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# Effect of Methods and Timings of Vegetative Propagation in Aonla (*Emblica officinalis* Gaertn.) under the Northeastern Region of Uttar Pradesh, India

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***Authors' contributions***

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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***Short Research Article***

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## Abstract

Vegetative propagation enables large-scale multiplication of plants using suitable propagation techniques, as it produces true-to-type plants and ensures early fruit bearing. Among the vegetative methods, budding and grafting are commonly practiced in aonla. The present experiment was undertaken to standardize suitable propagation methods and optimal propagation times for aonla in the northeastern region of Uttar Pradesh, India. The investigation was conducted during the year 2024-25 at the Experimental Unit of the Department of Horticulture, Tilak Dhari Post Graduate College, Jaunpur, Uttar Pradesh. The experiment was undertaken to determine the most suitable time and method of vegetative propagation for aonla

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(*Emblica officinalis* Gaertn.). The study comprised six propagation dates at fortnightly intervals from July to September, namely 1 July, 16 July, 1 August, 16 August, 1 September, and 16 September. Two methods of vegetative propagation, *viz*., wedge grafting and patch budding, were evaluated during the course of the investigation. The results of the study revealed that among the propagation methods, wedge grafting produced the best results compared to patch budding. It recorded the minimum number of days to bud sprouting (13.43 days), the highest bud take percentage (87.19%), total number of leaves (27.90), sprout length (15.85 cm), and survival percentage (82.46%). Among the different propagation dates, 16 August proved to be the most suitable time, recording superior performance in terms of bud/graft sprouting, sprout length, and survival percentage.

*Keywords: Aonla; wedge grafting; patch budding; bud take percentage; shoot length; survival percentage.*

## 1. Introduction

Indian gooseberry, commonly known as aonla (*Emblica officinalis* Gaertn.), is an important fruit crop widely used in the traditional Indian system of medicine as well as in the modern pharmaceutical industry. The aonla plant is native to tropical Southeast Asia, particularly central and southern India. Aonla is often regarded as the "king of medicinal plants" and has gained worldwide recognition due to its high nutritional value and immense commercial potential. Therefore, it is essential to promote and conserve aonla in order to develop and maintain a rich genetic resource of this valuable crop. Most cultivated horticultural crop varieties have originated through selection from wild species possessing superior traits during natural hybridization. The primary objective of plant propagation is to produce progeny that retain the desirable characteristics of the parent plant. Hence, a successful propagation method is the one which is able to transmit all desirable characters of the parent plant to its offspring.

Aonla can be propagated both by seeds and by various vegetative methods. However, seed propagation often results in considerable variability in fruit size, maturity period, and yield per plant among seedling populations. Aonla is commonly propagated naturally through self-sown seeds or from seeds of unknown parentage in forest areas (Bajpai et al., 1969; Angadi et al., 2012). Consequently, a wide variation is observed in fruit yield, quality, plant growth, size, and shape. Since aonla is a cross-pollinated crop and exhibits a high degree of heterozygosity, vegetative methods of propagation are essential for producing genetically uniform and true-to-type planting material. Vegetative propagation enables large-scale multiplication of plants using suitable propagation techniques, as it produces true-to-type plants and ensures early fruit bearing. Among the vegetative methods, budding and grafting are commonly practiced in aonla. Generally, grafting in aonla is carried out during the monsoon season (June-July) due to favorable environmental conditions and active sap flow. The success and survival of grafts are influenced by several factors, such as the source of the scion, season of grafting or budding, method of propagation, age of the rootstock, and prevailing climatic conditions. The lack of healthy, true-to-type plants of superior cultivars of aonla due to the absence of efficient vegetative propagation methods at the appropriate time is one of the major bottlenecks in the expansion of its commercial cultivation. Therefore, there is a need to standardize suitable propagation techniques under different conditions for its large-scale commercial propagation. In view of this, the present experiment was undertaken to standardize suitable propagation methods and optimal propagation times for aonla in the northeastern region of Uttar Pradesh.

