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# Effects of IBA on Hardwood Cuttings of Peach Rootstocks under Greenhouse Conditions

Ch. Muhammad Shamshad Ahmed, Nadeem Akhtar Abbasi and Muhammad Amer
Department of Horticulture, University of Arid Agriculture, Rawalpindi, Pakistan

**Abstract:** Present studies pertaining to the propagation of three imported peach rootstocks *viz.* Hansen, GF-655 and GF-677 with IBA (indole butyric acid) at four regimes viz. 2500, 3000, 3500 and 4000 ppm was used. According to the results rootstocks were at variance with respect to different characters studied. GF-655 rootstock showed a consistent response for rooting final survival of transplanted cuttings. The best dose for propagation of GF-655 rootstock through cuttings was 2500 ppm IBA, while the other two rootstocks were not responsive to IBA even up to 4000 ppm.

**Key words:** Indole butyric acid, peach rootstocks, cuttings, propagation

## Introduction

In Peshawar, yellow local peach is used as a rootstock and gives fruits of better quality and flavour but is prone to certain pests and diseases which necessitates studying other alternative rootstocks. GF-655 (plum rootstock from France), GF-677 (Peach almond hybrid, a chance seedling also from France) and Hansen (Almond B-peach selection-1-8-2 from California) have been imported by NARC. These are resistant to extremes of lime and salt contents in the soil, pests and diseases attacks (Toit *et al*., 1995; Hartmann *et al*., 1997). However, they are shy to propagate by hardwood cuttings, which is the simplest and least expensive technique for vegetative propagation (Scalabrelli *et al*., 1986).

Many publications have summarized the usefulness of auxins as a rooting aid (Audus *et al*., 1950; Biasi *et al*., 2000; Rufato *et al*., 2000), indicating that IBA is considered to be a well-accepted rooting auxin in cuttings. Therefore, in these studies this chemical has been selected to evaluate suitable concentrations for multiplication of rootstocks for peach varieties cultivated in Pakistan.

## Materials and Methods

The present studies were carried out at Horticultural Research Institute (HRI) of National Agricultural Research Center (NARC) Islamabad, Pakistan, during the year 1997-98. The rootstocks included in these studies were GF-655 (Plum rootstock from France), GF-677 (Peach Almond hybrid, a chance seedling from France) and Hansen (from hybrid seedlings of Almond B-Peach Selection 1-8-2 in California) imported by NARC.

During the month of December 1997, 216 hardwood cuttings 6-7 inches long having 5-6 buds each were made from each of the 3-rootstocks that is 648 cuttings were utilized in the experiment. The experiment was laid out in a completely randomized design (CRD) with factorial arrangement in a greenhouse using 3-replications and 6 treatments which were as under. The treatments included control, distilled water and IBA at 2500, 3000, 3500 and 4000 ppm, respectively.

Under the facilities of mist irrigation system, a block of sand measuring 15×12×1 $ft^3$ was prepared in a greenhouse to be used as a planting medium. This block was divided into three equal sub blocks measuring 5 x 4 x 1 $ft^3$ each. These sub-blocks were allocated randomly to each of the rootstocks. Each of these sub blocks were further divided equally into 3-sections, each of which representing a replication. Each section of the replication was then divided equally into 6 treatments using 12 cuttings per treatment per replication.

The cuttings of different rootstocks were treated in various concentrations of IBA and were allowed to develop their root system for 10 weeks in each of the replicated block under the same conditions. After which they were taken out gently with the help of an appropriate garden tool and the sand was washed away gently to record root formation.

Prior to transplanting of these cuttings, data on rooting percentage, average number of roots, average root length, time of bud sprouting and average number of buds sprouted per cuttings per treatment were recorded.

Latter on the data so collected was analyzed statistically by LSD test at $P \leq 0.05$ (Steel and Torrie, 1980).

