's test ($P \leq 0.01$ and $P \leq 0.05$) showed that the control cv. Seinovo had a highly significantly greater percentage of survived plants and as compared to the selections tested. As for years, the LSD test ($P \leq 0.05$) revealed a highly significantly greater percentage of survived plants (72.1%) in 2004 as compared to those in 2003 (62.3%) (Table 4).

The highest survival of plants on average during both years was obtained with cv. Seinovo (69.9% in 2003 and 78.6% in 2004), followed by selections G-286 (63.4% - 2003 and 73.5% - 2004), Ovcar (60.2% - 2003 and 71.9% - 2004), G-139 (59.3% - 2003 and 68.6% - 2004) and Elit (58.9% - 2003 and 67.8% - 2004).

Table 4. Survival of nursery walnut plants at the end of the first growing season

Tabela 4. Prijem sadnica oraha na kraju prve vegetacione sezone

		Procenat prijema sadnica na kraju I vegetacione sezone / *Percentage of survival plants at the end of the 1st growing season*
Sorta / *Cultivar (A)*	Ovcar	66.0±0.92 **
	Elit	63.3±0.68 **
	G-139	63.9±0.92 **
	G-286	68.4±0.64 **
	Seinovo	74.2±0.58
Godina / *Year (B)*	2003	62.3±0.47 b
	2004	72.1±0.43 a
ANOVA		
Sorta / *Cultivar (A)*		**
Godina / *Year (B)*		**
A x B		**

A and B represent cultivar and years, respectively / *A i B predstavljaju sorte i godine.*

Asterisks in vertical columns represent significant differences between the means at P≤0.05 and P≤0.01 according to Dunnett's test and ANOVA (F-test); ns- non-significant / *Zvezde u vertikalnim kolonama obeležavaju značajne razlike između sredina za P≤0.05 i P≤0.01 na osnovu Dunnett testa i rezultata ANOVA (F-test); ns- nije značajno.*

The values designated with same small letters within columns for years and interaction means do not differ significantly at P≤0.05 according to LSD test / *Vrednost u kolonama za godine i interakcijske sredine označene istim malim slovima značajno se ne razlikuju za P≤0.05 na osnovu LSD-testa.*

At the end of the second growing season, Dunnett's test (P≤0.01 and P≤0.05) showed a highly significantly greater percentage of class I plants in cv. Seinovo than in the selections tested. No significant difference was observed in the percentage of class II and unclassed plants between the control cultivar and the selections tested. LSD test (P≤0.05) indicated a highly significant difference in the percentage of class I plants between 2004 and 2005, and no significant difference in the percentage of class II and unclassed plants (Table 5).

The survival percentage of cv. Seinovo in 2004 was 65.9% - (58.4% class I plants, 7.5% class II plants) and 4.0% of unclassed plants, and that in 2005 - 75.2% (68.4% class I, 6.8% class II) and 3.4% of unclassed plants. The selection Ovcar had 55.6% of plant survivals (46.8% class I, 8.8% class II) and 4.6% of unclassed plants in 2004, and 67.8% (60.4% class I, 7.4% class II) and 4.1% of unclassed plants in 2005. The survival percentage of Elit in 2004 was 54.3% (46.0% class I, 8.3% class II) and 4.6% of unclassed plants, and that in 2005 was 63.3% - (55.9% class I, 7.4% class II) and 4.5% of unclassed plants. The selection G-139 showed a survival percentage of 54.8% (46.6% class I, 8.2% class II) and 4.5% of unclassed plants in 2004, and 64.7% (57.4% class I, 7.3% class II) and 3.9% of unclassed plants in 2005. The survival percentage in the selection G-286 was 59.1% (51.2% class I, 7.9% class II) and 4.3% of unclassed plants in 2004, and 69.7% - (62.5% class I, 7.2% class II) and 3.8% of unclassed plants in 2005.

