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HORTICULTURE

Response of IBA on Rhizogenic Capacity and Shoot Characteristics of Clonal Rootstocks for Pear

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ABSTRACT

The present experiment was conducted to study the response of IBA on pear rootstocks Quince-C and BA-29 with respect to rhizogenic capacity and shoot characteristics. The finding of experiment shows that IBA application had significant effect on these clonal rootstocks of pear. IBA application @ 1000 ppm resulted in maximum rooting and root growth. The IBA treatment @ 1000 ppm was also found to be the best in terms of all shoot characteristic parameters. Higher concentrations of IBA above 1000 ppm were found detrimental.

Highlights

- The IBA treatment @ 1000 ppm resulted in maximum rooting and root growth of pear.
- IBA @ 1000 ppm was found best for multiplication of Quince C and BA 29 rootstocks of pear.

Keywords: IBA, pear, rhizogenic, clonal, rootstocks

Among temperate fruits pear occupies an important place due to its wider climatic adoptability, longer shelf life and uses. In India its area is spread over 42.28 thousand ha producing 316.70 thousand tons of fruit with average productivity of 7.49 tones/ ha. (NHB Database 2015). Low density orchards with larger inter spaces due to vigorous tree growth of plants grafted on seedling rootstocks is the major cause of low productivity in pear. In India, mainly the pear is grafted on seedling stock of wild pear *Pyrus pashia* (Kainth). Though this rootstock has been found resistant to root rot and pear decline disease (Randhawa and Kishore 1981) it is susceptible to wooly pear aphid, cold and imparts vigorous plant growth. Moreover, the qualities of pear fruits deteriorate when grafted on *Pyrus pashia*. On the other hand clonal rootstocks are desirable not only to produce uniformity but also to equally impart special influence on scion cultivar (Mehraj *et al.* 2017, Hartmann and Kester 1986).

Therefore, for regulating vegetative growth in intensive orchard system of pear, many clonal rootstocks of quince (*Cydonia oblonga*) such as QA, QB, QC, BA- 29 and C132 were developed. Quince C and BA 29 are dwarfing in nature and induces precocity in the scion cultivar. Further, quince is also resistant to black end, pear decline, crown gall and wooly pear aphid and tolerant to heavy clay soils. In comparison to the seedling rootstocks, quince allows the plants to be trained in a more compact form and confer better qualitative characteristics to the fruits. All these benefits of clonal rootstocks can only be availed when they are produced in large numbers. Moreover, the produced rootstocks should have adequate root system to support proper water and nutrient supply to the scion and should also attain proper shoot growth suitable for grafting and budding. Auxins particularly IBA (Indole 3 Butyric acid) is used with varying concentration for rooting in many fruit crops which are propagated

through cuttings, layering or stooling (Singh *et al.* 2015). But, the available observations about the use of IBA for the propagation of Quince C and BA 29 through cuttings are still lacking and do not give a clear evaluation of the rhizogenic capacity and shoot growth of *Cydonia oblonga*. Therefore, the investigation conducted on this aspect is being presented that has unfolded the response of different concentrations of IBA on contributing attributes for rhizogenic capacity and multiplication rate of Quince C and BA 29. The findings of this study will also be helpful for cost efficient production of these clonal rootstocks by using judicious amount of expensive IBA.

