

Effect Of Different Doses Of IBA On Success, Survivability And Growth Of Lemon Using Leaf Cut Method Under Glass House And Field Condition

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Abstract

An experiment was conducted at the Horticulture division of Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh during the period from March, 2024 to June, 2024 to evaluate the quick propagation techniques from lemon leaves by using IBA under glass house and field condition. The experiment was consisted of two factors such as Environmental condition: (i) glass house and field condition and (ii) Different doses of IBA: D₀ (Control), D₁ (1000ppm IBA for 3mins) D₂ (1500ppm IBA for 3mins) and D₃ (2000ppm IBA for 3mins). Mature leaves were collected from BINA Lebu-1 mother plants. Collected leaves were exposed by different doses of IBA solution separately and also a control. The experiment was laid out in RCBD with three replications. Total 24 treatment combinations of the environmental condition and IBA levels. IBA exposed leaves of lemon were planted in the unit plots on 8 March, 2024 in the afternoon with spacing of 15cmx15cm (row to row and leaf to leaf distance). Different environmental condition showed significantly influenced on almost all the mentioned parameters studied concerned with growth and growth contributing characteristics. The highest percentage of success (66.34%), survivability (56.86 and %) and canopy volume (0.055m³) were found in glass house condition and the lowest % success (50.35%) % survivability (44.26%) and canopy volume (0.028m³) were found in field condition. The glasshouse condition took the minimum time for root and shoot (43.22 and 70.82 days respectfully) initiation. The application of 1500ppm IBA for 3mins took the minimum time for root and shoot (21.83 and 31.00 days respectfully) initiation and the maximum success (97.70 %), survivability (92.77%) and canopy volume (0.088m³). The maximum time took for root and shoot (51.08 and 66.08 days respectfully) initiation and the minimum success (48.35 %), survivability (45.59%) and canopy volume (0.008m³) were found from control treatment. The combined effect of environmental condition and IBA was statistically significant on the success, survivability and growth of lemon. The treatment in glasshouse condition with 1500ppm IBA solution for 3mins took the minimum time for root and shoot (18.00 and 51.44 days respectfully) initiation and the maximum success (98.70 %), survivability (96.90%) and canopy volume (0.015m³) as compare to control. Therefore, the overall results indicate that glasshouse condition with 1500ppm IBA solution for 3 mins might be an efficient and eligible practice for developing mutant from leaves. Therefore, the overall results indicate that glasshouse condition with 1000ppm IBA solution for 3mins might be an efficient and eligible practice for quick propagation techniques from leaves.

Keywords: IBA, growth, Environmental condition, Lemon leaf

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I. Introduction

Citrus Species including lemon (*Citrus limon*) have played a vital role in human culture and agriculture for centuries (Nicolosi *et. al.*, 2000). However, the propagation and cultivation of lemon species present complex challenges that demand attention in modern agriculture. Approximately 95411.89 metric tons of lime and lemons are produced year from 30248.22 acres of land, yielding 18.34 kgs per fruit bearing trees (BBS,2021-22) whereas global production was 215,000 tons including 26.5 million tons in china, 3 million tons in EU and 1.9 million in turkey (USDA,2022). In comparison to other countries, the yield is quite poor. Lemon is very important in respect of its nutritional values especially in Vitamin C. Different environmental conditions have significant effect of lemon production. The excessive heat and low temperature can retard the growth of

