Standardization techniques for grafting in pomegranate (*Punica granatum* Linn.)

ABSTRACT

An Experiment was conducted at Department of Agriculture, School of Agriculture and Veterinary Science, Shridhar University, Pilani, Rajasthan, India during 2023- 2024. softwood grafting and (T_1 on June 15; T_2 on June 30; T_3 on July 15; T_4; on July 30; T_5 on August 15; T_6 on August 30), tongue grafting (T_7 on June 15; T_8 on June 30; and T_9 on July 15, T_{10} on 30th July, T_{11} on August15, T_{12} on August 30) these were the 12 grafting techniques that used as treatments in the study. For this study, one-year-old Ganesh seedlings were utilized as the rootstock. Experiment T3, which entailed grafting softwood on July 15th, had the highest outcomes in terms of early bud break (15.16 days), improved sprouting percentage (57.32%) at 150 DAG, and grafting success (74%), at 60 DAG. When softwood and whip & tongue grafting methods were compared, softwood grafting produced better results in terms of bud break, sprouting percentage, and grafting success.

***Keywords**:* pomegranate, grafting methods, graft success, grafting time, Softwood grafting, tongue grafting

INRODUCTION

The pomegranate, *Punica granatum* (L.), commonly referred to as the Chinese apple, is a plant belonging to the Punicaceae family with chromosomes no. 2n=18. One of the most revered and ancient beloved fruits. A common term for it is "friendship fruit." Customers all across the world seek for this well-known commercial fruit because of its exceptional combination, superb dessert quality, and sweet-acid flavor. Due to its robust nature, pomegranates may thrive in a broad range of climates, including tropical, subtropical, desert, and temperate ones. The world's largest producer of pomegranates is India. There are over 760 varieties of pomegranate. Each pomegranate has about 840 seeds. One of the richest and oldest fruits is the pomegranate. It is grown commercially in the state of Maharashtra, Gujrat, Karnataka, Andhra Pradesh, Tamil Nadu, Madhya Pradesh and Rajasthan. Just 1.79% of India's entire production is exported. It has enormous medicinal, nutritional value and one of the richest sources of anti-oxident. Currently,

275,500 hectares are planted with this fruit crop, which yields 3 million metric tons (MMT) of fruit year (NHB statistics 2021-22). With over 75% of the country's pomegranate output and area, Maharashtra leads the field, followed by Andhra Pradesh and Karnataka. The most common propagation strategy for pomegranates is air layering. Examining the entire matter, a task was posed to evaluate pomegranate vegetative proliferation using grafting (softwood and whip/tongue grafting).

MATERIALS AND METHODS

The current study was conducted in 2023–2024 at the Department of Agriculture (experimental field), School of Agriculture and Veterinary Science, Shridhar University, Pilani, Rajasthan, India. The study was conducted in the IV agro-climatic zones of Rajasthan (Transitional Plain of Inland Drainage), which are located at an altitude of 533 meters above mean sea level and at 28° 27 North latitude and 75° 63 East longitude. In the current study, 12 treatment combinations totaling 2 grafting methods—tongue grafting and wedge grafting—were included at every fortnightly interval throughout the months of June, July, and August. The treatments were set up in a totally randomized design with three replications. About 15 cm long scion of ‘Bhagawa’ was used for grafting. A one year-old seedling of Ganesh were used .Rootstocks of pencil thickness (0.6-0.8 cm diameter) having uniform growth were selected. The rootstock was headed back when the scion was chosen, leaving a 15–17 cm long stem above the polythene bag. The beheaded rootstock was split open around 2.5-5.0 cm deep through the center from the cut end of the rootstock with a grafting knife. A wedge shaped cut, slanting from both the sides (5 cm long), was made on the proximal end. The scion was inserted into the stock and pressed it so that cambium tissue of the stock and scion both are together come into contact. Then, the stock and scion combination was tied with the help of a 150-gauge polythene strip, 1.5 cm in width and 30-40 cm in length. Immediately after grafting, the graft was covered by a 2.5×16 cm long white polythene cap that was tied with thread at the lower end. After grafting, the percentage of sprouting was noted at 30days, 60days, 90days, 120days, and 150 days. The percentage of success was measured at 60 days after grafting, and the length of the scion was measured at 30days, 60days, 90days, 120days, and 150 days. The Panse and Sukhatme (1978) protocol was followed in doing the statistical analysis of the data.

