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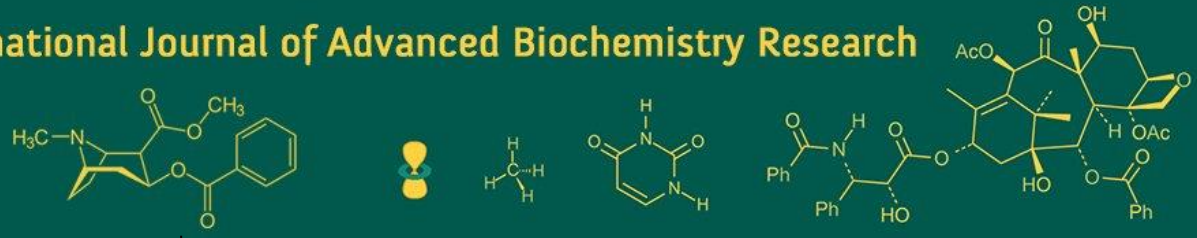

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Effect of Gibberellic acid on seed germination and seedling vigour of Indi's Kagzi Lime [*Citrus aurantifolia* (Christmas) Swingle]

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Abstract
The present experiment was carried out inside the shade net house (Horticulture nursery) of ICAR, KVK- Vijayapura-1 to find out the effect of gibberellic acid (GA_3) on seed germination, seedling growth and its vigour of Indi's Kagzi Lime. Six treatments were employed *viz*., T_1- control, T_2 (50 ppm GA_3), T_3 (100 ppm GA_3), T_4 (150 ppm GA_3), T_5 (200 ppm GA_3) and T_6 (250 ppm GA_3) and each treatment were replicated for three times. All treatments significantly performed better as compared to control. According to the results obtained, after 60 days of sowing the maximum seed germination (94.57%) with minimum number of days taken for seed germination (21 days) was observed in the treatment of T_6 *i.e.,* 250 ppm gibberellic acid pre sowing seed treatment. Further, maximum seedling length (26.23 cm), maximum number of leaves (10.33), higher length of primary shoots (12.17 cm) and maximum number of secondary roots (23.33) were also observed in the pre sowing gibberellic acid seed treatment of T_6 (250 ppm). Therefore, pre-sowing treatment of Indi's Kagzi Lime seeds with 250 ppm GA_3 may be recommended to the farmers than other gibberellic acid concentration to enhance seed germination percentage, rate of growth and Vigournes of seedlings leading to the production of vigorous plants which can be utilized for better nursery development, rootstock studies, commercial citrus cultivation as well as crop improvement programme.

Keywords: Gibberellic (GA_3) acid, Indi's Kagzi Lime, seed germination, growth

1. Introduction
Kagzi Lime *i.e., Citrus aurantifolia* (Christm) Swingle is an important species of citrus group of fruits, having high demand in India for its consumption due to nutritional, medicinal properties especially in Ayurveda as the fruits are highly acidic, rich in ascorbic acid, pectin, anti-oxidants, flavonoids and volatile oils. The fruits are used in processing industry for pickling and marmalade preparation. Kagzi lime cultivation can be best done in troika and sub-tropical weather conditions. Parts of India suitable for lime cultivation includes Gujarat, Maharashtra, Karnataka and Andhra Pradesh, Telangana and Tamil Nadu. They prefer full summers and no frost. Temperature below 8 ºC is not recommended and flowering occurs between best when summer is at its peak at 35-40 ºC, rains and humidity is not tolerated during during flowering season and affects yield. Flooding in root area causes root rot and decline in heavy soils so it should be avoided. Karnataka is just a few months away from securing the Geographical Indication (GI) tag for a rare variety of lime largely growing in the Northern plains of the state, especially in the Indi taluk of Vijayapura district. Often referred to as 'Kagzi lime', this is the second lime variety in India to get the label after Manipur's Kachai lime. The cultivation of 'Kagzi Limes', a distinctive variety of Central India, was started across Vijayapura as early as 1900. However, the ones cultivated in Indi are known for their unique texture and high acidic value. Compared to other popular varieties, Kagzi Limes of Indi have a thinner rind and have more juice, adding to the overall weight of the fruit and the ascorbic acid content is the highest in these varieties (Janhavi, 2023) [6]. The Kagzi limes are propagated sexually through seeds which are sluggish and irregular in germination. Kagzi lime seeds are recalcitrant in nature. The recalcitrant seeds impose serious storage problems due to their desiccation and chilling sensitivity. However, easiest and cheapest methods of propagation. Further, sexually raised plants are long lived, have extensive root system as well as bear a heavy crop.