## 2. Materials and Method

The present study was conducted during 2024–2025 at the Experimental Unit of Tilak Dhari Post Graduate College, Jaunpur, Uttar Pradesh. The experimental site is characterized by a dry subtropical climate with sandy loam soil. One-year-old aonla (*Emblica officinalis* Gaertn.) seedlings were used as rootstock for budding and grafting. The experiment was laid out in a factorial randomized block design (FRBD) with 12 treatments and three replications. Two propagation techniques, viz., patch budding and wedge grafting, were employed in the study. The budding and grafting operations were performed in the open field at fortnightly intervals on 1 July, 16 July, 1 August, 16 August, 1 September, and 16 September. The observations were recorded on various parameters viz., days to taken bud sprouting, highest percentage of bud take, total number of leaves, length of sprout, and the survival (%).After grafting/budding operation, the buds were observed regularly for its greening till it was sprouted or dried. The grafts/budwas under observation regularly up to 120 days after

grafting/budding operation and after computing the mean. The significant effect of different factors was calculated at 5% level of significance.

## 3. Results and Discussion

### 3.1 Days Taken to Bud Sprouting

The perusal of the data presented in table (Table 1) revealed that both time and methods of propagation significantly influenced the number of days taken to bud sprouting. Among the different methods of vegetative propagation (wedge grafting and patch budding), wedge grafting resulted in significantly minimum days to taken bud sprouting (17.50 days).The time of propagation also significantly influenced the days taken to graft/bud sprouting recording minimum days to sprouting in grafting and budding performed on 16 August (16.23 days) which was significantly lower as compared to other dates of propagation. Our findings are in conventionality with the results obtained by (Moti *et al.*, 1976) in bael and (Rani *et al.*, 2014) in guava and (Panchal *et al.*, 2022) in custard apple.

**Table 1. Effect of time and methods on days taken to bud sprouting in aonla**

| Time of propagation | Methods of propagation | | Mean |
|---|---|---|---|
| | Wedge grafting | Patch budding | |
| 01 July | 21.85 | 24.13 | 22.993 |
| 16 July | 19.26 | 23.18 | 21.222 |
| 1 August | 16.42 | 21.69 | 19.057 |
| 16 Aug | 13.43 | 19.04 | 16.238 |
| 01 Sep | 15.18 | 20.68 | 17.932 |
| 16 Sep | 18.86 | 21.16 | 20.010 |
| Mean | 17.50 | 21.65 | |
| Factors | C.D. @5% | SE(d) | SE(m) |
| Factor (A) | 0.936 | 0.449 | 0.317 |
| Factor (B) | 1.622 | 0.777 | 0.550 |
| Factor (A X B) | N/A | 1.099 | 0.777 |

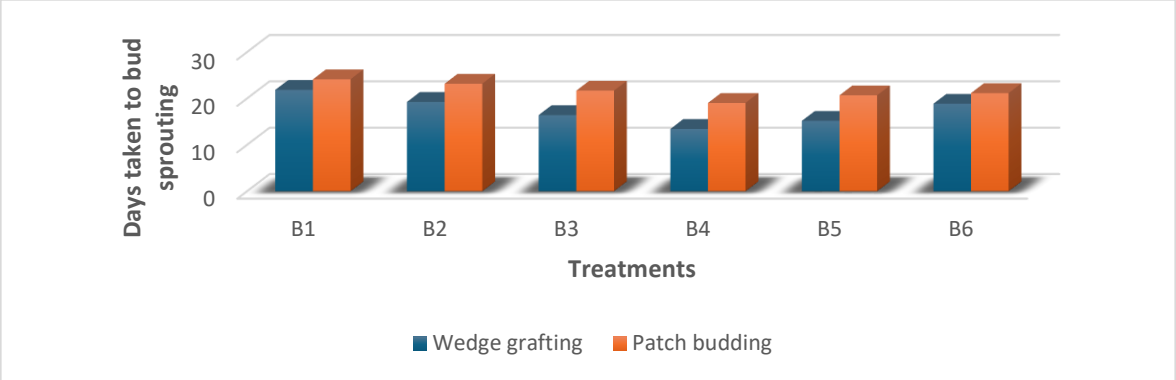


**Fig. 1. Graph showing effect of time and methods on days taken to bud sprouting in aonla**

### 3.2 Graft/Bud Sprouting Percentage

Among the methods (Table 2), wedge grafting resulted in significantly higher graft/bud percentage (82.21%) as compared to patch budding (63.28%). The time of grafting and budding also significantly influenced the graft/bud sprouting percentage, recording maximum bud-take in budding performed on 16 August (79.94%) which was significantly higher as compared to other dates of budding. The present results are also in conformity with the research findings of (Singh & Singh 2006) in jamun, (Prasanth *et al.*, 2007) in mango, (Sharma *et al.*, 2022) in walnut and (Dewangan *et al.*, 2023) in cashew.

