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# Effect of Different Auxins on Rooting of Semi Hard and Soft Wood Cuttings of Guava (*Psidium guajava* L.) CV. Safeda

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ABSTRACT

*An experiment was conducted to investigate the effect of different auxin on rooting in soft and semi-hard wood stem cuttings of guava. The maximum 80.3% sprouting response was recorded after 32 days of planting when soft wood cuttings were treated with 100 mg IAA/100 g talcum powder. Comparatively IAA was stronger than IBA in sprouting for both types of cuttings. The maximum number of leaves (8) was recorded in soft wood cuttings treated with IBA. The number of leaves in soft wood cuttings treated with either IBA or IAA and NAA were greater than semi hard wood cuttings. The maximum number of roots (27.6) per cutting was recorded in soft wood cuttings treated with IAA. As compared to control, auxin treatment promoted rooting in both types of cuttings. The maximum number of roots per cutting ranged from 11 to 17.3 in semi hard wood cuttings, while in soft wood cutting it ranged from 15.6 to 27.6. Irrespective of cutting type, IAA and NAA seem to be the most efficient in promoting roots. By contrast, IBA was more effective only in soft wood cuttings. The ultimate plant survival is, however, the key in such studies. In overall experiment, a maximum of 28% survival rate was recorded in soft wood cuttings when exposed to IAA at 100 mg per 100 g talcum powder combination.*

## 1. Introduction

Guava (*Psidium guajava* L.) is an economically important fruit crop of Pakistan and other warm countries of the world. Mature guava fruit are sweet in taste and have attractive flavor [1]. Fruit is not only used for fresh consumption but is also used in a variety of ways in food processing industry for making jellies, jams, squashes as well as in herbal products [2, 3]. Guava Fruit contains 82% water, 0.7% protein, 11% carbohydrate and desirable amounts of vitamin A, B, C, minerals and high amount of pectin [4]. It also contains higher amount of vitamin-C than tomatoes and oranges [3, 5]. Guava is a good source of calcium, nicotinic acid, phosphorous and soluble fiber [6]. Guava fruit is also medicinally important [1]. It accelerates immune system, reducing cholesterol level and protecting the heart [4, 6]. Guava is extensively grown in Sindh, Punjab and Khyber Pakhtunkhwa provinces of Pakistan and occupies third position after citrus and mango in terms of area and production [7]. Guava is a productive and highly profitable fruit crop. Guava is preferred by fruit growers due to its wide adaptability and higher return per unit area as can be grown on a wide variety of soils from heavy clay to light sandy soil with a pH range of 4.5 to 8.5 [8, 9].

Most of horticultural plants are vegetatively propagated by different methods such as air layering, stooling, budding, grafting, root cuttings and stem cuttings [4]. However, guava does not lend itself easily to various asexual propagation methods [10]. The only method of its commercial propagation is through seed but this method limits the standardization of its cultivars [3, 11]. Guava is difficult to propagate by methods most commonly employed with other fruits. It is also difficult to propagate by stem cuttings through the use of ordinary methods [10]. However, investigation on propagation of guava has been carried out on a limited scale and scope [12].

In general cuttings are the cheapest, rapid and simplest method of propagation and the new plants which develop from cutting are true to type and uniform in growth [13]. Such plants start bearing earlier than seedlings and do not require any special techniques as needed in grafting, budding and layering [1]. Stem cuttings of guava are normally difficult to root but different root promoting plant growth regulators can be used for induction of rooting [5]. Among the plant growth regulators, auxins are most extensively studied for its promoting effects [13]. Synthetic auxins can be utilized for induction of roots on stem cuttings of various plants, micropropagation of plant species and setting of fruits [5, 13, 14].

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Thus, treatment of cuttings with auxins appears to be the most satisfactory method of propagation so far tested [1]. Therefore, current studies were carried out to establish a reliable protocol for the propagation of guava from stem cuttings (semi-hard wood and soft wood) by the application of different auxins (IBA, IAA and NAA @100mg/100g talcum powder.