lemon (Singh *et al.*, 2003). High temperatures affect citrus plants increasing transpiration, photosynthesis, destabilizing their cell membrane and increasing oxidative damage. Moreover low rainfall can also be an effect of lemon production. Induce mutation through gamma irradiation can cause changes in chromosome and genome, which bring to successful variation in the morphology of plant (Shamsiah Abdullah, 2018). A cutting is a piece of the part of plants used to propagate which regenerate there missing part is called cutting. Leaf cuttings have been used for the vegetative propagation of citrus (Platt and Opitz, 1973; Debnath *et al.*, 1986; Singh *et al.*, 2013). Roots were formed at the petiole end. Adventitious bud formation occurred at a very low frequency and could not be stimulated by application of growth regulators. Leaf cuttings with auxiliary buds formed plants at a higher frequency but development of buds into shoots was slow and irregular. As no vascular connections were found between petiole and auxiliary bud, the slow growth of the buds was attributed to insufficient supply of assimilates from the leaves. In order to achieve the following goals, the current study was conducted i) to investigate the effect of IBA on the success, survivability, growth of lemon; ii) to find out the suitable environment for maximum success, survivability on the growth of lemon sapling; and iii) to find out the appropriate combination of IBA doses and suitable environment on success, survivability, growth and yield of lemon sapling.

II. Materials And Methods

An experiment was conducted at the Horticulture division of Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh during the period from March, 2024 to June, 2024 to evaluate the quick propagation techniques from lemon leaves by using IBA under glass house and field condition. The experiment was consisted of two factors such as Environmental condition: (i) glass house and field condition (ii) Different doses of IBA: D₀ (Control), D₁ (100ppm IBA for 3mins) D₂ (1500ppm IBA for 3mins) and D₃ (2000ppm IBA for 3mins). Mature leaves were collected from BINA Lebu-1 mother plants. Collected leaves were exposed by different doses of IBA solution separately and also a control. The experiment was laid out in RCBD with three replications. Total 24 treatment combinations of the environmental condition and IBA levels. IBA exposed leaves of lemon were planted in the unit plots on 8 March, 2024 in the afternoon with spacing of 15cmx15cm (row to row and leaf to leaf distance). The spaces between the plots and blocks served to facilitate quick drainage of rain or irrigation water. Flood irrigation was given after 15 days of planting the leaf cuttings and in later period necessary irrigation was given by watering can whenever needed. Weeds, whenever appeared were removed very carefully by holding the base and pulling without disturbing cuttings. Insecticides were sprayed over the new shoots of the cuttings to protect the leaves from insect damage at an interval of 15 days. Periodical data were taken from 10 cuttings on time of root initiation, time of shoot initiation, canopy volume per plant at 150 days after planting of cutting, percent success & percent survivability at 150 days after plant of cutting. The recorded data for each parameter from the present experiment was analyzed statistically to find out the variation resulting from experimental treatment using MSTAT package program. The means for all treatments were calculated and analyses of variances of parameters under study were performed by F variance test at 5% and 1% levels of significance. The means of the parameter were separated by least significant difference test.



a. Length of root



b. Initiation of shoot



c. Plant in field condition



d. Plant in glasshouse condition



e. Measuring Plant height under filed condition



f. Measuring canopy volume under glass house condition

III. Results

Main effect of environmental condition

Time of root and shoot initiation, canopy volume, percent success and percent survivability were significantly influenced by the environmental condition. The minimum time required to root and shoot initiation (43.22 and 70.82 days) in the glasshouse condition than the maximum time took in the field condition (50.19 and 74.81days) respectively. The earliest root and shoot initiation under glass house condition might be due to the favorable environment conditions with abundant supply of carbohydrate and other food materials prevailed at the time. The canopy volume was found higher in glass house condition (0.055m³) and the lowest canopy volume was obtained in the field condition (0.028 m³). The highest % success and % survivability (66.34% and 56.86%) were recorded from glasshouse condition and the lowest % success and % survivability (50.35% and 44.26%) were recorded from field condition (Table 1). This is might be due to the quick root and shoot initiation that enhanced the translocation of food materials from leaves which also enhanced excellent emergence of new leaf.

