



Effect of Different Times of Budding on Budding Success and Subsequent Seedling Growth in Peach

Mohammad Afzal Rohani^{*1}, Mohammad Qayom Mangal², Matiullah Akbari³

^{1,3}Department of Horticulture, Paktia University, Paktia Province, Afghanistan

²Department of Agronomy, Paktia University, Paktia Province, Afghanistan

ABSTRACT: The present experiment entitled “Effect of different times of budding on subsequent seedling growth of Peach” was carried in open field conditions at fruit nursery, Department of Horticulture, Paktia University, Gardiz, Paktia province, Afghanistan during the year 2018-2019. Peach cv. Benidict was T-budded on peach seedling rootstocks with four different times (May 9; June 13; July 7 and August 23, 2018). The objective of this investigation was to find out the appropriate time of budding in order to obtain vigorous budded saplings under climatic conditions of Paktia province. The experiment was laid out in Randomized Completely Block design with 10 replicates. The results showed that different budding times had significantly affected the bud take success rate and vegetative growth of budded saplings. Budding in August and June (T4 and T2) revealed the highest bud takes success rate (87% and 83,33%) respectively, however budding in May (T1) with lowest bud take success rate (20%). Budding in June (T2) and August (T4) had not showed significant difference among themselves. Budding in May (T1) obtained first rank with highest average number of lateral branches (14,85), stem diameter (13,73mm), longest sprout length (104,7cm) and highest average number of leaves (207,7), though budding in June (T2), July (T3) and August(T4) had not showed significant difference in vegetative growth parameters like number of lateral branches and stem diameter. According to Fisher’s LSD test budded saplings in August (T4) obtained the shortest sprout length (53,8cm), However, the sprout length among the budded saplings in May (T1), June (T2) and July (T3) was not found significantly different. The highest average number of leaves (207, 7) and lowest average number of leaves (54, 2) was recorded under T1 (May budding) and T4 (August budding) respectively, Meanwhile the average number of leaves was not significantly different among T2 (June budding) and T3 (July budding) budding times.

KEY WORDS: Bud take success, Economical importance, Peach, Time of budding, Vegetative growth.

INTRODUCTION

Peach (*Prunus persica* L.) is one of the ten most important fruit crops globally, primarily consumed fresh. According to FAO (2004), global peach production was recorded at 17.5 million tons (Awasthi & Negi, 2016). In Afghanistan, peaches are cultivated in most provinces, covering a total area of 2,498 hectares, with an overall production of 27,934 tons (Afghanistan Agricultural Statistics, 2015).

Peach seedlings can be propagated through seeds, cuttings, grafting and budding. Although peach trees are self-pollinating, sexual propagation does not preserve the original traits of the plant. Therefore, rootstock plants are first obtained through sexual propagation, followed by grafting desirable scion varieties using different grafting techniques (Malik, 2009; Li et al., 2015). While propagation through cuttings is possible, it is not widely practiced due to environmental constraints (Carvalho et al., 2017; Chatterjee & Dutta, 2011).

Peaches are primarily propagated asexually through shield (T-budding) or ring budding techniques (Salari, 2015). In nurseries, the rootstock should be trained as a single-stem plant, and the budding process should be carried out when sap flow is optimal (Hamzakhel, 1980; Bouniols & Poncet, 2008). Budding is a grafting method in which a single bud is inserted into the rootstock. The bud may include a small portion of wood or only the bud and bark tissue. Afghan horticulturists typically insert the bud without wood, as wood reduces the success rate (Salari, 2015).

Budding techniques including T-budding, inverted T-budding, patch budding, chip budding, and ring budding are practiced in Afghanistan. Budding is preferred over scion grafting due to its simplicity, shorter time requirement, and minimal need for specialized tools (Hamzakhel, 1980; Malik, 2009; García-López et al., 2015). It maximizes the use of scion branches, reduces labor, and enhances efficiency when scion plants are limited (Fayaz & Haider, 2014; Mason et al., 2013).



