Effects of IBA on rooting performance of *Citrus auriantifolia* Swingle (Kagzi-lime) in different growing conditions

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Abstract: Considering the unavailability of information of the effect of rooting hormones in combination with modified growing conditions on the rooting characteristics of *Citrus auriantifolia* Swingle cuttings under valley conditions of Garhwal Himalaya, the experiment was undertaken at the HRC, Garhwal University Srinagar, Uttarakhand, India. The effect of different concentration of Indolebutyric acid (IBA) and different growing conditions have been examined for stimulatory effects adventitious root formation in stem cutting of Kagzi-lime. Properly prepared cuttings of about 22-24 cm length in the month of June were treated with different concentrations of IBA viz., 500, 1000, 1500 ppm for 5 second by concentrated solution dip method and planted in 3 different conditions namely open area, under partial shade and under low cost polyhouse. The cuttings treated with IBA 500 ppm, performed the best in all aspects, as root formation, length of root, thickening of root and leaf sprouting in shoot, whereas, the open area growing condition was found effective in increasing the success rate of the cuttings. All the rooting parameters performance was recorded highest under polyhouse condition. Overall treatment C_1M_3 (IBA 500ppm and polyhouse) combination was found best in all parameters taken. [Nature and Science 2010;8(7):8-11]. (ISSN: 1545-0740).

Key words: Kagzi lime, cuttings, IBA, rooting, low-cost poly house, Garhwal Himalaya.

1. Introduction

Kagzi lime belongs to family Rutaceae, is one of the most important citrus fruit as a major source of Vitamin C and acidic acid (Souci *et al.*2000) grown throughout the world (Babu, 2001). In India, it grown in the states of Andra Pradesh, Karnataka, Maharashtra, Punjab, Rajasthan and Uttarakhand in a total area of 125457.00 ha from which about 1617783.00 tonnes of production is obtained annually (Salaria, 2006 and FAO, 2008). In Uttarakhand the Lime is grown in certain portion of Pauri, Chamoli, Rudraprayag and Dehradun districts of Garhwal and some parts of Kumaon region, but there are hardly any systemic plantations of kagzi lime orchards in the state. Besides having high nutritional value and table purpose use, kagzi lime is extensively used as rootstock for malta and santra.

Generally, kagzi lime is regenerated through seeds, but there is a problem of non-uniformity of progeny and high chance of viral disease contamination by this method (Babu, 2001). For overcoming this problem the vegetative multiplication through cutting is only practicable and widely used option for augmenting natural regeneration and for large scale cultivation programmes. Owing to high intensity of polyembroyny (90-100%) and least chance of contamination of viral diseases (Babu, 2001) in Kagzi-lime, the stem cutting is suitable method for regeneration for the species. It is inexpensive, rapid and simple and does not require the special techniques as required in other vegetative methods.

The stimulation of adventitious root formation in stem cuttings treated with auxins is well known (Blazich, 1988). In addition, the combination with other compounds has been shown to enhance the root formation (Kling and Meyer 1983, Singh and Singh 2005). Phloroglucinol (1,3,5-trihydroxibenzene) stimulated *in vitro* root formation in apple root stocks (James and Thurbon, 1979); it was also reported to act synergistically with IBA in apple (James and Thurbon, 1981), *Rubus* (James, 1979) and in *Prunus* (Jones and Hopgood 1979) species. Although, there is a lot of work done on different aspects of propagation of citrus fruits, however, the effects of IBA with different growing condition in stimulation of rooting of cuttings appear to be unknown.

Keeping these facts in view, the present study, deals with the use of IBA with slight modifications of growing conditions for rooting

parameter and success percentage in the stem cuttings of kagzi lime with view to developing a mass scale clonal multiplication technology package which is cheap and simple.

2. Material and Methods

2.1 Study area

The experiment was carried out at the Horticulture Research Centre (HRC), in Chauras campus of HNB Garhwal University, Srinagar (Garhwal). Geographically the experimental site is lying between 30° 12′ to 30° 13′ North latitude and 78° 45′ to 78° 50′ East longitude while altitudinally located at 570 m asl. The site in the valley area of Garhwal Himalaya and experience a wide range of temperature variation ranging from 0°C in winter to a maximum of 40°C during summer. The relative humidity varies from 39.24 to 79.83 % and mean annual rainfall from 2.50 to 235.24 mm.

