Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 6, Issue, 12, pp.10974-10976, December, 2014

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

EFFECT OF VARIOUS CONCENTRATIONS OF IBA, TYPE OF CUTTINGS AND PLANTING TIME ON THE ROOTING OF CUTTINGS OF LEMON (*CITRUS LIMON* BURM.) CV. PANT LEMON-1 UNDER VALLEY CONDITIONS OF GARHWAL HIMALAYA

***Satpal, Manju, Rawat, S. S. and Singh, K. K.**

Department of Horticulture, Chauras Campus, HNB Garhwal University (A Central University), Srinagar (Garhwal) 246174, Uttarakhand, India

ARTICLE INFO

Article History:
Received 21st September, 2014
Received in revised form
24th October, 2014
Accepted 07th November, 2014
Published online 30th December, 2014

Key words:

Pant lemon,
IBA, Type of cutting,
Planting time and Rooting.

ABSTRACT

The present investigation was carried out at Horticultural Research Centre, Department of Horticulture, Chauras Campus, H.N.B. Garhwal University, Srinagar (Garhwal), Uttarakhand, India during the year 2012-13. The experiment consisted of thirty six treatment combinations, which comprised of concentrations of IBA viz; 200 ppm, 400 ppm, 600 ppm and control, type of cuttings viz; Softwood, Semi-hard wood, Hardwood cuttings and three planting times viz; November 20, December 20 and January 20. The experiment was replicated thrice with 10 cuttings in each treatment and a total of 360 cuttings were tested. The cuttings were planted in polythene bags (1 kg capacity). The results indicated that among the various treatment combinations, $T_2C_3S_2$ (December planting time, 600 ppm concentrations of IBA and semi-hardwood cutting) treatment combination was recorded superior. Thus, it can be suggested that semi-hardwood cuttings of Lemon (*Citrus limon* Burm.), cv. Pant Lemon-1 planted in December after treatment with 600 ppm concentrations of IBA is an effective way to improve propagation under valley conditions of Garhwal Himalaya.

INTRODUCTION

Pant lemon belongs to the Family *Rutaceae*, subfamily *Aurantoideae* having chromosome number 2n=18. Most of the Citrus species are native to tropical and sub-tropical regions of South-East Asia, particularly India and china and the regions between these two countries (**Gosh, 1990**[a]). Its juicy containing 5 percent citric acid is used primarily in cooking. Lemon peel, dehydrated, is marketed as cattle feed.

Propagation by asexual method has gained importance over sexual method, due to advantage like preservation of original characters, early bearing etc. Among asexual means, raising the plants by cutting is most commercial and simple. It has been reported that the citrus species when propagated by cuttings give lower percentage of success without any treatment. Therefore, to achieve higher percentage of success, bio-regulators have been tested in lemons to standardize the concentrations of growth regulators. A very little work has so for been done in the Lemon (*Citrus limon* Burm.) cv. Pant Lemon-1, particularly under the valley conditions of Garhwal Himalaya.

Corresponding Author: Satpal,
Department of Horticulture, Chauras Campus, HNB Garhwal University (A Central University), Srinagar (Garhwal) 246174, Uttarakhand, India.

MATERIAL AND METHODS

Stem cuttings of Pant lemon were collected from 4 to 6 year old plants and prepared in 15 cm long cuttings. The experiment consisted of thirty six treatment combinations, which comprised of concentrations of IBA viz; 200 ppm, 400 ppm, 600 ppm and control, type of cuttings viz; Softwood, Semi-hard wood, Hardwood cuttings and three planting times viz; November 20, December 20 and January 20. For preparing the rooting media, sandy soil and farm yard manure (FYM) in ratio of 1:1 by v/v were mixed thoroughly, cleaned for stones and grasses, then the mixture was filled in polythene bags (1 kg capacity). The basal ends of the cuttings were dipped in dilute solutions, 200 ppm, 400 ppm, 600 ppm and control of indole-3-butyric acid by socking method for 24 hours before planting them in the rooting medium. The treated cuttings were planted carefully in the polythene bags. The experiment was replicated thrice with 10 cuttings in each treatment and a total of 1080 cuttings were tested. The number of sprouts, length of sprouts, diameter of thickest sprouts and number of leaves on new sprout were measured 15 days interval of planting. The number of primary and secondary roots, length of roots, diameter of thickest roots, fresh weight of shoots and roots, dry weight of shoots and roots recorded 90 days after cuttings were planted. The data recorded were subjected to statistical analysis for least significant difference factorial randomised block design (FRBD) as described by (Cochran and Cox, 1992).