Budding is performed during active growth when the bark easily separates from the wood and cambium cells are actively dividing. Low water availability, leaf drop, or decreased temperature can reduce grafting success (Hansen et al., 2012; Olesen et al., 2014). Chip budding does not require bark separation and can be done on young trees or branches with 1–3 cm diameter (Davis et al., 2008; Verma & Kumar, 2011). Skilled horticulturists can graft 2,000–3,000 seedlings per day (Hartmann et al., 2011; Kumar & Singh, 2014). Budding creates a stronger union than scion grafting, reducing breakage risk during strong winds (Hamzakhel, 1980; Singh & Raghav, 2000; Zhao et al., 2014).

Environmental factors including temperature, humidity, and light intensity significantly influence bud take success and seedling vigor (Baryla & Kaplan, 2012; Al-Khader & Al-Refai, 2010; Iqbal et al., 2016). Early budding allows longer vegetative growth, while late budding increases bud take success but may limit growth due to shorter remaining season (Khoshkhui & Chalavi, 1995; Sharma et al., 2012; Singh et al., 2013)

MATERIALS AND METHODS

This study was conducted in the field nursery of the Horticulture Department, Faculty of Agriculture, Paktia University, located in Gardez, the capital of Paktia province. The research was carried out during the years 2018-2019. The geographical coordinates of the study site are 69°13'57" E longitude, 33°38'60" N latitude, and an altitude of 2,384 meters above sea level.

This study evaluated the effects of budding time on the success rate of budding and the vegetative growth of the subsequent seedlings. The Benedict variety was budded on Peach seedling rootstock. The experiment included four treatments:

- **T1:** 2nd week of May
- **T2:** 2nd week of June
- **T3:** 1st week of July
- **T4:** 4th week of August

Treatment	Description
T ₁	2 nd week of May
T ₂	2 nd week of June
T ₃	1 st week of July
T ₄	4 th week of August

Each treatment was replicated 10 times, and each replicate included 10 seedlings, making a total of 400 seedlings under investigation. The study was arranged in a Randomized Complete Block Design (RCBD). The peach rootstock seeds used in this study were obtained from the local peach nursery registered with Perennial Horticulture Development Project and brought from Jalalabad Province, the eastern part of the Afghanistan. These seeds were subjected to a three-month stratification period in moist sand before being planted in nursery rows in the spring (Carvalho et al., 2017). The spacing between seedlings was 20 cm, and the row spacing was 75 cm respectively. Agricultural practices were uniformly applied across all four blocks, and a 50 cm buffer zone was maintained around the blocks to minimize external effects. The bud wood scions were collected from an 8-year-old Benedict peach variety mother stock, registered in Perennial Horticultural Development Project. The bud sticks were selected based on their moderate diameter. After collection, the scion branches were wrapped in moist cloth and kept in the shade until use. The T-budding method was applied at 10 cm above the ground level, aligning with the smooth part of the rootstock bark. The T-budding method was performed following Hartmann et al. (2011) procedures. The process involved making a horizontal cut one-third of the stem diameter deep, followed by a vertical cut starting from the middle of the horizontal incision and extending 2.5 cm downward. The scion bud was separated from the scion branch and inserted into the prepared T-shaped incision, then wrapped with budding tape. The following parameters were studied;

1. Budded seedling height (cm):
 - The shoot length of each grafted seedling was measured in millimeters two weeks after successful bud sprouting.
 - Measurements were taken at 5 days and 15 days post-budding to determine initial growth rate over a 10-day period.
2. Stem Diameter (mm):
 - The stem diameter was measured using a Vernier caliper at 5 days and 15 days post-budding, and the difference was used to assess radial growth over a 10-day period.



3. Number of Lateral Branches:
 - The number of lateral branches was recorded six months after budding.
4. Number of leaves:
 - The total number of leaves per budded seedling was recorded six months after budding.
5. Budding Success Rate (%):
 - The Budding success rate was calculated using following procedure;

$$\text{Budding Success Rate}\% = \frac{\text{Number of Successfully Sprouted buds}}{\text{Total number of budded seedling per Replication}} \times 100$$

- A bud was considered successful if it grew ≥ 2 mm (Mahmoud & Hussein, 2011; Jones et al., 2010).

