

Propagation of Jojoba Shrub by Grafting

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Abstract: A seedy female jojoba shrub of good traits (seeds of high oil content) was selected as a source of scions and propagated in two dates, April and August during 2010 and 2011 seasons by two grafting methods namely top wedge and veneer grafting. Twelve seedy mature male or non-productive female jojoba shrubs (15 years old) were used as rootstocks. Data showed that grafting practiced in April were significantly higher in success percentage and sprout length than that of August while, grafting in August showed significantly lower number of days for sprouting. Top wedge grafting scored significantly higher success percentage and sprout length. On the other hand, veneer grafting scored significantly lower number of days for sprouting. April was the recommended time for jojoba grafting and top wedge grafting as well.

Key words: Jojoba • *Simmondsia chinensis* • Propagation • Grafting • Top wedge grafting • Veneer grafting

INTRODUCTION

Jojoba [*Simmondsia chinensis*, (Link) Schneider], the only member of family Simmondsiaceae is an oil-yielding shrub native to the Sonora desert of northern Mexico and south western USA. Jojoba shrubs have an exceptionally deep tap root system which helps to survive in drought conditions. Hence, it could be a prime plant species to be introduced for arid land cultivation [1]. Its economic importance is due to its saturated seed oil waxes that well recognized for utilization in cosmetics, lubricants and pharmaceuticals etc. [2]. Plantations are established by using seeds, seedlings, rooted cuttings, or plantlets produced from tissue culture. Being dioecious, the male plants outnumber the females when raised from seeds, so it's important to cultivate sexually-known clones [3]. Several asexual methods of propagation have been used to propagate jojoba, these include air-layering, grafting, stem cuttings and tissue culture [4, 2, 5, 6, 7, 1]. Each of these asexual methods shares the major advantage over seed propagation that allows propagation of unique and desirable shrubs [1, 2]. Also they have shorter juvenile period than those grown by the seed [2].

Thomson [8] illustrated that scions of mature wood attained better results compared with those of immature wood. Assaf [5] successfully transformed 20% jojoba males into females by grafting. Most of the grafted males produced nuts in two years. Veneer grafting resulted in

75-85% of success, when it was carried out during August and September. Sprouted grafts from February and March wilted and died due to hot winds of April and May [6]. Bashir *et al.* [2] reported that veneer grafting in August resulted in the highest percentage of success (76.39%) with the longest sprouts.

Grafting of jojoba has many advantages as keeping the deep tap root of the rootstock which helps to survive in drought and salinity conditions, propagating plants with previously known sex, propagating unique and desirable shrubs which will allow predictable plant growth and yield, also shortening juvenile phase of jojoba shrubs.

This study was conducted to examine the probability of propagating jojoba by grafting for transforming male or unproductive female seedy shrubs to productive female shrubs.

MATERIALS AND METHODS

The study was conducted at the experimental orchard of Horticulture Research Institute at Giza Governorate, Egypt during two successive seasons (2010 and 2011) on seedy male or non-productive female fifteen years old jojoba shrubs used as rootstocks in both seasons of study planted in loamy soil spaced at 3 × 3 m. Used scions were taken from seedy single female mother plant of high oil content seeds. The scions were prepared from two

years old wood of 10-15 cm length with four pairs of leaf buds. Two grafting methods were used namely top wedge and veneer grafting. Three branches from each tree were selected to be grafted by three scions from mother plant. All sprouts arising from rootstock below the scion-stock combinations were removed during the experimental period. Eighteen branches of six shrubs were allocated for each grafting method keeping six grafts under one replication. Each rootstock shrub was grafted in two times at the beginning of April and August. Data regarding the following characteristics were recorded.

Number of Days for Sprouting: The grafted plants were carefully observed during the experimental period. The days from the grafting to the sprouting of scion were recorded.

Success Percentage: Six months after grafting the success percentage was recorded.

Sprout Length (cm): Six months after grafting the length attained by the sprouts of each scion was measured.

