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Suneel Kumar Patel
C.S. Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh, India

JP Singh
C.S. Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh, India

Abhay Kumar Yadav
A.N.D. University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh, India

Vivekanand
C.S. Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh, India

Corresponding Author:
Abhay Kumar Yadav
A.N.D. University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh, India

Effect of IBA and NAA levels on growth traits of Kagzi lime (*Citrus aurantifolia* Swingle)

Suneel Kumar Patel, JP Singh, Abhay Kumar Yadav and Vivekanand

Abstract
The present experiment entitled "Effect of IBA and NAA levels on growth traits of Kagzi lime (*Citrus aurantifolia* Swingle)" was conducted at Garden, College of Horticulture, Department of Fruit Science, Chandra Shekhar Azad University of Agriculture and Technology Kanpur, Uttar Pradesh in the year 2018-2019. It was carried out in complete randomized design with 16 treatment and each treatment replicated thrice. The results of this study on the effect of IBA 1000-3000 ppm and NAA 1000-3000 ppm alone and combination on the growth of citrus cutting are discussed and interpreted in the light of previous research in India and abroad. The experiment showed significant finding and concluded that treatment of T_{15} (IBA 3000 ppm + NAA 3000 ppm) showed early days of sprouting (22.00 days), increased in number of sprouts per cuttings (8.33), sprouts length (14.56cm) and diameter (6.01mm), number of leaves per cutting (20.97), length of leaves (5.16cm), width of leaves (4.37 cm) and percentage of sprouted cuttings (73.09%) was maximum.

Keywords: citrus, significant, cutting, sprouting, NAA, IBA, diameter

Introduction
Kagzi lime (*Citrus aurantifolia* Swingle.) belongs to family Rutaceae, originated in India. It is commercially grown in tropical and sub-tropical region of India. Kagzi lime is the third most important fruit after mandarin and sweet orange and India ranks fifth among major lime producing countries (Anonymous, 2014) [1]. Maharashtra state is leading in acid lime cultivation. Kagzi lime is principle citrus fruit grown commercially in vidarbha and Marathwada region. Lime is being acidic generally consumed as fresh but mostly used for flavouring vegetable dishes, fish, meat and salads. It also makes delicious and refreshing cold drinks the fruit are valued not only for its nutritional qualities but also medicinal purpose. Kagzi lime is one of the important fruit crop grown throughout the world. The major Kagzi lime producing countries are China, Maxico, Brazil and India.

Lime has been in cultivation for several countries, there are not improved varieties. Commonly grown lime is the acid lime called Kagzi lime. Kagzi lime is required to a wide range of soil and climatic conditions and is hard enough to withstand considerable neglect as compared to other fruit crops. It is relatively a disease free crop subjected to only a few diseases and insects, and requires less plant protection and irrigation as compared to other important fruit crops.

Kagzi lime is propagated commercially through seed but it can be propagated by cutting, layering and budding owing to high intensity of polyembryony (90-100%) and least chance of contamination of viral diseases. It is the cheapest and easiest method of propagation. Nucellar embryony is an important feature of propagation in citrus through seed. Asexual embryos provide genetically uniform seedlings which reproduce the seed parent genotype without variations caused by segregation in sporogenesis or recombination in fertilization Propagation of plants by seed become extra tall and come into bearing after a long period. For overcoming this problem, the vegetative multiplication through cutting, grafting, layering and budding are commonly practiced. The vegetative methods of reproduction differs from sexual reproduction in that while the latter involves meiosis, in the former, new cells are formed by mitosis only (Hartmann and Kester, 1997) [12]. In addition to cambium frequent division may also take place in the cells of immature secondary phloem where callus origin (Esau, 1965) [6].

The fruits of Kagzi lime extensively used for squashes, pickels, syrup and cordials, manufacture of citric acid and for table purpose in daily life of Indians. The peel contains volatile oil which is used in the production of perfumes and different kinds of sweet. Lime has medical uses like citric acid which is used as a drug. Kagzi lime also used for preparation of limeade mixed drinks, pickles and ice tea and is squeezed on to seafood to bring out the flavour. It is also used in bottled lime juice like "Limca" and carbonated beverages etc.

The juice is acidic with distinctive flavour and used for the preparation of "Shubuta" and "Sugar Sharbat". These qualities make Kagzi lime an important and one of the most popular fruits of India.