2.2 Methodology

4-5 gunny bags of sandy loam soil were taken from HRC field, exposed to Sun for killing the insects, spores of pathogens and the weeds. Stones, gravels and weeds were removed manually. After 2-3 hours drying in Sun in the month of June, 1 part of FYM was mixed thoroughly with the 2 parts of well dried sandy loam soil. This prepared media was filed in perforated polythene bags of about 1kg capacity y (20-22 cm height x 8-10 cm diameter). IBA solution of 500, 1000 and 1500 ppm were prepared and kept in 1 L beakers. The juvenile branches of mature Kagzi-lime trees (8-10 years) were used to obtain the cuttings in the end of June 2003. Approximately 22-24 cm long cuttings having 6-8 nodes with 0.6 - 1.2 cm diameter were prepared from central and basal parts of the branch. Cuttings were defoliated for reducing the transpiration rate and allowing the closer spacing in the bags. The cuttings were arranged into the 4 bundles each with 81 cuttings. Three bundles of cuttings were treated with different concentrations of IBA viz., 500 ppm, 1000 ppm and 1500 ppm respectively. The basal parts (2-3 cm) of all the cuttings were dipped in different concentrations of IBA for 5 second, concentrated solution dip method, (Hartmann *et al.* 2002) at room temperature of 20 $\pm$ 2 ^{0}C (3). Fourth bundle of cuttings was used as control (simply dipped for 5 sec in plain tap water). The treated cuttings were planted in the 3 different growing conditions, viz, open sunny area (M_1), partial shade of big tree throughout the day (M_2) and polyhouse conditions (M_3) of 3m (l) x 2m (b) x 2m (h) size.

Standard methodology was used to record the observations on root characteristics (Hartmann *et al.* 2002). The experiment was laid out in the factorial randomised block design (FRBD) with 3 replications having 9 cuttings in each replication within each treatment combination. The analysis of the data was done as per the standard methods (Cochran ad Cox, 1992).

3. Results and Discussion

The rooting response of *Citrus auriantifolia* cuttings treated with different IBA concentration and growing conditions is shown in table 1. The first callusing was observed on 14th day after planting the cutting and observed till 130 days. The lower concentration of IBA (500ppm) was found more effective. The mean values indicate that the maximum number of sprouted cuttings after 130 days was recorded in the treatment C_1 (500 ppm of IBA) with 68.50% followed by C_2 (1000 ppm IBA) treatment with 51.83 %. While, least number of sprouted cuttings (37.%) were recorded in C_0 treatment (control). Present findings are in line with the some earlier reports in the literature (Verma *et al.* 2005) but contradictory to the findings of Singh and Singh (2005), who noticed maximum sprouting percentage in higher concentration (3000 ppm of IBA). The maximum mean sprouting percentage (60.50%) was observed under the treatment M_1 (open area) closely followed by the treatment M_2 (partial shade) with 48.54% whereas, the lowest was recorded in M_3 (polyhouse) condition. However, C_1M_3 (500ppm of IBA with polyhouse condition) treatment was found the best treatment combination with 83.33% of sprouted cuttings. This may be due to favourable climatic conditions to the survival of cuttings under polyhouse condition as well as the effect of rooting hormones in lower doses.

Mean values of table 1 also reveals that the maximum number of primary roots (8.76) was obtained under C_2 (1000 ppm IBA) treatment followed by treatment C_1 (500 ppm of IBA) with 7.54. Present findings of the experiment is supported and strengthened by the work of Singh and Singh (2005), who observed the 13.55 number of primary roots per cuttings after treated with 1000ppm of IBA and Kumar *et al.* (1995). Treatment M_3 (polyhouse) produce the maximum number of primary roots (11.24) followed by M_1 (open area) treatment with 7.08, while, cuttings growing under M_2 (partial shade) condition produced minimum number of primary roots (4.06) among all the growing conditions. The interaction between various IBA concentrations and different

growing conditions was also found to be significant. The maximum number of primary roots (18.66) were observed under C_2M_3 (1000 ppm of IBA with polyhouse condition) treatment combination and followed by the treatment C_3M_3 (1500 ppm of IBA with polyhouse) treatment with 11.66. The C_1M_2 and C_2M_2 combination shown equal number of primary root (2.62) induction. The better rooting and their development (500 ppm of IBA with polyhouse) might be attributed due to greater metabolic activity and maximum utilisation of sugar and starch after hydrolysis from stem.

