**Advances in Bioresearch**
Adv. Biores., Vol 14 (4) July 2023: 411-416

Print ISSN 0976-4585; Online ISSN 2277-1573
Journal's URL:http://www.soeagra.com/abr.html
CODEN: ABRDC3
DOI: 10.15515/abr.0976-4585.14.4.411416

Advances in Bioresearch

## REVIEW ARTICLE

# Effect of Plant Growth regulator on best time and type of cuttings in Peach: A Review

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**ABSTRACT**
*Peach is commercially propagated by tongue grafting, and it is clonally propagated through cuttings with the help of PGR. PGR application is a well-known technique to improve plant rooting and growth of cuttings. The effect of regulators on peach branches can vary depending on the types and concentration used, as well as type of cuttings, time to plant cuttings and environmental conditions. In addition, some PGRs shows negative effects on peach cutting if used improper concentrations, such as inhibiting root growth or abnormal shoots. This review comprises the effect of PGRs and best time of planting cuttings in Peach. IBA shows the best results in root formation and shoot development in cuttings, that are collected in the month of November and February gave the highest percentage of survival rate. In in-vitro condition the combination of PGRs, IBA with paclobutrazol show positive results on shoot formation. This review summarizes the current knowledge on the application of PGRs in peach cutting and highlights the potential advantages and problems associated with this technique.*
*Keywords: Plant Growth regulator, IBA, Peach, Shoot formation*

Received 04.05.2023 Revised 22.06.2023 Accepted 22.07.2023

**How to cite this article:**
Ritik T, Vikram S, Vishal J, Dhrubajyoti B, Shravan K.Effect of Plant Growth regulator on best time and type of cuttings in Peach: A Review. Adv. Biores., Vol 14 (4) July 2023: 411-416.

## INTRODUCTION

Botanically peach is known as *Prunus persica* (L.) Batsch, and it is native to China. Peach cultivation in Punjab has undergone miraculous changes occurred by the introduction of low-chilling, high yielding and early ripening varieties of superior quality traits mainly in Amritsar, Jalandhar, Patiala, Kapurthala, Ludhiana and Sangrur districts [22]. The peach was first called *Amygdalus persica* by Linnaeus in 1758. Finally, in the 19th century, western China was recognized as the geographical origin of peaches [32]. Peach is widely grown in temperate regions around the world, and they are valued for their beautiful flowers, edible fruit, and their use as ornamental trees [13]. Peach is temperate winter deciduous stone fruit plant. The family is Rosaceae [33]. Sub-family Prunodieae and order Rosales, included under the genus Prunus. Chromosome no. Is 2n =16 [29]. Peach fruits are rich source of carbohydrates, vitamin-A, iron, sugars (sucrose), proteins and minerals [12]. Peach is a good source of antioxidants and fibers which helps in digestion of food and prevents constipation and have good source of low calorific diet. It is mainly self-pollinated crop because male and female flower parts are mature at same time and crosspollination is also done by insects. Peach is commercially propagated by budding and grafting on peach seedling rootstocks [41]. Peach is clonally propagated through hardwood cuttings on a limited scale. In budding and grafting methods, the rootstock becomes fit for operation after one year, and 2 years plants become ready for transplanting in the orchards [4]. Simultaneous both grafting and rooting have been successfully tried on the cuttings of peach rootstock 'Sharbati' [29]. Peach is commonly known as 'Aaru'. among the temperate fruits peach ranks 3rd after apple and pear. In Unani it is called as-Aaaduu, Khokh. Most of the Prunus fruits and seeds are mainly used for processing purpose including jam production, canning purpose, drying or for roasting and are regularly consumed year-round. Among the stone fruits peach contribution of phenolics compound to the diet is highest [27]. The qualitative and quantitative profiles of these compounds vary considerably depending upon the varieties [54]. Fruit of Peach is rich sources of

antioxidants as ascorbic acid, carotenoids, and phenolic compounds [43]. Auxin is derived from the Greek word 'auxin', which means 'to grow' [39]. Because auxin promotes of cell division, cell expansion, and cell differentiation in plants. The main biosynthesis pathway uses the auxin is tryptophan. Indole-3-acetic acid is the most commonly occurring natural plant hormone. It is predominantly produced in bud and very young leaves of plants. Auxin is a central regulator of plant growth and development [14].

