EFFECT OF DIFFERENT DOSES OF IBA AND ROOTING MEDIA ON ROOTING OF STEM CUTTING OF LEMON (*CITRUS LIMON* BURM) CV. PANT LEMON-1

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Abstract: The present investigation was conducted during 2011-12 at Horticultural Research Centre of Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut (UP) - 250110. The experiment was laid of Randomized Block Design (RBD) with three replications. The experiment consisted of ten treatment viz., T_1 - 400ppm IBA +garden soil + sand (1:1),T_2 - 400ppm IBA + garden soil + sand + FYM (1:1:1), T_3 - 400ppm IBA + garden soil + sand + vermi-compost (1:1:1), T_4 - 800ppm IBA + garden soil + sand (1:1), T_5 - 800ppm IBA + garden soil + sand + FYM (1:1:1) ,T_6 - 800ppm IBA + garden soil + sand + vermi-compost (1:1:1), T_7 - 1200ppm IBA + garden soil + sand (1:1), T_8 -1200ppm IBA + garden soil + sand + FYM (1:1:1), T_9 - 1200ppm IBA + garden soil + sand + vermi-compost (1:1:1), T_{10} - Control (Garden soil). Out of these, the treatment 800ppm IBA + garden soil + sand + vermi-compost (1:1:1) was gave significant results on rooting of stem cuttings and survival percentage of lemon (*Citrus limon* Burm) cv. Pant Lemon-1 as compared to control ones under western UP conditions.

Keywords: Lemon stem cutting, IBA, Vermi-compost, Survivality

INTRODUCTION

Fruits are nature's gift to mankind. These are not only delicious and refreshing also the chief source of vitamins, minerals and proteins, carbohydrates and roughages. Among these, the fruits of citrus group are recognizing as leading fruits in world trade. They are mostly grown in subtropical regions of India. Most of citrus fruits are rich in vitamin C. Hence, citrus fruit having great socio-economic importance to fruit growers for better living of standard. In developing countries like India, deficiency of vitamin C is quite common in human beings. Therefore, lemon is a good source of vitamin C to compensates the deficiency symptoms of this vitamin through the plenty availability in fruit like lemon and add in regular diet.

Fruits have great value to fetch the maximum return by exporting them and value added products. India share 10 per cent of total fruit production of the world. Citrus is an important group of fruit crops among all the fruits in India. Citrus has second rank in area and third rank in production among the all fruits in Indian scenario (Anonymous, 2012).

The total area under citrus cultivation is 942.7 thousand hectare in India with an annual production 8082.95 thousand metric tones. The productivity of citrus fruit is 9.0 $MTha^{-1}$. The area under lime/lemon cultivation in Uttar Pradesh is 0.52 thousand hectare with an annual production 1.42 thousand metric tons (Anonymous, 2013).

Lemon has been found to be the most suitable citrus fruit crop of western UP due to its better adaptability and availability of fruits throughout the year. Lemons are primarily used as a fresh fruit. Beside, these fresh lemons are used to making of lemonade, shikanji and for preparing lemon tea. Lemon is a good source of citric acid, which is used for pharmaceutical purposes and manufacturing aerated water. Lemon is good source of lemon oil and used as stimulant and carminative. Lemon juice with common salt is recommended as a remedy for dysentery and heat strokes during summer season. Lemon squash and pickles are also valuable preserves food items which are extensively used in most of Indian homes.

Lemon trees put on new growth as series of discrete growth cycles or flushes. There is a major flush of new growth in spring season, which produces most of the flowers and some new leaves on shoot tips at mature branches. There is great variation in initiation of growth, flushes and its behaviour depending upon a number of factors such as environmental, type of soil, species, varieties and age of tree etc.

Several cultivars of lemon are being grown in all part of India. Out of these, Pant Lemon-1 is the most promising cultivar for western UP conditions. It is a single plant selection from "Kagzi Kalan Lemon". It bears flowers and fruits in two main flushes and exhausts more nutrients to maintain vegetative growth, include flowering and fruiting (Raj, 1990).

