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Effect of growth regulators and rooting media on biochemical attributes in leaves of air layered Kagzi lime (*Citrus aurantifolia* Swingle) plants and their economics

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Abstract
The present investigation was undertaken to study the "Effect of growth regulators and rooting media on bio-chemical attributes in leaves of air layered kagzi lime (*Citrus aurantifolia* Swingle) plants and their economics", at the Horticulture Garden of Department of Fruit Science, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur (U.P.) during the rainy season of 2018-19 and 2019-20. The experiment was laid out in Factorial R.B.D. with three replications and twenty treatments. Two levels each of IBA and NAA (2000 ppm and 4000 ppm) four rooting media i.e. soil, F.Y.M., vermicompost and moss grass were taken and these media were also taken as unit of control. Data on biochemical attributes i.e. carbohydrate, nitrogen, C/N ratio, chlorophyll a and b content and economics of requiring plants through air layering was also worked out during respective years. NAA 4000 ppm significantly maximized carbohydrate (3.54 and 3.59%), nitrogen (1.05 and 1.11%) and chlorophyll a and b (0.93, 0.97 g/m^2 and 0.96, 1.03 g/m^2) contents during corresponding years. Minimum values showed to the tune of (3.15 and 3.17%), nitrogen (0.84 and 0.90%) and chlorophyll a and b (0.83 and 0.88 g/m^2 and 0.81, 0.91 g/m^2) under IBA 2000 ppm treatment. C/N ratio was significantly maximized (3.75 and 3.64) under IBA 2000 ppm and poorest ratio 3.34 and 3.23 were noted under NAA 4000 ppm during respective years. Moss grass proved significantly more effective and enhanced the carbohydrate (3.14 and 3.44%), nitrogen (0.96 and 1.01%) and chlorophyll a and b contents (0.99, 1.03 g/m^2 and 0.98, 1.09 g/m^2) than the rest of treatments. Minimum content of carbohydrate (3.20 and 3.22%), nitrogen (0.89 and 0.92%) and chlorophyll a and b (0.77, 0.81 g/m^2 and 0.81, 0.87 g/m^2 recorded under soil respectively during corresponding years. Soil media showed maximum C/N ratio registering 3.62 and 3.52 against the minimum of 3.53 and 3.40 ratio were observed under moss grass and vermicompost respectively during first and second year of study. Interacting treatment NAA 4000 ppm × moss grass proved significantly effective and enhanced carbohydrate content (3.68%) against the minimum of 3.11% under IBA 2000 ppm × soil during first year. Comparison of treatment with control when observed the former significantly revealed higher carbohydrate (3.24 and 3.34%), nitrogen (0.92 and 0.98%) and chlorophyll a and b content (0.89, 0.94 g/m^2 and 0.91, 0.98 g/m^2) than the later. Later produced i.e. carbohydrate (3.04 and 3.07%), nitrogen (0.78 and 0.83%) and chlorophyll a and b content (0.74 and 0.77 g/m^2 and 0.77and 0.83 g/m^2). Control recorded significantly higher C/N ratio (3.91 and 3.63) against treatment (3.57 and 3.45) during corresponding years of investigation. Regarding Benefit-cost ratio (B:C) IBA 4000 ppm recorded maximum (2.56) ratio followed by NAA 4000 ppm (2.40). Similarly, vermicompost achieved the maximum (1.78) ratio followed by moss grass (1.77) and interactive treatment IBA 4000 ppm × vermicompost showed maximum 2.72 ratio followed by NAA 4000 ppm × vermicompost (2.69 ratio). In this regards the minimum B:C ratio was obtained *viz.* IBA 2000 ppm (2.29) soil media (1.66) and NAA 2000 ppm × soil (1.98) respectively with two years average data.