## Results and Discussion

**Percentage of rooted cuttings per treatment:** Comparison of various treatments (Table 1) reflected that IBA @ 2500,

Table 1: Effect of indole butyric acid (IBA) on rooting of different varieties of peach rootstock cuttings

| | % rooted cuttinhs | Av. no of roots$^{-1}$ cuuting | Average root length cutting$^{-1}$ | Time of buds sprontin g | A. of buds sprouted cutting$^{-1}$ | % survival of rooted cutting |
|---|---|---|---|---|---|---|
| Control | | | | | | |
| Hamsem | 0.00H | 0.00F | 0.00E | 0.00G | 0.00E | 0.00F |
| GF-655 | 61.10C | 19.20DE | 7.16D | 57.00AB | 0.90E | 78.00ABC |
| GF-677 | 0.00H | 0.00F | 0.00E | 0.00G | 0.00E | 0.00F |
| Distilled water | | | | | | |
| Hamsem | 11.10GH | 17.00E | 7.50CD | 61.70A | 2.00D | 50.10BCDE |
| GF-655 | 69.40BC | 29.00C | 7.50CD | 55.70ABC | 3.90AB | 64.90ABCD |
| GF-677 | 0.00H | 0.00F | 0.00E | 0.00G | 0.00E | 0.00F |
| IBA 2500 ppm | | | | | | |
| Hamsem | 22.2EFG | 34.6BC | 12.0B | 43.7F | 3.0BC | 100.00A |
| GF-655 | 86.10A | 43.60A | 15.70A | 44.00F | 4.0A | 83.30ABC |
| GF-677 | 36.10DE | 16.10E | 8.10CD | 54.00BCD | 3.00BC | 83.30ABC |
| IBA 3000 ppm | | | | | | |
| Hamsem | 19.40FG | 31.00C | 10.10BC | 47.30DEF | 3.00BC | 88.90AB |
| GF-655 | 83.30AB | 40.60AB | 12.10B | 46.00EF | 3.00BC | 88.90AB |
| GF-677 | 38.90D | 19.30DE | 10.10BC | 54.70BC | 3.00BC | 100.00A |
| IBA 3500 ppm | | | | | | |
| Hamsem | 16.70G | 17.30E | 8.5CD | 54.00BCD | 2.3CD | 17.00EF |
| GF-655 | 75.00ABC | 36.00ABC | 8.5CD | 51.00BCDE | 2.6.CD | 44.30CDE |
| GF-677 | 33.30DEF | 27.20CD | 7.30D | 46.00EF | 3.70AB | 75.60ABC |
| IBA 4000 ppm | | | | | | |
| Hamsem | 16.70G | 16.60E | 9.5BCD | 56.00AB | 2.40CD | 33.70DEF |
| GF-655 | 72.20ABC | 27.30CD | 8.50CD | 52.00BCDE | 2.00D | 78.00ABC |
| GF-677 | 0.00H | 0.00F | 0.00E | 49.00CDEF | 2.00D | 0.00F |

Means following the different letters differ significantly at 5% probability by least signfiicatn difference test\

3000, 3500 and 4000 ppm caused rooting in the highest number of cuttings of GF-655 rootstock i.e. 86.11, 83.33, 75.00 and 72.22%, respectively as compared with other two rootstocks. Similar pattern seems prevailing in Hansen and GF-677 rootstocks with 2500, 3000 and 3500 ppm IBA and showed better response than rest of the interactions. Two of the rootstocks *viz* Hansen and GF-677 did not root with $T_1$ (control). Whereas GF-655 rootstock rooted much more with distilled water (69.44%) and control (61.11%) than rest of the rootstocks. One of the major deviations from the trend of the results was total inhibitory effect of 4000 ppm IBA when used for rooting of cuttings in GF-677 rootstocks, whereas other rootstocks viz. GF-655 and Hansen exhibited certain rooting response in descending order with this treatment. An average number of GF-655 cuttings rooted even if no IBA was applied in control and distilled water treatments whereas the rest of the rootstocks were lacking such character indicating the presence of naturally occurring hormones in this rootstock in sufficient amount for root initiation. The phenomenon confirm the observations of Hess (1964) who obtained the higher amount of extractable root promoting co-factors in easy to root cuttings than in the difficult to root varieties of Chrysanthemum.

