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Muneer Ahmad
ICAR-Central Institute of Temperate Horticulture Srinagar, India

Sajad H Wani
ICAR-Central Institute of Temperate Horticulture Srinagar, India

Javid Iqbal Mir
ICAR-Central Institute of Temperate Horticulture Srinagar, India

DB Singh
ICAR-Central Institute of Temperate Horticulture Srinagar, India

OC Sharma
ICAR-Central Institute of Temperate Horticulture Srinagar, India

Sajad un Nabi
ICAR-Central Institute of Temperate Horticulture Srinagar, India

Danish Bashir
ICAR-Central Institute of Temperate Horticulture Srinagar, India

Gowher Dar
ICAR-Central Institute of Temperate Horticulture Srinagar, India

Wajeeda shafi
ICAR-Central Institute of Temperate Horticulture Srinagar, India

Sumaira Jan
ICAR-Central Institute of Temperate Horticulture Srinagar, India

Magna Rashid
ICAR-Central Institute of Temperate Horticulture Srinagar, India

Correspondence
Muneer Ahmad
ICAR-Central Institute of Temperate Horticulture Srinagar, India

Effects of IBA and GA3 on Rangpur lime (*Citrus limonia* Osbeck)

Muneer Ahmad, Sajad H Wani, Javid Iqbal Mir, DB Singh, OC Sharma, Sajad un Nabi, Danish Bashir, Gowher Dar, Wajeeda shafi, Sumaira Jan and Magna Rashid

Abstract
The experiment was conducted in a mist chamber to study the effect of IBA and GA3 alone comprising five concentrations each and in combination on rooting and shooting parameters of Rangpur lime cuttings. Among the various treatments used in the experiment it was found that I_2 (IBA 1000 PPM) gave the best response in respect of all the parameters studied viz., maximum number of roots/cutting (3.93), girth of the thickest root (1.38 mm), length of the longest root (4.47 cm), percentage of rooting/cutting (45.37), survival percentage of rooted cuttings (60.00) number of leaves/cutting (2.27), number of secondary branches/cutting (1.87) cutting and number of leaves/sec. branch (4.60) and minimum was with control. With the increase in concentration of GA3 it has consistently inhibited adventitious root formation.

Keywords: Rangpur lime, IBA, GA3, Plant

Introduction
Citrus fruits have a prominent place among popular and extensively grown as tropical and sub-tropical fruits. Citrus is the world's leading tree fruit crop, it is a crop adaptable to wide range of soils, terrain, planting and cultural arrangements and over 100 nations reported citrus in 1980 (1). Citrus fruits contain high levels of vitamin A and vitamin C. Among the citrus fruits cultivated in India, the Rangpur lime has been identified as suitable rootstocks for the Nagpur mandarin, Coorg mandarin, Mosambi and Sathgudi oranges. Rangpur lime (*Citrus limonia* Osbeck.) is a natural hybrid exhibiting the characters of both acid limes (*Citrus aurantifolia*Swingle) and mandarins (*Citrus reticulate*, Blanco). It is a native of India. It is a prolific variety of citrus with well flavoured and highly acidic fruits. The variety has world wide usage as a rootstock on account of its high resistance to tristiza virus and more tolerant to salts than others [2]. It is a principal rootstock in Brazil and Argentina for sweet oranges, mandarins and grape fruits.

Citrus trees are propagated both by seeds and vegetative means. Vegetative propagation is preferred because it ensures true to type plants, uniform quality & regular bearing. The purpose of treating cuttings with auxin type growth regulators is to increase the percentage of rooting, to hasten root initiation, to increase the number and quantity of roots produced per cuttings and to produce uniformity of rooting. Trees on these rootstocks are vigorous, precocious, less thorny, highly drought resistant and heavy bearer. In view of these characters, the present investigation was carried out.

Material and Methods
The present experiment was conducted in the mist chamber of Horticulture Department of Allahabad Agricultural Institute-Deemed University, Allahabad in the rainy season during the year 2003-2004. The cuttings were made on August 12, 2003 and were treated with IBA and GA_3 concentration alone and in combination as per different treatments by quick dip method. There were five different concentrations of IBA (I_0-Distilled water, I_1- 500ppm, I_2- 1000ppm, I_3-1500ppm, I_4-2000ppm) and five different concentrations of GA_3 (G_0-Distilled water, G_1-50ppm, G_2-100ppm, G_3-150ppm, G_4-200ppm).Fifteen cutting were taken under each treatment in three replications, so there were five cuttings in each replication under each treatment. About six months old mature branches were selected and cuttings were made about 15-20cm in length possessing 4-6 dormant buds with 2-3 leaves. While making cutting the lower basal cut was made horizontally at right angle to the axis and the upper cut was given just above the opposite side of the bud. The cuttings were dipped in respective growth regulators for 30 seconds. To see the combined effect of IBA & GA_3 the cuttings were treated first with GA_3

solution and then in IBA solution. After dipping the cuttings, they were removed and planted closely in rooting media sand. The cuttings were examined after 15 days of interval. The average number of roots/cuttings, average number of leaves/cutting, average number of secondary branches/cutting, average number of leaves/secondary branch, average length of the longest root, average girth of the thickest root, percentage of rooting/cutting and survival percentage of the rooted cuttings were recorded. The data were analyzed statistically as per method of analysis of variance [3].

Results and Discussion

The highest number of roots/cutting (3.93) was recorded with I_2 (1000ppm IBA) where as significantly lowest number of roots/cuttings (2.20) were recorded with I_O level of IBA. Similarly the highest percentage of rooting/cutting (45.37) was recorded with I_2 (1000ppm IBA) and lowest percentage of rooting/cutting (25.37) were recorded with I_O level of IBA. This might be due to that auxin is required for initiation of adventitious roots on stems and indeed it has been considered that divisions of the first root initial cells are dependent upon either applied or endogenous auxin [4].