Keywords: IBA, NAA, moss grass, vermicompost, carbohydrate, nitrogen, chlorophyll and economic Benefit- Cost ratio

Introduction
The acid lime (*Citrus aurantifolia* Swingle) is one of the citrus fruits commercially grown in India. It belongs to family Rutaceae and sub-family Aurantioideae. It has major source of vitamin-C and acidic content (Souci *et al.* 2000) [17] and grown throughout the world (Babu, 2001) [3]. It is widely distributed in all part of India for multi-purposes. It is also a cheap and very rich source of vitamin C, carbohydrate and minerals. India is perhaps its largest producer in the world but the fruit quality is poor due to lack of genuine planting material (Mishra, 2014). It is propagated by seed, budding, cutting and air layering but the success in vegetative

propagation is very poor. Loach (1988) [11] considered rooting media on integral part of the propagation. Growth regulators if applied in right concentration enhance rooting and shoot development (Parmer *et al.* 2018 and Chaudhary *et al.* 2018) [14, 4]. Therefore, an experiment was planned to find out suitable rooting media and optimal concentration of growth regulator for bulk production of genuine planting material of kagzi lime.

Materials and Methods

The experiment was conducted during rainy season of 2018-19 and 2019-20 at the garden, Department of Fruit Science, College of Horticulture, C.S.A. University of Agriculture and Technology Kanpur (U.P.) - 208002 in Factorial R.B.D. with twenty treatments and three replications. The unit of plant was 20 layers. Layering operation was done treating with two growth regulators i.e. IBA and NAA each at two concentration (2000 and 4000 ppm) using rooting media i.e. soil, F.Y.M., vermicompost and moss grass. Four rooting media were also utilized as unit of control. Layers were separated from mother plants and planted in nursery bed where all the cultural operations were managed. Other experimental details are followed according to norms as required. The data on biochemical parameters were recorded 90 days after planting of rooted layers. Carbohydrate and nitrogen contents of leaves were estimated as per method suggested by A.O.A.C. (1984) [1] and chlorophyll was determined by chlorophyll meter. Economics of preparing kagzi lime plants were worked out during both the years of investigation under each treatment and mean values were obtained. Regarding economics cost of rooting media, growth regulators, talcum powder, wrapping materials, labour charges of expert malies, revenue of nursery land, irrigation, manuring charges and plant protection charges were taken into account to infer benefit-cost ratio. The cost of prepared kagzi lime plants through layering according to prevailing market rate was calculated (Table-2). Thus, benefit: cost ratio was calculated treatment wise by dividing gross income with total expenditure under each treatment for both the years separately and average values were worked out (Table-3).

Results and Discussion

The carbohydrate content of kagzi lime leaves were estimated 90 days after planting of air layers. In this contest sixth and seventh leaves were sampled. NAA 4000 ppm induced significantly higher carbohydrate content (3.54 and 3.59%) when compared with rest of growth regulator treatments followed by its lower concentration i.e. NAA 2000 ppm exhibiting 3.33 and 3.36% values during respective years. The poorest content was revealed with IBA 2000 ppm treatment (3.15 and 3.17%) in respective years. However, an improvement of 12.38 and 13.25% was caused by NAA 4000 ppm over IBA 2000 ppm in this attribute. Enhancement in carbohydrate content may be attributed to the promotion of vegetative growth thereby accelerating the cell elongation and cell division in the apical meristem which have ultimately boosted photosynthesis causing considerable improvement in carbohydrate content. These findings are contrary with the reports of Chen *et al.* (1994) [5] in phlaenopsis Among rooting media moss grass proved significantly most effective expressing 3.14 and 3.44% carbohydrate than the rest of treatments closely followed by vermicompost (3.30 and 3.33%) during respective years of trial. The minimum (3.20 and 3.22%) carbohydrate content revealed under rooting media soil. An increase by 5.94, 6.83% and 3.12, 3.42% was noted due to moss grass and vermicompost respectively over soil in this regard during corresponding years of investigation. Interactive treatment NAA 4000 ppm in association with moss grass during first year expressed significantly maximum 3.68% value followed by NAA 4000 ppm X F.Y.M. (3.55%). The poorest carbohydrate i.e. 3.11% was however, observed under interactive treatment of IBA 2000 ppm X soil during respective year. Control versus treatment proved significantly effective during both the years. The later i.e. treatment recorded 3.24 and 3.34 carbohydrate being significantly higher than the former revealing 3.04 and 3.07% content during corresponding years.

