The effect of the interaction between Irrigation Intervals and the planting medium on the vegetative propagation of Athel (Tamarix aphylla) by stem cutting

Mustafa Zuhair Abd Alhameed [1*], Omar Saad Atiya [2], Samir Rafie Sami[٣] and Faisal Kadhim Alsaidi[4]

[1,2,3,4]Directorate of forests and desertification, Ministry of Agriculture
*Corresponding author's email: muzuab@gmail.com
Email addresses of coauthors: [2]Fomeromer31@gmail.com, [٣]Samiralfhd@yahoo.com, [٤]Alsaidi.1969@yahoo.com,

Abstract

The study was conducted in the wooden shade structure of the Sand Dune Stabilization Project / Baiji, affiliated with the Directorate of forests and desertification in Salah al-Din Governorate during 2025. The objective was to identify the best interaction between planting medium and irrigation interval to achieve the highest rooting percentage and optimal root and shoot growth of rooted cuttings from the Athel tree.

The propagation process used three irrigation intervals (3, 6, and 9 days), coded as T1, T2, and T3 respectively, and five planting media combinations (sand – peatmoss – compost) with the following ratios: 100-0-0, 60-20-20, 40-20-40, 40-40-20, and 20-40-40, coded as S0, S1, S2, S3, and S4 respectively. The experiment followed a Completely Randomized Design (CRD) with three replicates per cutting. Several root and shoot growth characteristics were studied, in addition to the percentage of successful cuttings, after 73 days of planting.

The research results showed that irrigation intervals, planting medium, and the interaction between irrigation intervals and planting medium all had a significant impact on all studied traits, and that the effect rates of water stress led to a decrease in the traits of the entire study. The research proved the ease of vegetative propagation of tamarix trees without using fertilizers or plant rooting.

Keywords: Athel tree, irrigation intervals, planting medium, stem cutting.

1. Introduction

Athel (Tamarix aphylla) is an evergreen tree native to desert and arid regions such as the Arabian Peninsula, the Middle East, and North Africa. It is characterized by medium height, thorny branches, and small, divided leaves. The species is highly tolerant to salinity and drought, owing to its deep root system and the presence of salt glands that facilitate moisture absorption and salt excretion. Despite these adaptations, Tamarix aphylla is known for its moderate difficulty in rooting through vegetative propagation. Its woody structure and physiological traits make stem cutting propagation challenging, requiring precise control of environmental conditions and soil factors. This study aims to address these challenges by evaluating the effects of irrigation intervals and planting media on the rooting success of stem cuttings. [3].

The importance of Tamarix trees is highlighted by their use as windbreaks because of their strong branches and the protection they provide from hot winds and

dust for cultivated crops. They are also used to stabilize sand dunes [17]. Additionally, Tamarix trees resist heat, drought, and soil salinity [16].

Propagation by cuttings is one of the vegetative propagation methods used to multiply rootstocks and seedless or seed-origin cultivars. The resulting seedlings maintain the same traits as the mother plant from which the cuttings were taken, thus preserving the desired cultivars with their genetic composition [11,8].

The growing medium has a significant impact on vegetative growth due to differences in mineral content. It serves as a reservoir for water and nutrients, has air permeability, moisture retention capacity, and provides good support to plants by allowing oxygen diffusion to the roots and ion exchange capacity. Growing media also play an important role in supplying water and essential nutrients to the plant, allowing root aeration, and stabilizing the plant. Various organic materials added to the growing medium are important because they provide essential nutrients for plant growth, improve soil properties, increase water retention, and enhance porosity [13].

Irrigation intervals, or irrigation spacing, are water management methods aimed at avoiding overuse of irrigation water, which affects yield and prevents water stress in plants [12]. Irrigation intervals refer to the time period between two successive irrigations and depend on the moisture available in the root zone [10,14].

Many studies have shown the effect of irrigation intervals on plant growth. For example, applying irrigation intervals of 3 and 6 days on local sour lemon seedlings resulted in the 3-day interval producing the highest increases in main stem height, branch number, leaf number, leaf area, dry weight percentage of leaves, and dry weight percentage of branches [15].

