

## Standardization of the suitable Propagation Method in Apple (*Malus domestica* Borkh.) under Western Uttar Pradesh conditions

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**ABSTRACT:** The present investigation entitled “Standardization of the suitable propagation method in apple (*Malus × domestica* Borkh.) under western Uttar Pradesh 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 methods namely tongue grafting, cleft grafting, and side grafting were selected with three replications. The different parameters for these propagation methods were recorded to evaluate the best propagation method. 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 tongue grafted it took the minimum days (12.51) to bud intake and showed the maximum results in scion diameter (1.51 cm), rootstock diameter (1.82 cm), number of leaves (37.24), leaf area (11.72) and survival percentage (91.67%) and maximum results were found in percent success at 30 days (82.22%), number of branches (8.50) and plant height (54.76 cm) when plants were cleft grafted.

**Keywords:** *Malus × domestica* Borkh., Propagation, Tongue Grafting, Cleft Grafting, Side Grafting and Low chilling.

### INTRODUCTION

Apple (*Malus × domestica* Borkh.) belongs to the family Rosaceae and it is a widely cultivated fruit. It is the main fruit crop in the temperate regions of the world. The primary centre of origin of cultivars of *Malus* is within the region of Asia Minor, The Caucasus, Central Asia, Himalayan India, and Western China, in which at least 25 native species of *Malus* occur (Mitra, 2003). The world production of apple was estimated at 93.1 million tonnes across a cultivated area of 4.82 million hectares in 2021. China was leading the production followed by USA and Turkey with India ranks 5<sup>th</sup> in production and 2<sup>nd</sup> position in terms of area (World Data Atlas, 2020). In India production of apple was estimated at 2589000 MT across the cultivated area of 315000 hectares in 2021-22. Jammu & Kashmir was

leading the area (168570 ha.) and production (1898590 MT) followed by Himachal Pradesh (611900 MT) and Uttarakhand (64880 MT) (Anonymous, 2021-22). Most apple varieties require 1000-1600 chilling hours during winter to break the rest period, however some low chilling varieties require only 500-800 chilling hours such as Anna, Dorsett Golden, HRMN-99. Most cultivars grown in more efficient production areas of Jammu and Kashmir require 600-2000 hours of chilling temperature below 7°C during the dormant period for them to bloom and foliage normally.

Since healthy and good quality fruit plants are the foundation of successful and remunerative fruit production. So, the need for modernising our fruit nurseries became more urgent with rising demand for quality plants. Moreover, plant propagation has become a vastly specialized industry involving a large outlay of

certified and highly developed skill and technology. Thus, there is a need of standardizing suitable new propagation techniques in the fruit plants including apple (Rawat *et al.*, 2006). Apple trees can be propagated by seeds, restricted to the use of breeding programs, and multiplied by several methods of vegetative propagation, both for rootstocks and apple scion cultivars. Considering the high technological level currently used in apple crop management, plant propagation plays a very important role to enable seedling production with high morphological quality and free of diseases, requiring new advances and propagation improvements in new releases of rootstocks and apple scions (Petri *et al.*, 2019).

Graftage is to combine and fuse two plant parts and to allow them to grow and develop like a single plant. The part that forms the upper part or the crown of the new plant is known as 'scion' and the part that forms the lower part, or the root of the variety is called 'rootstock'. The process to obtain new plants by combining and fusing two vegetative plant parts is called 'grafting'. According to the time it is made, graftings are divided into two as exile and stagnant (Ak *et al.*, 2021).

Standardizing the suitable propagation method for apple (*Malus × domestica* Borkh.) under Western Uttar Pradesh conditions presents significant difficulties and challenges. Firstly, the region's diverse climatic conditions and soil types necessitate rigorous research to identify the most suitable propagation techniques. Additionally, the genetic variability of apple cultivars requires tailored approaches for each variety, making standardization a complex process. Furthermore, the limited availability of high-quality planting materials and skilled labor poses practical constraints. Overcoming these challenges demands extensive scientific studies, collaboration between agricultural institutions, and the adoption of innovative techniques to ensure successful propagation and sustainable apple cultivation in Western Uttar Pradesh. This study was conducted to determine the best grafting method in three apple cultivars viz., Anna, Dorsett Golden and HRMN-99 under western Uttar Pradesh conditions.