## 2. Material and Methods

Effect of auxins on rooting of semi hard and soft wood cuttings of guava (*Psidium guajava* L.) cv. Safeda was conducted in the lathe house of National Institute of Food & Agriculture (NIFA), Tarnab, Peshawar, Pakistan. The overall objective of the current experiment was to establish a reliable propagation protocol for guava from stem cuttings (semi-hard wood and soft wood) by the application of different Auxins (IBA, IAA and NAA at 100mg/100g talcum powder).

### *2.1 Filling and Preparation of Plastic Bags*

Plastic bags with small holes were filled with river silt which contains clay and sand. Small holes were made in the plastic bags before filling with sand to provide aeration and leaching of excessive water.

### *2.2 Preparation of Cuttings*

Soft and semi-hard wood stem cuttings of guava were taken from terminal portion of 5-6 years old bearing orchard. The cuttings 12-15cm long contained 6-8 buds each with a pair of leaves on the top of cutting.

### *2.3 Preparation of Auxin Mixture*

Stock mixture was prepared in a beaker by blending 100 mg of IBA with 100g of talcum powder. Similar procedure was repeated for preparing IAA and NAA mixtures. Two gram of fungicide (Radonil-Syngent Int.) was also added to each mixture.

### *2.4 Application of Auxin Mixture*

The basal portion (2-3 cm) of each cutting was dipped in the auxin mixture. In control treatments cuttings were planted without being dipped in the mixture.

### *2.5 Planting of Cuttings*

Treated cuttings were immediately planted 6-7 cm deep in plastic bags already filled with silt. For provision of sufficient humidity, these bags were covered in low tunnels of polythene sheets. Cuttings were irrigated immediately after planting with sprinkler. All other good cultural practices along with daily irrigation in the form of mist were practiced during the whole experiment.

### *2.6 Experimental Design and Data Recording*

The experiment was laid out in split plot design, replicated 3 times with 50 cuttings per replicate. There were two factors, i.e. auxins (IAA, IBA, NAA and control) as main factor and two types of cuttings (semi hard wood & soft wood) as sub factor. Therefore, total number of cuttings in the experiment were; 4x2x3x50=1200. The data were recorded on the following parameters;

#### *2.6.1 Days to sprout*

In order to record data on days to sprouting, the experiment was observed from the second week of planting and was daily checked. The days to sprouting was recorded when more than 50% (more than 25 cuttings) in each replication sprouted and then average of three replications was calculated.

#### *2.6.2 Percent sprouting*

The data on percent sprouting was recorded after 8 weeks of planting of cuttings in all replications of each treatment and the average of three replicates were converted into percent sprouting

#### *2.6.3 Number of leaves per cutting*

For this parameter five cuttings from all replications of each treatment were randomly selected and the average calculated.

#### *2.6.4 Number of roots per cuttings*

The data on this parameter was recorded after completion of the experiment and five randomly selected cuttings were taken from each replication and treatment and the average number of roots per cuttings was calculated.

#### *2.6.5 Percent survival*

The data on percent survival was recorded in March/April after completion of the whole experiment. The survived cuttings in each replication of every treatment were counted averaged and were converted into percent survival and the data were analyzed using the software Stat. 8.1 USA for analysis of variance and LSD test to check the difference among treatments.

## 3. Results and Discussions

### *3.1 Days to Sprout*

Data on the effect of different auxins on days to sprout of semi hard and soft wood cuttings of guava indicates that auxins have significantly affected days to sprouting (Fig. 1). The minimum mean number of days to sprouting (25.1) was recorded in IBA treated cuttings. This was followed by 26 days in control while the maximum number of days (28 and 28.6) taken to sprouting by those cuttings treated with IAA and NAA (Fig.1). Similarly the effect of different auxins on cutting types (semi hard and soft wood) was also significant. The lowest mean number of days (24.8) were taken to sprout by semi hard wood cuttings while soft wood cuttings took 29 days to sprout (Fig. 1). The interaction of auxins and types of cuttings