The nitrogen content was estimated by Kjeldhal method (A.O.A.C. 1984) [1] 90 days after planting of rooted layers. The nitrogen content was significantly improved by NAA during respective years. Its 4000 ppm treatment maximized (1.05 and 1.11%) nitrogen content when compared with rest of treatments followed by its lower concentration i.e. NAA 2000 ppm (0.95 and 0.98%). Significantly poorest values were obtained with IBA 2000 ppm treatment expressing 0.84 and 0.90% nitrogen respectively during corresponding years of experimentation. Increase over IBA 2000 ppm caused by NAA 4000 ppm and NAA 2000 ppm were as 25.00, 23.33% and 13.09, 8.89% respectively. However, nitrogen content might be due to NAA application which is known to enhance RNA level and ribosome content in plant cell which consequently accelerate metabolic activities and the formation of chlorophyll consequently enhanced maximizing nitrogen content. These findings are contrary with the reports Athraa and Khattab (2017) [2] in olive. Use of moss grass in air layering of Kagzi lime significantly improved nitrogen status in leaves (0.96 and 1.01%) followed by rooting media vermicompost expressing 0.93 and 1.01% values during corresponding years of study. The poorest contents i.e. 0.89 and 0.92% were estimated under soil. Leaf nitrogen due to moss grass and vermicomost improved to the tune of 7.86, 13.48% and 4.49, 9.78% over soil media during respective years. Control versus treatment varied significantly and the former expressed 0.78 and 0.83% nitrogen content in Kagzi lime leaves against 0.92 and 0.98% under the later. Treatment brought about 17.95 and 18.07% improvement in nitrogen level of leaves during corresponding years of investigation.

Application of IBA 2000 ppm showed significantly maximum (3.75 and 3.64) C/N ratio being significantly superior than the rest of treatments during respective years followed by its higher concentration i.e. 4000 ppm expressing 3.68 and 3.55 ratio. Lowest ratio of 3.34 and 3.23 was noted under NAA 4000 ppm treatment. IBA both 2000 and 4000 ppm concentration raised the C/N ratio to the tune of 12.27, 12.69% and 10.18, 9.91% over NAA 4000 ppm application during respective years of study. The ratio of C/N was noted higher under soil rooting media recording 3.62 and 3.52 followed by F.Y.M. (3.58 and 3.45) during corresponding years of study. Moss grass expressed the minimum of it (3.55 and 3.40). Rooting media soil and F.Y.M. showed enhancement of 2.84, 3.53% and 1.70, 1.47% over moss grass during respective years. When control was compared with treatment regarding C/N ratio during respective years the former excelled later representing 3.91, 3.63 and 3.57, 3.45 C/N ratio respectively. The control improved the ratio by 9.52 and 5.22% respectively over treatment (Table-1).

Chlorophyll content of kagzi lime leaves was significantly influenced due to growth regulators. Application of NAA 4000 ppm proved significantly superior than rest of the treatments showing maximum chlorophyll a and b (0.93, 0.97

g/m^2 and 0.96, 1.03 g/m^2) during respective years. It was, however, followed by its lower concentration i.e. 2000 ppm revealing 0.92, 0.96 g/m^2 and 0.95, 1.01 g/m^2 chlorophyll a and b being at par in between during respective years. The minimum chlorophyll both a and b were noted as 0.83, 0.88 g/m^2 and 0.81, 0.91 g/m^2 under IBA 2000 ppm treatment. An improvement in chlorophyll a and b content was due to NAA 4000 ppm and NAA 2000 ppm over IBA 2000 ppm treatment occurred to the tune of 12.05, 10.23% and 18.52, 13.19% and 10.84, 9.09% and 17.28, 10.99% respectively during corresponding years of study. These findings are contrary with reports of Deb *et al.* (2009) [7] in lemon, Dhatrikarani (2019) [9] and Rani *et al.* (2018) [16] in guava and in agreement with reports of Kachave and Bhosale (2009) [10] in kagzi lime. Rooting media moss grass being significantly effective increased chlorophyll a and b (0.99, 1.03 g/m^2 and 0.98, 1.09 g/m^2) to the maximum followed by F.Y.M. (0.91, 0.96 g/m^2 and 0.92, 0.99 g/m^2) during respective years. The poorest values of 0.77, 0.81 g/m^2 and 0.81, 0.87 g/m^2 were observed under soil media. However, chlorophyll both a and b improved by 28.57, 27.16% and 20.99, 25.29% and 18.18, 18.52% and 13.58, 13.79% due to moss grass and F.Y.M. over soil during corresponding years of investigation. When the effect of control and treatment were in-between compared the later revealed significantly higher values i.e. 0.89, 0.94 g/m^2 and 0.91, 0.98 g/m^2 chlorophyll a and b against the lower contents 0.74, 0.77 g/m^2 and 0.77, 0.83 g/m^2 noted under control respectively. An improvement in chlorophyll a and b was registered by 20.27, 22.08% and 18.18, 18.07% due to treatment over control during corresponding years of experimentation (Table-1).

