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Influence of IBA levels on rooting, growth, physiological traits and survival of different seedless lemon (*Citrus limon* (L.) Burm. f.) cuttings

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Abstract
The experiment was conducted at Fruit Research Station Imaliya, Department of Horticulture, JNKVV, Jabalpur (M.P.) in 3 x 4 Factorial Randomized Block Design (FRBD) consisting of 12 treatments with 3 replications. Factor-A had three levels of cuttings (hardwood, semi hardwood, soft wood cuttings and factor-B had four levels of IBA (0, 2000, 3000 and 4000 ppm). *Citrus limon* (L.) can be propagated successfully through stem cutting. Hence, this experiment was conducted to find out the effectivity of IBA levels on growth and success of cuttings. Among factor-A, hardwood (A_1) showed the significantly better results and soft wood (A_3) showed the low performance. Among factor-B, IBA @ 3000 ppm showed the significantly better results and IBA @ 0 ppm showed the lowest performance. However, treatment combination T_4 (hardwood cutting + IBA @ 4000 ppm) showed the minimum days to start sprouting (4 days) and light transmission ratio (80.00%, 65.67% and 62.67%) at 60, 90, 120 days respectively. Maximum number of shoots per cuttings (2.27 and 2.67) at 60 and 120 days after planting, survival percentage of cutting (83.33%), fresh weight of shoot (16.47 g), dry weight of shoot (6.73 g), total fresh weight of plant (19.17 g), total dry weight plant (7.30 g), fresh weight of root (2.70 g), dry weight of root (0.57 g) at 120 days. Leaf area index (0.91, 3.09 and 4.34), leaf area duration (60.00 and 111.46) (between 60 to 90 and 90 to 120 days), chlorophyll content index (56.10, 65.20 and 51.37) was also recorded maximum at 60, 90, 120 days after planting respectively in T_4 (hardwood cutting + IBA @ 4000 ppm).

Keywords: Seedless lemon (*Citrus limon* (L.) Burm. f.*)*, IBA levels, cuttings (Hardwood, semi hardwood, soft wood), propagation

Introduction
Among the citrus species, lemons (*Citrus limon* (L.) Burm. f.) represent a substantial crop. All around the world, it is used for both non-culinary and culinary reasons. It is of Indian origin and a member of the Rutaceae family (Spiegel-Roy and Goldschmidt, 1996) [21]. Lemons are a great source of minerals K, Ca, Fe, Mg, Na, S, and P, as well as vitamins C, B, and A. Among its many medicinal properties is antiseptic, antioxidant, anti-helminthic, stomachic, constipating, abdominal pain, antiallergic, anti-inflammatory, antiviral, anti-cancerous, and anti-carcinogenic properties (Mante, 2019) [15]. Its market-sold candies and flavour-infused drinks give it an abundance of socioeconomic importance (Liu and Associates, 2012) [14]. India leads the globe in the production of acid lime and lemons but ranks fourth in the world for citrus production. In metric tonnes, India produces 10.76 million.

According to Gautam *et al*. (2022) [5], plant growth regulators are synthetic compounds that function at relatively low concentrations in locations other than the site of synthesis. These chemicals regulate a range of physiological processes that influence the growth and development of plants. It has been demonstrated that plant growth agents given exogenously can help to promote healthy and early root formation in cuttings. Cutting root emergence is influenced by growth regulators such as auxins, cytokinins, gibberellin and ethylene. These substances have been reported to possess a greater impact on root formation associated with cuttings.

As per the findings of Mirra and Bose (1954), auxin plays a role in the differentiation of vascular tissues and the creation of callus tissue. It has been demonstrated that IBA (indole 3-

butyric acid) is the most successful root-promoting agent in lemon and lime cultivars (Khursheed and Abdul, 2003) [10]. The best material for general use is probably indole-3-butyric acid because it is safe for plants to consume at varying doses, which promotes the germination of numerous plant species (Hartmann and Kester, 1990) [8]. In certain instances, the development of cuttings is also negatively impacted by IBA concentrations (Blythe *et al*., 2007) [2]. Root initiation and development may be inhibited by auxin concentrations that are significantly higher than those observed in plant tissues. The optimum amount of auxin necessary to support the roots and survival of different cuttings. The purpose of the current study was to evaluate the growth, survival and performance of different lemon stem cuttings at various IBA levels.