MATERIALS AND METHODS

The investigation was carried out at Horticultural Research Block, G.B. Pant University of Agriculture and Technology, Hill Campus, Ranichauri (Tehri Garhwal), Uttarakhand. The experimental site is situated at 1950 meters above mean sea level; latitude of 30° 15′ North and 72° 02; East longitude. The region has a humid temperate climate, receiving an annual rainfall of 1278.40 mm. The seasonal rainfall distribution indicates that 59% of annual rainfall is restricted during South- West mansoon, while 20.5% rainfall is experienced between March to May. The meam maximum temperature ranges from 9.6 ˚C (January) to 2606 ˚C (June), while the mean minimum temperature ranges between 1.2 ˚C (January) to 18.8 ˚C (June). The winter season is very cold and snowfall is also experienced. The experimental material consisted of two rootstocks viz., Quince-C and BA-29, which are clonal selection of *Cydonia oblonga*. Both of these rootstocks are dwarfing in nature and induce precocity and compact growth in the scion cultivar. Moreover, the clones of *Cydonia oblonga* are resistant to black end, pear decline, crown gall, and wooly pear aphid. About 15-20 cm long and pencil thick cuttings of Quince C and BA 29 with 5-6 buds were taken for the experiment. These cuttings were treated with five different IBA concentrations i.e., 500 ppm, 1000 ppm, 1500 ppm, 2000 ppm, 2500 ppm and water was taken as control. The method used for IBA application was quick dip method and the cuttings were dipped for 10-15 seconds. The experiment consisting of total 12 treatment combinations was laid out in Factorial RBD, with four replications and 20 cuttings per plot. Data pertaining to rhizogenic capacity *viz*., rooting percentage, length of primary and secondary roots, number of primary and secondary roots, fresh and dry weight of roots and shoot characteristics *viz*., sprouting percentage, length and girth of sprout, fresh and dry weight of sprouts number of leaves, leaf area per plant, were recorded as per standard procedures.

Table 1: Response of IBA on rooting percentage, length and number of primary and secondary roots and fresh and dry weight of roots

Rootstock/ IBA Conc.	Rooting (%)		Length of primary roots (cm)		Length of secondary roots (cm)		Number of primary roots		Number of secondary roots		Fresh root weight (g)		Dry root weight (g)	
	Quince C	BA 29	Quince C	BA 29	Quince C	BA 29	Quince C	BA 29	Quince C	BA 29	Quince C	BA 29	Quince C	BA 29
Control	88.75	86.25	17.29	15.44	3.48	3.45	77.08	66.25	327.62	314.08	26.66	30.67	15.22	21.22
500 ppm	95.00	93.75	20.40	17.13	4.46	3.75	79.39	83.58	356.65	401.46	28.98	40.23	20.68	31.59
1000 ppm	95.00	96.25	21.39	23.43	4.42	4.51	124.50	89.26	457.75	612.25	35.01	47.45	22.94	33.31
1500 ppm	91.25	87.50	20.14	20.99	3.52	5.07	87.40	81.85	377.00	474.63	32.96	44.04	22.44	31.70
2000 ppm	90.00	86.25	19.43	19.11	3.48	4.63	84.23	80.04	368.45	387.30	31.81	39.05	18.98	27.68
2500 ppm	86.25	82.50	20.95	18.18	2.97	3.31	82.94	76.64	282.40	341.70	28.48	37.16	17.95	26.10
$CD_{0.05}$														
Rootstock	NS		NS		0.16		4.38		6.74		1.24		0.90	
IBA	7.78		0.75		0.28		7.59		11.68		2.16		1.57	
Rootstock × IBA	NS		1.06		0.40		10.73		16.52		3.05		2.22	