RESULT & DISCUSSION

Out of all the treatments, T_3 (softwood grafting) had the highest sprouting percentage (57.32%) at 150 DAG, whereas T_9 (whip and tongue grafting) had the lowest sprouting percentage (11.4%) at 150 Days after grafting (Table 1). In terms of grafting success percentage, the softwood grafting (T_3) on July 15th had the highest grafting success percentage (74%) 60 days after grafting (Table 2). On July 15, whip and tongue grafting in T_9 had the lowest grafting success rate (11.49%) (Table 2). The maximum shoot height (in cm) in T_3 at 150 DAG was measured at 56.00 cm. However, T_5 (softwood grafting on August 15) reported the largest shoot length (24.64 cm) at 60 DAG. In treatments including whip and tongue grafting, the minimum shoot length was noted (Table 3.) On July 30, at 150 DAG, the highest scion diameter (5.82 mm) was measured in softwood grafting (T_4), and on August 30, in whip and tongue grafting (T_{12}), the lowest scion diameter (5.9mm) was measured (Table 4).

Notably, T_3 (softwood grafting) showed the highest proportion of pomegranate graft sprouting (57.32%), whereas tongue and whip grafting showed lower percentages of sprouting (11.4%) at 150 DAG (Dubey et al., 2022; Das et al., 2024). The results show that the percentage of pomegranate grafts that sprouted was significantly influenced by the procedure and season. The extreme humidity and temperatures that were present at the time might account for this. Graft uptake was significantly impacted by the high humidity and warmth (Hartman and Kester, 1986). The results indicate that the percentage of pomegranate grafts that sprouted was significantly influenced by the procedure and season (Raj et al., 2024). The extreme humidity and temperatures that were present at the time might account for this. The high humidity and warmth had a major effect on graft absorption (Hartman and Kester, 1986; Patil et al., 2010; Sonawane et al., 2012) have confirmed the results of this study. It is plausible that incorrect interlocking of the scion and stocks causes less intimate contact between the two, preventing callus formation and reducing the sprouting percentage in tongue and whip grafting. A parallel result was defined by Hussain et al. (2016).The percentage of graft success (%) was highly impacted by the grafting method.

In contrast, T_9 had the lowest grafting success (%) of any species when whip and tongue grafting were used. The two primary factors that have a greater influence on the formation of graft unions are the optimal temperature and relative humidity, and they are to blame. In July, higher humidity helps to keep the scion from desiccating, which keeps the cells turgid and

facilitates the creation of a callus between the scion and stock quickly. Similar to what Ghosh et al. (2010) [2] observed, Nitish et al. 2019 saw increased graft success rates in July (72%) for softwood grafting in sapota. The highest grafting success (63.33%) in softwood grafted plants in sapota was reported by (Patil et al., 2010; Patil, 2019 also observed that the month of July (80.00%) had a higher grafting success percentage for softwood grafting. At 150 DAG, T_3 had a significant increase in shoot length (cm) of 56.00, whereas T_{11} had the lowest shoot length (44.15). Table 3 makes it clear that, in contrast to whip/tongue grafted plants, softwood grafted plants produced the longest shoots. It might be the result of increased warmth and humidity within the shade net, which raises cell metabolism and causes the scion's development to extend. Nitish et al. (2019) in sapota found the highest growth of scion in softwood grafting method performed in July month (Dubey et al., 2021; Sunil et al., 2023). There is a correlation between those research' findings and ours. Softwood grafting unquestionably provided the highest scion diameter (5.82 cm), as compared to whip and tongue grafting (5.9 cm) (Table 4). It occur because softwood grafted plants have more leaves and early development, which leads to a larger accumulation of carbohydrates. Additionally, the humidity and temperature in July were favorable for the grafts to flourish. The results of this study are in line with those of Patel et al. (2010), who examined the highest scion diameter of softwood grafted plants in July while doing research in Mandarin.