Materials and Methods

Three replications using an asymmetric factorial RBD design were used to set up the experiment. Three types of cutting-hardwood, Semi hardwood, softwood (Factor-A) and four levels of IBA-0 ppm, 2000 ppm, 3000 ppm, 4000 ppm (Factor-B) were employed in the experiment. A cutting was selected from a mother plant that was 9-10 years old. Dormant branches were utilized to make hardwood cuttings. Softwood cuttings were obtained from immature new shoots, while semi-hardwood cuttings derived from a branch that was both mature and immature in terms of physiological development.

The IBA solution was made up of 0, 2000, 3000 and 4000 ppm. The basal region of the stem cuttings was treated with the appropriate IBA concentrations (0 ppm, 2000 ppm, 3000 ppm and 4000 ppm) according to the treatment and was immediately planted in polythene bags containing media soil 75% and Vermicompost 25%.

Days to sprouting are calculated by difference taken between days of sprouting and days of planting of cutting. The number of shoots emerging out from three cuttings under each treatment was recorded at 60 and 120 days after planting. Total number of rooted cuttings survived under each treatment in each replication was recorded and survival percentage of cutting calculated. After the plant extraction from the poly bag at 120 days and after separation of plant and roots the fresh weight of shoot, root and plant was taken by using weighing balance. For dry weight evaluation shoot and root must sun dry for 5-6 days then oven dry them by using hot air oven till constant weight not obtained. The leaf area index was calculated by leaf area divide by ground area. Leaf Area Duration is the result of integrating LAI over time. Employing a SPAD chlorophyll meter chlorophyll content index was measured. Utilizing a LUX meter, LTR is measured at two different plant heights (above and below). The ratio of quantum light intercepted by the crop canopy at the top to the bottom was calculated.

Results and Discussion

Data regarding days to start sprouting is shown in Table 1. All treatments were recorded significant results in days to start sprouting. Among different IBA levels, minimum days to start sprouting (8.56 days) were observed in IBA @ 3000 ppm. Among cuttings, minimum days to start sprouting (6.25 days) were observed in hardwood cuttings. Among treatment combinations treatment T_4 (Hardwood cutting + IBA @ 4000 ppm) showed minimum days to start sprouting (4 days). However, maximum days to start sprouting (16 days) were observed in T_{12} (Soft wood + IBA @ 4000 ppm). This might be due to IBA enhanced the hydrolysis of reserve food material and regulated the endogenous auxin level through enhancement of IBA oxidase activity which was supported by the investigations of Seiar (2016) [19] in pomegranate.

Data pertaining to number of shoots is shown in Table 1. All treatments were performed significant results in number of shoots. Among different IBA levels, maximum number of shoots (1.87 and 2.26) was obtained at 60 and 120 days after planting respectively in IBA @ 3000 ppm. Among cuttings, maximum number of shoots (2.05 and 2.46) was observed at 60 and 120 days after planting respectively in hardwood cuttings. Among treatment combinations treatment T_4 (Hardwood cutting + IBA @ 4000 ppm) showed maximum number of shoots (2.27 and 2.67) at 60 and 120 days after planting respectively. However, minimum number of shoots (1.23 and 1.37) at 60 and 120 days after planting respectively in T_{12} (Soft wood cutting + IBA @ was obtained 4000 ppm). It might be due to It might be due to activation of auxin in vegetative part by using IBA. Such findings reported by Kumar and Singh (2020) [11].

Data regarding survival percentage is shown in Table 1. All treatments were recorded significant results in Survival percentage. Among different IBA levels, maximum survival percentage (55.56%) was observed in IBA @ 3000 ppm. Among cuttings, maximum survival percentage (70.83%) was observed in hardwood cuttings. Among treatment combinations treatment T_4 (Hardwood cutting + IBA @ 4000 ppm) showed maximum survival percentage (83.33%). However, minimum survival percentage (26.67%) was observed in T_{12} (Soft wood + IBA @ 4000 ppm). This might be due This might be due to growth regulator ability to encourage the growth of adventitious root systems and lengthen and increase the number of roots per cutting by absorbing water and minerals from the soil. This is going to assist the cuttings survive (Reddy *et al*., 2008) [17].