The layout of the experiment was completely randomized design with two factors and three replicates. The first factor was grafting date and the second factor was grafting method. The experiment was repeated for two seasons. The obtained data was statistically analyzed as a factorial experiment using MSTAT Computer Program according to MSTAT Development Team [9] and means were compared by Duncan's Multiple Range Test at 5% as described by Duncan [10] to verify the differences among means of various treatments.

RESULTS AND DISCUSSION

Table 1 presents the effect of grafting method and date of grafting on success percentage of jojoba shrubs in 2010 and 2011 seasons.

It's clear that success percentage of grafting in April was significantly higher than that of August in both seasons of study. Grafting in April recorded 53.81 and 43.69% while, that in August recorded 29.69 and 23.81% in 2010 and 2011, respectively.

Concerning grafting method top wedge grafting scored significantly higher success percentage in both seasons of the study. Top wedge grafting resulted in 54.12 and 48.25% while, veneer grafting resulted in 29.38 and 19.25% in 2010 and 2011, respectively.

Interaction was significant in both seasons. In 2010 season top wedge grafting in April was significantly higher percentage (72.37%) compared with that of August

(35.88%) of the first season. Whereas, success percentage of veneer grafting showed insignificant difference between the two dates (35.26 and 23.51%). Top wedge grafting in April was significantly the highest in this respect (72.37%). Insignificant differences were observed between top wedge grafting in August, veneer grafting in April and in August in 2010 season. In 2011, top wedge grafting in April showed higher percentage (54.74%) than that of August (41.75%) with no significant difference between them. Veneer grafting in April resulted insignificantly higher percentage (32.63%) than that of August (5.88%). Top wedge grafting in April was the highest in this respect with insignificant difference from top wedge grafting in August. Veneer grafting in April attained the second position with insignificant difference from top wedge grafting in August. Success percentage of veneer grafting in August was significantly the lowest (Table 1). A higher success in April grafting could be attributed to the suitable temperature that boosted the graft success (maximum temperature 28.9 and 27.6°C in 2010 and 2011, respectively). However, the lower success in August grafting was due to the stress caused by the high temperature (maximum temperature 35.0 and 35.4°C in 2010 and 2011, respectively). April average humidity was 56.5 and 50% while, in August it was 61.5 and 59% in 2010 and 2011, respectively.

Many scientists reported that the best grafting success percentage for several species was obtained in April [8, 11, 12, 13, 14]. Shaban [13] recommended using cleft grafting in April for high percentage of success of mango Zebda, Hindy Khassa and Alphonso. Also Abd El-Zaher [15] recommended that top cleft grafting of selected scions of mango onto 1 year old homogenous vegetative rootstocks in April. The highest survival percentage of mango was observed by cleft grafting at mid of April [16].

Regarding the effect of grafting method and date of grafting on number of days for sprouting of jojoba shrubs in 2010 and 2011 seasons, it's obvious from Table 2 that, grafting in August significantly showed less number of days for sprouting (33.63 and 39.21 days in 2010 and 2011, respectively) compared with that of April grafting (63.41 and 72.56 days in 2010 and 2011, respectively).

Concerning the grafting method (Table 2) veneer grafting scored less number of days for sprouting in both seasons of the study with insignificant difference in 2010 season (48.25 and 48.78 days for veneer and top wedge grafting, respectively) but in 2011 veneer grafting resulted in significantly less number of days (43.25 days) than top wedge grafting (68.25 days).

Table 1: The effect of grafting method and date of grafting on grafting success percentage of jojoba shrubs in 2010 and 2011 seasons

	2010 season			2011 season		
	Top wedge	Veneer	Mean	Top wedge	Veneer	Mean
April	72.37 a	35.26 b	53.81 a	54.74 a	32.63 b	43.69 a
August	35.88 b	23.51 b	29.69 b	41.75 ab	5.88 c	23.81 b
Mean	54.12 a	29.38 b		48.25 a	19.25 b	

Means designated with the same letter within column, line, or interaction in each season is not significantly differ at 0.05 level of probability.