In general lower doses (2500 ppm IBA) and (3000 ppm IBA) proved better than higher regimes in all the three rootstocks. These results are in accordance with the observations of Rashid *et al.* (1993) who reported the highest rooting success in Hansen rootstock with IBA concentration of 2500 ppm in sand media.

It may thus be concluded that the optimum dose for the root initiation in case of GF-655 and Hansen rootstocks could be still less than 2000 ppm IBA, while for GF-677 rootstock under prevailing experimental conditions could be ranging between 2000 to 3000 ppm IBA. At higher doses the rooting performance of Hansen and GF-677 rootstocks were reduced or showed no rooting. Results are also supported by Kracikova (1996) who found that the highest rooting success of 71.5% for GF-655 rootstock was achieved with 2500 ppm IBA concentration.

**Average number of roots per cutting per treatment:** Maximum number of roots, 43.50, 40.54 and 36.0 cutting belonged to 2500, 3000 and 3500 ppm IBA, respectively when applied to GF-655 rootstock (Table 1). There was no response to control in Hansen and GF-677 rootstocks. The latter one also failed to produce roots after receiving distilled water treatment or 4000 ppm IBA. Rest of the treatments ranged in between the two extremes. Moreover, trend set forth by the previous character has been maintained i.e. 2500, 3000 and 3500 ppm IBA induced more number of roots cutting$^{-1}$ in all the rootstocks except GF-677, where application of 2500 ppm IBA instead of promoting number of roots inhibited them i.e. 16.1. The other surprising deviation was the exchange of positions by two rootstocks i.e. GF-677 has been substituted from second place by Hansen rootstock, which occupied third place with regard to number of rooted cuttings.

It may be inferred from above that there is a synergism between the number of rooted cuttings and number of roots cutting$^{-1}$ in GF-655 rootstock i.e. more the rooted

cuttings, more will be the roots per cutting whereas there is an antagonism between these characters in rest of the rootstocks. In case of GF-677, more cuttings rooted than Hansen rootstock but its position is reversed over here. Moreover, GF-677 is highly sensitive to the dose applied with regard to this character because 2500 ppm IBA did improve rooting of the cuttings but the same level 2500 ppm IBA inhibited number of roots per cutting. The other possible reason may be that root growth in this case was too rapid to survive later on. The inverse correlation between rooted cuttings and number of roots cutting$^{-1}$ observed in GF-677 and Hansen rootstocks may be explained on the ground that once rooting was induced in Hansen it continued to proliferate while in GF-677, although more cuttings rooted than Hansen yet were shy to multiply further, thereby reducing their number. The results are supported by the findings of Rana and Chadha (1989) who indicated that highest rooting percentage and root number were reciprocal at lower IBA concentration of 2000 ppm in *Prunus* spp.

**Average root length per cutting per treatment:** Comparison of various treatment means (Table 1) showed almost similar pattern as that of previous results with some deviations, as root length was significantly higher (15.7 cm) in case of GF-655 treated with 2500 ppm IBA than rest of the interactions. This was followed by GF-655 treated with 3000 ppm IBA (12.2 cm) which was at par with Hansen treated with 2500 ppm IBA (12.0 cm) indicating a positive correlation between number of roots and the root length in these two rootstocks. However, GF-677 rootstock did not show a consistent trend here as evinced in number of roots, since the cuttings receiving the treatment 3500 ppm IBA did not surpass those treated with 2500 ppm IBA. Using IBA 3500 ppm and distilled water on GF-655 rootstock which was quite effective with regard to number of roots per cutting failed to prove their effectiveness here as they recorded 8.5 and 7.5 cm root length, respectively. Similarly, GF-655 rootstock under control although registered relatively more roots per cutting yet statistically non significant from cuttings of GF-677 when treated with 2500 ppm IBA reversed its position here with the latter as 7.16 and 8.16 cm root length was noted, respectively. The other shifts in position were 3500 ppm IBA×GF-655 and 3500 ppm IBA×GF-677 as both of these have been relegated in this character as compared with the number of roots per cutting whereas, 3500 ppm IBA×Hansen maintained its trend in both the attributes. While in case of 4000 ppm IBA×Hansen the root length increased (9.50 cm) although less (16.67) number of roots were recorded.