Table 1. Effect of environmental condition on the time of root and shoot initiation, canopy volume, % Success and % survivability of lemon

Variety	Time of root initiation at DAP	Time of shoot initiation	Canopy(m ³)	% Success	% survivability
C ₁	43.22	70.82	0.055	66.34	56.86
C ₂	50.19	74.81	0.028	50.35	44.26
LSD _{0.05}	0.69	0.98	0.0084	1.12	3.24
Level of significance	**	**	**	**	**
CV (%)	4.00	5.88	6.66	6.19	5.97

C₁ = Glasshouse condition, C₂ = Field Condition, ** = Significant at 1% level of probability

Main effect of different doses of IBA

The effect of different doses of IBA on time of root and shoot initiation, canopy volume, percent success and percent survivability were influenced significantly. The minimum time required to root and shoot initiation (21.83 and 51.00 days) in D₂ treatment than the maximum time took in control condition (51.08 and 66.08 days). The earliest root and shoot initiation under glass house condition might be due to the favorable environment conditions with abundant supply of carbohydrate and other food materials prevailed at the time. The canopy volume was found higher in D₂ treatment (0.088m³) and the lowest canopy volume was obtained in control condition (0.008 m³). The highest % success and % survivability (97.70% and 96.22%) were recorded from D₂ treatment and the lowest % success and % survivability (48.35% and 45.59%) were recorded from control condition (Table 2). This is might be due to that when using growth regulator boosting the rooting can be attributed to the favorable condition like high temperature (30-35°C) and high relative humidity (80-90%) with higher photosynthetic activity which promoted better rooting in cutting and survival percentage. These result are in close conformity with of the earlier workers Saini *et al.*(2021); Fraternal *et al.*(2010); Das *et al.*,(2021) and Chayanika *et al.*(2011).

Table 2. Effect of different doses of IBA on time of root and shoot initiation, canopy volume, % Success and % survivability of lemon

Radiation	Time of root initiation	Time of shoot initiation	Canopy(m ³)	% Success	% survivability
D ₀ (Control)	51.08	66.08	0.008g	48.35	45.59
D ₁ (100ppm IBA for 3mins)	23.16	64.00	0.027	95.10	91.25
D ₂ (1500ppm IBA for 3mins)	21.83	51.00	0.088	97.70	96.22
D ₃ (2000ppm IBA for 3mins)	22.00	55.50	0.069	94.50	92.77
LSD _{0.05}	2.29	2.99	0.0028	3.78	4.45
Level of significance	**	**	**	**	**
CV (%)	5.77	5.98	6.88	7.99	9.80

** = Significant at 1% level of probability

Combined effect of environmental condition and different levels of EMS

Combined effect of different doses of IBA solutions with environmental condition on time of root and shoot initiation, canopy volume, percent success and percent survivability were influenced significantly. The minimum time required to root and shoot initiation (18.00 and 51.44 days) in the glasshouse condition with D₃ treatment than the maximum time took in field condition (47.00 and 75.00 days) with control. The earliest root and shoot initiation under glass house condition might be due to the favorable environment conditions with abundant supply of carbohydrate and other food materials prevailed at the time. The canopy volume was found higher in glass house condition (0.019m³) with D₂ treatment and the lowest canopy volume was obtained in field condition (0.016 m³) with control. The highest % success and % survivability (98.70% and 96.90%) were recorded from glasshouse condition with D₂ treatment and the lowest % success and % survivability (45.59% and 42.55%) were recorded from field condition with control (Table 3). This is might be due to the quick root and shoot initiation that enhanced the translocation of food materials from leaves which also enhanced excellent emergence of new leaf. In addition, due to the excessive rainfall during rainy season which adversely affect the growth and mobilization of metabolites in plants. Kumar *et al.* (1995), they noted, cuttings of lemon (cv . Baramasi) taken in July had higher rooting success, required fewer days for sprouting and showed better shoot and root growth than those taken in February. IBA at 2000 ppm gave the highest rooting percentage.

