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Study to identify the suitable Propagation Time in Apple (*Malus × domestica* Borkh.) in Subtropical conditions

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ABSTRACT: The present investigation entitled "Study to identify the suitable propagation time in apple (*Malus × domestica* Borkh.) in subtropical conditions" was carried out at Horticultural Research Centre of Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut – 250110 during 2022-23. In this study, three propagation times *viz.*, 1 January, 15 January and 30 January were selected with three replications. The different parameters for these propagation times were recorded to evaluate the best propagation time. Climate was the major challenge in this study because of sub-tropical conditions and apple being a temperate fruit crop it was more challenging to propagate them in sub-tropical conditions. In order to overcome this situation, we used low chilling varieties of apple *viz.*, Anna, HRMN-99 and Dorsett Golden. When plants were grafted on 30 January it took the minimum days (11.62) to bud intake and showed the maximum results in scion diameter (1.50 cm), leaf area (11.78), plant height (58.69 cm) and survival percentage (95.56%). And maximum results were found in percent success at 30 days (86.67%), number of branches (8.91) and number of leaves (37.26) when plants were grafted on 15 January. Rootstock diameter was recorded maximum when plants were grafted on 1 January.

Keywords: Apple propagation time, *Malus* × *domestica* Borkh., Subtropical conditions, Climate challenges Low-chilling apple varieties, Grafting effects, Scion performance and Propagation success.

INTRODUCTION

Apple (*Malus* × *domestica* Borkh.) belongs to the family Rosaceae and is a widely cultivated fruit, particularly in temperate regions around the world. The primary center of origin for cultivars of Malus is located in Asia Minor, The Caucasus, Central Asia, Himalayan India, and Western China, where at least 25 native species of Malus can be found (Mitra, 2003). In 2021, the global apple production was estimated to be 93.1 million tonnes, cultivated across an area of 4.82 million hectares. China ranked first in apple production, followed by the USA and Turkey. India ranked fifth in terms of production and second in terms of cultivated area **(**World Data Atlas, 2021). In India, the production of apples in the year 2021-22 was reported 2589MMT, grown across 315 million hectares. Jammu & Kashmir was the leading region in terms of both area (168570 hectares) and production (1898590 metric tonnes), followed by Himachal Pradesh (611900 metric tonnes) and Uttarakhand (64,880 metric tonnes) (Anonymous, 2021-22).

Different apple varieties have varying chilling hour requirements during winter to break their rest period. Most varieties require 1000-1600 chilling hours, while some low-chill varieties such as Anna, Dorsett Golden, and HRMN-99 only require 500-800 chilling hours. In more efficient apple production areas like Jammu and Kashmir, cultivars typically need 600-2000 chilling hours at temperatures below 7°C during the dormant period to bloom and develop foliage normally.

The modernization of fruit nurseries has become crucial due to increasing demand for quality plants, as healthy and high-quality fruit plants are essential for successful and profitable fruit production. The propagation of fruit plants, including apple, has evolved into a specialized industry that requires certified skills and advanced technology. Therefore, it is important to standardize

suitable propagation techniques for fruit plants, including apple (Rawat *et al*., 2006). Apple trees can be propagated through seeds, primarily for breeding programs, or through various methods of vegetative propagation for both rootstocks and apple scion cultivars. Given the advanced level of technology employed in apple crop management, plant propagation plays a crucial role in producing seedlings with excellent morphological quality and free from diseases. This necessitates continuous advancements and improvements in propagation techniques for new rootstocks and apple scions (Petri *et al*., 2019).

In subtropical regions, where the climate may be characterized by higher temperatures, longer growing seasons, and limited chilling hours, achieving successful grafting and subsequent survival of apple trees becomes a complex task. The optimal timing of grafting plays a critical role in determining the success rate and overall performance of grafted apple plants. Therefore, it is imperative to standardize the grafting dates specific to subtropical conditions to maximize survival and ensure the establishment of healthy apple orchards.

Grafting is a technique used to combine and fuse two plant parts, enabling them to grow and develop as a single plant. The upper part of the new plant, known as the 'scion,' is grafted onto the lower part or rootstock of a different variety. Grafting can be categorized as either exiled or stagnant, depending on the timing of the procedure (Ak *et al*., 2021).

The objective of this study was to determine the most effective grafting times for three apple cultivars and their survival, namely Anna, Dorsett Golden, and HRMN-99, in subtropical conditions."