RESULTS AND DISCUSSION

The rooting response of Lemon (*Citrus limon* Burm.) cuttings treated with various concentrations of IBA, type of cuttings and planting time in showed in Table 1 and 2. significantly the maximum survival percentage of cuttings (72.59%), number of sprouts (4.48), length of longest sprout (6.75 cm), diameter of thickest sprout (0.26 cm), number of leaves on new sprout (18.44), fresh weight of shoot (1.01 gm), dry weight of shoot (0.18 gm), percentage of rooted cuttings (72.59%), number of primary roots (6.63), number of secondary roots (59.26), length of longest roots (8.50 cm), diameter of thickest roots (0.28 cm), fresh weight of roots per cutting (0.82 gm) and dry weight of roots per cutting (0.13 gm) was recorded under C_3 (600 ppm concentration of IBA) while the minimum survival percentage of cuttings (34.82%), number of sprouts (2.48), length of longest sprout (4.61 cm), diameter of thickest sprout (0.19 cm), number of leaves on new sprout (11.89), fresh weight of shoot (0.59 gm), dry weight of shoot (0.07 gm), percentage of rooted cuttings (34.82%), number of primary roots (3.37), number of secondary roots (27.00), length of longest roots (5.38 cm), diameter of thickest roots (0.19 cm), average fresh weight of roots (0.29 gm) and dry weight of roots (0.04 gm) was observed under C_0 (Control) treatment. Hormones have been shown to regulate different aspects of plant growth and development including cell division, cell elongation and differentiation. It may be due the presence of large number of chemically and physiologically unrelated compounds such as phenols, gibberellins, abscisic acid and others have been found to influence the regeneration of roots in cuttings of several plants (Hiss, 1968 and Gerter, 1969). Carbohydrate reserves in the cuttings are responsible for the maximum sprouting. It may be affected by season and several factors such as temperature, light and nutrient availability to the survival percentage of cuttings. It may be due to the action of auxin which might have caused hydrolysis and translocation of carbohydrates and nitrogenous substances at the base of cuttings and resulted in accelerated cell elongation and cell division in suitable environment (Hartmann *et al*., 2007). Auxin application has been found to enhance the histological features like formation of callus and tissue and differentiation of vascular tissue (Mitra and Bose, 1954). The present findings are similar to the findings of Singh *et al*. (2003) in cutting of long pepper (*Piper longum* L.). In case of the type of cutting, significantly the maximum survival percentage of cuttings (64.44%), number of sprouts (4.11), length of longest sprout (6.63 cm), diameter of thickest sprout (0.25 cm), number of leaves on new sprout (17.89), fresh weight of shoots (0.99 gm), dry weight of shoots (0.18 gm), percentage of rooted cuttings (64.44%), number of primary roots (5.89), number of secondary roots (53.42), length of longest roots (7.58 cm), diameter of thickest roots (0.25 cm), fresh weight of roots (0.75 gm), dry weight of

Table 1. Effect of various concentrations of IBA, type of cuttings and planting time on survival performance and vegetative growth of Lemon (*Citrus limon* Burm.) cv. Pant Lemon-1 cuttings

Treatments	Survival percentage of cutting	Number of sprout	Length of sprout (cm)	Diameter of sprout (cm)	Number of leaves	Fresh weight of shoot (g)	Dry weight of shoot (g)
Concentration of IBA (ppm)							
C_1 (200 ppm IBA)	60.74	3.74	5.74	0.23	15.29	0.74	0.09
C_2 (400 ppm IBA)	65.19	4.33	6.61	0.26	17.26	0.88	0.15
C_3 (600 ppm IBA)	72.59	4.48	6.75	0.26	18.44	1.01	0.18
C_0 (Control)	34.82	2.48	4.61	0.19	11.89	0.59	0.07
C.D. at 5%	0.959	0.097	0.100	0.005	0.320	0.025	0.008
Type of cuttings							
S_1 (Softwood)	53.33	3.44	5.39	0.20	13.53	0.67	0.07
S_2 (Semi-hardwood)	64.44	4.11	6.63	0.25	17.89	0.99	0.18
S_3 (Hardwood)	57.22	3.72	5.81	0.24	15.75	0.76	0.12
C.D. at 5%	0.719	0.073	0.075	0.003	0.240	0.019	0.006
Planting time							
T_1 (November 20)	52.22	3.61	5.67	0.22	13.36	0.79	0.13
T_2 (December 20)	63.33	3.83	6.23	0.24	18.22	0.98	0.17
T_3 (January 20)	59.44	3.83	5.93	0.24	15.58	0.65	0.08
C.D. at 5%	0.719	0.097	0.075	0.003	0.240	0.019	0.006