**Suitable cutting type and length of peach**

Determination of the appropriate cutting type and length for rooting of Shan-i-Punjab peach cultivar reported the larger cuttings show better rooting. A good response was obtained from mallet cuttings, with a cutting length of 45 cm achieving higher viability and rooting promotion parameters with good shoot number and leaf production [22]. In peach cutting from one year old tree having higher rooting percentage after store at 2 to 4 $^0$C for two or three months while cutting from 11-year-old tree at the first planting have higher rooting percentage and in cold storage appeared to decrease the rooting of 11-year-old tree [50]. In Rosaceae family effect of some cutting type and treatment on rooting of bitter almond hardwood cutting is perform. Different concentration of chemicals 8 thousand ppm and 10 thousand ppm were applied to hardwood cuttings in different time. The best results are found in cuttings that were sown on 15 November to 1 December. They show highest number of rooting percentages, shoot growth and number of leaves [21]. Propagation of fruit trees from cuttings, including peaches showed the use of hardwood cuttings for most fruit trees, and notes that softwood cuttings can also be used for some cultivars [45]. The in vitro propagation of peach rootstock used different types of specimens, including softwood and hardwood cuttings. Hardwood cuttings are the most effective material for creating shoots and roots and hardwood cuttings are also suitable for in vitro propagation of peach rootstock [41]. Used of hardwood cuttings 8 to 10 inches long for most fruit trees are best for rooting and shooting. Propagation of peach root by different length of hardwood cutting and the longest cuttings (10 inches) produced the highest percentage of rooting cuttings, while the shortest (4 inches) produced the lowest percentages. The longer cuttings are more suitable for propagating peach rootstock [8]. The propagation of peach by using hardwood cuttings by hardwood branches of different sizes were taken (diameter of 0.5-1.0 cm and 20-25 cm in length) and treated them with different concentrations of IBA to improve formation into roots [24]. Propagation of peach trees using different types of softwood cuttings (end, side and base) and different harvest dates (early June, mid-June and early July) reported that late-stage cuttings harvested in mid-June produced the highest rates of rooting and the strongest shoots [51].

**Effect of IBA on peach hardwood cutting**

This study is performed in winters. The hardwood cuttings of peach are treated with IBA for 5 sec with different IBA concentrations. Then cuttings were placed under sand in plastic trays and kept in the mist chamber. The best results are found in concentration of 2000 mg. L-1 of IBA acid for the treatment of hardwood cuttings, of the tested rootstocks for propagation in the winters [34]. In this research cuttings of peach were treated with the different concentrations of IBA. For determine the best rooting results of peach cutting at different concentrations. In peach propagation the highest rooting percentage (40 %) was achieved from 2000 mg L-1 IBA, although rooting was reduced at 3000 mg L$^{-1}$ IBA [32]. Hardwood cuttings of Shan-i-Punjab peach cultivar treated with different concentrations of IBA for 1–2 min took significantly less days to germinate than n days, and the germination rate, root circumference, root weight, It has been observed that the number of plants was the highest height, viability, average number of roots, taproot length, plant girth, number of branches, number of leaves and leaf area. The best results were shown in Shan-I-Punjab with 3000 IBA mgL-1 [23]. In this experiment peach hardwood cuttings were treated with IBA. Then cuttings are planted under mist propagation unit with bottom heat technique to find best rooting results. The effect of IBA on peach hardwood cutting at 2000mg/L gave the best results [50]. The cuttings whose only bases is dipped in IBA solution shows the better rooting then the cuttings are immersed both side, tip and base. The higher percentage of rooting is archived by pre heating of cuttings before the planting. There were also higher number of rooting percentages of GF677 hardwood shoot cutting which is collect from seven-year-old mother tree plant then one year old mother plant [49]. 6000 ppm solution of IBA shows best effect of rooting on nemaguard rootstock of peach as compared to 2000 ppm and 4000 ppm. Two experiments with nemaguard rootstock were taken at separately for the determination of optimum IBA concentration for nemaguard rootstock. Also find the best cutting type and media for rooting [52]. The present study evaluates the rooting capacity grafted 'Flordaguard' rootstock. Highest sprouting success is seen both the cultivars Shan-e-Punjab and Earli Grande peach cultivars were recorded in 2000 ppm IBA treatment. In this study the Flordaguard rootstock of peach is grafted with two peach cultivars. Then grafted rootstocks were treated with different concentrations of hormone to find best rooting percentage on different concentrations of solutions of IBA [17]. Evaluate the effect of different concentrations of IBA on rooting and survival of peach hardwood cuttings. They used hardwood cuttings