Table 5. . Survival of nursery walnut plants at the end of the second growing season
Tabela 5. Prijem sadnica oraha na kraju druge vegetacione sezone

		Percentage of class I plants *Procenat sadnica I klase*	Percentage of class II plants *Procenat sadnica II klase*	Percentage of unclassed plants *Procenat sadnica van klase*
Sorta / *Cultivar* (A)	Ovcar	53.6±0.99**	8.10±0.21ns	4.35±0.20ns
	Elit	50.9±0.81**	7.85±0.26ns	4.55±0.26ns
	G-139	52.0±1.02**	7.75±0.25ns	4.20±0.20ns
	G-286	56.8±0.96**	7.55±0.25ns	4.05±0.26ns
	Seinovo	63.4±0.78	7.15±0.16	3.70±0.24
Godina / *Year* (B)	2004	49.8 ±054 b	8.14±0.15 a	4.40±0.17 a
	2005	60.9±0.59a	7.22±0.16 a	3.94±0.13 a
ANOVA				
Cultivar / *Sorta* (A)		**	ns	ns
Year / *Godina* (B)		**	ns	ns
A x B		**	ns	ns

A and B represent cultivar and years, respectively / *A i B predstavljaju sorte i godine.*

Asterisks in vertical columns represent significant differences between the means at P≤0.05 and P≤0.01 according to Dunnett's test and ANOVA (F-test) results; ns - non-significant / *Zvezde u vertikalnim kolonama obeležavaju značajne razlike između sredina za P≤0.05 i P≤0.01 na osnovu Dunnett testa i rezultata ANOVA (F-test); ns- nije značajno.*

The values designated with same small letters within columns for years and interaction means do not differ significantly at P≤0.05 according to LSD test / *Vrednost u kolonama za godine i interakcijske sredine označene istim malim slovima značajno se ne razlikuju za P≤0.05 na osnovu LSD-testa.*

Dunnett's test (P≤0.01 and P≤0.05) used at the end of the first and second growing seasons (Table 6) showed that cv. Seinovo had highly significantly greater plant growth as compared to the selections Elit and G-139, whereas no significant difference was observed between the control cultivar and the selections Ovcar and G-286. LSD test (P≤0.05) revealed highly significantly lower plant growth at the end of the first growing season in 2003 than in 2004.

At the end of the second growing season, growth was found to be highly significantly greater during 2004 than in 2005. Vegetative growth of nursery walnut plants in 2003 was 13.4 cm in cv. Seinovo, 13.0 cm in Ovcar, 12.1 cm in Elit, 12.2 cm in G-139, and 13.9 cm in G-286. Plant growth during 2004 was 3.7 cm higher on average than in 2003, being 16.8 cm in cv. Seinovo, 17.0 cm in Ovcar, 15.8 cm in Elit, 16.1 cm in G-139, and 17.2 cm in G-286.

At the end of the second growing season in 2004, plant height was as follows: cv. Seinovo - 186.6 cm, Ovcar - 187.1 cm, Elit - 178.9 cm, G-139 - 179.4 cm and G-286 - 189.6 cm. In 2005, when the lowest average rainfall was recorded, the average plant growth was 24.0 cm lower, being 169.4 cm in cv. Seinovo, 162.8 cm in Ovcar, 152.5 cm in Elit, 157.6 cm in G-139, and 159.1 cm in G-286.

Table 6. Vegetative growth of nursery walnut plants
Tabela 6. Vegetativni porast sadnica oraha

		Vegetative growth of plants at the end of the 1st growing season *Vegetativni porast sadnica na kraju I vegetacione sezone* (cm)	Vegetative growth of plants at the end of the 2nd growing season *Vegetativni porast sadnica na kraju II vegetacione sezone (cm)*
Sorta / *Cultivar* (A)	Ovcar	15.0±0.69 ns	174.9±6.72 ns
	Elit	13.9±0.66 **	165.7±6.82 **
	G-139	14.1±0.75 **	168.5±5.58 **
	G-286	15.5±0.80ns	174.3±8.52 ns
	Seinovo	15.1±0.60	178.0±8.86
Godina / *Year* (B)			
	2003	12.9±0.39 b	
	2004	16.6±0.25 a	184.3±5.09 a
	2005		160.3±2.29 b
ANOVA			
Cultivar / *Sorta* (A)		**	**
Year / *Godina* (B)		**	**
A x B		**	**

A and B represent cultivars and years, respectively / *A i B predstavljaju sorte i godine.*

Asterisks in vertical columns represent significant differences between the means at P≤0.05 and P≤0.01 according to Dunnett's test and ANOVA (F-test) results; ns - non-significant / *Zvezde u vertikalnim kolonama obeležavaju značajne razlike između sredina za P≤0.05 i P≤0.01 na osnovu Dunnett testa i rezultata ANOVA (F-test); ns- nije značajno.*