Quality planting material is always prime need to the fruit growers. Therefore, the main aim to produce quality planting material for distribution to grower community. For the above purpose, a rapid method for multiplication of planting material is needed to obtained good quality plants. To obtained ideal planting material through vegetative propagation like cutting is the cheapest, rapid and simplest method of multiplication of plants. The developed plants through cuttings are true -to- type and have uniform

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growth and plant canopy. Such plant comes into bearing earlier than the seedlings plants. The success of cuttings depend upon the many factors, associated with plants i.e., age of the mother plant, parts used of tree, time of planting, rainfall, humidity, temperature, rooting media and after care (Frey *et al.* 2006). Besides these, mechanical treatment like ringing and girdling play an important role to promote rooting of cuttings (Biswas, 1995). Ringing and girdling interrupt the downward translocation of carbohydrates, hormonal status and other possible root promoting substances which helps in shoot initiation and formation. These techniques are used on shoots prior to their removal from mother plants to obtained cuttings. It enhance the rooting in cuttings(Evert and Smittle.1990).

The auxin *indole- butyric acid* has been identified as rooting hormones. Exogenous application of IBA induces rooting of stem cuttings. It promotes rooting as well as number of roots. In many fruit species, formation of adventitious roots can be induced by given treatment with auxin. The cell elongation in roots is also significantly improved with the application of exogenous auxin. Now-a-days, auxin has been employed as commercial application of rooting of cuttings. Auxin affects a variety of physiological process in plants i.e., nucleic acid directed protein synthesis, enzyme activity and membrane permeability, either directly or through some other metabolic activities. Similarly, rooting media is also play an important role for better root formation and development. An ideal rooting medium should be loose, porous with high water holding capacity. Rooting medium holds cutting in place, holding moisture content for new emerged roots, congenial conditions for respiration and maintains optimum temperature for the root initiation. The nature of roots arising from the cuttings is also influenced by the type of rooting medium e.g., cutting when planted in pure sand produce long, unbranched, coarse and brittle roots but those planted in a mixture of sand, soil and peat, produces well developed branches. (Chattopadhyay, 1994). Similarly, various rooting media i.e., garden soil, sand, FYM and vermi-compost were taken in appropriate ratio for planting of cutting. The FYM and vermi-compost are important key element of rooting media because they have various major and micro-nutrient. Keeping the above explanation an experiment entitled "Effect of different doses of IBA and rooting media on rooting of stem cutting of lemon (*Citrus limon* Burm) cv. Pant Lemon-1" was formulated and conducted at HRC, SVP University of Agriculture and Technology, Meerut.

MATERIAL AND METHOD

The present investigation was conducted during 2011-12 at the Horticulture Research Centre of Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, 250110 (UP), to Study the effect of different doses of IBA and rooting media on rooting of stem cutting of lemon (*Citrus limon* Burm) cv. Pant Lemon-1. The climate of this tract is subtropical with extreme weather conditions, consisting of hot dry summers and cold winters. The maximum temperature ranges from 40 to 45^0 C during summer and minimum temperature ranges from 7 to 8^0 C during winter. The frost was occasionally seen in the month of December and January. The experiment was conducted in Randomized Block Design (RBD) with three replications. Total ten treatments including control i.e., T_1- 400ppm IBA + garden soil + sand (1:1), T_2- 400ppm IBA + garden soil + sand + FYM (1:1:1), T_3- 400ppm IBA +garden soil + sand + vermi-compost (1:1:1), T_4-800ppm IBA + garden soil + sand (1:1), T_5- 800ppm IBA + garden soil + sand + FYM (1:1:1), T_6- 800ppm IBA + garden soil + sand + FYM (1:1:1), T_7-1200ppm IBA + garden soil + sand (1:1), T_8- 1200ppm IBA + garden soil + sand + FYM (1:1:1), T_9-1200ppm IBA + garden soil + sand + vermi-compost (1:1:1) and T_{10}- Control (Garden soil) were used. For obtaining stem cuttings, 9-10 month old shoots of Pant Lemon-1 cultivar of lemon was selected for conducting experiment.

According to treatment combinations, the different rooting media were prepared and filled in black colour poly-bags. The 22.50 cm long and pencil thickness sized cuttings were made and treated with prepared IBA solution according to different doses of IBA. Thereafter, cuttings were planted in poly-bags and placed in shade net-house during third week of July month. The various observation like days taken for sprouting (days), Per cent of sprouting cutting (%), Number of shoots per cutting, Number of leaves per cutting, Length of primary root (cm), Diameter of primary root (cm), Length of longest root (cm) and Survival Per cent (%) were recorded with proceeding of experiment. The recorded data were statistically analyzed by using randomized block design (RBD) as suggested by Gomez and Gomez (1996).