Data regarding fresh weight of shoot is shown in Table 2. All treatments were recorded significant results in Fresh weight of shoot. Among different IBA levels, maximum fresh weight of shoot (12.80 g) was observed in IBA @ 3000 ppm. Among cuttings, maximum fresh weight of shoot (14.93 g) was observed in hardwood cuttings. Among treatment combinations treatment T_4 (Hardwood cutting + IBA @ 4000 ppm) showed maximum fresh weight of shoot (16.47 g). However, minimum fresh weight of shoot (7.51 g) was observed in T_{12} (Soft wood + IBA @ 4000 ppm). This might be due maximum fresh weight of shoot and plant. Similar findings have been reported auxin play role in early plant activity, cutting produced more sprouts, leaves, increased leaf area, leaf chlorophyll content, more starch, total sugar, and C:N ratio resulted by H. Rymbai *et al*. (2010) [18], Seiar (2016) [19] and Ghosh *et al*. (2017) [6].

Data regarding dry weight of shoot is shown in Table 2. All treatments were recorded significant results in dry weight of shoot. Among different IBA levels, maximum dry weight of shoot (5.26 g) was observed in IBA @ 3000 ppm. Among cuttings, maximum dry weight of shoot (6.83 g) was observed in hardwood cuttings. Among treatment combinations treatment T_4 (Hardwood cutting + IBA @ 4000 ppm) showed maximum dry weight of shoot (6.73 g). However, minimum dry weight of shoot (3.02 g) was observed in T_{12} (Soft wood + IBA @ 4000 ppm). This might be due to optimum auxin concentration may encourage the

movement of natural auxin and nutrients in the upward direction from roots and other parts which result in accumulation at the place of incision on the dry weight of shoot. Similar findings are reported by Rymbai *et al*. (2010) [18]; Singh *et al.* (2015) [20].

Data regarding fresh weight of plant is shown in Table 2. All treatment combinations were recorded significant results in fresh weight of plant. Among different IBA levels, maximum fresh weight of plant (14.82 g) was observed in IBA @ 3000 ppm. Among cuttings, maximum fresh weight plant (17.22 g) was observed in hardwood cuttings. Among treatment combinations treatment T_4 (Hardwood cutting + IBA @ 4000 ppm) showed maximum fresh weight of plant (19.17 g). However, minimum fresh weight of plant (8.71 g) was observed in T_{12} (Soft wood + IBA @ 4000 ppm). This might be due auxin play role in early plant activity, cutting produced more sprouts, leaves, increased leaf area, leaf chlorophyll content, more starch, total sugar, and C:N ratio resulted by H. Rymbai *et al*. (2010) [18], Seiar (2016) [19], Ghosh *et al*. (2017) [6].

Data regarding dry weight of plant is shown in Table 2. All treatment combinations were recorded significant results in dry weight of plant. Among different IBA levels, maximum dry weight of plant (5.61 g) was observed in IBA @ 3000 ppm. Among cuttings, maximum dry weight of plant (6.90 g) was observed in hardwood cuttings. Among treatment combinations treatment T_4 (Hardwood cutting + IBA @ 4000 ppm) showed maximum dry weight of plant (7.30 g). However, minimum dry weight of plant (3.14 g) was observed in T_{12} (Soft wood + IBA @ 4000 ppm). This might be due optimum auxin concentration may encourage the movement of natural auxin and nutrients in the upward direction from roots and other parts which result in accumulation at the place of incision on the dry weight of shoot. Similar findings are reported by Rymbai *et al*. (2010) [18]; Singh *et al.* (2015) [20].