RESULTS AND DISCUSSION

Data pertaining to different attributes of rhizogenic capacity of studied pear rootstocks is presented in Table 1. It is evident from the results that IBA treatment had significant effect on rooting percentage of cuttings. The maximum rooting percentage was recorded under 1000 ppm IBA that was at par to the cuttings treated with 500 ppm IBA, while the minimum rooting percentage was reported with 2500 ppm IBA that was at par to the control. This may possibly be attributed to the division of the first root initial cells, which are dependent upon either applied or endogenous auxin application. Higher concentration of 2500 ppm is detrimental as that might cause tissue injury. These results are in conformity with those of Chalfun *et al*. (2007). The elaboration of data also shows that the length of primary and secondary roots were affected significantly by IBA (Table 1). The maximum length of primary and secondary roots measured in Quince-C. The possible reason behind this could be more number of secondary roots, which resulted in smaller length of primary roots in BA-29. The IBA treatment @ 1000ppm showed the highest length of primary and secondary roots, while the minimum value of primary roots were measured under the control treatment and secondary root length under 2500 ppm IBA treatment. The increased length of primary and secondary roots can be attributed to the fact that IBA can enhance tissue sensitivity for IAA and thus, increasing root length. IBA leads to the stimulation of cell division and cell elongation during root formation, which results in increased root length. The interaction between Rootstock and IBA resulted in the highest primary root length under BA-29 treated with 1000 ppm IBA and the least under BA-29 without IBA application. However, for secondary root length the best treatment combination was found to be BA-29 treated with 1500 ppm IBA. The results of our present investigation are in accordance with Shukla and Bist (1994). Maximum number of primary roots were registered under Quince-C, whereas maximum number of secondary roots were counted under BA-29. The number of primary and secondary roots were found to be directly associated with IBA treatments. The application of IBA @ 1000 ppm gave the highest number of primary and secondary roots. The treatment combination Quince-C treated with 1000 ppm IBA resulted in the highest number of primary roots, while the maximum number of secondary roots were recorded under BA-29 treated with 1000 ppm IBA. Our present findings are in line with those of Rana (1996). The rootstock BA-29 had the maximum fresh and dry weight of root. The treatment with IBA @ 1000 ppm resulted in the highest fresh as well as dry weight of root with a significant hike over the control treatment. Further for the inter-comparison effect of Rootstock x IBA interaction, the fresh and dry weight of root was found to be the maximum under BA-29 treated with 1000 ppm IBA. As the highest number of roots and more root length was found with 1000 ppm IBA, it is natural to have more root weight. These findings are in line with the findings of Jwanda *et al*. (1991).

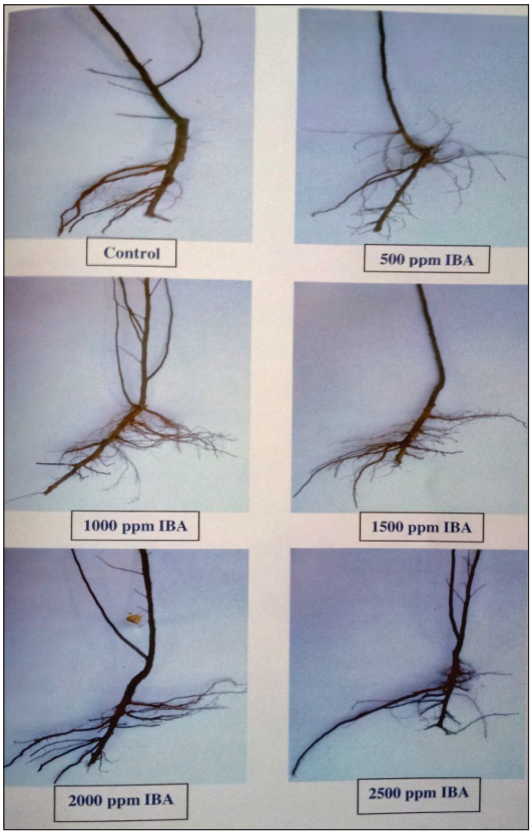

Plate 1: Root growth of pear rootstock BA-29 under various concentrations of IBA

Table 2 shows different parameters of shoot characteristics. These parameters are not only important from the survival and success point of view but also are essential to know the status of shoot length and girth which is required for grafting and budding. IBA had a significant influence sprouting percentage (Table 2). The sprouting

Table 2: Response of IBA on days to sprout, sprouting percentage, length and girth of sprout, number of leaves, leaf area, fresh and dry weight of shoot