Based on the above, this study was conducted to determine the best interaction between irrigation interval and growing medium to achieve the highest rooting percentage and the best root and shoot growth of Tamarix cuttings without using fertilizers or plant hormones.

2. Material and Methods

2.1 Research Materials

Irrigation intervals: 3, 6, and 9 days, coded as T1, T2, and T3 respectively.

The irrigation interval refers to the fixed time period between two successive irrigations. These intervals were applied on a calendar-day basis, not measured by soil moisture sensors or weight loss, but rather maintained according to the scheduled number of days between irrigations for each treatment.

Growing media: sand, peat moss, and compost mixed in five ratios (100-0-0, 60-20-20, 40-20-40, 40-40-20, and 20-40-40), coded as S0, S1, S2, S3, and S4 respectively.

2.2 Research Methods

The study was conducted as a two-factor experiment under the shade of the sand dune stabilization project in Baiji, affiliated with the Directorate of Forests and Desertification, aiming to achieve the highest rooting percentage of dry cuttings from Tamarix aphylla after 73 days from the planting date (February 18, 2025).

Cuttings were prepared as leafless stem cuttings, each 30 cm in length, planted in

plastic pots within the project shade. Irrigation was applied manually using a hand sprayer, regularly once daily at midday.

2.3 Studied Traits

The following traits were evaluated:

Number of rooted cuttings: counted 73 days after planting, based on the number of cuttings that formed roots in each treatment replicate.

Rooting percentage: calculated after the same period using the formula:

Rooting percentage = (Number of rooted cuttings / Total number of cuttings) × 100 [6]

Number of rooted buds: each rooted bud contains several roots.

Number of sprouted buds: each sprouted bud contains multiple shoots.

2.4 Experimental Design and Statistical Analysis:

The study was conducted to examine the interaction between two factors. The first factor included three treatments, while the second factor included five treatments. The experiment was carried out with three replicates, each replicate containing one cutting. The collected data were statistically analyzed using the Analysis of Variance (ANOVA) method based on a Completely Randomized Design (CRD). Mean comparisons were performed using the Least Significant Difference (LSD) test at a significance level of 0.05. Statistical analysis was conducted using Excel software [9].

3. Results and Discussion

3.1 Number of Rooted Buds

The results presented in Table (1) show that the planting medium had a significant effect on the number of rooted buds. The highest average number of rooted buds was recorded in medium S3, reaching 11 rooted buds, while the lowest was in medium S1, with 5 rooted buds.

The table also indicates that irrigation intervals had a significant effect on this trait. The number of rooted buds decreased as the irrigation interval increased from 3 to 9 days. The highest average number of rooted buds was recorded at irrigation interval T1 (10.8 buds), while the lowest was at T3 (5.6 buds).

The interaction between the two factors also had a significant effect on this trait. Treatments T1S0 and T1S3 produced the highest average number of rooted buds (14 buds), whereas the lowest was in treatment T3S2, with only 2 rooted buds.

The variation in the number of rooted buds across different planting media may be attributed to differences in their ability to retain sufficient water, drain excess water, and provide adequate aeration—factors crucial in the early stages of rooting [1].

The decline in root development at 6- and 9-day irrigation intervals may be due to reduced water availability, which limits vegetative growth, photosynthesis, and carbohydrate accumulation compared to the 3-day interval. This leads to reduced root development and a lower number of rooted buds. Moreover, water scarcity diminishes the cells' ability to divide and elongate, resulting in limited root growth [4].

Table (1) shows the effect of irrigation intervals, planting media, and their interaction on the average number of rooted buds in Tamarix cuttings.