The collected data were analyzed using SAS (Statistical Analysis System) software. To determine the effects of budding time on seedling growth and success rate, ANOVA (Analysis of Variance) was performed. The means were compared using Fisher’s Least Significant Difference (LSD) test at a 5% probability level, following Gomez and Gomez’s statistical methodology. Graphs and figures were generated using MS Excel (Gomez & Gomez, 1984; Canali et al., 2013).

RESULTS AND DISCUSSION

This study analyzed the impact of budding time on the success rate of budding, lateral branch count, stem diameter, longitudinal growth, and leaf count in budded saplings. The results showed that budding success significantly varied depending on the time of budding, with the highest success rate (87%) observed with T₄ and the lowest (20%) with T₁ and were significantly different (Fig.1). Lateral branch count was significantly affected by budding time, with saplings with T₁ had the highest number of branches (14.85), whereas the saplings with T₃ had the fewest (6.9) (Fig.2). Similarly, the stem diameter was obtained largest (13.73 mm) with T₁ and smallest (9.89 mm) with T₄ (Fig.2). Longitudinal growth of saplings followed the same trend, with the greatest height (104.7 cm) recorded for saplings budded with T₁ and the least (53.8 cm) for T₄ (Fig.3). The number of leaves was also significantly impacted, with the highest count (207.7 leaves) found in saplings budded with T₁ and the lowest (54.2 leaves) with T₃ (Fig.3). Statistical analyses confirmed that as the budding time progressed from spring to autumn, the success rate and other growth parameters were significantly influenced. The result showed that budding in the May can reduce the production period of peach seedlings from two years to one year. However, the only drawback is the lower budding success rate of the budded seedlings. In contrast, budding in the month of August results in a higher budding success rate, but the main limitation is that the seedlings can only be marketed after two years. In addition to the high budding success rate, budding in the month of May also results in a greater number of lateral branches in the budded seedlings. This characteristic is particularly important as it enhances the branching potential of the seedlings.

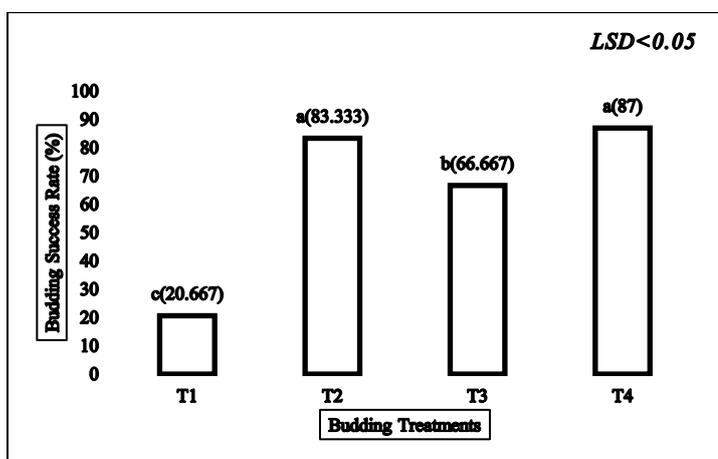


Fig 1. Effect of different Budding times on budding success rate.