Regarding economics of treatments, maximum total cost of production, gross income and net profit were recording Rs. 617.00, Rs. 1618.00 and Rs. 1001.00 respectively under treatment of IBA 4000 ppm + moss grass being most effective when compared than other treatment followed by IBA 2000 ppm + moss grass exhibiting Rs. 596.00, Rs. 1558.00 and Rs. 962.00 values respectively. The minimum mean values of production cost, gross income and net profit were observed under control showing Rs. 453.00, Rs. 787.00 and Rs. 338.00 respectively (Table-2). Benefit/Cost ratio (B:C) was calculated and in this regard IBA 4000 ppm produced the maximum 2.56 benefit cost ratio followed by NAA 4000 ppm (2.40) and the minimum ratio 2.29 was indicated under IBA 2000 ppm. These findings are contrary with the reports of Zeeshan and Singh (2018) [18] in phalsa. Rooting media moss grass showed the maximum 2.58 Benefit-cost ratio closely followed by vermicompost (2.54) and the poorest ratio 2.13 was observed under rooting media soil. An improvement due to moss grass and vermicompost were recorded 21.13 and 19.25% over soil respectively. These results are in line with the reports of Das *et al.* (2016) [6] in Litchi. Interactive treatment IBA 4000 ppm in association with vermicompost revealed maximum (2.72) B:C ratio (Table-3) followed by 2.69 benefit cost ratio under NAA 4000 ppm × vermicompost and IBA 4000 ppm × moss grass (2.62). The minimum benefit cost ratio 1.98 was revealed under interactive treatment NAA 2000 ppm in combination with soil media. These findings are in agreement with reports of Reddy *et al.* (2014) [15] in fig and Maurya *et al.* (2012) [12] in guava. When comparison within unit of control were pertained to examine their benefit cost ratio, however vermicompost recorded the maximum value (1.78) closely followed by moss grass (1.77). The lowest benefit cost ratio was noted under soil (1.66) in this regard. As per examination of treatment versus control, it was found that treatment revealed 2.39 benefit-cost ratio (Table-3) being superior against control showing 1.73 value in this context (Table-3).

Table 1: Effect of growth regulators, rooting media, unit of control and treatment versus control on metabolites in kagzi lime leaves

Treatments	Carbohydrate Content (%)		Nitrogen content (%)		C/N ratio		Chlorophyll content			
							Chlorophyll-a (g/m^2)		Chlorophyll-b (g/m^2)	
	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20
I_1	3.15	3.17	0.84	0.90	3.75	3.64	0.83	0.88	0.81	0.91
I_2	3.19	3.24	0.87	0.91	3.68	3.55	0.87	0.93	0.90	0.97
N_1	3.33	3.36	0.95	0.98	3.51	3.36	0.92	0.96	0.95	1.01
N_2	3.54	3.59	1.05	1.11	3.34	3.23	0.93	0.97	0.96	1.03
R_1	3.20	3.22	0.89	0.92	3.61	3.52	0.77	0.81	0.81	0.87
R_2	3.32	3.36	0.92	0.96	3.58	3.45	0.91	0.96	0.92	0.99
R_3	3.30	3.33	0.93	1.01	3.55	3.40	0.88	0.94	0.90	0.96
R_4	3.39	3.44	0.96	1.01	3.53	3.41	0.99	1.03	0.98	1.09
C_1	3.02	3.04	0.76	0.79	3.97	3.84	0.70	0.74	0.75	0.81
C_2	3.05	3.07	0.78	0.83	3.91	3.70	0.75	0.78	0.77	0.83
C_3	3.03	3.05	0.77	0.85	3.93	3.59	0.74	0.75	0.76	0.82
C_4	3.08	3.12	0.80	0.87	3.85	3.58	0.78	0.82	0.81	0.87
T	3.24	3.34	0.92	0.98	3.57	3.45	0.89	0.94	0.91	0.98
C	3.04	3.07	0.78	0.83	3.91	3.63	0.74	0.77	0.77	0.83
C.D. at 5%										
G	0.04	0.06	0.04	0.05	0.06	0.08	0.04	0.06	0.05	0.06
R	0.04	0.06	0.04	0.05	0.06	0.08	0.04	0.06	0.05	0.06
Within control	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
Treatment v/s control	0.02	0.03	0.02	0.02	0.03	0.04	0.02	0.03	0.02	0.03