Keeping in view there need to work out the effective dose of boron on the growth, flowering and yield attributes of phalsa, the present experiment was undertaken with following objectives:

1. To find out the effect of IBA and NAA alone and with its combinations for survivability of Kagzi lime stem cuttings.
2. To investigate the best treatment of IBA and NAA for survivability of Kagzi lime stem cuttings.

Materials and Method

The present experiment was conducted at the Horticulture Garden, Department of Fruit Science, College of Horticulture, C.S. Azad University of Agriculture and Technology, Kanpur (U.P.). "Influence of IBA and NAA levels and their combinations on regeneration of Kagzi lime (Citrus aurantifolia Swingle) through stem cuttings" was carried out under Kanpur agro climatic conditions at the research farm. In the present investigation healthy and disease free branches of mother plants were selected.

Mature shoots having thickness of about 1.0 cm were selected and cuttings of about 20-25 cm in length were made containing 4-5 buds. The data obtained on each aspect on each treatment were statistically computed in C.R.D. design with 16 treatments in each treatment there is 20 number of cuttings and each treatment thrice replicated by which making the total number of cutting 960. All treatments were planted in polybags with spacing of polybags 20×25 cm. The observation regarding Days to sprouting, Number of sprouts per cutting, Percentage of sprouted cuttings, Length of sprouts, Diameter of sprouts, Number of leaves per cutting, Length of leaves, width of leaves were recorded. Statistical analyses of the data obtained in the different sets of experiments were calculated as suggested by Panse and Sukhatme and results were evaluated at 5% significance.

Table 1: Treatment and their contribution for experiment:

Sl. No.	Treatment Symbol	Treatment Contribution
1.	T_1	IBA 1000ppm
2.	T_2	IBA 2000ppm
3.	T_3	IBA 3000ppm
4.	T_4	NAA 1000ppm
5.	T_5	NAA 2000ppm
6.	T_6	NAA 3000ppm
7.	T_7	IBA+NAA 1000+1000ppm
8.	T_8	IBA+NAA 2000+1000ppm
9.	T_9	IBA+NAA 3000+1000ppm
10.	T_{10}	IBA+NAA 1000+2000ppm
11.	T_{11}	IBA+NAA 2000+2000ppm
12.	T_{12}	IBA+NAA 3000+2000ppm
13.	T_{13}	IBA+NAA 1000+3000ppm
14.	T_{14}	IBA+NAA 2000+3000ppm
15.	T_{15}	IBA+NAA 3000+3000ppm
16	T_{16}	Control (Distilled water)

Result and Discussion: The findings of the present study as well as relevant discussion have been presented under following heads:

1. Days to sprouting

Number of days required for sprouting of cutting, the data for each treatment were noted thus, obtained data were subjected to statistically on analysis. The mean values of data were summarized and displayed in table-2. The significantly minimum (22.00days) to sprouting were observed under the plant which were treated with IBA 3000ppm combined with NAA 3000ppm closely followed by treatments of IBA 3000ppm combined with NAA 2000ppm (22.11) days and treatment of IBA 3000 ppm coupled with NAA 1000 ppm (22.56 days) respectively.

The plants which were treated devoid of hormone i.e. Control T16 revealed significantly maximum (27.26 days) to sprouting of cutting of kagzi lime. Treatments of NAA 1000ppm (T4), NAA 2000ppm (T5) and NAA 3000ppm (T6) revealing 26.52, 26.40 and 26.02 days to sprouting respectively when these treatments were compared with control did not exhibited significant variation. All other remained treatments i.e. T1, T2, T3, T7, T8, T10,T11, T13, and T14 revealing 23.54, 23.48, 23.08, 23.48, 23.43, 22.70, 23.39, 23.62, 23.43 days to sprouting when these treatments compared among themselves did not differ significantly but showed significantly lesser when compared with control (T16).