Rootstock/ IBA Conc.	Sprouting percentage		Length of sprout (cm)		Girth of sprout (mm)		Fresh weight of shoot (g)		Dry weight of shoot (g)		Number of leaves per plant		Leaf area per plant (cm^2)	
	Quince C	BA 29	Quince C	BA 29	Quince C	BA 29	Quince C	BA 29	Quince C	BA 29	Quince C	BA 29	Quince C	BA 29
Control	81.25	75.00	84.52	88.47	9.31	9.54	19.42	21.51	13.09	14.55	82.49	89.26	694.40	827.83
500 ppm	87.50	85.00	89.16	101.16	9.62	10.79	24.19	28.32	15.40	17.19	89.83	103.93	840.19	1186.10
1000 ppm	92.50	95.00	102.25	108.81	11.05	11.14	31.23	35.84	18.18	22.55	126.01	107.25	1330.23	1489.50
1500 ppm	97.50	86.25	99.14	108.31	10.50	11.15	25.66	32.24	16.86	20.18	118.27	103.55	1200.74	1334.22
2000 ppm	86.25	82.50	91.65	101.64	9.50	10.71	21.38	29.55	14.32	18.00	98.72	96.48	932.45	1113.38
2500 ppm	80.00	77.50	87.66	94.20	9.39	10.67	21.24	22.54	14.11	14.44	90.57	93.92	829.03	878.57
$CD_{0.05}$														
Rootstock	2.06		1.41		0.16				0.31		1.50		21.51	
IBA	3.57		2.45		0.27				0.53		2.60		37.27	
Rootstock × IBA	5.05		3.47		0.39				0.76		3.68		52.71	

percentage was the highest in Quince-C. The treatment with IBA @ 1000 ppm lead to the highest sprouting percentage. The treatment combination, comprising Quince-C treated with 1500 ppm IBA recorded the maximum sprouting percentage, which is in agreement with the findings of Singh and Pandey (1990). The application of IBA, which initiates root formation by increasing internal free IBA, or synergistically modifying the action of IAA or endogenous synthesis of IAA, could be a reason for high sprouting percentage. The length and girth of sprout were significantly influenced by IBA. The highest length and girth of sprout were recorded on BA-29. This might be due to earliest sprouting in BA-29. The maximum length and girth of sprout were recorded under 1000 ppm IBA treatment while the least under control. These results are in line with Singh (2001). Among the interaction effect, the maximum length and girth of sprout were measured under BA-29 treated with 1000 ppm IBA and BA-29 treated with 1500 ppm IBA, respectively. In a trial on root formation on Le Conte pear as influenced by auxin treatments, El- Shazly and El- Sabrout (1994) found IBA to induce the maximum length of sprout. The present study revealed that the mean fresh and dry weight of shoot was significantly affected by IBA. The BA-29 rootstock recorded the highest fresh and dry weight of shoot. As far as the IBA treatments are concerned application of 1000 ppm recorded the maximum fresh and dry weight while the minimum with control. Among the different treatment combinations BA-29 treated with 1000 ppm IBA attained the highest fresh and dry weight of shoot. The improvement in fresh weight and dry weight of shoot in BA-29 treated with 1000 ppm IBA may possibly be due to increased length, girth and leaf area which resulted in greater amount of dry matter accumulation as a consequence of high photosynthates. These findings are in line with the findings of Shukla and Bist (1994). The maximum numbers of leaves at the final stage were counted on Quince-C. The IBA concentration @ 1000 ppm was found to be the best in terms of number of leaves per plant, while the lowest was reported under control (Table 3). As far as interaction effects are concerned, Quince-C when treated with 1000 ppm IBA leads to maximum number of leaves. Our present findings are in accordance with Sharma et al. (2005). The leaf area was recorded to be the highest under BA-29. The maximum leaf area was noticed under 1000 ppm IBA. The treatment combination comprising BA-29 and 1000 ppm IBA resulted in maximum leaf area. This may be possibly due to IBA which leads to the formation of root initials and thus root formation and finally into the absorbance of more amount of nutrient from soil. Jawanda et al. (1991) also reported that IBA promote leaf area.

CONCLUSION

Based on the overall effects of rootstocks and IBA, it can be concluded that Quince C and BA 29 responded very well for IBA treatments. Varying concentrations of IBA had pronounced an effect on both rhizogenic capacity and shoot characteristics and IBA treatment @1000 ppm was found the best for these parameters. Higher concentrations above 1000 ppm are not only detrimental to the success rate and growth of the cuttings, but will also unnecessary increase the cost of production. Therefore, keeping in view the various advantages of clonal rootstocks and the response of IBA in the regeneration potential of rootstocks, application of IBA @ 1000 ppm is being recommended for multiplication of Quince C and BA 29 rootstocks of pear.

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