Similarly GA_3 application at G_O level had recorded significantly the highest number of roots/cutting and highest percentage of rooting/cutting followed by G_1 level of GA_3 and lowest due to G_4 (200ppm GA_3) (Table.1).It is seen that GA_3 also increased number of roots/cutting from higher level to lower level, may be due to cell elongation by synthesizing enzymes and the effect of inhibitors [5]. The proportional decrease in number of roots/cutting and percentage of rooting/cutting have been recorded with the increase in the levels of GA_3 [6], they showed in their study that GA_3 partially inhibit auxin oxidase activity in an enzyme extract from crown gall tissue culture of parthenocissus tricuspidata. Similar statements have also been reported by Kato [7].

The maximum girth of the thickest root (1.38mm) and length of the longest root (4.47cm) were recorded significantly with I_2 (1000ppm IBA) level and minimum girth of the thickest root (0.80mm) and length of the longest root (2.20cm) were recorded with Io level of IBA. Similarly Go level of GA_3 produced the maximum girth of the thickest root and length of the longest root as compared to other levels of GA_3, whereas minimum girth of the longest root and length of the thickest root was recorded with G_4 level of GA_3. (Table 1). This may be due to that auxin play an important role in the metabolic activities and cell division which results in an increase of the growth of root [8, 9]. Thus it may be concluded that increase in the size of roots judged in terms of length and diameter was due to IBA treatment. This result was in confirmity with the findings of Dhua *et al* [10] in Jack fruit, Sandhu *et al*. [11] in Sweet lime and Kin *et al* [12] in *Citrus junos*.. The maximum survival percentage of rooted cuttings (60.00) was also recorded with I_2 level of IBA and minimum survival percentage of rooted cuttings (34.66) was recorded with Io level of IBA. Similarly Go level of GA_3 recorded maximum survival percentage than other level of GA_3 and G_4 level recorded minimum survival percentage of rooted cuttings.

The maximum number of leaves/cutting (2.27) was recorded with I_2 level of IBA and minimum number of leaves/cutting (1.17) was with Io where as other treatments remain at par. Similarly in case of GA_3, Go level recorded the highest number of leaves/cutting and G_4 recorded the lowest number of leaves/cutting (Table 2). The present finding suggested that number of leaves increased in the same trend as the number of roots increased with the same treatment. This may be attributed to its effect of shifting of assimilate partitioning from roots to leaves or leaves to roots and increased levels of chlorophyll and carbohydrates in leaves, stems and roots besides increased mineral content, hormonal balance and soluble protein in leaves. This result was in agreement with findings of Purohit and Shekkarapa [13] in *Punica granatum*, Sandhu *et al* [11] in sweet lime and Zora *et al.* [14] in *Citrus jambhiri.*

The highest number of secondary branches/cutting (1.87) and number of leaves/sec. branch (4.60) were recorded with I_2 (1000ppm IBA) whereas lowest number of secondary branches (1.33) and number of leaves/sec branch (2.06) were recorded with Io. Similarly Go level of GA_3 recorded the highest number of secondary branches/cutting and number of leaves/secondary branch and was lowest with G_4 level of GA_3. As the number of roots increased under IBA treatment so more number of apical roots also increased which are responsible for synthesis of cytokinin thus lead to the formation of more number of secondary branch per cutting and number of leaves/secondary branch. This result was in conformity with the findings of Abdul *et al.* [15].

Table 1: Effect of different doses of growth regulators on Rooting Parameters of cuttings.

Treatments	Number of roots/ cutting	Girth of the thickest root (mm)	Length of the longest root (cm)	Percentage of rooting/cutting	Survival percentage of rooted cuttings
I_O (Dist. water)	2.20	0.80	2.20	25.37	34.65
I_1 (500 PPM)	3.27	1.05	2.87	37.05	45.49
I_2 (1000 PPM)	3.93	1.38	4.47	45.37	60.00
I3 (1500 PPM)	3.33	1.11	3.13	38.45	53.06
I_4 (2000 PPM)	2.60	1.07	2.47	31.50	42.26
C.D at 5%	1.32	0.20	0.60	5.72	4.01
G_O (Dist. water)	5.26	1.76	6.20	60.12	57.69
G_1 (500 PPM)	3.33	1.22	3.27	39.97	50.12
G_2 (1000 PPM)	2.73	0.93	2.40	31.53	45.89
G_3 (1500 PPM)	2.20	0.82	1.78	25.35	42.79
G_4 (2000 PPM)	1.80	0.68	1.48	20.78	38.33
C.D at 5%	1.32	0.20	0.60	5.72	4.01
Interaction (IxG) C.D. at 5%	2.96	0.45	1.36	12.79	8.97

Table 2: Effect of different doses of growth regulators on vegetative parameters of cuttings.

Treatments	No. of leaves/cutting	No. of 2dry branches/cuttings	Number of leaves/sec. branches
I_O (Distilled water)	1.17	1.33	2.06
I_1 (500 PPM)	2.00	1.60	2.87
I_2 (1000 PPM)	2.27	1.87	4.60
I3 (1500 PPM)	1.93	1.60	3.27
I_4 (2000 PPM)	1.73	1.53	2.60
C.D at 5%	0.31	0.17	0.66
G_O (Distilled water)	2.60	2.15	6.20
G_1 (500 PPM)	2.27	1.80	3.40
G_2 (1000 PPM)	1.73	1.60	2.47
G_3 (1500 PPM)	1.33	1.33	1.84
G_4 (2000 PPM)	1.17	1.05	1.48
C.D at 5%	0.31	0.17	0.66
Interaction (IxG) C.D. at 5%	0.71	0.38	1.49

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