MATERIAL AND METHOD

The present investigation entitled “Study to identify the suitable propagation time in apple (*Malus* × *domestica* Borkh.) in subtropical conditions” was conducted at Horticultural Research Centre of Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut - 250110, Uttar Pradesh during 2022-23. One year old healthy and uniform seedlings of apple having a diameter of 0.75 cm to 1.0 cm and height of 50-60 cm were used as rootstock for the entire study. The seedlings were maintained healthy by using appropriate cultural practices during the investigation. One year old shoots of 0.75 to 1.0 cm in diameter and 40 to 50 cm in length with well-developed narrow and pointed vegetative buds were used as scion wood of Anna, Dorsett Golden and HRMN-99 cultivars. The scion woods were healthy and disease free. These were collected during the first week of January. The experiment was laid out in Factorial Randomized Complete Block Design (RCBD) with three grafting methods *viz*., Tongue grafting, Cleft grafting and Side grafting and three grafting times *viz*., 1 January, 15 January and 30 January consisting of three replications. All propagation operations were done from 1 January to 30 January with 15 days of interval. White and soft plastic tapes were used for wrapping. Cultural practices such as irrigation, weeding and removal of suckers were applied at regular intervals. The data on days taken to bud intake, percent success at 30 days, scion diameter (cm), rootstock diameter (cm), number of branches, number of leaves, leaf area (cm^2), plant height (cm) and survival percentage (%) were recorded in an interval of one month for a period of 3 months. Statistical analysis of the data was performed using the standard procedure as described by Gomez and Gomez (1996).

RESULT AND DISCUSSION

Data presented in the Table 1 showed that it was evident that there were significant variations in the duration required for bud sprouting across different propagation timings. Grafting on 30 January exhibited the shortest duration (11.62 days) for bud sprout. These findings are consistent with a previous study conducted by Chakraborty and Singh (2011), which indicated that sprouting in peach (*Prunus persica*) scions grafted at different time intervals progressively increased from January to February.

After examining the data presented in Table 1, it was observed that the percentage of successful grafts at 30 days varied significantly among different propagation timings. Grafting on 15 January exhibited the highest success rate (86.67%). These findings are consistent with the research conducted by Jaipal (2019), which reported in peach (*Prunus persica*) a significantly higher graft success rate of 60.95% on 9th January compared to 58.24% on 25th January. The decrease in graft success on 25th January can be attributed to the reduced activity of growth promoters and callus proliferation, which are crucial for achieving a successful graft union. Wani *et al*. (2017) also found similar results in walnut (*Juglans regia* L.) that maximum grafting success 80.43% was recorded 30th January, followed by 72.33% on 20th January under poly house conditions.

Upon examining the data presented in Table 1, it was evident that the scion diameter varied significantly under different dates of grafting. In different grafting times 30 January showcased the maximum scion diameter (1.50 cm). Similar results were also found by Zenginbal *et al*. (2010), which reported in kiwifruit (*Actinidia* deliciosa) that highest shoot diameter (9.17 mm and 8.43 mm) were recorded when grafting was done on 1 February.

After reviewing the data presented in Table 1, it is evident that the rootstock diameter varied significantly under different grafting times. Grafting on 1 January demonstrated the maximum rootstock diameter (1.79 cm), surpassing 30 January (1.78 cm) and 15 January (1.76 cm).

It is evident that the number of branches varied significantly under different times of grafting. In different grafting times 15 January demonstrated the maximum number of branches (8.91) compared to 30 January (8.89) and 1 January (5.89). Wani *et al*. (2017), found similar results in walnut (*Juglans regia* L.) that the maximum number of leaves were recorded in plants grafted on 30 January.

After analysing the data presented in Table 1, it is evident that the number of leaves varied significantly under different grafting dates. Grafting on 15 January demonstrated the maximum number of leaves (37.26) compared to 30 January (36.63) and 1 January (33.58).

Upon examining the data presented in Table 1, it is evident that the leaf area varied significantly under different times of propagation. Grafting on 30 January demonstrated the maximum leaf area (11.78 cm^2) compared to 15 January (9.87 cm^2) and 1 January (9.22 cm^2). Similar results were also obtained by Upadhyay *et al*. (2017), who reported in walnut (*Juglans regia* L.) that plants grafted in January showed the maximum leaf area.

After examining the data presented in Table 1, it is evident that the plant height varied significantly under different grafting times. Among different grafting times 30 January exhibited the maximum plant height (58.69 cm) compared to 1 January (51.77 cm) and 15 January (48.26 cm). These results were consistent with the findings of Jaipal (2019), who reported that in peach (*Prunus persica* L.) plants grafted on 25th January showed significantly greater plant height compared to plants grafted on 9th January at all observation dates. This might be attributed to better ecological conditions available for plant height on 25th January.