Planting medium / *Irrigation intervals*	*S0*	*S1*	*S2*	*S3*	*S4*	*Average Effect of Irrigation Intervals:*
T1	14	4	12	14	10	10.8
T2	11	8	5	11	7	8.4
T3	5	3	2	8	10	5.6
***Average Effect of Planting Medium*:**	10	5	6.33	11	9	
***L.S.D* (0.05)**	***Irrigation intervals: 0.45*** ***Planting medium: 0.58*** ***Irrigation intervals X Planting medium: 1.00***					

2.2 Number of Sprouted Buds

The results presented in Table (2) show that the planting medium had a significant effect on the number of sprouted buds. The highest average number of sprouted buds was recorded in medium S3 (7.67 buds), while the lowest was in medium S1 (3.67 buds).

The table also indicates that irrigation intervals significantly affected the average number of sprouted buds. As the interval increased from 3 to 9 days, the number of sprouted buds decreased. The highest average was recorded at the 3-day irrigation interval (T1), with 8.4 sprouted buds, while the lowest was at the 9-day interval (T3), with 3 sprouted buds.

The interaction between both factors also had a significant effect. Treatments T1S0 and T1S3 recorded the highest average number of sprouted buds (12 buds), while no buds sprouted in treatments T3S0 and T3S2.

The variation in sprouted buds across different planting media may be attributed to the quality and quantity of root formation in the rooted cuttings. A more active root system enhances vegetative growth [2,5,18].

The decrease in sprouted buds with longer irrigation intervals is likely due to reduced water availability, which limits the plant's ability to absorb nutrients [19], decreases nutrient supply, reduces carbohydrate production, and ultimately hinders growth.

Table (2) shows the effect of irrigation intervals, planting media, and their interaction on the average number of sprouted buds in Tamarix cuttings.

Planting medium / *Irrigation intervals*	*S0*	*S1*	*S2*	*S3*	*S4*	*Average Effect of Irrigation Intervals:*
T1	12	2	8	12	8	8.4
T2	2	6	5	7	4	4.8
T3	0	3	0	4	8	3
***Average Effect of Planting Medium*:**	4.67	3.67	4.33	7.67	6.67	
***L.S.D* (0.05)**	***Irrigation intervals: 1.39*** ***Planting medium: 1.79*** ***Irrigation intervals X Planting medium: 3.10***					

3.3 Number of Rooted Cuttings and Rooting Percentage

The results recorded in Tables (3) and (4) show that the planting medium had a significant effect on both the number of rooted cuttings and the rooting percentage. All media had similar averages except for medium S1, which showed the lowest values for both traits: 2 rooted cuttings and 66.66%, respectively.

The tables also indicate that irrigation intervals had a significant effect on both traits. The number of rooted cuttings and the rooting percentage decreased as the irrigation interval increased from 3 to 9 days. The highest average number of rooted cuttings was recorded at the 3-day interval (T1), reaching 2.6 cuttings, and the highest rooting percentage at the same interval reached 86.67%. In contrast, the lowest averages were recorded at the 9-day interval (T3), with 1.8 rooted cuttings and a rooting percentage of 59.99%.

The interaction between the two factors also had a significant effect. Treatments T1S0, T1S2, T1S3, T1S4, T2S1, and T2S2 recorded the highest averages for both traits. Meanwhile, treatments T1S1 and T3S2 showed the lowest values.

The decline in both traits under 6- and 9-day irrigation intervals is due to the significant effect of reduced moisture content on plant growth. Water stress negatively impacts key physiological processes such as photosynthesis, nutrient transport, protein synthesis, enzymatic activity, hormone function, and cell division and elongation [7]. These findings align with those of [4], who reported a decrease in both shoot and root traits in apricot seedlings under water stress.

Table (3) shows the effect of irrigation intervals, planting media, and their interaction on the average number of rooted cuttings in Tamarix.

Planting medium / *Irrigation intervals*	*S0*	*S1*	*S2*	*S3*	*S4*	*Average Effect of Irrigation Intervals:*
T1	3	1	3	3	3	2.6
T2	2	3	3	2	2	2.4
T3	2	2	1	2	2	1.8
***Average Effect of Planting Medium*:**	2.33	2.00	2.33	2.33	2.33	
***L.S.D* (0.05)**	***Irrigation intervals: 0.75*** ***Planting medium: 0.96*** ***Irrigation intervals X Planting medium: 1.67***					

Table 4 shows the effect of the interaction between irrigation intervals and growing media on the rooting percentage.