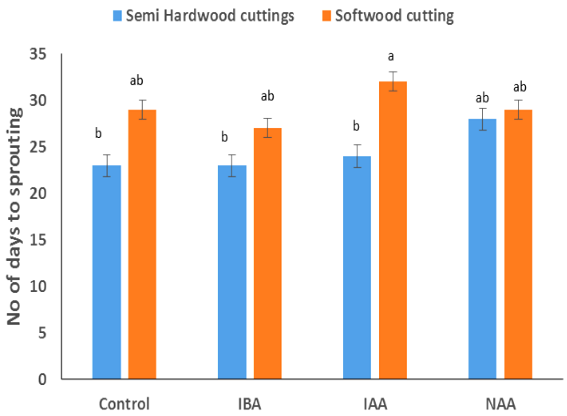


Fig. 1: Effect of auxin on days to sprouting of semi hard and soft wood cuttings of guava. Means with same letters are not significantly different at P<0.05 using DMR test

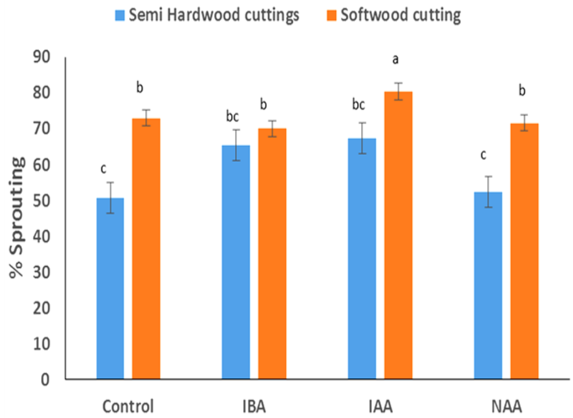


Fig. 2: Effect of auxin on percent sprouting of semi hard and soft wood cuttings of guava. Means with same letters are not significantly different at P<0.05 using DMR test

was non significant. Overall experiment, the minimum number of days (23.3) was recorded in the semi hard wood cuttings treated with IBA while the maximum number of days (29) was the soft wood cuttings treated with NAA at 100 mg/100g talcum powder.

The present study shows that mere sprouting of cuttings is not important as depicted from the final survival of the cuttings. The control treatments took the least days to sprout (23.3) in semi hard wood cuttings (Fig. 11). In earlier experiments the effect of Indole-3-acetic acid, Indole-3- butyric acid and Naphthalene acetic acid on semi hardwood cuttings of guava was studied and very little effect of these auxins was reported on days to sprout [15]. Similarly no effect of different concentrations of IBA was reported on days to sprouting [16]. As seen from present findings, earlier results [15, 16] also suggest that auxins play little role in days to sprout.

### *3.2 Percent Sprouting*

Different auxins significantly affected percent sprouting in semi hard and soft wood cuttings of guava. The maximum mean percent sprouting 73.8% was recorded in the cuttings treated with IAA. This was followed by 67.6 and 62% sprouting in the cuttings treated with IBA and NAA respectively. While the lowest mean sprouting of 61.8% was recorded in the control treatment. Similarly, the effect of auxins on types of cuttings was also significant with mean sprouting of 73.7% in soft wood and 58.9% in semi hard wood cuttings (Fig. 2). The interaction of auxins and types of cuttings was significant. In interaction, the maximum 80.3% sprouting was recorded in soft wood cuttings treated with IAA. However, the sprout percentage in control was 50.6% and 73% in semi hard wood and soft wood cuttings respectively. The relatively superior performance of soft wood cutting is evident from observation that all the treatments had higher with soft wood cuttings. The sprouting percentage in IAA treated both types of cuttings (semi hard and soft wood) which were, however, higher (67.3 and 80.3% respectively) as compared to control (Fig. 2).

The data in Fig. 2, however, points to the fact that auxin also plays a role in initial sprouting. Indol acetic acid (IAA) seems affective in sprouting of both semi-hard wood and soft wood cuttings. When compared to IAA, IBA did not enhance sprouting markedly and was about as effective as to control. Overall a maximum of 80.3% sprouting was observed when soft wood cuttings were treated with IAA while 70% sprouting response was recorded when soft wood cuttings were exposed to similar concentration of IBA (Fig. 2). For semi-hard wood cuttings treated with IBA, 65.3% sprouting was recorded. With similar concentration of IAA, semi-hard wood cuttings exhibited 67.3% sprouting. Compared to IAA treatment, IBA seems the least affective in sprouting of cuttings.