Upon reviewing the data presented in Table-1, it is evident that the survival percentage varied significantly under different grafting times. Grafting performed on 30 January exhibited the maximum survival percentage (95.56%) compared to 15 January (92.78%) and 1 January (71.67%). Similar results were also obtained by Upadhyay *et al*. (2017), who reported in walnut (*Juglans regia* L.) that plants grafted in February in open conditions showed the maximum survival of grafts.

Table 1: Effect of propagation times on Days taken to bud intake, Percent success at 30 days, Scion diameter, Rootstock diameter, Number of branches, Number of leaves, Leaf area, Plant height and Survival percentage.

Treatments	Days taken to bud intake	Percent success at 30 days	Scion diameter (cm)	Rootstock diameter (cm)	Number of branches	Number of leaves	Leaf area (cm^2)	Plant height (cm)	Survival percentage (%)
1 January	**17.16**	**64.44**	**1.45**	**1.79**	**5.89**	**33.58**	**9.22**	**51.77**	**71.67**
15 January	11.82	**86.67**	1.45	1.76	**8.91**	**37.26**	9.87	48.26	92.78
30 January	**11.62**	83.33	**1.50**	1.78	8.89	36.63	**11.78**	**58.69**	**95.56**
S.Em. ±	0.258	2.066	0.013	0.007	0.192	0.385	0.210	0.444	1.974
CD at 5%	0.780	6.248	0.040	0.020	0.580	1.164	0.635	1.343	5.969

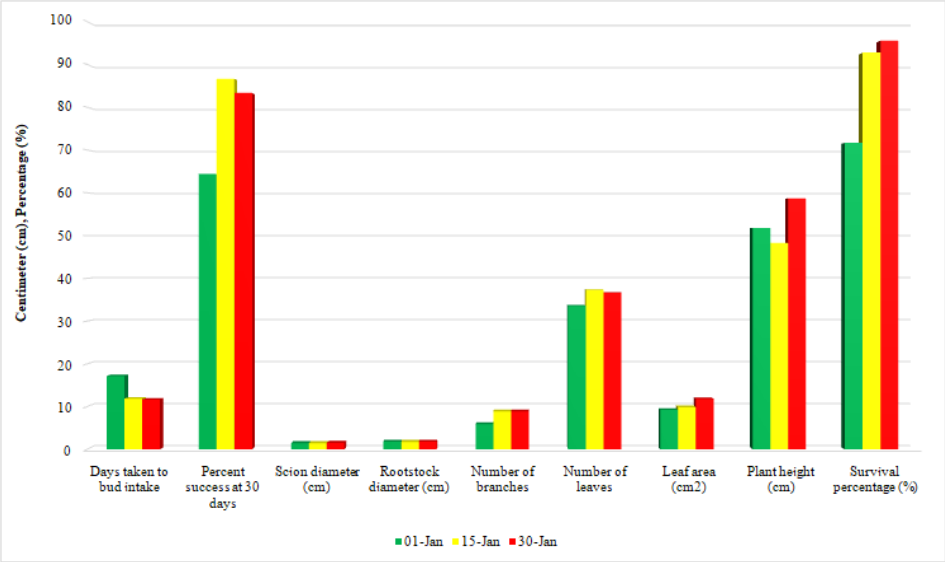

Fig. 1. Effect of propagation times on Days taken to bud intake, Percent success at 30 days, Scion diameter, Rootstock diameter, Number of branches, Number of leaves, Leaf area, Plant height and Survival percentage.

CONCLUSIONS

In this study, some low chilling varieties of apple *viz*., Anna, Dorsett Golden and HRMN-99 were grafted on apple rootstocks on different grafting dates *viz*., 1 January, 15 January and 30 January. Based on the findings of this study, it can be concluded that 30 January is the most suitable propagation time for Apple, followed by 15 January in subtropical conditions.

FUTURE SCOPE

The future prospects of study to identify the suitable propagation time in apple (*Malus* × *domestica* Borkh.) in subtropical conditions appear promising, given the findings that grafting on 30 January demonstrated the best results in this study. Further research can delve deeper into the reasons behind success of grafting done on 30 January and explore ways to optimize this

grafting time for various apple cultivars in the region. Additionally, grafting done on 15 January, which also showed favorable results, can be studied in combination with other innovative techniques to enhance its effectiveness further. As more data accumulates and knowledge is shared among agricultural experts, a comprehensive propagation guideline can be developed, considering factors like rootstock selection, planting practices, and environmental conditions. By adopting standardized propagation time, apple growers in subtropical region can potentially achieve higher yields, improved crop quality, and sustainable orchard management, contributing to the growth and stability of the apple industry in the region.

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