**Table 2. Effect of time and method on graft/bud sprouting percentage in aonla**

| Time of propagation | Methods of propagation | | Mean |
|---|---|---|---|
| | Wedge grafting | Patch budding | |
| 01 July | 73.92 | 56.02 | 64.97 |
| 16 July | 78.51 | 58.15 | 68.33 |
| 1 August | 84.08 | 64.02 | 74.04 |
| 16 Aug | 87.19 | 72.69 | 79.94 |
| 01 Sep | 86.01 | 67.98 | 76.99 |
| 16 Sep | 83.53 | 60.82 | 72.17 |
| Mean | 82.21 | 63.28 | |
| Factors | C.D. @5% | SE(d) | SE(m) |
| Factor (A) | 1.171 | 0.561 | 0.397 |
| Factor (B) | 2.028 | 0.972 | 0.687 |
| Factor (A X B) | 2.868 | 1.374 | 0.972 |

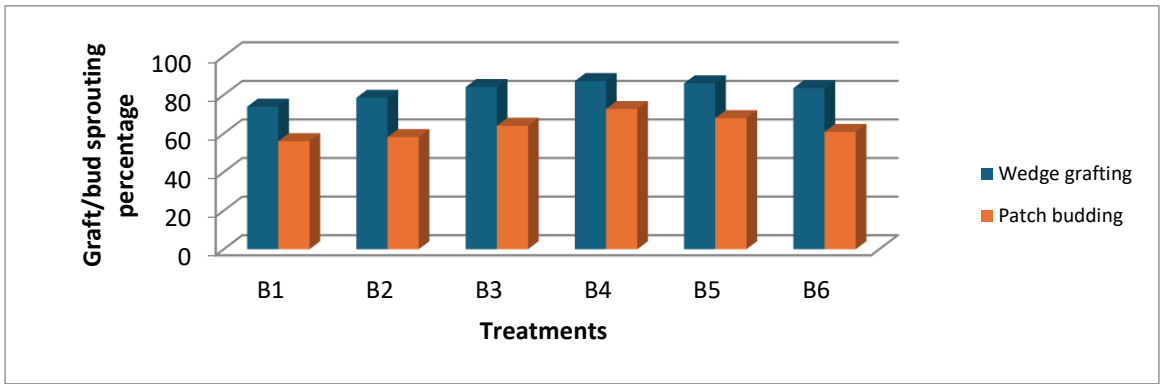


**Fig. 2. Graph showing effect of time and method on graft/bud sprouting percentage in aonla**

## 3.3 Total Number of Leaves Per Plant

Among the methods (Table 3), wedge grafting resulted in significantly higher total number of leaves per plant (22.81) as compared to patch budding (12.24) leaves. Among the propagation timings, total number of leaves per plant recording maximum in grafting and budding performed on 16 August (22.23) which was significantly higher as compared to other dates of propagation. The similar finding was also obtained by (Jadia *et al*., 2015), (Rani *et al*., 2015) in guava and (Nithya *et al*., 2022) in guava.

**Table 3. Effect of time and methods on total number of leaves in aonla**

| Time of propagation | Methods of propagation | | Mean |
|---|---|---|---|
| | Wedge grafting | Patch budding | |
| 01 July | 17.78 | 8.49 | 13.13 |
| 16 July | 20.13 | 9.03 | 14.58 |
| 1 August | 23.12 | 12.73 | 17.92 |
| 16 Aug | 27.90 | 16.56 | 22.23 |
| 01 Sep | 26.15 | 15.33 | 20.74 |
| 16 Sep | 21.80 | 11.34 | 16.57 |
| Mean | 22.81 | 12.24 | |
| Factors | C.D. @5% | SE(d) | SE(m) |
| Factor (A) | 0.863 | 0.413 | 0.292 |
| Factor (B) | 1.495 | 0.716 | 0.506 |
| Factor (A X B) | N/A | 1.013 | 0.716 |