Similarly treatments T12 (22.11days), T15 (22.00days) and T9 (22.56days) when compared among themselves showed non-significant variation

Table 2: Effect of IBA and NAA levels and their combination on days to sprouting

Symbol	Treatment	Days to sprouting
T_1	IBA 1000 ppm	23.54
T_2	IBA 2000 ppm	23.48
T_3	IBA 3000 ppm	23.08
T_4	NAA 1000 ppm	26.52
T_5	NAA 2000 ppm	26.40
T_6	NAA 3000 ppm	26.02
T_7	IBA 1000 ppm + NAA 1000 ppm	23.48
T_8	IBA 2000 ppm + NAA 1000 ppm	23.43
T_9	IBA 3000 ppm + NAA 1000 ppm	22.56
T_{10}	IBA 1000 ppm + NAA 2000 ppm	22.70
T_{11}	IBA 2000 ppm + NAA 2000 ppm	23.39
T_{12}	IBA 3000 ppm + NAA 2000 ppm	22.11
T_{13}	IBA 1000 ppm + NAA 3000 ppm	23.62
T_{14}	IBA 2000 ppm + NAA 3000 ppm	23.43
T_{15}	IBA 3000 ppm + NAA 3000 ppm	22.00
T_{16}	Control (distilled water)	27.26
	S.E. Difference	0.6965
	C.D. @ 5%	1.4193

2. Number of sprouts per cutting

The numbers of sprouts per cutting were noted under each treatment after 30 days of planting at 10 days interval i.e. 30, 40, 50 and 60 days and all data regarding mean values of number of sprouts per cutting were expressed in table 3, only data obtained at 60 days were subjected to statistical analysis and the mean value were summarized and displayed in table-3.

Treatment of IBA 3000 ppm coupled with NAA 3000ppm treated plants produced significantly maximum (8.33) number of sprouts per cutting and this regard, control treated plants were produced significantly lesser (5.69) number of sprouts per cutting.

Treatments T6, T9, T13, and T14 and T5 sowing 8.01, 7.97, 8.14, 8.21 and 8.33 sprouts per cutting respectively, when these treatments compared among themselves did not differ significantly. Treatments T2, T3, T4, T5, T7, T8, T10, T11, and T12 recorded 7.56, 7.74, 7.28, 7.13, 7.23, 7.49, 7.56, 7.63, and 7.67 numbers of sprouts per cutting respectively. When these treatments were compared with control differed

significantly, as well as compared with treatment T15 showed 8.33 sprouts varied significantly but when compared among themselves found to be non-significant.

Table 3: Effect of IBA and NAA levels and their combination on number of sprouts per cutting

Symbol	Treatment	Number of sprouts per cutting (30days)	Number of sprouts per cutting (40days)	Number of sprouts per cutting (50days)	Number of sprouts per cutting (60days)
T_1	IBA 1000 ppm	3.33	5.71	7.03	7.14
T_2	IBA 2000 ppm	3.78	6.23	7.51	7.56
T_3	IBA 3000 ppm	4.49	6.84	7.88	7.74
T_4	NAA 1000 ppm	3.62	6.0	7.21	7.28
T_5	NAA 2000 ppm	3.76	6.17	7.05	7.13
T_6	NAA 3000 ppm	4.37	6.7	7.3	8.01
T_7	IBA 1000 ppm + NAA 1000 ppm	3.68	5.92	7.15	7.23
T_8	IBA 2000 ppm + NAA 1000 ppm	3.76	6.19	7.41	7.49
T_9	IBA 3000 ppm + NAA 1000 ppm	4.42	6.74	7.91	7.97
T_{10}	IBA 1000 ppm + NAA 2000 ppm	3.82	6.37	7.53	7.56
T_{11}	IBA 2000 ppm + NAA 2000 ppm	3.88	6.41	7.57	7.63
T_{12}	IBA 3000 ppm + NAA 2000 ppm	3.96	6.48	7.68	7.67
T_{13}	IBA 1000 ppm + NAA 3000 ppm	3.41	6.96	8.10	8.14
T_{14}	IBA 2000 ppm + NAA 3000 ppm	4.53	6.98	8.13	8.21
T_{15}	IBA 3000 ppm + NAA 3000 ppm	4.61	7.5	8.26	8.33
T_{16}	Control (distilled water)	2.38	4.76	5.78	5.69
	S.E. Difference				0.2366
	C.D. @ 5%				0.4827

3. Percentage of sprouted cuttings

The percentage of sprouted cuttings were recorded treatment wise and thus, data were subjected to statistically analysis. The mean value were summarized and presented in table-4. The plants which were treated under the treatment of IBA 3000 ppm coupled with the NAA 3000 ppm recorded significantly maximum (73.09%) sprouted cuttings and in this regard control revealed significantly minimum (48.76%) sprouted cutting during experimental year 2018-19. Treatments T1, T2, T3, T4, T5, T6, T7, T8, T9, T10, T11, T12, T13, T14 were revealed 56.33, 61.45, 69.26,54.13, 59.66, 67.83, 58.68, 63.12, 69.89, 59.98, 63.16, 70.96, 68.07, 70.27% of sprouted cuttings respectively. When these treatments were compared with control (48.76%) found to be significant variation similarly, these treatments when compared with (T15), all treatments exhibited significantly lower values in this regards**.**