It may be deducted from above that the rule as more the number of roots more the length holds good only with GF-655 and Hansen rootstocks, whereas in case of third rootstock GF-677 there was a partial deviation as only 3500 ppm IBA recorded less root length (7.33 cm) in comparison with root numbers (27.33) induced by it. Same observation was noticed with respect to 3500 ppm IBA×GF-655 and distilled water×GF-655.

Surprisingly, 3000 ppm IBA×GF-677 improved its root length (10.17 cm) in comparison with low root number (19.30). It is evident that root length in GF-677 rootstock is very sensitive to the dose of chemical as it gave only response to 3000 ppm IBA while, the higher concentrations 3500 ppm IBA and 4000 ppm IBA became inhibitory. It is probable that 2500 ppm IBA was too low to be an optimum level.

**Time of buds sprouting:** It may be inferred (Table 1) that Hansen rootstock took minimum time (43.7 days) for buds to sprout in 2500 ppm IBA treatment which is at par with 2500 ppm IBA×GF-655, 3000 ppm IBA GF-655, 3500 ppm IBA×GF-677, 3000 ppm IBA×Hansen and 4000 ppm IBA×GF-677 treatments. Maximum time of (61.67 days) was recorded by Hensen treated with distilled water followed by control×GF-655 treatment (57 days). Two of the other treatments *viz.* 4000 ppm IBA×Hansen and distilled water×GF-655 remained equivalent with above ones. Rest of the treatments were in between these two extremes, whereas none of the buds sprouted from control×GF-677, distilled water×GF-677 and control×Hansen combinations. They also failed to produce roots and the buds could not sprout in the absence of the nutrition supplied by the roots.

It is evident from these studies that higher doses i.e. 4000 and 3500 ppm IBA in all the 3 rootstocks responded moderately to this character as the period of bud sprout was observed to be in between the two extremes except 4000 ppm IBA×Hansen which recorded 56 days for buds to sprout. Other notable point here is sprouting of buds in 4000 ppm IBA×GF-677 where no rooting was observed, most likely due to stored food material in the cuttings necessary for bud sprouting but death of cuttings occurred in the absence of roots which are essential to absorb nutrients from the media. These studies indicated that probably a suitable level of IBA for bud sprouting seems to be in the range of 2500 and 3000 ppm with Hansen and GF-655 rootstocks whereas for GF-677 rootstock 3500 ppm showed better performance. These results are in accordance with the results of Erez and Lerner (1990) who recorded bud break with low levels of chemical in peach cultivar Early Grande and Maravilla.

Results were also predicted by Tomaszewski (1957) as the dormancy in numerous fruit tree buds is correlated with auxin contents of the shoots.

It has been observed that number of roots and the time required for buds to sprout was inversely correlated i.e. more the number of roots less the days required for the buds to sprout. Because wherever the number of roots were more i.e. in treatments 2500 ppm IBA×GF-655 and 3000 ppm IBA×GF-655 there less time was exhibited in bud sprouting except 3500 ppm IBA×GF-677 in which case although number of roots were less yet it took less time (46.00 days) to sprout. This situation may be attributed to some internal factors, like level of accumulation of growth inhibiting substances.

**Average number of buds sprouted per cutting per treatment:** Means for average number of buds sprouted (Table 1) showed that maximum number of buds (3.94) sprouted in GF-655 rootstock by applying 2500 ppm IBA followed by the same rootstock treated with distilled water having 3.83 sprouted buds per cutting. Lowest number of (0.99) sprouted buds were attained in control×GF-655, whereas control×GF-677, distilled water×GF-677 and control×Hansen did not show any bud sprout.

It may be deducted from above that 3000 and 2500 ppm IBA had an intermediate effect on all the rootstocks. It is clear that the most effective range of chemicals for all the rootstocks seem to be different as GF-655 rootstock performed better at 2500 ppm IBA, while for GF-677 the optimum dose 3500 ppm IBA which is at par with the latter treatment but at lower pedestal from the former. Similar results were elucidated by Sharma and Mehta (1992) that cultivars varied in their response to bud sprout in relation to regime of chemicals applied due to fluctuation in their dormancy status. One phenomenal distortion here was maximum buds sprouted in the presence of less number of roots even with distilled water by GF-655 rootstock, may be due to enough food material already stored in the cuttings as a source of food for buds to sprout. The situation may be comparable to the findings of Nanda (1970), who reported that in certain cases schlerenchymatous tissues surrounding the vascular tissues prevent the emergence of root initials. Alternatively the endogenous levels of the hormones might have been sufficient for initiating the bud sprout or growth inhibitors were not at maximum level to reduce bud sprouting.