Table 2. Effect of various concentrations of IBA, type of cuttings and planting time on rooting performance of Lemon (*Citrus limon* Burm.) cv. Pant Lemon-1 cuttings

Treatments	Percentage of rooted cuttings	Number of primary roots	Number of secondary root	Length of root (cm)	Diameter of roots (cm)	Fresh weight of roots (g)	Dry weight of roots (g)
Concentration of IBA (ppm)							
C_1 (200 ppm IBA)	60.74	5.19	43.04	7.08	0.25	0.52	0.07
C_2 (400 ppm IBA)	65.19	6.07	52.70	7.88	0.27	0.65	0.08
C_3 (600 ppm IBA)	72.59	6.63	59.26	8.50	0.28	0.82	0.13
C_0 (Control)	34.82	3.37	27.00	5.38	0.19	0.29	0.04
C.D. at 5%	0.959	0.133	1.511	0.165	0.006	0.025	0.006
Type of cuttings							
S_1 (Softwood)	53.33	4.86	40.22	7.11	0.24	0.44	0.06
S_2 (Semi-hardwood)	64.44	5.89	53.42	7.58	0.25	0.75	0.13
S_3 (Hardwood)	57.22	5.19	42.86	6.95	0.25	0.52	0.06
C.D. at 5%	0.719	0.100	1.133	0.124	0.004	0.019	0.005
Planting time							
T_1 (November 20)	52.22	4.50	38.53	6.47	0.23	0.57	0.08
T_2 (December 20)	63.33	6.69	55.14	7.99	0.27	0.65	0.11
T_3 (January 20)	59.44	4.75	42.83	7.17	0.25	0.49	0.06
C.D. at 5%	0.719	0.100	1.133	0.124	0.004	0.019	0.005

roots (0.13 gm) was recorded under S_2 (Semi-hardwood cutting) treatment while the minimum survival percentage of cuttings (53.33%) number of sprouts (3.44), length of longest sprout (5.39 cm), diameter of thickest sprouts (0.20 cm), number of leaves on new sprout (13.53), fresh weight of shoots (0.67 gm), dry weight of shoot (0.07 gm), percentage of rooted cuttings (53.33%), number of primary roots (4.86), number of secondary roots (40.22), diameter of thickest roots (0.24 cm), fresh weight of roots (0.44 gm) and dry weight of roots (0.6 gm) was recorded under S_1 (Softwood cutting) treatment. Length of longest roots (6.95 cm) was recorded under S_3 (Hardwood cutting) treatment. Carbohydrate reserves in the cuttings are responsible for the maximum sprouting. It may be due to wood maturity of cutting which probably reserves high starch and sugar.