 

from the peach varieties 'Flordagold' and 'Sharbati'. At different concentrations of IBA the cuttings were treated (0, 1000, 2000 and 3000 ppm) and grown on sand in a mist chamber. The study showed that the application of IBA significantly improved rooting and survival rates of dug hardwood cuttings. The highest rooting rate (83.33%) was observed when applying 2000 ppm IBA in the variety 'Flordagold'. Likewise, the highest rooting rate (73.33%) was observed with the concentration of 2000 ppm IBA application in the variety 'Sharbati'. The study also reported that the survival rate of rooting cuttings was higher when applying IBA compared to the control treatment [25]. The effect of different concentrations of auxin, plant growth regulator and sucrose on rooting of peach hardwood cuttings reported that the IBA (Indole-3-butyric acid) at application of 4000 $mg^{-L}$ was the most effective hormone for root formation. They also found that the combination of IBA and NAA (naphthalene acetic acid) produced a higher rooting rate than using IBA alone. Research shows that regulating auxin levels and using a combination of hormones can improve the successful rooting of peach hardwood cuttings [38].

**Effect of auxin and cytokinin's in peach cuttings**

Auxin (IBA and NAA) and cytokinin (Benzyl adenine or BA and KIN) effect on rooting of hardwood peach branches, reported that IBA and NAA significantly increased rooting rate and number of roots, while BA and KIN had no significant effect. They also found that a combination of IBA and NAA was the most effective treatment for rooting cuttings [20]. This study investigated the cause of different concentrations of auxin (indole acetic acid or IAA) and cytokinin (benzyl adenine or BA) on the in vitro regeneration of peach plants from leaf explants. They found that the combination of 2.0 $mg^{-L}$ IAA and 0.5 $mg^{-L}$ BA was the most effective treatment for shoot stimulation and plantlets regeneration [19]. This study investigated the effects of different auxin concentrations (IBA, IAA and NAA) on the growth and development of peach cuttings. IBA at 3000 ppm was the most effective treatment for promoting rooting and shoot growth in peach cuttings [44].

**Best time to taken peach cuttings and iron deficiency in rooting.**

Shoot cuttings that were collected from peach trees in February and November gave the highest number of sprouting percentages. The results show the effectiveness of IBA treatment application to induce root formation on detached root and shoot [47]. The experiment described the timing and propagation technique for peach, the best result was found with the wedge grafting under, 30 January and their combination may be suggested for propagation of Peach under the western UP Conditions. Two treatments were drawn one is T-budding and another one is wedge grafting during January to March. The conclusion is found that wedge grafting performs better than T-budding [29]. Result shows the difference between the rooting, the number of roots and the dry weight of roots. Application of iron compounds, especially ferrous sulfate and chelated iron significantly reduced yellowing symptoms and improved rooting of cuttings from iron-deficient trees although there was a negative impact on peach tree [46]. The effects of iron deficiency on the growth, rooting and physiological responses of peach cuttings and found that at the optimal time to take cuttings from peach trees. Research shows that iron deficiency significantly reduces rooting rate and root length of peach cuttings. The researchers reported the best time to take peach cuttings was in late autumn, which resulted in the highest rooting rate and root length [28]. The effect of leaf position and iron concentration on rooting of peach cuttings noticed that highest rooting rates and root length were obtained when the second or third leaf from the top of the shoot was used as cuttings. They also found that iron concentrations between 5 and 10 mg/L were optimal for rooting. Research shows that choosing the right leaf location and providing adequate iron concentrations can improve the successful rooting of peach cuttings [53]. This study investigates the establishment of a clone repository for peach trees using dormant hardwood cuttings. The best time to take cuttings is mid to late winter, before the buds begin to swell. Research shows that cuttings during this time can improve rooting success [35]. The highest rooting rates were obtained from cuttings taken in mid to late winter in the context of the previous season's growth. Research shows that pruning during this period and from the middle of last season's growth spurt can improve rooting success [7].

**Effect of media and invitro propagation of peach hardwood cuttings**

In invitro propagation of peach the MS media results if found superior to other medias for hybrid almond peach rootstock by vegetative method. In this experiment hybrid almond peach rootstock is treated with different types of media in invitro propagation method [3]. IBA and paclobutrazol application on peach rootstock Ishtra reduce the level of abscisic acid. The combination of IBA with paclobutrazol shows the positive results on shoot formation in invitro culture. Effect of IBA with paclobutrazol were studied in the peach rootstock Ishtra in the presence of light [1]. The rooting media of cocopeat + soil (1:1) proved successful in generating sprouting in lesser time, achieving maximum sprouting, survival, root and shoot parameters on peach cutting. Different mixtures of rooting media are prepared, and peach cuttings were

