RELATIONSHIPS BETWEEN GRAFT SUCCESS AND CLIMATIC VALUES IN WALNUT (JUGLANS REGIA L.)

VEZA IZMEĐU USPJEŠNOSTI KALAMLJENJA I KLIMATSKIH VRIJEDNOSTI KOD ORAHA

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ABSTRACT

The study determines the graft take of walnut in Ordu province located in the East Black Sea Region. Grafting studies were carried out in nursery conditions in late August from 1993 to 2000. During these years, a total of 87 264 applied grafts were evaluated by using patch-grafting method. The graft take varied from 29% to 64 % depending on years. Relations between the graft take and climate conditions were also considered. Graft take under nursery conditions was affected by especially relative moisture (%) in addition to the mean and maximum temperature (°C) in August and September months.

KEY-WORDS: Patch-grafting, graft take, nursery, correlations, Ordu

SAŽETAK

Istraživanjem se određuje kalem uzet iz oraha u provinciji Ord u istočnom dijelu Crnog mora. Istraživanja glede kalamljenja obavljena su u uvjetima rasadnika krajem kolovoza u razdoblju 1993.-2000. Tijekom tih godina aplicirano je ukupno 87 274 kalema metodom pomoću zaštitne krpice. Uspješnost kalemljenja varirala je od 29-64%, ovisno o godini. Povezanost između uzetih kalema i klimatskih uvjeta bila je, također, predmet rasprave u ovom radu. Na kalem uzet u uvjetima rasadnika, posebno je utjecala relativna vlažnost (%), uz prosječnu i maksimalnu temperaturu (°C) u kolovozu i rujnu.

KLJUČNE RIJEČI: cijepljenje pomoću zaštitne krpice, uzimanje kalema, rasadnik, povezanost, Ordu

INTRODUCTION

Walnuts are grown in large part of Turkey. Recently, the area planted to walnuts has extended, therefore demands for grafted walnut saplings have increased. The production of grafted walnut saplings in Turkey is insufficient to meet the demand.

Difficulties regarding other vegetative propagation methods for walnut such as cutting, layering, and tissue culture, were reported [5,7,12,13,15,16].

Today, propagation techniques other than grafting are not considered practical. However, graft take and sapling survival of walnut are not currently satisfactory. Several researchers have reported that graft take of walnut under outdoor conditions is highly influenced by environment [3,6,10,20], which can be controlled for indoor graftings.

The production of grafted walnut sapling in nurseries can annually fluctuate depending on the environmental conditions of culture area. In this study, effects of environment conditions on the graft take of nursery graftings of walnut in Ordu were evaluated based on 8 year period (1993-2000).

MATERIAL AND METHODS

Ordu situated in the East Black Sea Region has a humid climate, approximate 1600 mm annual rainfall. Ordu province is between 38.40′-38.07′ east longitude, between 40.18′-41.09′ north latitude, and 4 meter altitude from sea level. It has average temperature of 13.9°C, maximum temperature 33°C, minimum temperature –7.2°C, average annual rainfall 1196.6 mm, average number of frozen day 9, average number of snow days 6.1, average sunshine period of 4.3 hour/day and average relative moisture of 76 %.

Scions from promising local types of walnut and 1-2-year- old seedlings were used for grafting. The seedlings grown in nursery were grafted by using the patch-grafting technique [19] in the second half of August of every year. Raffia was used as the graft tie. The grafted plants were exposed to nursery conditions, and they were irrigated at certain intervals. Climate averages such as temperature (°C), annual rainfall (mm), relative moisture (%) and sunshine (hour) for August and September were obtained from the Meteorological Station of Ordu. The graft take (%) in the nursery was recorded based on the number of survived plant at the end of the next growing season. During 8 years, a total of 87 264 grafts was evaluated. The number of applied grafts varied from year to year. The relations between the graft take and climatic values of August and September months were assessed.

RESULTS AND DISCUSSION

The number of grafts applied each year varied from 2539 to 22358. The highest survival percentage for plants was obtained in 1994 (64%) followed by 1993 (62%), 1995 (50%), 1996 (42%), 2000 (39%), 1999 (37%), 1997 (37%) and 1998 (29%), respectively (Table 1). The second half of August was a suitable period for patch-grafting of walnut under Ordu ecological conditions since rootstock, scion and buds were well-maturated in this period.