Data regarding fresh weight of root is shown in Table 2. All treatment combinations were recorded significant results in fresh weight of plant. Among different IBA levels, maximum fresh weight of root (2.02 g) was observed in IBA @ 3000 ppm. Among cuttings, maximum fresh weight of root (2.29 g) was observed in hardwood cuttings. Among treatment combinations treatment T_4 (Hardwood cutting + IBA @ 4000 ppm) showed maximum fresh weight of root (2.70 g). However, minimum fresh weight of root (1.20 g) was observed in T_{12} (Soft wood + IBA @ 4000 ppm). This might be due to IBA enhance cell permeability in favour of enhanced water and mineral build up within them, thus ensuring the formation of a robust root system, which inevitably accounted for the increment in the fresh weight of root. Increased number and length of root achieved through auxin was also influential in positively affecting fresh weight of roots. Hardwood cutting have higher amount of sugar, total carbohydrate and peroxidase enzyme activity, as well as low nitrogen are provided ideal condition for rooting. Similar findings supported by Bhardwaj and Mishra (2005) [1].

Data regarding dry weight of root is shown in Table 2. All treatment combinations were recorded significant results in dry weight of root. Among different IBA levels, maximum dry weight of root (0.35 g) was observed in IBA @ 3000 ppm. Among cuttings, maximum dry weight of root (0.52 g) was observed in hardwood cuttings. Among treatment combinations treatment T_4 (Hardwood cutting + IBA @ 4000 ppm) showed maximum dry weight of root (0.57 g). However, minimum dry weight of root (0.12 g) was observed in T_{12} (Soft wood + IBA @ 4000 ppm). This might be due stimulating effect of auxin on cell division which fostered the emergence of adventitious roots, further proteins and carbohydrates accumulated in large quantities in auxin treated cuttings resulted increase root dry weight of cuttings. Similar findings supported. Basal cutting (hard wood cutting) from the branch was best rooted and gave highest rooting and survival compared to medium and terminal cuttings. Similar findings reported by Elsheikh (1999) [3]. Hardwood cutting show best root and shoot development also reported.

Data pertaining to leaf area index is shown in Table 3. All treatments were performed significant results in leaf area index. Among different IBA levels, maximum leaf area index (0.67, 2.33 and 3.36) was recorded at 60, 90, 120 days respectively in IBA @ 3000 ppm. Among cuttings, maximum leaf area index (0.85, 2.75 and 3.87) was observed at 60, 90, 120 days respectively in hardwood cuttings. Among treatment combinations treatment T_4 (Hardwood cutting + IBA @ 4000 ppm) showed maximum leaf area index (0.91, 3.09 and 4.34) at 60, 90, 120 days respectively. However, minimum leaf area index (0.37, 1.25 and 2.08) was observed at 60, 90, 120 days respectively in T_{12} (Soft wood + IBA @ 4000 ppm). It might be due to optimum IBA concentration provide a greater number of roots which increased nutrient uptake and aerial growth of the plants resulted highest leaf area. Auxin might activate more photosynthates by expanding leaves and resulted more leaf area. Similar findings are supported by Navjot and Kahlon (2002) [16]. Hard wood cutting had fastest physiological process completion, early sprouting, and a higher leaf count and greater rooting. Which facilitate more mineral and water uptake and affect photosynthesis activity which expand leaf area.

Data pertaining to leaf area duration is shown in Table 4. All treatments were performed significant results in leaf area duration. Among different IBA levels, maximum leaf area duration (44.93 and 85.32) was recorded between 60 to 90 and 90 to 120 days interval respectively in IBA @ 3000 ppm. Among cuttings, maximum leaf area duration (54.11 and 94.29) was observed between 60 to 90 and 90 to120 days interval respectively in hardwood cuttings. Among treatment combinations treatment T_4 (Hardwood cutting + IBA @ 4000 ppm) showed maximum leaf area duration (60.00 and 111.46) between 60 to 90 and 90 to120 days interval respectively. However, minimum leaf area duration (24.32 and 49.92) was observed between 60 to 90 and 90 to120 days interval respectively in T_{12} (Soft wood + IBA @ 4000 ppm). It might be due to basal cutting from the branch were best rooted and IBA facilitate the greater number of leaves which enhance the quantity of chlorophyll produced, which in turn increases photosynthesis and, eventually, sink yield and vegetative cell growth. Singh and colleagues (2015) [20]. This affects the leaf area index which directly affect the leaf area duration in different intervals.