But, the presence of growth inhibitors and the seed coat acts as barrier to radical protrusion. But, Gibberellic acid, thus, is crucial for the conversion of carbohydrates to sugar during germination as well as the production of various hydrolytic enzymes, including protease and amylase, which break down the dietary resources that are stored in the embryo and endosperm. So, Gibberellic acids are crucial for the germination and development of seedlings (Nanda and Purohit, 1965) [10]. The effect of GA_3 has been studied in different fruit crops including guava (Hosseini *et al*., 2020) [5], papaya (Anjanawe *et al.,* 2013) [1], apple (Grzesik *et al.*, 2017) [4] and jackfruit (Maiti *et al.,* 2003) [8] *etc.* Several researchers have reported that pre sowing treatment of citrus seeds with gibberellic acid (GA_3) promotes better germination and uniform growth of seedlings (Dilipet *et al.*, 2017) [3] and the maximal amount of seed germination occurs at a given standard concentration. Thus, the goal of the current study is to determine how Gibberellic acid affects the germination, growth, and vigour of seedlings as it decides its yield and quality of final fruit harvest.

2. Materials and Methods

2.1 Experimental Design and Treatments Preparation

This investigation was carried out in a shade net house (Horticulture nursery) of ICAR, KVK- Vijayapura-1. Fully mature and healthy fruits of Indi's Kagzi lime were collected from Regional Horticultural Research and Extension Centre, Tidgundhi, UHS, Bagalkot for this study. Seeds were extracted carefully, rubbed and mixed with wood ash washed for a week and washed in running water and dried under shade for 1 hour to leaching out of jelly like inhibitor. Before drying of seeds, they were dipped in water to remove the dead floating seeds. The seeds are treated with different gibberellic acid for 24 hours *viz.*, T_1- control, T_2-50 ppm GA_3, T_3- 100 ppm GA_3, T_4- 150 ppm GA_3, T_5- 200 ppm GA_3 and T_6- 250 ppm GA_3. Treated citrus seeds were sown in polythene bags which were properly filled with red soil, sand and vermicompost, labelled with tags and placed in net house at proper spacing. Seeds were irrigated immediately after sowing using a rose-can and subsequently seedlings were watered as and when required.

2.2 Observations Recorded

Observations were recorded from five randomly selected and labelled saplings in each treatment in a repetition. The data obtained from all plots per repetition under each treatment were averaged and reported. Number of days taken for germination was observed by counting number of days after sowing from 15- 30 days of sowing. Germination percentage was recorded after 30 and 60 DAS by dividing number of seeds germinated to number of seeds sown and multiplied with 100. Seedling length, length of primary roots was recorded by plucking the seedlings without damage to any roots and shoot and measured using long scale, and the same seedlings are used for counting number of leaves and number of secondary roots.

2.3 Data Analysis

The experimental data were subjected to the statistical analysis by using variance for completely randomized design with Factorial concept (FCRD). The treatment differences were tested by F-test of significance based on null hypothesis. The appropriate standard error of mean (S.Em ±) was calculated in each treatment and critical difference (CD) at 5% level of probability was worked out to compare the treatment means, where the treatment effects were significant.

Plate 1: Seeds of Indi's Kagzi Lime rubbed and mixed with wood ash

Plate 2: Seedlings of Indi's Kagzi Lime at 60 DAS treated with different gibberellic acid treatment

Table 1: Effect of gibberellic acid on seed germination and seedling growth of Indi's Kagzi Lime at 60 DAS

Treatments	Seed germination (%)	Number of days taken for seed germination	Seedling length (cm)
T_1	90.50	29.00	14.47
T_2	90.73	26.07	17.00
T_3	91.57	24.40	20.27
T_4	92.73	23.73	21.73
T_5	94.00	23.00	24.50
T_6	94.57	21.00	26.23
S.Em ±	0.05	0.33	1.42
CD (5%)	0.15	0.99	4.32

T_1- control, T_2-50 ppm GA_3, T_3- 100 ppm GA_3, T_4- 150 ppm GA_3, T_5- 200 ppm GA_3 and T_6- 250 ppm GA_3.

3. Results and Discussion

3.1 Seed germination percentage

A perusal of Table 1 indicated that pre-sowing treatments of different concentration of GA_3 had a significant effect on % of seed germination. Freshly extracted Indi's Kagzi lime seeds when soaked for 24 hours in an aqueous solution of GA_3 250 ppm (T_6) noticed maximum percent of seed germination (94.57%), which is on par with T_5 (200 ppm). Whereas, minimum seed germination was recorded in the control treatment of no gibberellic acid treatment. This might be attributed to involvement of GA_3 in de novo synthesis of hydrolysing enzymes particularly amylase and

protease, and this activity increases up to increasing in GA_3 concentration up to reaching of saturated ideal concentration of GA_3 of 250 ppm and may beyond it. The hydrolysed food was subsequently utilized for growth of embryo which in turn enhanced germination. Similar results were reported in Kagzi Lime by Asha Chaudari *et al.* during 2019 [2] and by Puja Archana, P. *et al.* during 2018 [12] in Kagzi Lime, in papaya by Anjanawe *et al.* during 2013 [1], and in jackfruit by Prajapati, DD. *et al.* during 2013 [11].

3.2 Number of days taken for seed germination

The result indicated that when seeds treated with 250 ppm GA_3 (T_6) took minimum days (21.00) to start germination. While the highest days (29.00) were registered under control treatment (T_1). The early germination might be due to involvement of GA_3 in the activation of cytological enzymes resulted into the production of energy and substrates, which in turn provide the structural components, essential for growth and emergence of the embryo along with increase in cell wall plasticity and better water absorption. The findings are supported by Puja Archana, P. *et al.* during 2018 [12] in Kagzi Lime, by Burns and Coggnies (1969) who reported that the growth and uniformity of seedling of sweet orange were also enhanced by seed treatment with GA_3.