Table 1: Sprouting percentage at various days of grafting

Treatment	**Sprouting percentage (%) at DAG**				
	30	**60**	**90**	**120**	**150**
T_1	24.00 (29.00)	32.32 (34.16)	28.16 (31.58)	28.15 (31.58)	24.00 (28.48)
T_2	32.32 (34.16)	32.32 (34.16)	32.32 (34.16)	32.32 (34.16)	32.32 (34.16)
T_3	53.16 (46.40)	74.00 (59.53)	61.49 (51.23)	57.32 (48.81)	57.32 (48.82)
T_4	11.49 (19.69)	24.00 (29.00)	24.00 (29.00)	24.00 (29.00)	24.00 (29.00)

T_5	36.49 (36.75)	36.49 (36.75)	36.49 (36.75)	36.49 (36.75)	36.49 (36.75)
T_6	49.00 (44.00)	53.16 (46.40)	49.00 (44.00)	44.82 (41.57)	44.82 (41.58)
T_7	0.00	0.00	0.00	0.00	0.00
T_8	0.00	0.00	0.00	0.00	0.00
T_{10}	0.00	0.00	0.00	0.00	0.00
T_{11}	40.67 (39.16)	53.16 (46.40)	53.16 (46.40)	53.16 (46.40)	53.16 (46.46)
T_{12}	40.66 (39.16)	36.49 (36.75)	32.32 (34.16)	32.32 (34.16)	32.32 (34.16)
S. E±	**1.42**	**2.11**	**1.83**	**1.79**	**2.12**
C.D 5%	**4.17**	**6.21**	**5.38**	**5.26**	**6.24**

Table 2: Graft success percentage at 60 days after grafting

Treatment	**Percentage of Graft success**
T_1	32.32 (34.16)
T_2	32.32 (34.16)
T_3	74.00 (59.53)
T_4	24.00 (29.00)
T_5	36.49 (36.75)
T_6	53.16 (46.40)
T_7	0.00 (0.00)
T_8	0.00 (0.00)

T_9	11.49 (19.69)
T_{10}	0.00 (0.00)
T_{11}	53.16 (46.40)
T_{12}	36.49 (36.75)
S. E±	**2.11**
C.D 5%	**5.21**

Table 3: Impact of grafting on length of shoot at various days of grafting

Treatment	**Shoot lenght (cm) at DAG**				
	30	**60**	**90**	**120**	**150**
T_1	15.61	20.00	32.42	38.33	47.14
T_2	14.35	18.80	29.72	38.65	48.14
T_3	16.57	20.49	40.19	44.19	56.00
T_4	16.29	20.24	28.84	35.17	51.52
T_5	11.77	24.65	27.08	33.15	44.21
T_6	14.75	21.41	27.58	43.61	49.75
T_7	0.00	0.00	0.00	0.00	0.00
T_8	0.00	0.00	0.00	0.00	0.00

T_9	11.72	17.52	26.00	30.79	42.06
T_{10}	0.00	0.00	0.00	0.00	0.00
T_{11}	8.92	19.81	28.86	35.23	44.15
T_{12}	14.72	19.74	24.65	34.22	47.84
S. E±	**0.69**	**1.00**	**1.27**	**2.15**	**2.24**
C.D 5%	**2.06**	**2.92**	**3.75**	**6.33**	**6.59**

Table 4: Impact of grafting on scion diameter at various days after grafting (DAG)

Treatment	**Scion diameter (mm) at DAG**				
	30	**60**	**90**	**120**	**150**
T_1	4.62	4.82	5.06	5.32	5.44
T_2	4.71	5.08	5.32	5.45	5.76
T_3	5.17	5.21	5.28	5.46	5.55
T_4	5.73	5.37	5.44	5.81	5.82
T_5	4.65	4.92	5.28	5.43	5.65
T_6	4.68	4.77	4.97	5.15	5.22
T_7	0.00	0.00	0.00	0.00	0.00

T_8	0.00	0.00	0.00	0.00	0.00
T_9	5.07	5.18	5.26	5.37	5.46
T_{10}	0.00	0.00	0.00	0.00	0.00
T_{11}	4.53	4.73	4.79	5.01	5.41
T_{12}	4.57	4.47	5.05	5.02	5.9
S. E±	**0.12**	**0.18**	**0.06**	**0.9**	**0.10**
C.D 5%	**0.37**	**0.54**	**0.18**	**0.29**	**0.31**

DAG - Days after grafting

CONCLUSION

In summary according to the current research, grafting might be used to propagate pomegranates. Based on all the parameters examined, the softwood grafting that was done on July 15th produced the best results under shade net conditions. As a result, softwood grafting may be employed commercially by employing rootstocks resistant to different serious diseases, such as pomegranate wilt.

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