The maximum length of the root (15.11 cm) was found under C_1 (500 ppm of IBA) treatment followed by C_0 (control) treatment with 13.44 cm. The results of present investigation are strengthened by Verma *et.al.* (2005), reported that maximum root length (15.27 cm) in citrus cuttings. Whereas the growing condition M_3 (polyhouse) was found best, to producing the maximum length of root (18.75 cm), while the M_1 (open condition) shown the minimum length of root (9.08 cm). Combination treatment C_1M_3 (500 ppm of IBA with polyhouse grown) and C_2M_3 (1000 ppm IBA with polyhouse) were found equally good in term of producing the maximum length of longest root (20.33 cm), while, minimum length of root (4.66 cm) was found under C_2M_1 (1000 ppm of IBA with open area grown) treatment combination.

Furthermore, it is very clear from table 1 that the treatment C_1 has the maximum effect on root thickness (0.24 cm) and significantly better than all other treatments. The present findings are conformed by Singh and Singh (2005), who also observed the maximum effects of IBA to obtain the maximum diameter of root (1.93 mm) among all other growth regulators like IAA and NAA. Growing of cuttings under different growing conditions, M_3 (polyhouse) condition was found most suitable to give the maximum diameter of thickest root (0.26 cm), while minimum diameter of thickest root (0.21 cm) was observed under M_1 (open area) condition. Treatment combinations C_2M_3 (1000 ppm of IBA with polyhouse) and C_3M_3 (1500 ppm of IBA with polyhouse) were found equally good for producing the maximum diameter of root (0.30 cm).

4. Conclusion

The results of investigation clearly reveal that the IBA 500 ppm is most effective in the stimulation of root system arising from cutting and development of roots of *Citrus auriantifolia* cutting, and can be used for mass scale multiplication. It was interesting to observe that open area growing condition alone gives good results but moreover, IBA 500 ppm gives good results with combination of polyhouse growing condition. The results of this investigation are expected to pave the way for substantially augmenting natural regeneration through seeds; in addition, this has the advantage clonal or true to type propagation of elite trees.

Table 1: Effect of different concentrations of IBA and various growing conditions on success percentage and rooting parameters of kagzi-lime cuttings.

IBA Conc.	Percentage of sprouted cuttings (%)				Number of primary root (cm)				Length of longest root (cm)				Diameter of thickest root (cm)			
	M_1	M_2	M_3	Mean	M_1	M_2	M_3	Mean	M_1	M_2	M_3	Mean	M_1	M_2	M_3	Mean
Control (Water)	61.00	33.33	15.33	36.55	7.33	7.66	5.66	6.88	10.33	11.33	18.66	13.44	0.20	0.20	0.20	0.20
500 ppm	72.16	50.00	83.33	68.50	11.00	2.62	9.00	7.54	14.00	11.00	20.33	15.11	0.26	0.20	0.26	0.24
1,000 ppm	50.00	55.50	55.50	53.67	5.00	2.62	18.66	8.76	4.66	11.66	20.33	12.22	0.20	0.20	0.30	0.23
1,500 ppm	58.83	55.33	38.83	51.00	5.00	3.33	11.66	6.88	7.33	7.33	15.66	10.11	0.20	0.20	0.30	0.23
Mean	60.50	48.54	48.25		7.08	4.06	11.24		9.08	10.33	18.75		0.21	0.20	0.26	
$CD_{0.05}$																
IBA Conc. (C)			3.07			1.37				2.26				0.016		
Growning conditions (M)			2.66			1.18				1.95				0.018		
C x M			5.32			2.37				3.92				0.032		

M_1= Open sunny area, M_2= Partial shade of big tree throughout the day, M_3= Polyhouse condition

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