Table 4: Effect of IBA and NAA levels and their combination on percentage of sprouted cuttings (%)

Symbol	Treatment	Percentage of sprouted cuttings (%)
T_1	IBA 1000 ppm	56.33
T_2	IBA 2000 ppm	61.45
T_3	IBA 3000 ppm	69.26
T_4	NAA 1000 ppm	54.13
T_5	NAA 2000 ppm	59.66
T_6	NAA 3000 ppm	67.83
T_7	IBA 1000 ppm + NAA 1000 ppm	58.68
T_8	IBA 2000 ppm + NAA 1000 ppm	63.12
T_9	IBA 3000 ppm + NAA 1000 ppm	69.89
T_{10}	IBA 1000 ppm + NAA 2000 ppm	59.98
T_{11}	IBA 2000 ppm + NAA 2000 ppm	63.16
T_{12}	IBA 3000 ppm + NAA 2000 ppm	70.96
T_{13}	IBA 1000 ppm + NAA 3000 ppm	68.07
T_{14}	IBA 2000 ppm + NAA 3000 ppm	70.27
T_{15}	IBA 3000 ppm + NAA 3000 ppm	73.09
T_{16}	Control (distilled water)	48.76
	S.E. Difference	1.0882
	C.D. @ 5%	2.2175

4. Length of sprouts

Length of longest sprout in each replication under each treatment was measured and average values were obtained thus, data obtained were statistically analysis. The mean value were summarized and displayed in table-5. The effect of IBA and NAA values and there combination on length of sprouts greatly influenced and in this regards, significantly maximum 14.56 cm length of sprout were achieved under the treatment of IBA 3000 ppm coupled with NAA 3000 ppm (T15) and this regard significantly minimum sprouts length 9.83 cm was exhibited in plants under control. Treatment of IBA 1000 ppm revealed 10.28 cm length of sprout, when this value compared with control, did not bring significant variation. Remaining treatments T2, T3, T4, T5, T6, T7, T8, T9, T10, T11, T12, T13, T14 were revealed 10.92, 11.38, 10.39, 11.02, 11.52, 10.49, 11.13, 11.68, 11.04, 11.43, 11.79, 11.87, 12.91 cm length of sprout when a deep vision on values of length of sprout of different treatments were focused it was found that all above treatments were significantly superior when compared with control. Similarly, when these treatments compared with treatment T15 (14.56 cm) differed significantly

Table 5: Effect of IBA and NAA levels and their combination on length of sprouts (cm) length of sprouts (mm)

Symbol	Treatment	Length of sprouts (cm)
T_1	IBA 1000 ppm	10.28
T_2	IBA 2000 ppm	10.92
T_3	IBA 3000 ppm	11.38
T_4	NAA 1000 ppm	10.39
T_5	NAA 2000 ppm	11.02
T_6	NAA 3000 ppm	11.52
T_7	IBA 1000 ppm + NAA 1000 ppm	10.49
T_8	IBA 2000 ppm+ NAA 1000 ppm	11.13
T_9	IBA 3000 ppm+ NAA 1000 ppm	11.68
T_{10}	IBA 1000 ppm+ NAA 2000 ppm	11.04
T_{11}	IBA 2000 ppm+ NAA 2000 ppm	11.43
T_{12}	IBA 3000 ppm+ NAA 2000 ppm	11.79
T_1	IBA 1000 ppm+ NAA 3000 ppm	11.87
T_{14}	IBA 2000 ppm+ NAA 3000 ppm	12.91
T_{15}	IBA 3000 ppm+ NAA 3000 ppm	14.56
T_{16}	Control (distilled water)	9.83
	S.E. Difference	0.2756
	C.D. @ 5%	0.5620