The values designated with same small letters within columns for years and interaction means do not differ significantly at P≤0.05 according to LSD test / *Vrednost u kolonama za godine i interakcijske sredine označene istim malim slovima značajno se ne razlikuju za P≤0.05 na osnovu LSD-testa.*

An analysis of both air temperatures during the 2003-2005 study period and the long-term average (1992-2002) suggests that the mean annual air temperature and growing season air temperature were 2.2°C and 1.9°C lower, respectively. No early autumn and late spring frosts occurred during the period under study. Bulatović (1985) reports that regions with mean air temperatures during the growing season exceeding 16.5°C are most favourable for normal growth of walnut plants. This is in agreement with Šoškić (2007). Ogašanović et al. (1991) found that winter frosts occurring at a temperature of -23°C damage buds, insufficiently lignified upper plant portions or whole plants above the snow cover. Less severe autumn frosts occurring at a temperature of -3°C result in leaf damage, thus forcing early termination of foliation and leading to complete or partial defoliation.

An analysis of both average annual rainfall during 2003-2005 and the long-term average (1992-2002) suggests that the average annual rainfall during the experiment and over the growing season was 124.0 mm and 119.9 mm lower, respectively. Rainfall showed significant variations during the period under study. As compared to the long-term average, a lower amount of rainfall was recorded in 2003 and 2005, being 65.4 and 53.0 mm in June, 21.8 mm and 75.8 mm in July, and 45.6 mm and 28.9 mm in August, respectively. Total rainfall in 2004 was higher than the long-term average - 24.1 mm in June, 1.8 mm in July and 19.1 mm in August. During the first year after grafted walnut planting, a total of 121.8 mm of rainfall was recorded for the January-March period, with March receiving only 2.5 mm rainfall, at an average air temperature during the period (January-March) of -0.3°C. During the summer period of 2003 (June-August), total rainfall was 89.8 mm. The lowest average rainfall during the period was in August (6.0 mm) when the highest average monthly air temperature (22.2°C) was recorded, which induced a stress effect on young plants. During the second year after planting of grafted walnut plants in the nursery, the climatic conditions were observed to be much more favourable. The period prior to planting was characterised by sufficient rainfall and moderate temperature. The summer months had sufficient rainfall which was evenly distributed. During the initial growth of grafted walnut plants in June, July and August, a total of 267.6 mm of rainfall and an average temperature of 20.5°C were recorded. Total rainfall in 2003 was 126.1 mm lower than in 2004. The rainfall deficiency in this year induced a 9.8% decrease in plant survival and 3.7 cm lower vegetative growth, as compared to the survival and growth of plants in 2004. The lowest average amount of rainfall during the experiment was recorded in 2005 (269.5 mm). Namely, dry periods were particularly characteristic of the summer months receiving rainfall totals of 64.9 mm (June 35.4 mm, July 6.8 mm and August 22.7 mm). The rainfall amount during the

2005 growing season was 173.0 mm lower than in 2004, and resulted in the 23.5 cm lower vegetative growth of plants.

Some authors report different water requirements of walnut plants as dependent upon the agro-environmental characteristics of a particular region. Karadeniz (2005) emphasises the dependence of walnut nursery tree production on the climatic conditions of the soil used for walnut cultivation. The author reveals that number of survived plants in the second year of cultivation is governed not only by temperature and relative air humidity during August and September but also much more by climatic conditions during winter. Bulatović (1985) reports the rainfall requirement for walnut growth of over 600 mm. Šoškić (2007) reports variations in water requirements of walnut plants depending on agro-environmental conditions of a particular region, viz. about 750 mm water is required in California (USA) and somewhat lower amounts in Serbia due to lower summer temperatures than in California. The mean annual rainfall received in the walnut growing region in Bulgaria ranges from 400 to 600 mm (Dzuvinov et al., 2009).

Walnut plants show substantial variations in survival rate, depending on the effect of climatic factors. Stanisavljević and Mitrović (1997) studied plant survival of a large number of walnut cultivars and selections, and reported the total survival percentage at the end of the first year of walnut cultivation of 86.5%. The survival percentage of the selection Elit obtained by Solar et al. (2001) was within the 43.0-73.0% range. Korać (1987) and Korać et al. (1997) deem it realistic to produce 40.0 to 50.0% of class I walnut plants at the end of the second year of walnut production.