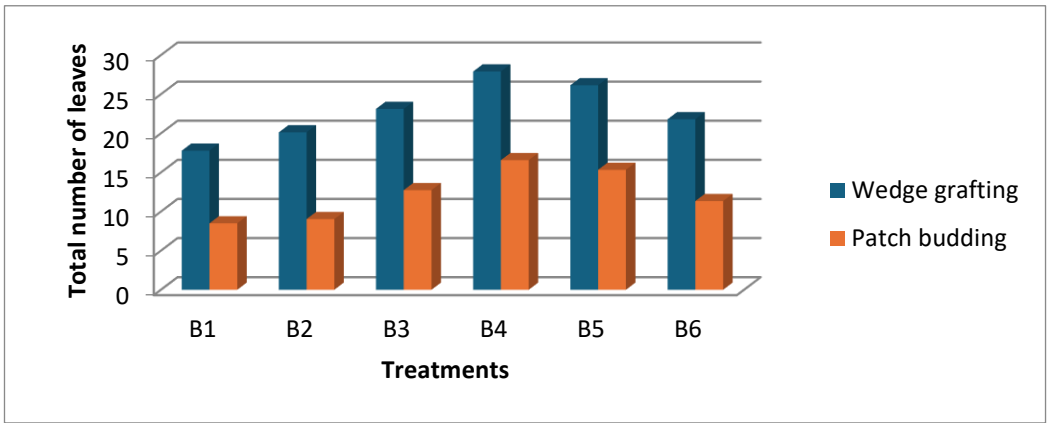


**Fig. 3. Graph showing effect of time and methods on total number of leaves in aonla**

### 3.4 Shoot Length

Among the methods (Table 4) propagation, wedge grafting resulted in significantly higher shoot length (13.06 cm) as compared to patch budding (10.24). The time of propagation also significantly influenced the shoot length and recording maximum shoot length in grafting and budding performed on 16 August (14.49 cm) which was significantly higher as compared to other dates of propagation. The most probable reason for the increase in length of sprout might be as a result of the nutritional status of the plant, which is responsible for protein synthesis and cell division, which ultimately lead to vegetative growth. Parallel findings were reported by (Anadi and Karadi 2012) in jamun and (Rawat *et al*., 2023) in jamun.

**Table 4. Effect of time and methods on length of sprout (cm) in aonla**

| Time of propagation | Methods of propagation | | Mean |
|---|---|---|---|
| | Wedge grafting | Patch budding | |
| 01 July | 9.46 | 7.11 | 8.28 |
| 16 July | 12.11 | 8.52 | 10.31 |
| 1 August | 13.84 | 10.49 | 12.17 |
| 16 Aug | 15.85 | 13.13 | 14.49 |
| 01 Sep | 14.58 | 11.75 | 13.16 |
| 16 Sep | 12.55 | 10.46 | 11.50 |
| Mean | 13.06 | 10.24 | |
| Factors | C.D. @5% | SE(d) | SE(m) |
| Factor (A) | 0.697 | 0.334 | 0.236 |
| Factor (B) | 1.208 | 0.579 | 0.409 |
| Factor (A X B) | N/A | 0.818 | 0.579 |