5. Diameter of sprouts (mm)

The diameter of the sprouts was measured with the help of vernier calliper at 60 days after planting thus, the data obtained were processed statistically. The mean values summarized and presented in table-6. The plants treated with IBA 3000ppm coupled with NAA 3000ppm observed thickest (6.01cm) plants being significantly greater than all the other treatments closely followed by treatments of IBA 2000ppm coupled with NAA 3000ppm (5.66cm). The poorest 4.06 mm diameters of sprouts were noted under the plant which were untreated (control). Treatments T14 and T13 were recorded 5.66 and 5.25 mm diameter having sprouts respectively, when these treatments were compared one another did not show significant variation, whereas, these treatments when compared with treatments of T15,treatment of T14 showed at par value but treatment of T13 varied significantly. Treatments T3, T6, T9, T10, T11, and T12 were revealed 4.71, 4.77, 4.56, 4.59, 4.80 and 4.96 mm diameter of sprouts when these treatments were compared among each other did not touch level of significance. Similarly treatments T1, T2, T4, T5, T7, T8, revealed 4.28, 4.42, 4.33, 4.49, 4.36, and 4.41 mm diameter of sprouts when these treatments compared among themselves found to be non-significant influences.

Table 6: Effect of IBA and NAA levels and their combination on diameter of sprouts (mm)

Symbol	Treatment	Diameter of sprouts (mm)
T_1	IBA 1000 ppm	4.28
T_2	IBA 2000 ppm	4.42
T_3	IBA 3000 ppm	4.71
T_4	NAA 1000 ppm	4.33
T_5	NAA 2000 ppm	4.49
T_6	NAA 3000 ppm	4.77
T_7	IBA 1000 ppm + NAA 1000 ppm	4.36
T_8	IBA 2000 ppm + NAA 1000 ppm	4.41
T_9	IBA 3000 ppm + NAA 1000 ppm	4.56
T_{10}	IBA 1000 ppm + NAA 2000 ppm	4.59
T_{11}	IBA 2000 ppm + NAA 2000 ppm	4.80
T_{12}	IBA 3000 ppm+ NAA 2000 ppm	4.96
T_{13}	IBA 1000 ppm+ NAA 3000 ppm	5.25
T_{14}	IBA 2000 ppm+ NAA 3000 ppm	5.66
T_{15}	IBA 3000 ppm+ NAA 3000 ppm	6.01
T_{16}	Control (distilled water)	4.06
	S.E. Difference	0.2607
	C.D. @ 5%	0.5324

6. Number of leaves per cutting:

The number of leaves in individual cuttings was counted under each treatment after 60 days of planting and average number of leaves per cutting were work out. Thus, the numbers of leaves on the planted cuttings were recorded and data obtained were subjected to statistically analysis and illustrated in table 7. The plants which were treated with IBA 3000 ppm coupled with NAA 3000 ppm exerted significantly the maximum 20.97 number of leaves closely followed by T14 (20.64) in this regard, control treated plant were observed the minimum 13.98 number of leaves during experimental year of study. Treatments of T7, T8, T9, T10, T11, T12 and T13 exhibiting 19.73, 19.87, 20.06, 19.28, 19.39, 19.51 and 19.96 number of leaves respectively, when compared among these treatments themselves did not touch level of significance. Similarly, treatment of T2 (18.09), T3 (18.77), T5 (18.02), T6 (18.68) also influence non-significant variation when compared among themselves. As for as, treatments T2 (18.09), T3 (18.77), T5 (18.02) did not differ significantly and treatments T1, T4, T5 revealed 17.30, 17.21 and 18.02 number of leaves respectively, when compared among these treatments themselves, there were also found non-significant differences during respective year of experimentation.

Table 7: Effect of IBA and NAA levels and their combination on number of leaves per cutting in kagzi lime

Symbol	Treatment	Number of leaves per cutting
T_1	IBA 1000 ppm	17.30
T_2	IBA 2000 ppm	18.09
T_3	IBA 3000 ppm	18.77
T_4	NAA 1000 ppm	17.21
T_5	NAA 2000 ppm	18.02
T_6	NAA 3000 ppm	18.68
T_7	IBA 1000 ppm + NAA 1000 ppm	19.73
T_8	IBA 2000 ppm + NAA 1000 ppm	19.87
T_9	IBA 3000 ppm + NAA 1000 ppm	20.06
T_{10}	IBA 1000 ppm + NAA 2000 ppm	19.28
T_{11}	IBA 2000 ppm + NAA 2000 ppm	19.39
T_{12}	IBA 3000 ppm + NAA 2000 ppm	19.51
T_{13}	IBA 1000 ppm + NAA 3000 ppm	19.96
T_{14}	IBA 2000 ppm + NAA 3000 ppm	20.64
T_{15}	IBA 3000 ppm + NAA 3000 ppm	20.97
T_{16}	Control (distilled water)	13.98
	S.E. Difference	0.4690
	C.D. @ 5%	0.9563