RESULT AND DISCUSSION

The data pertaining from the Table-1 indicated that different doses of IBA and rooting media significantly affect the various parameters of stem cutting of lemon cv. Pant Lemon-1 during course of investigation. The T_6- (800ppm IBA + garden soil + sand + vermi-compost (1:1:1) was found significantly superior as compared to control and other applied treatment in terms of days taken for sprouting, percentage of sprouting cutting, number of shoot per cutting, number of leaves per cutting, length of primary root (cm), diameter of primary root (cm), length of longest root (cm) and survival percentage (%) of lemon cutting. Results from the Table-1 showed that each increment in IBA

concentration significantly affected in terms of days taken to sprouting as compared to control and other treatments. The minimum days were taken to sprouting upto T_6- 800ppm IBA + garden soil + sand + vermi-compost (1:1:1), thereafter it was slightly more. The minimum days (6.00) to sprouting was observed in T_6 followed by T_7-1200ppm IBA + garden soil + sand (1:1) and T_8- 1200ppm IBA + garden soil + sand + FYM (1:1:1) whereas, maximum days(17) were noticed under control (T_{10}). The Treatment (T_4 and T_9) were gave at par results on days taken to sprouting. The minimum days to sprouting may be due to down ward translocation of carbohydrates and accumulation of auxin inside of cuttings for completion of physiological process. Similarly, rooting media like soil + sand +vermi-compost may also be provided good congenial condition for early sprouting in cuttings. Similar findings were also reported by Kour, *et al*. 2006 and Awasthi, *et al*. 2008. Similar results were also found in terms of percentage of sprouting cutting. The per cent sprouting cuttings were significantly affected by increasing doses of IBA up to 800ppm and garden soil + sand + vermi-compost; thereafter it was markedly declined with further application of higher doses of IBA. The maximum per cent of sprouting cutting (81.90 %) was recorded with T_6- 800ppm IBA + garden soil + sand + vermi-compost (1:1:1)] followed by T_5-800ppm IBA + garden soil + sand + FYM (1:1:1) and T_7-1200ppm IBA + garden soil + sand (1:1), whereas the minimum per cent of sprouting cutting (39.40 %) was recorded with T_{10} (control). I might be due to high accumulation of callus formation in cuttings with optimum dose of auxin resulting highest percentage of sprouted cuttings. The present findings collaborated with earlier findings of Pio *et al*. 2002, Pandey *et al.,* 2003 and Bassan *et al.,* 2010.

In context of number of shoots per cutting and number of leaves per cutting were significantly influenced by different doses of IBA and rooting media in lemon cutting during the investigation (Table-1).The number of shoot per cutting and number of leaves per cutting were significantly increased with the increment of each dose of IBA upto T_6- 800ppm IBA + garden soil + sand + vermi-compost (1:1:1) then a declined trend was noticed with further higher doses of IBA. The data clearly stated that plant receiving dose of T_6 [800ppm IBA + garden soil + sand + vermi-compost (1:1:1)] gave the maximum number of shoot (8.0%) per cutting followed by T_5 [800ppm IBA + garden soil + sand + FYM (1:1:1)] and T_7- 1200ppm IBA + garden soil + sand (1:1), while minimum number of shoot (1.80) per cutting was recorded under T_{10} (control). Likewise, the number of leaves per cutting was also found in significant manner with application of lower to higher doses of IBA and various combinations of rooting media as compared to control. The maximum number of leaves per cutting (14.0) were recorded in T_6- 800ppm IBA + garden soil + sand + vermi-compost (1:1:1)] followed by T_5 (11.0) and T_7 (10.0), while minimum number of leaves (3.0) per cutting was recorded under T_{10} Control. Such types of observation might be due to activation of auxin in vegetative parts by using auxin like IBA. Similarly, vermi-compost favoured the vegetative growth due to it has major and micro nutrients in rooting media. So that it favoured number of shoots and number of leaves per cutting. Similar findings are close in conformity with the earlier results given by Kumar *et al*., 2004, Urban and Leachouder, 2005, Murkute *et al*., 2009.