In a similar study on stem cuttings from mature stock plants of guava, 60% sprouting response was recorded in cuttings treated with 0.4% IBA solution [13]. In another experiment, 71.2% sprouting response was reported in soft wood cuttings treated with paclobutrazol at 1000 ppm solution [5]. In contrast to our experiment, [16] earlier studies on semi hard wood stem cuttings of guava treated with different concentrations of IBA recorded (37.49%) sprouting. In this experiment 52.3% sprouting response was recorded when semi hard wood cuttings were exposed to NAA. However, in the present study with similar NAA concentration, soft wood cutting produced 71.6% sprouting response as compared to 80.3% with IAA (Fig. 2). Thus, IAA seems superior to NAA. However, when comparing in cutting type, all the auxins had higher sprouting in soft wood cuttings as compared to semi hard wood cuttings. The effectiveness of IAA for achieving high sprouting percentage (67.3 and 80.3%) compared to control, irrespective of cutting types, points to the fact that IAA is a stronger auxins for treatment of cuttings and gives high sprouting percentage and that soft wood cutting is more desirable than semi hard wood cutting. These results are in conformity with findings of as several researchers who reported effectiveness of auxins treatment in sprouting of stem cuttings of guava [5, 15, 17]. The relatively superior response of soft wood cutting as compared to semi hard wood cutting may be due to it greater response to auxins treatments [15].

### 3.3 *Number of Leaves*

Data regarding effect of auxin on number of leaves per cutting had no significant effect in semi hard and soft wood cutting of guava. A maximum mean number of leaves (5.8) was recorded in cuttings treated with IBA followed by 5.5 in IAA treated cuttings while control and NAA treated cuttings were comparable and produced 4.8 leaves. The effect of auxins on types of cuttings was significant with a mean of 6.6 and 3.7 leaves in soft and semi hard wood cuttings respectively. The interaction of auxins and types of cuttings was also insignificant. Overall a maximum of eight leaves were recorded in soft wood cuttings treated with IBA. It was followed by IAA with 7.7 numbers of leaves. Contrarily NAA was less effective (5.6 leaves) than IBA and IAA in soft wood cuttings (Fig. 3). Minimum number of leaves was recorded in control and NAA treated cuttings. In semi-hard wood cuttings, however, NAA proved most effective by producing four leaves. In our studies the maximum number of leaves (8.0) was recorded with IBA treated cuttings. The findings of our results can be confirmed from earlier experiments [16] in which the highest (13.9) number of leaves per cuttings treated with IBA were recorded. In contrast, the effectiveness of IAA over other auxins was investigated in previous experiments [15]. However, in our study we also obtained the second highest 7.7 numbers of leaves with IAA treated soft wood cuttings (Fig. 3). In the present study the least number of leaves were recorded in semi hard wood cuttings treated with auxin. The possible explanation for this could be that in soft wood cuttings the internodes length is the least resulting in higher number of nodes per unit cutting length. Though not recorded, it is presumed that greater number of nodes in soft wood as compared to semi hard wood cuttings has resulted in mix leaves to compensate for the higher number of roots in auxin treated cuttings (Fig. 4).