Better rooting in cuttings taken from the middle portion of the shoot or tip portion and the percentage of rooting was higher from ringed shoots. The better rooting and their development might be attributed due to greater metabolic activity and maximum utilization of sugar and starch after hydrolysis from stem. Semi-hardwood cuttings gave the best result in terms of rooting when cuttings were taken from juvenile plants (Koltsov, 1988). The present findings are similar to the findings of Maity and Mitra (1990) in semi hardwood cuttings of litchi. significantly maximum survival percentage of cutting (63.33), number of sprouts (3.83), length of longest sprout (6.23 cm), diameter of thickest sprout (0.24 cm), number of leaves on new sprout (18.22), fresh weight of shoot (0.98 gm), dry weight of shoot (0.17 gm), percentage of rooted cuttings (63.33%), number of primary roots (6.69), number of secondary roots (55.14), length of longest roots (7.99 cm), diameter of thickest roots (0.27 cm), fresh weight of roots (0.65 gm) and dry weight of roots (0.11 gm) was recorded under T_2 (December planting time) treatment while the minimum survival percentage of cuttings (52.22%), number of sprouts (3.61), length of longest sprout (5.67 cm), diameter of thickest sprout (0.22 cm), number of leaves on new sprout (13.36), percentage of rooted cuttings (52.22%), number of primary roots (4.50), number of secondary roots (38.53), length of longest roots (6.47 cm), diameter of thickest roots (0.23 cm) was observed under T_1 (November planting) treatment. Fresh weight of shoots (0.65 gm), dry weight of shoot (0.08 gm), fresh weight of roots (0.49 gm) and dry weight of roots (0.06 gm) was observed under T_3 (January planting) treatment. This may be affected by season and several factors such as temperature, light and nutrient availability to the survival percentage of cuttings. It may be depends on species, favourable climatic conditions to the percentage of sprouted cuttings. Shafrir and Mendel (1970) found that the rooting behavior of cuttings varied with the seasons, low temperature adversely affecting rooting. The present findings are similar to the findings of Bondok *et al.* (1984) in persimmon.

Conclusion

Among various concentration of IBA, Concentration C_3 (600 ppm IBA) treatment showed the best performance in terms of percentage of survival percentage of cuttings, number of sprouts, length of longest sprouts, diameter of thickest sprouts, number of leaves on new sprout, fresh and dry weight of shoots per cutting, percentage of rooted cuttings, number of primary and secondary roots, length of longest roots, diameter of thickest roots, fresh and dry weight of roots, while among the different cuttings of Pant lemon-1, Semi-hardwood cutting has shown best result in present study. It may also be successfully used for clonal propagation. December 20 was found to be the most appropriate time for planting in term of rooting of cuttings. It is suggested that semi-hardwood cutting treated with 600 ppm concentration of IBA gives the overall best performance under field condition to produce tallest plant of Pant lemon-1 within a short time and recommend for commercial vegetative multiplication.

REFERENCES

*Hiss, C.E. 1968. Internal and external factors regulating root initiation. *In* : W. J. Whittington (ed.), Root Growth. Proc. 15th Easter School in *Agri. Sci. Nottingham,* pp. 42-53.

*Koltsov, D.P. 1988. Rooting of Turkish Filbert summer cutting using auxin stimulus of rhizogenesis. *Referativnyi Zhurnal*, 6 : 597.

*Shafrir, M. and Mendel, K. 1970. Effect of season and shoot maturity in rooting Washington Navel orange cuttings. *Plant Propagator,* 16 (4) : 6-9.

Bondok, A.S., Salama, M.A. and Moustafa, A.A. 1984. Studies on persimmon propagation by root cuttings. *Annals of Agricultural Science*, Ain Shams Univ., Cairo, Egypt., 29(2) : 1045-1054.

Ghosh, S.P. 1990[a]. Citrus. *In*: Fruits: Tropical and subtropical. Eds. Bose and Mitra, Naya Prokash, Calcutta. pp. 65.

Gorter, C.J. 1969. Auxin synergists in the rooting of cuttings. *Plant physiol*., 22 : 497-502.

Hartmann, H.T., Kester, D.E., Devies, F.T. and Geneve, R.L. 2007. Plant Propagation Principles and Practices. Seventh Edition, Prentice Hall of India Pvt. Ltd., New Delhi.

Maity, S.C. and Mitra, S.K. 1990. Litchi. *In*: Fruits: Tropical and Subtropical. Eds. Bose and Mitra, Naya Prokash, Calcutta. pp. 428.

Singh, A.K., Singh R., Mittal, A.K., Singh, Y.P. and Jauhari, S. 2003. Effect of plant growth regulators on survival rooting and growth characters in long pepper (*Piper longum* L.). *Prog. Hort.,* 35(2) : 208-211.

Cochran, W.G. and Cox, M.G. 1992. Experimental design. John Wiley Sons, Inc, New York, : 106-117.

*Mitra, G.C. and Bose, N. 1954. Rooting and histological responses of detached leaves to B-Indolebutyric acid with special reference to *Boerhavia diffusa* Linn. *Phytomorphology,* 7 : 370.

****