Data pertaining to chlorophyll content index is shown in Table 5. All treatments were performed significant results in chlorophyll content index. Among different IBA levels, maximum chlorophyll content index (50.12, 60.08 and 44.63) was recorded at 60, 90, 120 days respectively in IBA @ 3000 ppm. Among cuttings, maximum chlorophyll content index (51.89, 61.24 and 47.10) was observed at 60,

90, 120 days respectively in hardwood cuttings. Among treatment combinations treatment T_4 (Hardwood cutting + IBA @ 4000 ppm) showed maximum chlorophyll content index (56.10, 65.20 and 51.37) at 60, 90, 120 days respectively. However, minimum chlorophyll content index (38.57, 50.00 and 32.90) was observed at 60, 90, 120 days respectively in T_{12} (Soft wood + IBA @ 4000 ppm). It might be due to basal cutting from the branch were best rooted and IBA might activated more photosynthates resulting in more chlorophyll content of leaves. Similar findings reported by Galston and Davies (1972) [4] and Kumari (2014) [13]. The observed decrease in chlorophyll concentration over 120 days compared to 90 days may be the result of leaves senescing at that point. Hardwood cutting have mature tissue facilitate early completion of physiological process, facilitates more mineral water uptake and photosynthesis process which facilitate more leaf chlorophyll content and canopy spread.

Data pertaining to light transmission ratio is shown in Table 6. All treatments were performed significant results in light transmission ratio. Among different IBA levels, minimum light transmission ratio (65.44, 46.78 and 42.33) was recorded at 60, 90, 120 days respectively in IBA @ 3000 ppm. Among cuttings, minimum light transmission ratio (60.50, 39.25 and 36.33) was observed at 60, 90, 120 days respectively in hardwood cuttings. Among treatment combinations treatment T_4 (Hardwood cutting + IBA @ 4000 ppm) showed minimum light transmission ratio (55.67, 33.67 and 31.67) at 60, 90, 120 days respectively. However, maximum light transmission ratio (80.00, 65.67 and 62.67) was observed at 60, 90, 120 days respectively in T_{12} (Soft wood + IBA @ 4000 ppm). It might be due to basal cutting from the branch were best rooted and LTR is correlated with LAI which exhibit the lowest and highest transmission through the crop canopy is reflected in higher value of LAI, more canopy size more light interception and less transmission through the canopy. Similar findings supported by Thakur and Kaur (2001) [22]. IBA at higher concentration provided more leaf area which gave more canopy of cutting resulted less LTR. Hard wood cutting provide more canopy spread because of more LAI so LTR is low in them.

Table 1: Influence of IBA and types of lemon cuttings on days to start sprouting (days), survival percentage (%) and number of shoots (at 60 and 120 days)

	Days to start sprouting (days)	**Survival Percentage (%)**	**Number of shoot at 60 DAP**	**Number of shoot at 120 DAP**
Factor-A (Cuttings)				
Hard wood cutting	6.25	70.83	2.05	2.46
Semi Hard wood cutting	9.00	45.00	1.73	2.33
Soft wood cutting	12.25	35.83	1.48	1.69
S.Em(±)	0.294	2.508	0.045	0.052
CD at 5%	0.863	7.357	0.132	0.151
Factor-B (IBA levels)				
IBA @ 0 PPM	9.78	41.11	1.61	2.02
IBA @ 2000 PPM	8.67	54.44	1.84	2.24
IBA @ 3000 PPM	8.56	55.56	1.87	2.26
IBA @ 4000 PPM	9.67	51.11	1.70	2.11
S.Em(±)	0.34	2.896	0.052	0.062
CD at 5%	0.996	8.495	0.153	0.175
Treatment Combination				
T_1	8.33	60	1.77	2.03
T_2	6.67	66.67	1.97	2.50
T_3	6	73.33	2.20	2.63
T_4	4	83.33	2.27	2.67
T_5	9.67	30	1.57	2.20
T_6	9.33	50	1.83	2.33
T_7	8	56.67	1.93	2.47
T_8	9	43.33	1.60	2.30
T_9	11.33	33.33	1.50	1.83
T_{10}	10	46.67	1.73	1.90
T_{11}	11.67	36.67	1.47	1.67
T_{12}	16	26.67	1.23	1.37
S.Em(±)	0.588	5.017	0.090	0.103
CD at 5%	1.725	14.714	0.264	0.302