### 3.4 *Number of Roots*

Data in Fig. 4 indicates that all auxins significantly promoted rooting irrespective of cutting types. The maximum mean number of roots (22.1) was produced by cuttings treated with IAA followed by 20.1 in cuttings treated with NAA. The interaction of auxins and types of cuttings on the number of roots was insignificant. In the present study maximum number of roots range from 11 to 17.3 in semi hard wood cuttings, whereas, in soft wood cutting it range from 15.6 to 27.6 roots per cutting. IAA and NAA seem the most efficient in promoting roots irrespective of cutting type. However, IBA gave good results only in soft wood cuttings. This parameter, once again confirm the effectiveness of IAA over IBA. Rooting is the most important parameter in the ultimate survival of plants. Soft wood cuttings treated with IAA produced a maximum of 27.6 roots as compared to 23 roots with NAA and IBA. In semi hard wood cuttings, NAA and IAA have shown their effectiveness over IBA. In the cuttings treated with NAA, 17.3 roots were counted which is almost similar to those treated with IAA. Similar results with the application of IAA and NAA have also been reported by [5, 15]. In the present investigation when the soft wood cuttings were treated with IBA, a maximum number of 23 roots was recorded. The results of our findings with IBA treated cuttings is confirmed by earlier experiments of [16] in which 21.2 number of roosts in semi hard wood cuttings treated with 1000 ppm IBA were reported. In a separate study it was reported that as the IBA concentration increases in one liter water, its potential of root initiation also increases [18]. Similar results were also observed by other researchers that IBA can enhance rooting response in soft and semi-hard wood cuttings of guava [5, 13, 15].

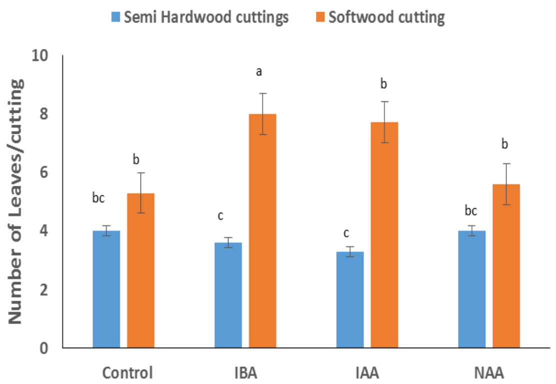


Fig. 3: Effect of auxin on number of leaves in semi hard and soft wood cuttings of guava. Means with same letters are not significantly different at P<0.05 using DMR test

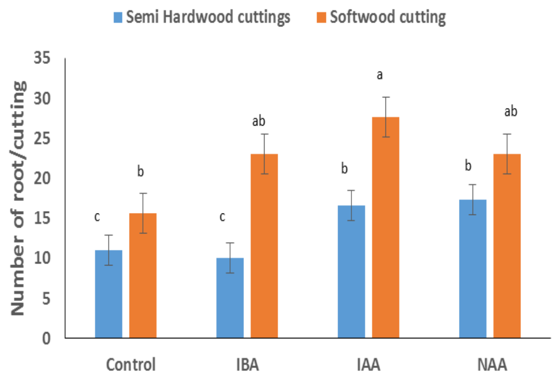


Fig. 4: Effect of auxin on number of roots in semi hard and soft wood cuttings of guava. Means with same letters are not significantly different at P<0.05 using DMR test

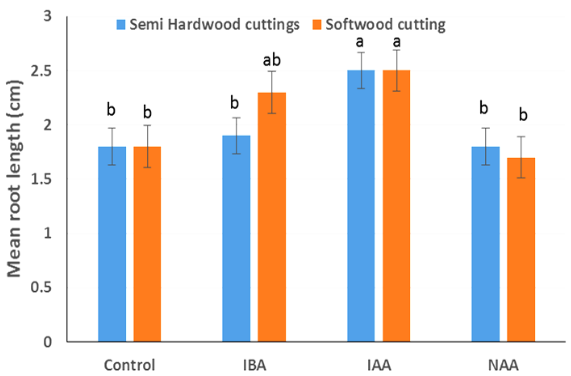


Fig. 5: Effect of auxin on root length of semi hard and soft wood cuttings of guava. Means with same letters are not significantly different at P<0.05 using DMR test

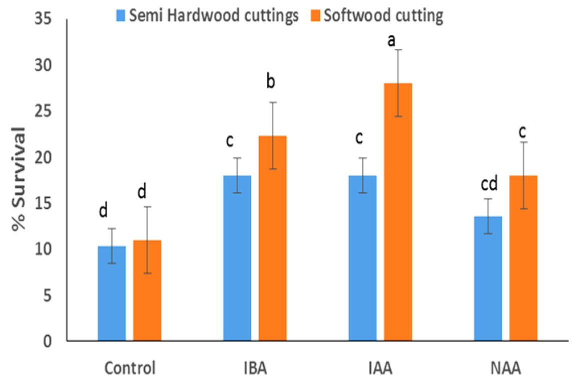


Fig. 6: Effect of auxin on percent survival of semi hard and soft wood cuttings of guava. Means with same letters are not significantly different at P<0.05 using DMR test