Planting medium / *Irrigation intervals*	*S0*	*S1*	*S2*	*S3*	*S4*	*Average Effect of Irrigation Intervals:*
T1	100	33.33	100	100	100	86.67
T2	66.66	100	100	66.66	66.66	80
T3	66.66	66.66	33.33	66.66	66.66	59.99
***Average Effect of Planting Medium*:**	77.77	66.66	77.78	77.77	77.77	
***L.S.D* (0.05)**	***Irrigation intervals: 3.73*** ***Planting medium: 4.81*** ***Irrigation intervals X Planting medium: 8.34***					

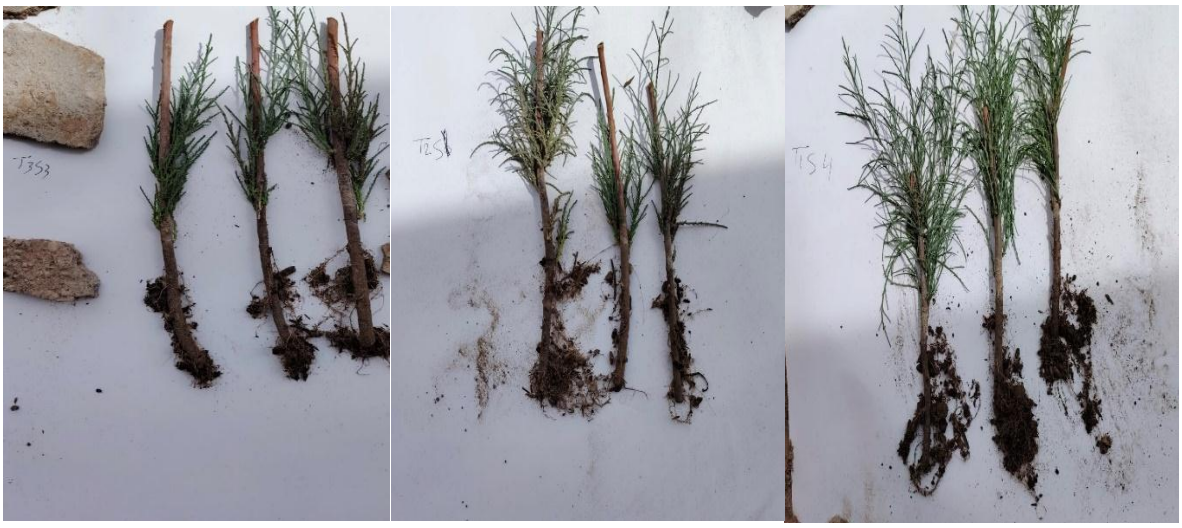

Figure (1) shows the success of rooting and growth in tamarix cuttings among some interaction factors of the three irrigation intervals.

4. Conclusion

The results of the study showed that irrigation intervals, planting media, and their interaction all had significant effects on all studied traits. Water stress led to ageneral decrease across all measured parameters.

The study demonstrated that Tamarix trees can be easily propagated vegetatively without the use of fertilizers or plant rooting hormones.

Acknowledgment: We are grateful to the Directorate of Forests and Desertification, Ministry of Agriculture, for providing the necessary support and facilities that made this research possible. This work was carried out by Mustafa Zuhair Abd Alhameed, Omar Saad Atiya, Samir Rafie Sami, and Faisal Kathem Mutasher.

References

[1] **Abdulrahman, Y. A., & Salih, T. J. (2012).** Effect of propagation media and different concentrations of IBA on rooting of Bougainvillea glabrac cuttings. Rafidain Journal of Agriculture, 40(1).

[2] **Al-Ani, T. A. (1991).** Physiology of plant growth and formation. Ministry of Higher Education and Scientific Research, University of Baghdad.