7. Length of leaves (cm)

The perusal of data indicated in table 8 was recorded during experiment and subjected to statistically analysis. The plants which were treated under the treatments of IBA 3000 ppm coupled with NAA 3000 ppm obtained significantly maximum 5.16 cm length of leaves and the minimum 3.72cm length of leaves was observed under control being significantly smallest over all the treatments. Treatment of IBA 2000 ppm coupled with NAA 3000 ppm T_{14} revealed 4.91 cm length of leaves when this treatments was compared with the treatment of IBA 3000 ppm coupled with NAA 3000 ppm (T_{15}) found to be non significant in this regard. All other treatments were significantly inferior when compared with treatment of IBA 3000 ppm coupled with NAA 3000 ppm. Remained treatments T_1, T_2, T_3, T_4, T_5, T_6, T_7, T_8, T_9, T_{10}, T_{11}, T_{12} and T_{13} were exhibited 3.85, 3.96, 4.08, 4.11, 4.33, 4.46, 4.00, 4.11, 4.19, 4.26, 4.34, 4.48 and 4.68cm respectively during experimental year 2018-19. Treatments of T_{14} and T_{13} showed significantly at par values as well as treatments T_9, T_{10}, T_{11}, T_{12} and T_6 when compared among themselves did not differ significantly. Similarly, treatments T_3, T_4, T_5, T_7, T_8, T_9, T_{10} and T_{11} did not show significant differences as far as, treatments T_1 and T_2 were found to be significantly equal in this regard.

Table 8: Effect of IBA and NAA levels and their combinations on length of leaves (cm)

Symbol	Treatment	Length of leaves (cm)
T_1	IBA 1000 ppm	3.85
T_2	IBA 2000 ppm	3.96
T_3	IBA 3000 ppm	4.08
T_4	NAA 1000 ppm	4.11
T_5	NAA 2000 ppm	4.33
T_6	NAA 3000 ppm	4.46
T_7	IBA 1000 ppm + NAA 1000 ppm	4.00
T_8	IBA 2000 ppm + NAA 1000 ppm	4.11
T_9	IBA 3000 ppm + NAA 1000 ppm	4.19
T_{10}	IBA 1000 ppm + NAA 2000 ppm	4.26
T_{11}	IBA 2000 ppm + NAA 2000 ppm	4.34
T_{12}	IBA 3000 ppm + NAA 2000 ppm	4.48
T_{13}	IBA 1000 ppm + NAA 3000 ppm	4.68
T_{14}	IBA 2000 ppm + NAA 3000 ppm	4.91
T_{15}	IBA 3000 ppm + NAA 3000 ppm	5.16
T_{16}	Control (distilled water)	3.72
	S.E. Difference	0.1732
	C.D. @ 5%	0.3535

8. Width of leaves (cm)

Influence of IBA and NAA levels and their combinations on width of leaves of kagzi lime sprouts were noted and thus, obtained data were statististically analyzed. The mean values summarized and displayed in table-9. Significantly maximum 4.37 cm width of leaves were recorded with plants which were treated IBA 3000 ppm coupled with NAA 3000 ppm during experimental year and significantly lesser 3.16 cm width of leaves presented under the control. Treatments T_9, T_{10}, T_{11}, T_{12}, T_{13}, T_{14} were recorded 4.09, 4.11, 4.16, 4.20, 4.27 and 4.31 cm width of leaves. In between these treatments when comparative studies among themselves were observed, did not differ significantly. Treatments T_1, T_2, T_3, T_4, T_5, T_6, T_7, T_8 recorded 3.62, 3.78, 3.92, 3.75, 3.86, 3.99, 3.81 and 3.89 cm width of leaves respectively when these treatments were compared among themselves found to be non significant variation in this regard.