It has been reported that walnut plant grafting at the nursery was usually resulted in lower takes, and the graft take was considerably affected by climate conditions of current year [9,16,17]. In addition, in the summer when the temperature and relative moisture are more suitable for graft union, the graft take percentage of walnut

Table 1. The results from nursery grafting of walnut in Ordu ecology
Tablica 1. Rezultati kalamljenja mladica oraha u ekološkom Ordu

Year *Godina*	The number of applied grafts *Broj apliciranih kalema*	The number of survived grafts in the next season *Broj održanih kalema u narednoj sezoni*	Graft take *Uzorak kalema* (%)
1993	2 539	1 580	62
1994	3 569	2 302	64
1995	8 140	2 811	34
1996	14 130	5 655	40
1997	24 867	8 355	33
1998	15 965	4 690	29
1999	13 000	4 927	37
2000	5 054	2 010	39
Total	87 264	32 330	

Table 2. Graft success in Walnut and the values meteorological of Ordu (1993-2000)
Tablica 2. Uspješnost kalamljenja oraha i meteorološke vrijednosti u Ordu (1993-2000)

Year *God.*	Grafting succ. *Uspjeh kalema* (%)	Average temp. *Prosj. temp.* (C°)		Rainfall *Padaline* (mm)		Relative moisture *Rel. vlažnost* (%)		Sunshine hours Sunčani sati		Max. temp. (C°)	
		Aug. Kolovoz	Sept. Rujan	Aug. Kolovoz	Sept. Rujan	Aug. Kolovoz	Sept. Rujan	Aug. Kolovoz	Sept. Rujan	Aug. Kolovoz	Sept. Rujan
1993	62.23	23.4	19.1	83.1	72.6	75.8	74.7	5.3	5.3	28.1	24.3
1994	64.50	23.5	22.9	73.2	28.6	73.7	74.2	7.2	6.7	29.3	28.3
1995	34.53	23.6	20.4	23.1	86.7	71.9	71.0	5.8	5.1	28.1	25.4
1996	40.02	23.5	20.4	105.6	150.4	70.4	69.0	5.9	5.5	27.9	25.5
1997	33.60	23.0	17.4	77.0	115.6	71.9	71.6	3.7	3.4	26.7	21.6
1998	29.38	24.5	20.6	20.4	34.6	64.9	62.0	6.1	5.3	28.2	24.7
1999	37.90	24.3	20.3	177.4	36.5	66.7	66.3	5.0	5.9	27.9	24.6
2000	39.77	23.8	20.4	38.9	51.9	60.9	63.1	5.9	5.2	27.6	24.3

Table 3. Correlations between graft take and climatic values in August
Tablica 3. Korelacija između kalamljenja i klimatskih vrijednosti u kolovozu

R	Temperature *Temperatura*	Rainfall *Padaline*	Moisture *Vlažnost*	Sunshine *Sunčani sati*	Max. temp.
Graft take *Uzorak kalema*	-0.491	0.009	0.736 *	0.405	0.598

*P<0.05

Table 4. Correlations between graft take and climatic values in September
Tablica 4. Korelacija između kalamljenja i klimatskih vrijednosti u rujnu

R	Temperature *Temperatura*	Rainfall *Padaline*	Moisture *Vlažnost*	Sunshine *Sunčani sati*	Max. temp.
Graft take *Uzorak kalema*	0.354	-0.093	0.834 *	0.450	0.563

*P<0.05

rises [16]. Therefore, the change of the temperature and relative moisture especially during and after grafting directly affects the development of a good graft union [2,17]. On the other hand, a good graft union of walnut takes one month at least [17].

As seen in Table 2, the mean temperatures of August varied from 23°C (1997) to 24.5 °C (1998), and the mean temperatures of September from 17.4 °C (1997) to 22.9 °C (1994). In the years 1993 and 1994, mean temperatures in August changed between 23.4 °C and 23.5 °C, whereas relative moisture between 73.7% and 75.8%. Although the temperature averages of August by years were closer values to each other, the relative moisture percents of August 1993 and 1994, as well as September 1993 and 1994 were higher than those of years. Accordingly, higher relative moisture during and after grafting had a positive effect on graft take under nursery conditions in addition to suitable temperature. Many researchers stated that the relative moisture directly influences the graft take of walnut [4,9,14,16,18]. Glonti et al. (1987) [6] reported that the highest graft take percentage was determined under conditions with 24°C and 75% relative moisture. In this study, a significant correlation ($p<0.05$) was found between the relative moisture and graft take in August and September (Table 3 and 4).

Asma and Ünal (1990) [1] and Karadeniz et al. (1996) [8] have recorded that high graft take percents in August period for Van and Adilcevaz ecologies. In addition, the daily temperatures did not greatly fluctuate in August and September by years. In order to establish a good graft union in walnut, temperatures such as 24-26°C [18,20], 25-28°C [11], 24°C [6] and 25°C [3] have been suggested.

On the other hand, the number of survived grafts in the next season may depend not only on the temperature and relative moisture conditions in August and September, but also fall and especially winter conditions per year.

The results showed that higher graft take will be obtained when the mean temperature in August reaches 23.5°C and the relative moisture about 76%. Also, higher mean temperature and relative moisture in August period can be expected to increase the graft take percentages.

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