## MATERIAL AND METHOD

The present investigation entitled 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 consisting of three replications. All propagation operations were done from 1 January to 30 January with 15 days of interval. Tongue grafting, Cleft grafting and Side grafting methods of propagation were used in this experiment. 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<sup>2</sup>), 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 methods and timings. Tongue grafting exhibited the shortest duration (12.51 days) for bud sprouts. These findings are consistent with a previous study conducted by Malasi *et al.* (2017), which reported that in apple (*Malus × domestica* Borkh.) tongue grafted plants sprouted earlier compared to plants propagated using other techniques. Plathia *et al.* (2016) also supported these findings by confirming that, in peach (*Prunus persica*) among the three methods tested, both tongue and cleft grafting methods exhibited earlier sprouting for both the initial and full stages, in comparison to side grafting. These results also confirm the findings of Rymbai *et al.* (2023) who reported that in wild Himalayas pear (*Pyrus pashia*) tongue grafted plants took minimum days for bud sprouting then wedge grafted plants.

After examining the data presented in Table 1, it was observed that the percentage of successful grafts at 30 days varied significantly among different methods and timings. Cleft grafting exhibited the highest success rate (82.22%). These results are similar to the findings of Sedagathoor and Noie (2016) who reported that in kiwifruit (*Actinidia deliciosa* L.) cleft grafted plants showed the maximum success rate.

Upon examining the data presented in Table 1, it was evident that the scion diameter varied significantly under different methods. In different grafting method stongue grafting showcased the maximum scion diameter (1.51 cm), surpassing cleft grafting (1.46 cm) and side grafting (1.42 cm). These findings are consistent with the research conducted by Thapa *et al.* (2021), who reported that in walnut (*Juglans regia* L.) tongue-grafted plants showed the highest scion diameter compared to other propagation techniques. This could potentially be attributed to factors such as soil nutrition availability and compatibility with the scion, which may contribute to the enhanced growth and development of the scion. These results are also in conformity with the results of Patel *et al.* (2015).

After reviewing the data presented in Table 1, it is evident that the rootstock diameter varied significantly under different methods. Tongue grafting demonstrated the maximum rootstock diameter (1.82 cm), surpassing cleft grafting (1.78 cm) and side grafting (1.73 cm). These findings align with the research conducted by Koyuncu *et al.* (2011), who reported that in apple (*Malus × domestica* Borkh.) tongue-grafted plants demonstrated higher rootstock diameter compared to other propagation techniques. These results also confirm the findings of Khanal *et al.* (2022) who reported that in kiwifruit maximum rootstock diameter was found in tongue-grafted plants as compared to veneer and wedge-grafted plants.

It is evident that the number of branches varied significantly under different methods. In different grafting methods, cleft grafting demonstrated the maximum number of branches (8.50) compared to tongue grafting (7.76) and side grafting (7.43). These findings align with the research conducted by Upadhyay *et al.* (2017), who reported that in walnut (*Juglans regia* L.) cleft grafted plants exhibited the highest number of branches in both open and greenhouse conditions when compared to other propagation techniques.