I_1- IBA 2000 ppm, I_2-IBA 4000 ppm, N_1- NAA 2000 ppm, N_2- NAA 4000 ppm, R_1- Soil, R_2- F.Y.M., R_3- Vermicompost, R_4- Moss grass, C_1- Unit of control (soil), C_2- Unit of control (F.Y.M.), C_3- Unit of control (Vermicompost), C_4- Unit of control (Moss grass), G- Growth regulator, R- Rooting media

Table 2: Economics of raising kagzi lime plants showing successful plants, total cost incurred, gross income and net profit for 60 years

Treatments	Number of successful plants	Total cost (Rs)	Gross income (Rs)	Net profit (Rs)
Soil	23.53	425	706	281
F.Y.M.	24.95	437	748	311

Vermicompot	26.51	446	795	349
Moss grass	29.89	505	897	392
Mean	26.22	453	787	338
IBA 2000 ppm + soil	32.53	472	976	504
IBA 2000 ppm + F.Y.M.	34.19	487	1026	539
IBA 2000 ppm + Vermicompost	40.25	507	1213	706
IBA 2000 ppm + Moss grass	51.95	596	1558	962
IBA 4000 ppm + soil	41.97	517	1259	742
IBA 4000 ppm + F.Y.M.	43.67	532	1310	778
IBA 4000 ppm + Vermicompost	50.23	554	1507	953
IBA 4000 ppm + Moss grass	53.94	617	1618	1001
NAA 2000 ppm + soil	29.43	445	883	438
NAA 2000 ppm + F.Y.M.	37.30	474	1119	645
NAA 2000 ppm + Vermicompost	35.78	476	1073	597
NAA 2000 ppm + Moss grass	46.66	559	1400	841
NAA 4000 ppm + soil	31.06	451	932	481
NAA 4000 ppm + F.Y.M.	38.83	481	1165	684
NAA 4000 ppm + Vermicompost	44.99	501	1350	849
NAA 4000 ppm + Moss grass	48.48	566	1454	888

Table 3: Benefit-Cost ratio of kagzi lime through air layering

Treatments / **Rooting Growth media Regulators**	**Soil**	**F.Y.M.**	**Vermicompost**	**Moss grass**	**Mean**
IBA 2000 ppm	2.06	2.11	2.39	2.61	2.29
IBA 4000 ppm	2.43	2.46	2.72	2.62	2.56
NAA 2000 ppm	1.98	2.36	2.35	2.50	2.30
NAA 4000 ppm	2.06	2.42	2.69	2.57	2.40
Mean	2.13	2.34	2.54	2.58	2.39
		Control			
	Soil	F.Y.M.	Vermicompost	Moss grass	
Mean	1.66	1.71	1.78	1.77	1.73