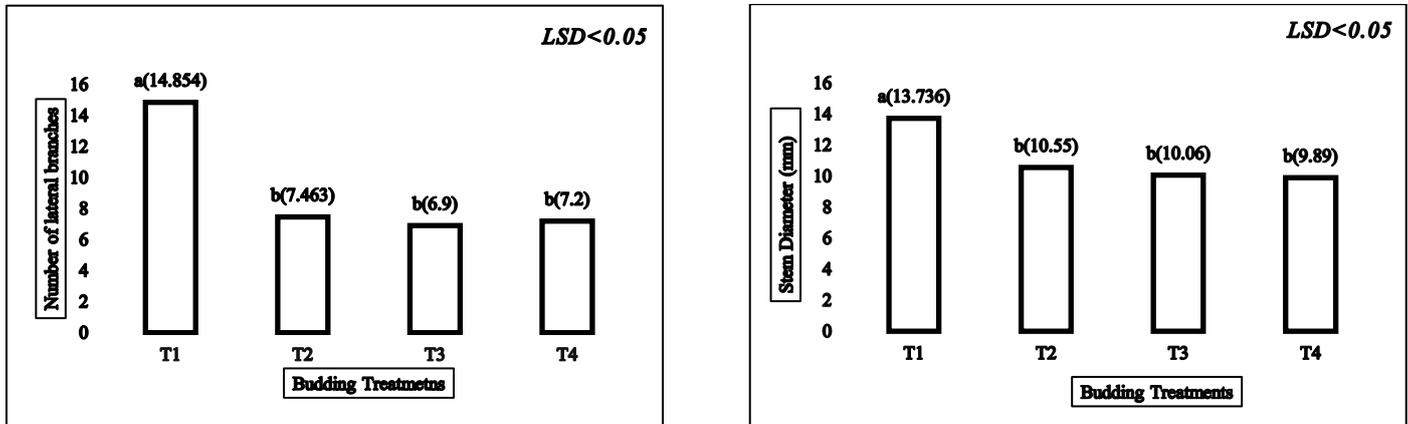


Fig 2. Effect of different budding times on number of lateral branches (left side), Effect of different budding times on stem diameter (right side).

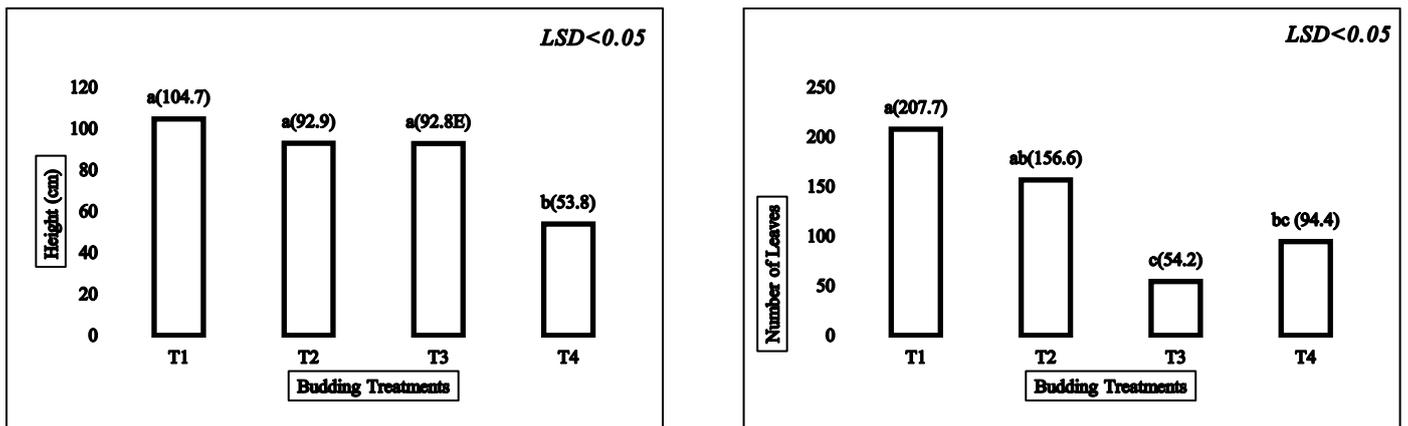


Fig 3. Effect of different budding times on Height (left side), Effect of different budding times on Number of leaves (right side).

The findings of this study reveal that the timing of budding exerts a significant influence on both the success rate of budding and the subsequent vegetative development of seedlings (Fig. 1, Fig. 2, and Fig. 3). Likewise, key growth parameters, including the number of lateral branches, stem diameter, plant height, and leaf count, were markedly affected by the timing of budding (Table 1). The results suggest that budding conducted in early spring tends to exhibit a lower success rate, likely due to the reduced flow of cellular sap and the increased rigidity of the bark in both the scion and the budding sapling.

Statistical analysis showed that Budding treatments significantly influenced budding success rate (Table 1).

Table 1. ANOVA for various parameters of Budding treatments (2018-19).