Out of these 3500 ppm IBA×GF-677 reflected a fluctuating response visibly with regard to root number, root length and bud sprouting as the root length was much less in comparison with root number.

However, a positive correlation existed between the time of bud sprouting and number of sprouted buds i.e. less the time taken to sprout more number of buds sprouted in 3500 ppm IBA×GF-677. This relationship is also manifested by 2500 ppm IBA×GF-655, 3000 ppm IBA×Hansen, 2500 ppm IBA×Hansen and 3000 ppm IBA×GF-655. The other characters where no relationship could be established were the number of buds sprouted and number of roots per cutting in treatments like 3000 ppm IBA×GF-677, 2500 ppm IBA×GF-677 and 3500 ppm IBA×GF-655. The treatments that demonstrated consistent behaviour with respect to above two characters were 2500 ppm×IBA GF-655, 2500 ppm IBA×Hansen and 3000 pm IBA×Hansen. These results are also supported by Ishtiaq *et al.* (1989) who observed the positive association relating to root formation and bud sprout in peach cultivar Peshawar local at 2000 ppm IBA concentration.

**Survival percentage of rooted cuttings per treatment:** Comparison of various treatment means (Table 1) recorded maximum survival of 100% in 3000 ppm IBA×Hansen, 3000 ppm IBA×GF-677 and 2500 ppm IBA×Hansen which are at par with 3000 ppm IBA×GF-655, 2500 ppm IBA×GF-655, 2500 ppm IBA×GF-677, 4000 ppm IBA×GF-655, control×GF-655, 3500 ppm IBA×GF-677 and distilled water×GF-655. Minimum survival (17.00%) was observed in 3500 ppm IBA×Hansen. Remaining interactions were in between these values. Cuttings from control×Hansen, 4000 ppm IBA×GF-677, distilled water×GF-677 and control×GF-677 exhibited no response obviously due to lack of root formation.

It can be concluded that all the three rootstocks responded to low regimes of chemical (2500 and 300 ppm IBA) with four distinct exceptions noticed in GF-655 and GF-677. In case of GF-655 rootstock not only control and distilled water were effective about this character but the highest dose of IBA i.e., 4000 ppm proved its efficacy as well reflect on wavering behaviour of the rootstock. Whereas in GF-677 the IBA even at higher level 3500 ppm IBA was good enough for this purpose. When a comparison is drawn between survival and number of roots it crystallizes that there was a correlation between these characters in case of 2500 ppm IBA×GF-655, 3000 ppm IBA×GF-655 and 2500 ppm IBA×Hansen whereas, in case of 2500 ppm IBA×GF-677 negative correlation was evident. The logical conclusion seems that large numbers of roots are associated with adequate nutrient absorption which account for ultimate survival. Results are in line with Prizhmontas (1991), who found that better rooting was associated with better survival rate in *Prunus*

*cerasus*. The phenomenon failed to hold good in 3500 ppm IBA×GF-655 as large number of roots were not proportional to survival of the cuttings. In this case poor root length may be accounted for poor absorption of nutrients ultimately leading to low survival percentage. However, when there is an inverse correlation the better survival could be associated with quality of the roots (Table 1). The phenomenon was peculiar with 3000 ppm IBA×GF-677 where survival was more even when root numbers were less. It seems that root number has been substituted by quality of the roots i.e. root length as supported by Bartolini (1994) who observed the positive association between rooting and survival rate of peach cultivar Fertilia.

It may be concluded that the best dose for propagation of GF-655 rootstock through cuttings was 2500 ppm IBA, while the other two-rootshocks were not given response to IBA even up to 4000 ppm.

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