Table 2: Influence of IBA and types of lemon cuttings on fresh weight (g) and dry weight (g) of shoot, root and plant

	Fresh weight of shoot (g)	Dry weight of shoot (g)	Fresh weight of root (g)	Dry weight of root (g)	Total fresh weight of plant (g)	Total dry weight of plant (g)
Factor-A (Cuttings)						
Hard wood cutting	14.93	6.38	2.29	0.52	17.22	6.9
Semi Hard wood cutting	12.42	4.82	1.84	0.27	14.26	5.09
Soft wood cutting	9.08	3.71	1.43	0.15	10.51	3.86
S.Em(±)	0.274	0.102	0.04	0.007	0.295	0.099
CD at 5%	0.805	0.298	0.116	0.021	0.864	0.292
Factor-B (IBA levels)						
IBA @ 0 PPM	10.68	4.68	1.52	0.27	12.2	4.95
IBA @ 2000 PPM	12.78	5.07	2	0.33	14.78	5.39
IBA @ 3000 PPM	12.8	5.26	2.02	0.35	14.82	5.61
IBA @ 4000 PPM	12.31	4.86	1.87	0.3	14.18	5.16
S.Em(±)	0.317	0.117	0.046	0.008	0.34	0.115
CD at 5%	0.929	0.344	0.134	0.024	0.997	0.337
Treatment Combination						
T_1	13.19	6.07	1.57	0.48	14.76	6.55
T_2	14.62	6.1	2.27	0.5	16.89	6.6
T_3	15.43	6.6	2.63	0.54	18.07	7.14
T_4	16.47	6.73	2.7	0.57	19.17	7.3
T_5	10.33	4.1	1.47	0.2	11.79	4.3
T_6	12.4	4.77	2.13	0.29	14.53	5.06
T_7	14	5.57	2.07	0.37	16.07	5.94
T_8	12.95	4.83	1.7	0.21	14.65	5.05
T_9	8.53	3.87	1.53	0.14	10.06	4.01
T_{10}	11.33	4.33	1.6	0.19	12.93	4.52
T_{11}	8.97	3.6	1.37	0.15	10.33	3.75
T_{12}	7.51	3.02	1.2	0.12	8.71	3.14
S.Em(±)	0.549	0.203	0.079	0.014	0.589	0.199
CD at 5%	1.609	0.596	0.233	0.042	1.728	0.583

Table 3: Influence of IBA and types of lemon cuttings on leaf area index

	60 DAP	90 DAP	120 DAP
Factor-A (Cuttings)			
Hard wood cutting	0.85	2.75	3.87
Semi Hard wood cutting	0.61	2.09	3.12
Soft wood cutting	0.44	1.5	2.29
S.Em(±)	0.012	0.053	0.076
CD at 5%	0.036	0.154	0.222
Factor-B (IBA levels)			
IBA @ 0 PPM	0.6	1.79	2.67
IBA @ 2000 PPM	0.65	2.19	3.2
IBA @ 3000 PPM	0.67	2.33	3.36
IBA @ 4000 PPM	0.62	2.14	3.14
S.Em(±)	0.014	0.061	0.087
CD at 5%	0.041	0.178	0.256
Treatment Combination			
T_1	0.81	2.27	3.22
T_2	0.82	2.68	3.63
T_3	0.87	2.97	4.27
T_4	0.91	3.09	4.34
T_5	0.57	1.76	2.57
T_6	0.64	2.16	3.43
T_7	0.65	2.33	3.47
T_8	0.59	2.1	3
T_9	0.41	1.33	2.22
T_{10}	0.49	1.73	2.53
T_{11}	0.48	1.68	2.33
T_{12}	0.37	1.25	2.08
S.Em(±)	0.024	0.105	0.151
CD at 5%	0.072	0.308	0.444

Table 4: Influence of IBA and types of lemon cuttings on leaf area duration (in days)