SOV	DF	MS	Budding	Number of	Stem	Height (cm)	Number of
			Success (%)	lateral branches	Diameter (mm)		
Block	9	192.72	14.126	14.3159	264.21	8375.4	
Treatment	3	8137.41	103.447	32.6332	4934.57	45817.5	
Error	27	122.59	22.524	8.1201	247.57	10645.1	
CV (%)		17.81	52.13	25.77	18.29	8.46	



The results of this study clearly indicate that the timing of budding has a significant impact on both the bud take success rate and subsequent vegetative growth of peach seedlings. Among the four budding times investigated, the highest budding success rates were achieved in August (87%) and June (83.33%), while May budding showed the lowest success rate (20%). These findings suggest that environmental conditions during August and June in the Paktia region, such as moderate temperatures and sufficient sap flow in rootstocks, are more conducive to successful graft union formation. Similar observations were reported by (Baryla & Kaplan, 2012; Olesen *et al.*, 2014), who found that bud take success in peach and other temperate fruits is strongly influenced by temperature and humidity at the time of budding.

Despite the lower success rate in May, this treatment produced the most vigorous seedlings in terms of sprout length, number of leaves, lateral branches, and stem diameter. This can be attributed to the extended growing period available for May-budded saplings, allowing for more photosynthetic activity and biomass accumulation. These findings align with the results of earlier studies (Khoshkhui and Chalavi, 1995; Sharma *et al.*, 2012 ; Singh *et al.*, 2013; Singh & Raghav, 2000; Zhao *et al.*, 2014; Li *et al.*, 2015), which reported that early budding, although riskier, provides ample time for vegetative growth when successful.

Interestingly, while August budding showed the highest bud take success, the vegetative growth parameters were significantly lower, with the shortest sprout length (53.8 cm) and the fewest number of leaves (54.2). This could be due to the limited time available for growth before the onset of dormancy in late autumn, preventing the full development of newly formed shoots. Such findings were also highlighted by Singh and Raghav (2000), who noted that late-season budding often leads to weak and underdeveloped saplings that are less suitable for field planting in the following season.

The June and July budding treatments presented intermediate results in terms of both bud success and seedling vigor, showing no significant differences from August budding in most vegetative traits. These results suggest that mid-season budding may offer a reasonable balance between success rate and growth performance under the environmental conditions of Paktia Province.

Overall, the study highlights a critical trade-off between budding success rate and seedling vigor. Early budding (May) is advantageous for producing robust saplings ready for sale or transplanting within one year but comes with a higher risk of failure. In contrast, late budding (August) ensures high propagation success but may delay the plant's readiness for market or field establishment. Consequently, budding in June and July are considered as an optimum time of budding under the above mentioned location and its environmental conditions. However, nursery managers must carefully consider their propagation objectives and environmental conditions when selecting optimal budding times.

CONCLUSION

The study demonstrated that the timing of budding has a significant impact on both the success rate of bud take and the subsequent vegetative growth of peach seedlings. Budding in August (T4) and June (T2) resulted in the highest budding success rates (87% and 83.33%, respectively), whereas May budding (T1) showed the lowest success rate (20%). Despite this, May-budded seedlings exhibited superior vegetative growth, including the highest sprout length, number of leaves, lateral branches, and stem diameter, likely due to the longer growth period available before dormancy. Conversely, August-budded seedlings, although showing higher success rates, had reduced vegetative growth due to the limited growth period. June and July buddings provided a balance between success rate and seedling vigor, suggesting that mid-season budding is optimal for combining successful propagation with satisfactory vegetative growth under the environmental conditions of Paktia Province. These findings indicate a trade-off between bud take success and seedling development, emphasizing the importance of selecting the appropriate budding time according to propagation objectives and climatic conditions.

REFERENCES

1. Afghanistan Agricultural Statistics. (2015). Ministry of Agriculture, Irrigation, and Livestock, Afghanistan.
2. Al-Khader, A., & Al-Refai, M. (2010). Environmental influences on graft success in peach. *International Journal of Agriculture*, 2(4), 210–215.
3. Awasthi, O. P., & Negi, K. S. (2016). Peach cultivation and global production trends. *Journal of Horticultural Science*, 11(2), 45–52.
4. Baryla, A., & Kaplan, F. (2012). Budding success in temperate fruit trees: Environmental influences. *Scientia Horticulturae*, 148, 20–27.