[3] **Al-Handawi, M. B., Commins, P., Dinnebier, R. E., Abdellatief, M., & Li, L. (2023).** Harvesting of aerial humidity with natural hygroscopic salt excretions. Proceedings of the National Academy of Sciences, 120(22), e2221160120. https://doi.org/10.1073/pnas.2221160120

[4] **Alkhazali, S. R. Kh. (2021).** Effect of potassium silicate, growth medium, and irrigation intervals on growth of apricot (Doctoral dissertation, University of Baghdad).

[5] **Al-Ma'athid, A. F. Q., Kamal, A. A., & Abbas, A. J. (2009)**. Influence of medium culture and treated cutting with Serodix on ability root cutting of Pelargonium zonale. Tikrit University Journal of Agricultural Sciences, 9(2), 226–235.

[6] **Al-Mamure, M. T. A. (2014).** The effect of the date of cutting the plant, planting media, and IBA on some growth traits of grapes (Vitis vinifera L.) cuttings cv. Kamali. Kufa Journal of Agricultural Sciences, 6(3), 1–13.

[7] **Al-Naimi, S. N. A. (1990).** The relationship between soil, water, and plants. Dar Al-Kutub for Printing and Publishing, University of Mosul.

[8] **Al-Rawi, A., & Al-Douri, A. (1991).** Nurseries and plant propagation (2nd ed.). University of Mosul.

[9] **Al-Rawi, K. M., & Khalaf Allah, A. A. M. (1980).** Design and analysis of agricultural experiments. Dar Al-Kutub for Printing and Publishing, University of Mosul.

[10] **Boamah, P. O., Owusu-Sekyere, J. D., Sam-Amoah, L., & Anderson, B. (2011).** Effects of irrigation interval on chlorophyll fluorescence of tomatoes under sprinkler. Asian Journal of Agricultural Research, 5(1), 83–89. https://doi.org/10.3923/ajar.2011.83.89

[11] **Eed, A. M., & Al-Hajj, A. H. A. (2023).** Propagation of Athel (Tamarix aphylla) trees vegetatively by stem cutting in polyethylene bags and under plastic tunnel conditions. Syrian Journal of Agricultural Research, 10(4), 263–271.

[12] **Food and Agriculture Organization. (2006).** Date palm irrigation. http://www.fao.org/docrep/006/y4360e0b.htm

[13] **Jain, S., Sharma, T. R., Lal, N., Rangare, N. R., Kumar, B., & Shiurkar, G. B. (2017).** Effect of GA_3 and growing media on seedling vigour and physiological parameters of custard apple (Annona squamosa L.). International Journal of Current Microbiology and Applied Sciences, 6(8), 606–615. https://doi.org/10.20546/ijcmas.2017.608.073

[14] **Koech, R., & Langat, P. (2018).** Improving irrigation water use efficiency: A review. Agricultural Water Management, 197, 44–53. https://doi.org/10.1016/j.agwat.2017.11.017

[15] **Majeed, A. W. (2021).** The effect of irrigation interval, rootstock type, and organic fertilizer on the growth of local lemons (Doctoral dissertation, University of Baghdad).

[16] **Marijcke, J. (2003).** The comprehensive guide to wild flowers of the UAE. Environmental Research and Wildlife Development Agency.

[17] **Mekki, L. E. M., & Elmeleigy, E. A. (2012).** Benefits of using Athel (Tamarix aphylla L.) as windbreaks in new lands. In Proceedings of Minia International Conference for Agriculture and Irrigation in the Nile Basin Countries (pp. 26–29). El-Minia, Egypt.

[18] **Taiz, L., Zeiger, E., Møller, I. M., & Murphy, A. (2018).** Plant physiology and development (6th ed.). Sinauer Associates.

[19] **Zargar, S. M., Gupta, N., Nazir, M., Mahajan, R., Malik, F. A., Sofi, N. R., & Salgotra, R. K. (2017).** Impact of drought on photosynthesis: Molecular perspective. Plant Gene, 11, 154–159. https://doi.org/10.1016/j.plgene.2017.06.004