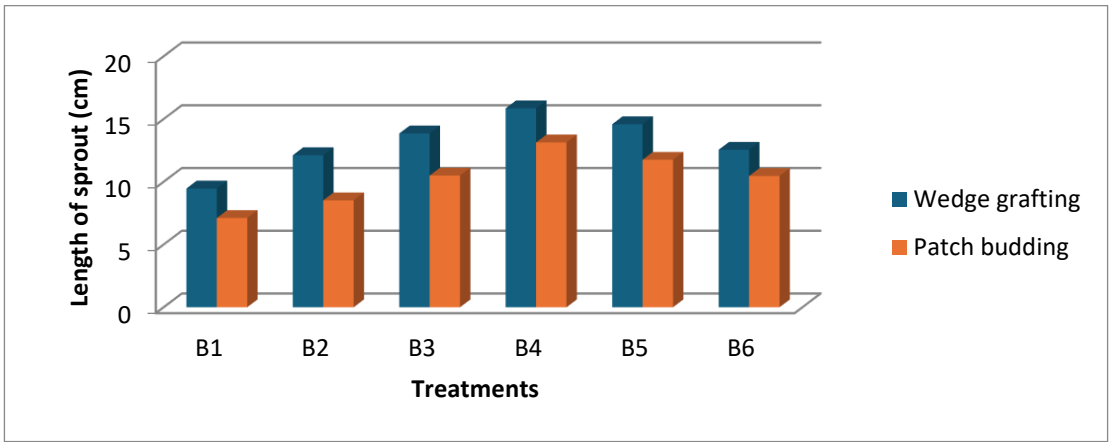


**Fig. 4. Graph showing effect of time and methods on length of sprout (cm) in aonla**

### 3.5 Survival Percentage

Among the methods (Table 5), wedge grafting resulted in significantly higher survival percentage (73.55%) as compared to patch budding (54.46%). The time propagation also significantly influenced the survival percentage and recording maximum in grafting and budding performed on 16 August (74.05%) which was significantly higher as compared to other dates of propagation. High wedge graft success on might be associated with the better healing process of the graft union. This result is in accordance with (Chandra et al., 2011) who reported that wedge grafting in pomegranate in the month of January recorded maximum (90.00%) survival, (Padmapriya *et al*., 2021) in guava and in mulberry.

**Table 5. Effect of time and method on survival percentage% in aonla**

| Time of propagation | Methods of propagation | | Mean |
|---|---|---|---|
| | Wedge grafting | Patch budding | |
| 01 July | 62.84 | 46.36 | 54.60 |
| 16 July | 67.11 | 49.43 | 58.27 |
| 1 August | 75.90 | 52.21 | 64.05 |
| 16 Aug | 82.46 | 65.65 | 74.05 |
| 01 Sep | 79.10 | 62.98 | 71.04 |
| 16 Sep | 73.91 | 50.14 | 62.02 |
| Mean | 73.55 | 54.46 | |
| Factors | C.D. | SE(d) | SE(m) |
| Factor (A) | 1.091 | 0.523 | 0.370 |
| Factor (B) | 1.889 | 0.905 | 0.640 |
| Factor (A X B) | 2.672 | 1.280 | 0.905 |

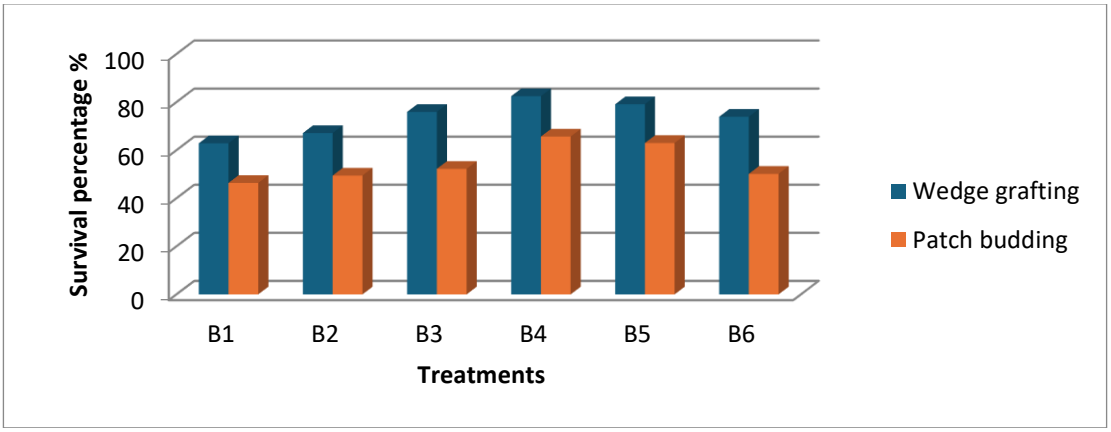


**Fig. 5. Graph showing Effect of time and method on survival percentage% in aonla**

### 4. Conclusion

Aonla, one of the most important native fruit plants, has many medicinal uses. Its numerous uses might increase its popularity in the future. Looking into the importance of this fruit, the demand for its planting material is increasing day by day. To meet the demand for true to type planting material, the vegetative propagation method was standardized to yield high-quality planting material. It was found that wedge grafting performed on 16 August (mid-August) proved the most appropriate propagation method and timing for Aonla (*Emblica officinalis* Gaertn.) under the sub-tropical conditions of Uttar Pradesh, as it takes minimum days for sprouting and yielded highest percentage of bud take, survival rate, longest sprouted shoot, highest number of leaves. This was closely followed by patch budding. As for as different propagation timings are concerned August month was found most suitable.

## Disclaimer (Artificial Intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

## Competing Interests

Authors have declared that they have no known competing financial interests or non-financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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