References

1. AOAC. Official Methods of analysis, association of official analytical chemist, 14th edition, Arlington, U.S.A, 1984.
2. Athraa KA, Khattab A. Effect of GA_3 and PBR_S spray on growth and leaf mineral content of olive transplants. Journal of Agriculture and Veterinary Science. 2017**;** 10(8):74-78.
3. Babu RSH. Limes and Lemons. In: Chadha, KL ed. Handbook of Horticulture, ICAR, New Delhi, 2001, 212.
4. Chaudhari HJ, Panchal BH, Vasava SR, Parmar CB. Effect of etiolation, wrapping materials and media on growth characteristics and survival of air layering in guava (*Psidium guajava* L.) cv. Allahabad Safeda. International Journal of Chemical Studies. 2018; 6(4):2314-2317.
5. Chen WS, Liu HY, Liu ZH, Yang L, Chen WH. Gibbereline and temperature influence on carbohydrate content and flowering in phlaenopsis. Physiologia Plantarum. 1994; 90(2):391-395.
6. Das AK, Das S, Prasad B, Mehta S, Ranjan RD. Assessment of rooting media for enhancing survivability and profitability of air layering in Litchi. International Journal of Agriculture Sciences. 2016; 8(51):2260-2262.
7. Deb P, Bhowmick N, Ghosh SK, Suresh CP. Effect of Different concentrations of napthalmic acetic acid (NAA) and indole butyric acid (IBA) on success and growth of semi-hard wood cutting of lemon (*Citrus Limon*). Enviro and Ecolo. 2009; 27(3):1130-1131.
8. Dhatrika Rani T, Srihari D, Dorajeerao AVD, Subbaramamma P. Effect of rooting media and IBA treatments on shoot production and survival of terminal cuttings in guava (*Psidium guajava* L.) cv. Taiwan Pink. International Journal of Current Microbiology and Applied Sciences. 2018; 7(11):231-242.
9. Dhatrikarani. Effect of rooting media IBA treatments on shoot and leaf production of terminal cuttings in guava (*Psidium guajava* L.) cv. Taiwan Pink. Journal of crop and weed. 2019; 15(2):104-109.
10. Kachave DB, Bhosale AM. Effect of plant growth regulators and micronutrients on certain qualityattributes of Kagzi lime (*Citrus aurantifolia* Swingle). International Journal of Agricultural Sciences. 2009; 5(1):50-52.
11. Loach. Controlling environment conditions to improve adventitious rooting. In: Adventitious root formation in cuttings (Davis, T.D.,Haissig, B.E. and Sankhla N., eds.) Dioscorides Press, Porland, Oregon, 1988, 248-279.
12. Maurya RK, Ray NR, Chavda JC, Chauhan VB, Patil AK. Evaluation of different organic media and water holding materials with IBA on rooting and survival of air layering in guava (*Psidium guajava* L.) cv. Allahabad Safeda. The Asian Journal of Hort. 2012; 7(1):44-47.
13. Mousa GT, Abdel-Rahman SSA, Ibrahim OHM, Soliman, Hala B. Improving rooting characterstics in air layers of *Ficus elastica* var. decora using indole-3-butyric acid (IBA) in the presence of *Bacillus subtilis* and arbuscular mycorrhiza fungi. Assiut J Agric. Sci. 2019; 50(2):140-158.
14. Parmar JP, Tiwari R, Gautam KK, Yadav L, Upadhyay N. Effect of Indole 3-butyric acid (IBA), rooting media and their interaction on different rooting and growth characteristic of air-layers in guava (*Psidium guajava* L. cv. L-49). Journal of Applied and Natural Science. 2018; 10(1):241-246.
15. Reddy PPN, Ray NR, Patel AD, Patel JS. Effect of rooting media and IBA (Indole butyric acid) levels on rooting and survival of air layering in fig (*Ficus carica*

L.) cv. Poona under middle Gujarat agro-climatic conditions. The Asian Journal of Hort. 2014; 9(1):1-5.
16. Rani DG, Srisari D, Dorajeerao AV, Suggaralalla. Effect of rooting media and IBA treatments on short production and survival of terminal cuttings in guava (*Psidium guajava* L.) cv. Taiwan Pink, 2018.
17. Souci SW, Fachmann W, Kraut H. Food composition and nutrition tables. 6th edn. Medpharm Scientific Publishers, Stuttgart, 2000.
18. Zeeshan, Singh JP. Studies on foliar application of boron and GA_3 on physic-chemical composition and yield of phalsa (*Grewia subinaequalis* D.C.). Hort. Flora Research Spectrum. 2018; 7(1):52-57.