The vegetative growth analysed in this study was lower during the first year of walnut cultivation. At the end of the second year, the results on vegetative growth were in agreement with those obtained by other authors. Under the agro-environmental conditions of Cacak, Stanisavljević and Mitrović (1997) produced plant growth at the end of the first year of 23.4 cm in cv. Seinovo, 24.1 cm in Ovcar, 11.2 cm in Elit, 17.6 cm in G-286, and 21.4 cm in G-139. In the same study, plant growth during the second year was highest in Ovcar - 187 cm, followed by cv. Seinovo - 185 cm, G-286 - 172 cm, G-139 - 167 cm, and Elit - 152 cm. Korać (1987) and Korać et al. (1997) report that walnut plants generally reach 10-25 cm in height at the end of the first growing season and about 150 cm at the end of the second. These data are in agreement with the results of the present study. Cultivar-dependent plant height in the second year of walnut cultivation ranged from 150-180 cm in Bulgaria (Gandev, 2009), 168-172 cm in Romania (Achim and Botu, 2001) and 179.7-244.5 cm in Turkey (Ozkan et al., 2001).

CONCLUSION

In conclusion, the results presented in this study show that the survival and vegetative growth of nursery walnut plants are dependent upon the effect of climatic factors, primarily air temperature and rainfall.

The adverse effect of climatic factors on walnut production under partially altered temperate continental climate in Western Serbia, notably rainfall and air temperature variations during summer months (June-August), should be overcome through the use of different methods of irrigation and conservation of soil moisture from autumn and winter rainfall.

REFERENCES

ACHIM, G.H., BOTU, I.: Results in walnut propagation by using different methods. Acta Horticulturae, 544:504-520, 2001.
BULATOVIĆ, S.: Orah, lešnik i badem. Nolit, Beograd, pp.120-123, 1985.
DZUVINOV, V., GANDEV, S., KUMANOV, K., ARNAUDOV, V.: Oreh. Biofrut BG-EOOD, Plovdiv, pp.114,2009.
GANDEV, S.: Walnut propagation in Bulgaria. Walnut propagation training short course, COST Action Spain, 873, pp. 8, 2009.
KORAĆ, M.: Orah. Nolit, Beograd, pp.14-92, 1987.
KORAĆ, M., CEROVIĆ, S., GOLOSIN, B.: Orah. Prometej, Novi Sad, pp.15-122, 1997.
KARADENIZ, T.: Relationships between graft success and climatic values in walnut (*Juglans regia* L.). Journal Central European Agriculture, 6 (4):631-634, 2005.
OGASANOVIĆ, D., MITROVIĆ, M., NIKOLIĆ, M.: Susceptibility of nursery trees of some walnut cultivars and selections to early autumn and winter frost. Journal of Yugoslav Pomology 25:75-81, 1991.
OZKAN, Y., EDIZER, Y., AKCA, Y.: A study on propagation with patch budding of some walnut cultivars (*Juglans regia* L.). Acta Horticulturae 544:521-525,2001.
PAUNOVIĆ, M.S.: Stratifikovanje i dinamika rasta kalemova oraha. Magistarka teza, Univerzitet u Kragujevcu, Agronomski fakultet, Čačak, 2010.
STANISAVLJEVIĆ, M., MITROVIĆ, M.: Effect of variety on successful grafting and development of nursery trees of walnut (*Juglans regia* L.). Acta Horticulturae 442:281-283, 1997.
SOLAR, A., STAMPAR, F., TROST, M.: Comparison of different propagation methods in walnut (*Juglans regia* L.) made in Slovenia. Acta Horticulturae 544,527-530, 2001.
ŠOŠKIĆ, M.: Orah i leska. Pantenon, Beograd, pp.39-40, 2007

PRIJEM I VEGETATIVNI PORAST OKALEMLJENIH SADNICA ORAHA U RASTILU

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Izvod

Ispitivan je prijem i vegetativni porast okalemljenih sadnica oraha u rastilu kod sorte Šeinovo i selekcija Ovčar, G-286, G-139 i Elit. Najveći prijem (74,2%) i najveći procenat sadnica I klase (63,4%) imala je sorta Šeinovo, a najmanji prijem (63,3%) i najmanji procenat sadnica I klase (50,9%) selekcija Elit. Najveći porast u prvoj godini imala je selekcija G-286 (15,0 cm) a najmanji Elit (13,6 cm). U drugoj godini najveći porast bio je kod sorte Šeinovo (177,6 cm), a najmanji kod Elita (165,5 cm).

Ključne reči: vegetativni porast, sadnice oraha, rastilo, sorta.

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