5. Bouniols, A., & Poncet, C. (2008). Vegetative growth assessment in budded peach seedlings. *Scientia Horticulturae*, 116(3), 278–285.
6. Canali, S., et al. (2013). Influence of scion and rootstock on vegetative development. *Horticulture Science*, 48(2), 145–152.
7. Carvalho, S. D., et al. (2017). Optimizing budding and grafting in Prunus species. *Plant Biology*, 19(5), 642–650.
8. Chatterjee, S., & Dutta, A. (2011). Seasonal impact on grafting efficiency in peach. *Journal of Applied Horticulture*, 13(2), 88–94.
9. Davis, T. D., et al. (2008). Physiological factors influencing bud take success. *Horticultural Reviews*, 34, 87–112.
10. Fayaz, M., & Haider, N. (2014). Peach nursery management practices in South Asia. *Asian Journal of Horticulture*, 9(1), 33–40.
11. García-López, J., et al. (2015). Budding timing and seedling vigor relationships. *Scientia Horticulturae*, 187, 37–44.
12. Gomez, K. A., & Gomez, A. A. (1984). *Statistical procedures for agricultural research* (2nd ed.). John Wiley & Sons.
13. Hamzakhel, S. (1980). Propagation techniques for temperate fruit crops. Kabul: Agriculture Press.
14. Hartmann, H. T., Kester, D. E., Davies, F. T., & Geneve, R. L. (2011). *Plant propagation: Principles and practices* (8th ed.). Pearson.
15. Hansen, P., et al. (2012). Effects of environmental stress on graft union formation. *Plant Physiology*, 158(2), 1096–1103.
16. Iqbal, M., et al. (2016). Influence of seasonal temperature on T-budding success. *International Journal of Agriculture & Biology*, 18(6), 1097–1103.
17. Jones, M., et al. (2010). Rootstock-scion compatibility in Prunus persica. *Journal of Plant Growth Regulation*, 29(1), 45–52.
18. Khoshkhui, M., & Chalavi, M. (1995). Effect of budding time on peach seedling growth. *Journal of Fruit Research*, 12(1), 15–22.
19. Kumar, R., & Singh, P. (2014). Peach propagation techniques under temperate conditions. *Horticultural Science*, 41(2), 115–123.
20. Li, Y., et al. (2015). Seasonal effects on vegetative growth of grafted peach seedlings. *Scientia Horticulturae*, 193, 141–149.
21. Mahmoud, A., & Hussein, S. (2011). Budding and grafting efficiency in peach cultivars. *Journal of Fruit Crops*, 19(3), 45–53.
22. Malik, M. (2009). Peach propagation techniques and nursery management. *Asian Journal of Horticulture*, 4(2), 78–86.
23. Mason, R., et al. (2013). Influence of rootstock on scion growth and bud success. *Plant Growth Regulation*, 70(2), 115–123.
24. Olesen, T., et al. (2014). Environmental and physiological factors affecting peach bud take. *Scientia Horticulturae*, 178, 77–85.
25. Salari, H. (2015). Rootstock and scion interactions in peach propagation. *Journal of Horticultural Science*, 10(1), 55–63.
26. Sharma, R., Singh, R., & Gupta, S. (2012). Seasonal effects on T-budding in peach and nectarine. *Horticultural Research*, 8(3), 102–110.
27. Singh, A., et al. (2013). Influence of budding time on growth and yield of Prunus persica. *Indian Journal of Horticulture*, 70(2), 159–164.
28. Singh, P., & Raghav, R. (2000). Late-season budding of temperate fruit trees. *Indian Journal of Horticulture*, 57(1), 41–46.
29. Verma, S., & Kumar, P. (2011). Peach propagation: Techniques and seasonal effects. *Horticultural Journal*, 24(3), 67–74.
30. Zhao, L., et al. (2014). Rootstock and scion interactions in peach grafting. *Scientia Horticulturae*, 176, 127–135.

Cite this Article: Rohani, M.A., Mangal, M.Q., Akbari, M. (2025). Effect of Different Times of Budding on Budding Success and Subsequent Seedling Growth in Peach. International Journal of Current Science Research and Review, 8(11), pp. 5658-5663. DOI: <https://doi.org/10.47191/ijcsrr/V8-i11-22>