Table 2: The effect of grafting method and date of grafting on number of days for sprouting of jojoba shrubs in 2010 and 2011 seasons

	2010 season			2011 season		
	Top wedge	Veneer	Mean	Top wedge	Veneer	Mean
April	64.15 a	62.67 a	63.41 a	68.29 a	76.83 a	72.56 a
August	33.42 a	33.83 a	33.63 b	68.75 a	9.67 b	39.21 b
Mean	48.78 a	48.25 a		68.52 a	43.25 b	

Means designated with the same letter within column, line, or interaction in each season is not significantly differ at 0.05 level of probability.

Table 3: The effect of grafting method and date of grafting on sprout length of jojoba shrubs in 2010 and 2011 seasons

	2010 season			2011 season		
	Top wedge	Veneer	Mean	Top wedge	Veneer	Mean
April	8.63 a	0.50 b	4.56 a	9.92 a	1.03 b	5.47 a
August	5.93 a	0.69 b	3.31 a	3.75 b	0.11 b	1.93 b
Mean	7.28 a	0.60 b		6.83 a	0.57 b	

Means designated with the same letter within column, line, or interaction in each season is not significantly differ at 0.05 level of probability

In 2010 season interaction was insignificant, top wedge grafting in April required more days for sprouting (64.15 days) than that of August (33.42 days) in 2010 season with insignificant difference between them. Veneer grafting showed the same trend with no significant difference between the two dates. The difference between top wedge grafting and veneer one was insignificant. In 2011 season interaction was significant, top wedge grafting in August was higher concerning the number of days to sprout (68.75 days) than that of April (68.29 days) with no significant difference between them while, veneer grafting in April was significantly higher (76.83 days) than that of August (9.67 days). Top wedge grafting in April and in August also veneer grafting in April needed significantly more number of days for sprouting than that of veneer grafting in August (Table 2).

Thomson [8] found that certain scions from some bushes of jojoba take the graft more readily than others from grafting by splice or whip technique during early spring from mid-February to mid-April. Bashir *et al.* [2] reported that scions grafted in February sprouted one week earlier than those grafted in August in Pakistan.

Table 3 presents the effect of grafting method and date of grafting on sprout length of jojoba shrubs in 2010 and 2011 seasons.

Data shown in Table 3 revealed that grafting in April scored longer sprout length value than that of August in both seasons of study. In 2010 season no significant difference was obtained between grafting in April and that in August (4.56 and 3.31cm, respectively). In 2011 season, grafting in April significantly scored the higher sprout length than that of August (5.47 and 1.93 cm, respectively).

Dealing with the effect of grafting method on sprout length, it's obvious from Table 3 that in both seasons of the study top wedge grafting (7.28 and 6.83 cm in 2010 and 2011 seasons respectively) significantly surpassed veneer grafting (0.60 and 0.57 cm in 2010 and 2011 seasons, respectively).

Interaction was significant in both seasons of the study. In 2010 season top wedge grafting significantly surpassed both veneer grafting in April and in August with no significant difference between the two dates for each grafting method (Table 3). In 2011 season top wedge grafting in April showed a significantly higher value (9.92 cm) than in August (3.75 cm). Veneer grafting showed higher sprout length in April than that of August with no significant difference between them. Top wedge grafting gave the highest significant sprout length in comparison with top wedge grafting in August, veneer

grafting in April and in August (Table 3). The slower growth of the sprouts resulting from August grafting could be due to the stress caused by the gradual increase in temperature that started before August (average maximum temperature of May, June and July in 2010 was 31.9, 34.3 and 33.5°C while in 2011 it was 31.7, 34.2 and 36.2°C, respectively).

The above results go in line with Tawfik *et al.* [17] who used different methods for budding and grafting olive in April and stated that cleft grafting gave the 2nd higher length of scion after chip budding. Islam *et al.* [16] found that scions of grafted mango significantly grew twice longer in mid April than that of mid August and also reported that cleft grafting significantly showed higher growth of scion than that of veneer grafting and finally Zaen El-Deen and Abd El-Rhman [18] mentioned that cleft grafting method gave the highest significant mean shoot length of pistachio trees during the first and second seasons as compared with side grafting.

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