Table 2. Combined effects of different doses of IBA and growing condition on the time of root and shoot initiation, canopy volume, % Success and % survivability of lemon under glass house and field condition

Environmental Condition	Doses	Time of root initiation	Time of shoot initiation	Canopy (m ³)	% Success	% survivability
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C ₁ (Field condition)	D ₀ (Control)	47.00	75.00	0.016	45.59	42.55
	D ₁ (1000ppm IBA for 3mins)	24.33	71.00	0.053	90.30	88.40
	D ₂ (1500ppm IBA for 3mins)	22.66	68.00	0.017	92.20	89.20
	D ₃ (2000ppm IBA for 3mins)	26.00	70.00	0.016k	94.70	91.06
C ₂ (glass house condition)	D ₀ (Control)	41.00	78.00	0.023	48.30	45.50
	D ₁ (100ppm IBA for 3mins)	20.00	54.11	0.005	93.10	86.20
	D ₂ (1500ppm IBA for 3mins)	18.00	51.44	0.019	98.70	95.90
	D ₃ (2000ppm IBA for 3mins)	19.12	54.25	0.014k	96.50	92.70
	LSD _{0.05}	2.88	3.95	0.0058	3.38	3.25
	Level of significance	**	**	**	**	**
	CV (%)	4.86	5.78	7.77	5.79	3.66

** = Significant at 1% level of probability

IV. Discussion

Time of root and shoot initiation, canopy volume, percent success and percent survivability were significantly influenced by the environmental condition. The minimum time required rooting and shooting initiation as well as maximum canopy volume, percent success and percent survivability were obtained in the glasshouse condition. On the other hand maximum time took for rooting and shooting initiation as well as minimum canopy volume, percent success and percent survivability were found in the field condition. It is revealed that glass house conditions resulted in more canopy volume of plant which was significantly higher than that under open field conditions. This might be due to modification in environmental factors like temperature and soil moisture in the glass house condition due to partial shade. The absolute light conditions may have an injurious effect on growth of seedlings due to increase in temperature and decreased moisture in soil. The present findings are in agreement with the findings of Muller (1988) who reported that maximum plant height was recorded in citrus in 40 per cent shade.

The effect of different doses of IBA on time of root and shoot initiation, canopy volume, percent success and percent survivability were influenced significantly. The minimum time required to root and shoot initiation in D₂ treatment than the maximum time took in D₀ treatment. The canopy volume was found higher in D₂ treatment and the lowest canopy volume was obtained in D₀ treatment. The highest % success and % survivability were recorded from D₂treatment and the lowest % success and % survivability were recorded from D₀ treatment. This might be inhibition of auxin synthesis due to low doses apparently while larger doses can destroy auxin activity directly (Dwelle, 1975; Chervinet *et al.*, 1992; Liu *et al.*, 2008). As a result, plant growth retarded by the high dose of radiation.

Combined effect of different doses of IBA with environmental condition on time of root and shoot initiation, canopy volume, percent success and percent survivability were influenced significantly. The minimum time required to root and shoot initiation in the glasshouse condition with D₂ treatment than the maximum time took in D₀ treatment in field condition. The canopy volume was found higher in glass house condition (0.097m³) with D₂ treatment and the lowest canopy volume was obtained in D₀ treatment in field condition. The highest % success and % survivability were recorded from glasshouse condition with D₂ treatment and the lowest % success and % survivability were recorded from field condition with D₀ treatment. The inhibition of propagation at high doses could be due to the damage in seed tissue, chromosomes and subsequent mitotic retardation and the severity of the damage depend on the doses used (Thapa,1999).

V. Conclusion

The percentage of success and percentage of survivability were positively influenced by different environmental conditions. Between the environmental factors tested glasshouse condition had given the higher success. In case of different doses of IBA, the percentage success and percentage of survivability were the highest in D₂ treatment. The treatment combination with the best glasshouse condition and the D₂ treatment gave the maximum values for most of all the parameters studied in the propagation of lemon plant from lemon leaves.

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