	60 to 90 DAP	90 to 120 DAP
Factor-A (Cuttings)		
Hard wood cutting	54.11	99.29
Semi Hard wood cutting	40.51	78.09
Soft wood cutting	29	56.82
S.Em(±)	0.816	1.493
CD at 5%	2.392	4.379
Factor-B (IBA levels)		
IBA @ 0 PPM	35.76	66.82
IBA @ 2000 PPM	42.6	80.81
IBA @ 3000 PPM	44.93	85.32
IBA @ 4000 PPM	41.52	79.29
S.Em(±)	0.942	1.724
CD at 5%	2.762	5.057
Treatment Combination		
T_1	46.24	82.32
T_2	52.59	94.74
T_3	57.6	108.64
T_4	60	111.46
T_5	35	64.93
T_6	42	83.85
T_7	44.79	87.07
T_8	40.25	76.5
T_9	26.05	53.22
T_{10}	33.21	63.86
T_{11}	32.41	60.26
T_{12}	24.32	49.92
S.Em(±)	1.631	2.986
CD at 5%	4.784	8.759

Table 5: Influence of IBA and types of lemon cuttings on chlorophyll content index

	60 DAP	90 DAP	120 DAP
Factor-A (Cuttings)			
Hard wood cutting	51.89	61.24	47.1
Semi Hard wood cutting	48.08	57.09	42.39
Soft wood cutting	44.33	54.54	38.39
S.Em(±)	0.869	0.909	0.864
CD at 5%	2.548	2.666	2.535
Factor-B (IBA levels)			
IBA @ 0 PPM	46.18	54.79	40.02
IBA @ 2000 PPM	49.06	58.68	44.23
IBA @ 3000 PPM	50.12	60.08	44.63
IBA @ 4000 PPM	47.06	56.96	41.62
S.Em(±)	1.003	1.05	0.998
CD at 5%	2.942	3.078	2.927
Treatment Combination			
T_1	47.2	56.27	42.93
T_2	50.7	59.8	45.87
T_3	53.57	63.7	48.23
T_4	56.1	65.2	51.37
T_5	45.97	54.8	39.87
T_6	49.43	58.53	43.7
T_7	50.43	59.37	45.4
T_8	46.5	55.67	40.6
T_9	45.37	53.3	37.27
T_{10}	47.03	57.7	43.13
T_{11}	46.37	57.17	40.27
T_{12}	38.57	50	32.9
S.Em(±)	1.737	1.818	1.729
CD at 5%	5.096	5.332	5.07

Table 6: Influence of IBA and types of lemon cuttings on light transmission ratio

	60 DAP	90 DAP	120 DAP
Factor-A (Cuttings)			
Hard wood cutting	60.5	39.25	36.33
Semi Hard wood cutting	67.25	46.5	41.58
Soft wood cutting	76.58	62.58	56.58
S.Em(±)	1.283	1.292	0.969
CD at 5%	3.762	3.789	2.843
Factor-B (IBA levels)			
IBA @ 0 PPM	71.56	52.67	47.33
IBA @ 2000 PPM	66.56	47.78	43.22
IBA @ 3000 PPM	65.44	46.78	42.33
IBA @ 4000 PPM	68.89	50.56	46.44
S.Em(±)	1.481	1.492	1.119
CD at 5%	4.344	4.375	3.282
Treatment Combination			
T_1	69	47	43.33
T_2	60.67	40.33	37.33
T_3	56.67	36	33
T_4	55.67	33.67	31.67
T_5	69.67	49.67	44
T_6	66.33	42.67	39.67
T_7	62	41.33	37.67
T_8	71	52.33	45
T_9	76	61.33	54.67
T_{10}	72.67	60.33	52.67
T_{11}	77.67	63	56.33
T_{12}	80	65.67	62.67
S.Em(±)	2.565	2.584	1.938
CD at 5%	7.523	7.578	5.685

Conclusion

On the basis of result, it is concluded that among different cuttings hardwood performed best and among different levels of IBA, IBA @ 3000 ppm showed best results. While among treatment combination, hardwood cutting treated with IBA @ 4000 ppm performed best with respect to rooting, growth, survival and physiological parameters. The hardwood cutting treated with IBA @ 3000 ppm was found next best treatment combination for propagation of seedless lemon.

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