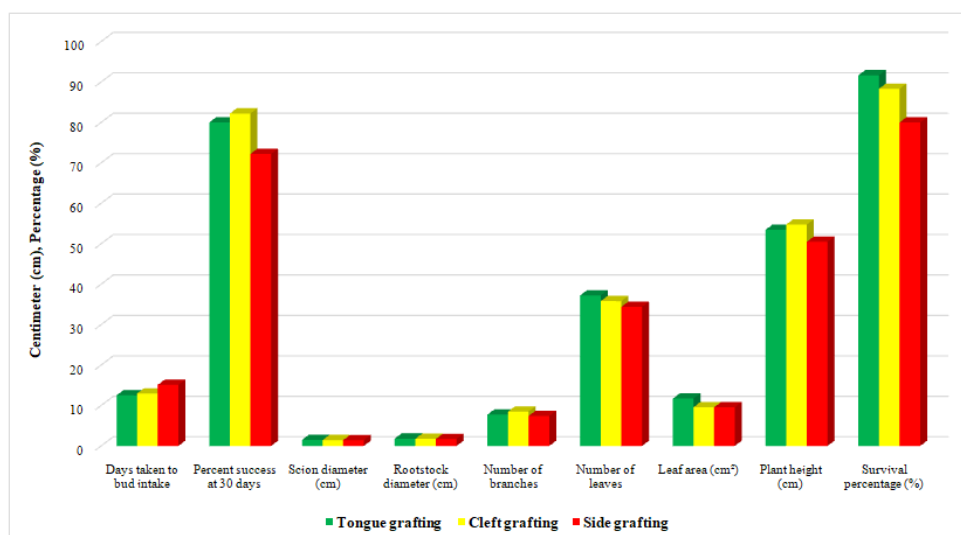
After analyzing the data presented in Table 1, it is evident that the number of leaves varied significantly under different methods. Tongue grafting demonstrated the maximum number of leaves (37.24) compared to cleft grafting (35.82) and side grafting (34.41). These findings align with the research conducted by Negi and Upadhyay (2017), who reported that in apple (*Malus × domestica* Borkh.) tongue-grafted plants displayed the highest number of leaves compared to other

propagation techniques. Similar results were obtained by Rabi *et al.* (2012), where their studies demonstrated that in apple (*Malus × domestica* Borkh.) the number of leaves per plant was significantly influenced by the cultivar and rootstock.

Upon examining the data presented in Table 1, it is evident that the leaf area varied significantly under different methods. Tongue grafting demonstrated the maximum leaf area (11.72 cm<sup>2</sup>) compared to cleft grafting (9.58 cm<sup>2</sup>) and side grafting (9.56 cm<sup>2</sup>). These findings align with the research conducted by Negi and Upadhyay (2015), who reported that in apple (*Malus × domestica* Borkh.) tongue-grafted plants displayed the highest leaf area compared to other propagation techniques. Kumar and Ananda (2002) also reported a similar result in apple (*Malus × domestica* Borkh.), where tongue grafting resulted in the maximum leaf area closely followed by chip budding.

After examining the data presented in Table 1, it is evident that the plant height varied significantly under different methods. Among different grafting techniques cleft grafting exhibited the maximum plant height (54.76 cm) compared to tongue grafting (53.46 cm) and side grafting (50.49 cm).

Upon reviewing the data presented in Table 1, it is evident that the survival percentage varied significantly under different methods. Tongue grafting exhibited the maximum survival percentage (91.67%) compared to cleft grafting (88.33%) and side grafting (80.00%). These results align with the findings of Langpoklakpam *et al.* (2017), who reported that in Sohiong (*Prunus nepalensis* L.) tongue grafted plants demonstrated the highest survival percentage compared to other propagation techniques.



**Fig. 1.** Effect of propagation methods 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

**Table 1: Effect of propagation methods 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 <sup>2</sup> )	Plant height (cm)	Survival percentage (%)
Tongue grafting	12.51	80.00	1.51	1.82	7.76	37.24	11.72	53.46	91.67
Cleft grafting	12.98	82.22	1.46	1.78	8.50	35.82	9.58	54.76	88.33
Side grafting	15.11	72.22	1.42	1.73	7.43	34.41	9.56	50.49	80.00
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	0.042	0.020	0.580	1.164	0.635	1.343	5.969

## CONCLUSIONS

In this study, some low chilling varieties of apple viz., Anna, Dorsett Golden and HRMN-99 were grafted on apple rootstocks with different grafting methods viz., Tongue grafting, Cleft grafting and Side grafting. Based on the findings of this study, it can be concluded that tongue grafting is the most suitable propagation method for Apple, followed by cleft grafting in western Uttar Pradesh conditions.

## FUTURE SCOPE

The future prospects of standardizing the suitable propagation method for apple (*Malus × domestica* Borkh.) under Western Uttar Pradesh conditions appear promising, given the findings that tongue grafting demonstrated the best results in this study. Further research can delve deeper into the reasons behind tongue grafting's success and explore ways to optimize this method for various apple cultivars in the region. Additionally, cleft grafting, 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 practices, apple growers in Western Uttar Pradesh 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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**Conflict of Interest.** None.

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