 

planted in it. For find the best rooting efficiency of peach cuttings in these media [43]. The explant of peach was put in dark for 2-3 days shows positive growth results. In this study explants are cultivated in 3 types of media MS., OL and BS. OL media gives the yellowish shoots and resistance of 95 % toward vitrification. The explants shoot tip and nodes are taken from the peach cultivar florin, mimi and filip [16]. MS medium was most effective medium for shoot multiplication and rooting of peach specimens. Highest number of shoots/explant (8.8) was obtained on MS medium with segments as explants. The study also reported that WPM medium was the least effective medium for shoot growth and rooting of peach specimens [31]. Murashige and Skoog medium with 1.0 $mg^{-L}$ BAP (Benzyl aminopurine) and 0.5 $mg^{-L}$ IAA (indole-3-acetic acid) was the most effective for in vitro propagation of peach hardwood cuttings. The micropropagation through axillary shoot development resulted in higher survival rates and better growth performance than direct regeneration from hardwood cuttings [6]. Different media during in vitro propagation of hardwood peach branches and reported that MS medium with 2.0 mg/L BAP and 0.5 mg/L NAA was the most effective medium for shoot growth and multiplication. Research shows that optimizing the composition of the medium can improve the growth and propagation of hardwood peach branches [2]. Effect of different types and concentrations of cytokinin's on in vitro propagation of hardwood peach branches. The researchers found that BA (6-benzyladenine) at a concentration of 4.0 $mg^{-L}$ was the most effective hormone for shoots multiplication. The study showed that the selection of the appropriate cytokinin type and concentration could improve the in vitro propagation of peach hardwood cuttings [18]. Different media and their components for in vitro rooting of hardwood peach cuttings. They noticed that medium containing half-strength MS salt, 0.5 mg/L IBA and 30 g/L sucrose was the most effective medium for rooting. Research shows that optimizing the composition of the medium can improve rooting of hardwood peach branches [26]. The shoot segments of mature plants produced the greatest number of shoots on MS medium supplemented with 3.0 mg/L BAP and 0.5 mg/L IBA. The study also revealed that the RAPD and ISSR markers were effective in assessing the fidelity of clones of regenerated plants. The study shows that the segments can be used for efficient in vitro propagation of peaches and that the molecular markers can be used to assess the fidelity of the clones [9].

**Peach cuttings grown in mist chambers.**

Result of different concentrations of IAA (indole-3-acetic acid) and IBA (indole-3-butyric acid) on rooting of dug hardwood cuttings under mist conditions reported the highest rooting rates were obtained with a combination of 1000 ppm IAA and 1000 ppm IBA, and the highest root length was obtained with 2000 ppm IAA and 1000 ppm IBA [5]. The mist chamber had a higher rooting rate and root length compared to other propagation methods, such as open rooting and plastic tunnel [10]. Cut size and IBA (indole-3-butyric acid) on rooting of peach cuttings by different propagation methods including mist chamber. The mist chamber had a higher rooting rate and root length than other propagation methods, and that cut size had a significant effect on rooting [36]. Cutting position (top, middle and bottom) and hormone treatment (IBA or NAA) on rooting ability of hardwood cuttings under mist chamber conditions. Reported the highest rooting rates were obtained with root cuttings treated with IBA, while middle cuttings had the lowest rooting rates, regardless of hormone treatment [15]. The longer cuttings (20-25 cm) had a higher rooting rate than shorter cuttings (10-15 cm) and that rooting significantly increased the rate of rooting [37]. This study investigated the effect of different rooting media (perlite, vermiculite, sand and peat moss) on the rooting of hardwood cuttings under foggy conditions. The researchers found that perlite had the highest rate of rooting and root length, followed by vermiculite, sand and peat moss [30]. This study investigated, the effects of intermittent mist and low tunnel (plastic cover) conditions on the rooting of peach stem cuttings. Both mist and low tunnel significantly increased rooting percentage and root length, and that a combination of both treatments was the most effective [11].

**Conclusion**

PGR application to peach cuttings has the potential to improve rooting and overall growth. The use of auxins, cytokinin's and gibberellins have shown promising results in stimulating rooting and promoting shoot growth in peach cuttings. However, the effectiveness of PGR can vary depending on various factors such as cutting pattern, duration and environmental conditions, as well as the type and concentration of PGR used. In addition, some PGRs can have adverse effects on peach branches if used incorrectly. Therefore, it is essential to optimize PGR application techniques to achieve optimal results. In addition, further research is needed to better understand the optimal PGR application techniques for peach branches and to explore the potential uses of other PGRs.

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