In other hand, the different concentration of IBA and various rooting media was gave a advantageous response in the expressions of length of primary root (cm), diameter of primary root (cm) and Length of longest root (cm) as compared to control and other applied treatments in rooting of cuttings of lemon during the course of study. The maximum length (7.9 cm) of primary root was recorded with an application of T_6- 800ppm IBA + garden soil + sand + vermi-compost(1:1:1) followed by T_5 (6.3cm) and T_7 (5.9cm), while minimum length (2.1cm) of primary root was recorded under T_{10} (control). Similarly, the maximum diameter (0.43 cm) of primary root was noticed with T_6-800ppm IBA + garden soil + sand + vermi-compost (1:1:1) followed by T_5 (0.37 cm) and T_7 (0.35 cm) and minimum diameter (0.14 cm) of primary root was found under T_{10} (control). In addition to that similar results were also reported in terms of length of longest root. The maximum length (9.50 cm) of longest root was recorded with an application T_6- 800ppm IBA + garden soil + sand + vermi-compost(1:1:1), followed by T_5 (8.2 cm) and T_4 (7.8cm) whereas minimum length of longest root (3.9 cm) was recorded under T_{10} (control). These parameters showed significant results may be due to optimum level of auxin accelerated cell elongation, cell division and proliferation of callus at base of cuttings. Similarly, the media like garden soil + sand + vermi-compost (1:1:1) might be favoured the excellent growth of roots of cutting. It may be due to friable nature of rooting media, resulting good penetration of roots in rooting media. These findings are in close conformity with earlier results of Abdullah and Khateeb (2004), Deb, *et al*., 2009, Sharma *et al.,* 2009.

The survival per cent was significantly influenced by different concentration of IBA and various combinations of rooting media on rooting of cuttings of lemon as compared to control and other treatments during course of investigation. The maximum survival per cent (88.7%) was recorded with T_6-(800ppm IBA + garden soil + sand + vermi-compost (1:1:1), followed by T_5 (80.3%) and T_7 (78.50 %), consequently, minimum survival percentage (57.6%) was recorded under T_{10} (control).The survival

percentage directly associated with the use of root promoting auxin like IBA and ideal rooting media for rooting of cuttings. Similarly, optimum temperature and high humidity per cent also play a vital role for high accumulation of auxin content in cuttings. These favourable conditions may lead to good photosynthesis to accumulate photosynthates and carbohydrates, resulting significant rate of survival of rooted cuttings. Similar results were also reported by Saini *et al.*, 2010 and Chayanika, *et al.*, 2011.

CONCLUSION

In present investigation different IBA concentrations and rooting media were applied for rooting of cuttings of lemon cv. Pant Lemon-1. In this respect total ten treatments were tried. Out of these, the treatment 800ppm IBA + garden soil + sand + vermi-compost (1:1:1) was found most significant treatment for rooting of stem cuttings and survival percentage of lemon (*Citrus limon* Burm) cv. Pant Lemon-1 as compared to control ones under western UP conditions.

Table 1. Effect of different doses of IBA and rooting media on rooting performance and survival percentage of stem cutting of Lemon cv. Pant Lemon-1

Treatments	Days taken for sprouting	Percentage of sprouting cutting (%)	Number of shoots per cutting	No. of leaves/ cutting	Length of primary root(cm)	Diameter of primary root(cm)	Length of Longest root(cm)	Survival (%)
T_1	14	43.50	2.5	4	2.8	0.18	4.6	59.80
T_2	13	47.70	3.0	6	3.3	0.21	5.2	63.90
T_3	11	54.30	4.0	7	4.1	0.28	6.1	67.20
T_4	10	63.20	5.7	9	5.6	0.32	7.8	73.80
T_5	8	74.70	6.0	11	6.3	0.37	8.2	80.30
T_6	6	81.90	8.0	14	7.9	0.43	9.5	88.70
T_7	7	71.20	5.8	10	5.9	0.35	7.0	78.50
T_8	9	60.50	4.4	9	4.7	0.29	6.5	70.40
T_9	10	56.10	3.1	8	3.5	0.26	5.8	65.90
T_{10}	17	39.40	1.8	3	2.1	0.14	3.9	57.60
S.Em+	**0.612**	**0.110**	**0.152**	**0.459**	**0.078**	**0.005**	**0.074**	**0.547**
CD at 5%	**1.831**	**0.328**	**0.455**	**1.376**	**0.233**	**0.014**	**0.222**	**1.638**

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