### 3.5 *Average Root Length (cm)*

The data shows that different auxins significantly affected the root length of semi hard and soft wood cuttings. The maximum mean root length of 2.5 cm was recorded in cuttings treated with IAA. This was followed by 2.1 cm in IBA treated cuttings. NAA and control treatments showed almost similar root length of 1.8 cm. The effect of auxins on root length of both types of cuttings was insignificant with 2.1 1and 2.0 cm root length in soft and semi hard wood cuttings respectively. The interaction of auxins and types of cuttings was also insignificant. In the present study, a maximum mean root length of 2.5 cm, irrespective of cutting type, was recorded in IAA treated cuttings. These results are confirmed by earlier findings [15] recorded a maximum root length of 14.1 cm in guava stem cuttings treated with 3000 ppm IAA as compared to the smallest root length with 4000 ppm IBA treated cuttings. By contrast Mitra et al. [14] studied the effect of IBA on guava cuttings and found that application of IBA improved the rooting quality in guava especially the root length and number of roots in cuttings. Similarly a root length of 6.5 cm was reported in hard wood cuttings of guava treated with 1000 ppm IBA solution and it was also observed that IBA is better than at all concentrations than other treatments [19].

### 3.6 *Percent survival*

Cutting survival was significantly affected by the application of different auxin (Fig. 6). A maximum mean survival of 23% was recorded in IAA treated cuttings followed by 20.2% in IBA. The lowest mean survival of 10.6% was recorded in control treatments. The effect of different auxin on types of cutting was also significant with 15% survival in semi hard and 19.8% survival in soft wood cuttings.

The interaction of auxin and types of cuttings was also significant. Overall experiment, IAA treated cuttings have maximum (28) survival percentage, whereas control cuttings have the lowest (only 10.3%). Compared to lowest survival in control the highest survival percentage in cuttings treated with auxin could be due to differences in number of roots on one hand but most importantly due to time taken for root initiation. Since auxin promote roots initiation, delayed root initiation exposes cuttings to lengthy dehydration which may have happened in control cuttings and consequently have resulted in the lowest plant survival. On the contrary, forced and rapid root initiation in auxin treated cuttings may have, irrespective of the number of roots, as is the case in IBA treated cuttings, shortened the dehydration span of cuttings and thus resulted in higher survival rate. It is the logical explanation of higher plants survival in IAA treated cuttings where the number of root is almost equal to those in control treatment. The maximum plant survival in auxin treated cuttings could also be due to root length (Fig. 5). Earlier it was reported that survival of stem cuttings of guava are significantly affected by various types of root promoting auxins [5]. In another study it was reported that application of auxins on semi hard wood cuttings of guava significantly increased the survival percentage [15]. Similar findings were also reported by Abdullah et al. [13] that the application of auxins can enhance the number of roots in cuttings which leads to increased rooting in stem cuttings of guava and can indirectly increase survival rate of the cuttings. The effect of growth regulators (IBA, NAA and paclobutrazol) on the roots of guava cuttings had significant effect on rooting and final survival of the cuttings [20, 21].

## 4. Conclusions

The sprout percentage in treated cuttings was higher (52.3 to 80.3%) as compared to control treatments (50.6% and 73% in semi hard wood and soft wood cuttings, respectively). All auxins promoted rooting irrespective of cutting types. Soft wood cuttings treated with IAA produced a maximum of 27.6 roots as compared to 23 roots with NAA and IBA. IAA is the strongest auxin in case of root enhanced in semi hard wood cuttings followed by NAA and IBA. The ultimate plant survival is the key in such studies. Overall experiment, IAA treated cuttings had the maximum 28 survival percentage, whereas control cuttings had the lowest (only 10.3%). The highest survival percentage in cuttings treated with auxin could be due to differences in number of roots on one hand but most importantly due to time taken for root initiation.

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