Table 9: Effect of IBA and NAA levels and their combination on width of leaves on the sprout of kagzi lime stem cuttings (cm)

Symbol	Treatment	Width of leaves on the sprouted
T_1	IBA 1000 ppm	3.62
T_2	IBA 2000 ppm	3.78
T_3	IBA 3000 ppm	3.92
T_4	NAA 1000 ppm	3.75
T_5	NAA 2000 ppm	3.86
T_6	NAA 3000 ppm	3.99
T_7	IBA 1000 ppm + NAA 1000 ppm	3.81
T_8	IBA 2000 ppm + NAA 1000 ppm	3.89
T_9	IBA 3000 ppm + NAA 1000 ppm	4.09
T_{10}	IBA 1000 ppm + NAA 2000 ppm	4.11
T_{11}	IBA 2000 ppm + NAA 2000 ppm	4.16
T_{12}	IBA 3000 ppm + NAA 2000 ppm	4.20
T_{13}	IBA 1000 ppm + NAA 3000 ppm	4.27
T_{14}	IBA 2000 ppm + NAA 3000 ppm	4.31
T_{15}	IBA 3000 ppm + NAA 3000 ppm	4.37
T_{16}	Control (distilled water)	3.16
	S.E. Difference	0.1633
	C.D. @ 5%	0.3312

Conclusion

It is of obviously fact that results obtained with the present experimentation it may concluded that treatment of IBA 3000 ppm + NAA 3000 ppm significantly brought about early sprouting (22.00 days), increased in number of sprouts (8.33), sprouts length (14.56cm) and diameter (6.01mm), number of leaves per cutting (20.97), length of leaves (5.16cm), width of leaves (4.37 cm) and percentage of sprouted cuttings (73.09%).Treatment of IBA 2000 ppm + NAA 3000 ppm was found next effective treatment of Investigation. Hence, behalf of above result are present investigation it may be advice to orchardist fruit growers as well as farmers Central Uttar Pradesh to use solution of IBA 3000 ppm + NAA 3000 ppm for obtaining genetically pure and unique newly plants for plantation of kagzi lime through cuttings.

Reference

1. Anony. Indian Horticulture Database-2014, Ed. Mistry NC, Singh Brajendra, Gandhi P Chander. Published by ministry of agriculture, GOI 2014.
2. Bhatt BB, Bhatt V. Effect of IBA and growing conditions on vegetative performance of Citrus aurantifolia Swingle cuttings. Report and Opinion 2014;6(8):50-54.
3. Krishnamoorthy C, Subha Shru B, Suvetha B. Effect of NAA and IBA on stem cutting of rose. Agriculture update 2017;12:88-91
4. Chandel SRS. Principles of Experimental Designs. A handbook of Agricultural Statistics 1984, B-36-43
5. Debnath S, Hore JK, Dua RS, Sen SK. Auxin synergists in the rooting of stem cuttings of lime (*C. Aurantifolia*). Prog. Hort 1986;18(1-2):60-64
6. Esau K. Plant anatomy, Edition-II, Johwiley &sons Inc.New York 1965.
7. Ghosh A, Dey K, Mani Arghya, Bauri FK, Mishra DK. Efficacy of different levels of IBA and NAA on rooting of Phalsa (*Grewia asiatica* L.) cuttings. International Journal of Chemical Studies 2017;5(6):567-571.
8. Ram RB. Effect of IBA and PHB on regeneration of pomegranate (*Punica granatum* L.) Through stem cuttings. New Agriculturist 2005;16(1-2):113-122
9. Sandhu AS, Singh Z. Effect of auxins on the rooting and spouting behaviour of stem cuttings of sweet lime. Indian J Hort 1986;43(3-4):224-226.
10. Singh AR, Pandey NC, Pandey AK. Studies on the regeneration of sweet lime (*C. Limettiodes* Tanaka) by stem cutting with the aid of IBA and NAA, Haryana J Hort. Science 1986;15(1-2):25-28
11. Singh Z, Sandhu AS, Dhillon BS. Rooting and sprouting of stem cuttings of citrus jambhiri lush. in response to Indole Butyric Acid and Cyclophosphamide. Acta Horticulturae 1988;227:22
12. Hartmann HT, Kester DE. Plant propagation principles and practices Sixth edition. Prentice- hall of India Pvt. Ltd., New Delhi 1997. 100001.
13. Pandey A, Patel RM, Agrawal S, Sharma HG. Effect of plant growth regulator on rooting and survival percentage of different species of citrus cuttings. Orissa J. Hortic 2003;31(2):42-44.
14. Panse VG, Sukhatme PV. Statistical methods for agricultural workers, 4th Edn., New Delhi 1985.