3.3 Seedling length

At 60 DAS, significantly the highest seedling length (26.23 cm) was observed in GA_3 250 pm (T_6) which is at par with T_5 at GA_3 200 pm with seedling length of 24.50 cm. The lowest seedling length (14.47 cm) was noted in control treatment of no gibberellic acid treatment. This increase of seedling length in the treatment treated with gibberellic acid is due to gibberellins are well known for inter nodal cell elongation, thereby increased the seedling length. The application of growth regulator increases the seedling height and such effect might be due to increase in photosynthetic activity and also enhancement in the mobilization of photosynthates and change in membrane permeability (Shukla *et al.* 1997). These results are in agreement with the results reported by Puja Archana, P. *et al.* during 2018 [12] in Kagzi Lime.

Table 2: Effect of gibberellic acid on seedling growth and vigour of Indi's Kagzi Lime at 60 DAS

Treatments	Number of leaves	Length of primary roots	Number of secondary roots
T_1	5.00	9.00	13.23
T_2	6.57	9.13	16.57
T_3	8.57	10.03	15.23
T_4	9.00	10.03	18.57
T_5	9.23	11.37	21.23
T_6	10.33	12.17	23.33
S.Em ±	0.92	0.95	2.48
CD (5%)	2.75	2.90	7.52

T_1- control, T_2-50 ppm GA_3, T_3- 100 ppm GA_3, T_4- 150 ppm GA_3, T_5- 200 ppm GA_3 and T_6- 250 ppm GA_3.

3.4 Number of leaves

It is evident from the data that, pre-sowing treatments of GA_3 with Indi's Kagzi Lime seeds significantly affects number of leaves (Table 2). Freshly extracted seeds treated with GA_3 250 ppm showed maximum number of leaves (10.33) after 60 days of sowing whereas minimum number of leaves was observed in the treatment of T1 with no GA treatment. This can be attributed to the movement of GA_3 to the shoot apex which promoted cell division and cell growth apparently leading to increased development of young leaves (Salisbury FB, 1988) [13]. This is in line with results of Asha Chaudari *et al.* during 2019 [2] in Kagzi Lime.

3.5 Length of primary roots

At 60 DAS, the highest primary root lengths (12.17 cm) were recorded under T_6 treatment (250 ppm GA_3) which was at par with T_5 (11.37) and control treatment T_1 gave the lowest root length (9.00 cm). The increase in primary root length could be due to gibberellic acid which causes cell division and elongation of already existing cells by enlargement of the vacuoles which in turn increase the root length or it might be due to more production of photosynthates and their translocation through phloem to the root zone which responsible for improving root length. This finding is supported by findings of by Puja Archana, P. *et al.* during 2018 [12] in Kagzi Lime.

3.6 Number of secondary roots

At 60 DAS, the maximum secondary roots (23.33) were recorded under T_6 treatment (250 ppm GA_3) which was at par with T_5, T_4, T_3 and T_2. Whereas, only control treatment (T_1) recorded the minimum secondary roots (13.23). The increase in number of secondary roots could be due to gibberellic acid which causes cell division, supplying photosynthates to root meristem. This finding is supported by findings Meshram *et al.* (2015) [9] in acid lime with the use of different growth regulators.

4. Conclusion

Based on the above investigation, it can well be concluded that, pre-sowing treatment of Indi's Kagzi Lime seeds with 250 ppm GA_3 may be recommended to the farmers than other gibberellic acid concentration to enhance seed germination percentage, rate of growth and vigournes of seedlings leading to the production of vigorous plants which can be utilized for better nursery development, rootstock studies, commercial citrus cultivation as well as crop improvement programme. Thus, nurserymen can raise healthy Indi's Kagzi Lime rootstocks in a shorter duration by soaking freshly extracted seeds in an aqueous solution of 250 ppm gibberellic acid prior to sowing.

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6. References

1. Anjanawe SR, Kanpure RN, Kachouli BK, Mandloi DS. Effect of plant growth regulators and growth media on seed germination and growth vigour of papaya. Ann Plant Soil Res. 2013;15(1):31-34.
2. Chaudhary A, Ahlawat TR, Kumar S, Jena S, Patel D. Effect of Gibberellic Acid on Germination and Vigour of Kagzi Lime Seedlings. Curr. J Appl. Sci. Technol. 2019;38(6):1-8.
3. Dilip WS, Singh D, Moharana D, Rout S, Patra SS. Effect of gibberellic acid (GA) different concentrations at different time intervals on seed germination and seedling growth of Rangpur lime. J Agroecol Nat Resource Manage. 2017;4:157-165.

4. Grzesik M, Górnik K, Janas R, Lewandowski M, Romanowska-Duda Z, Duijn BV. High efficiency stratification of apple cultivar Ligol seed dormancy by phytohormones, heat shock and pulsed radio frequency. J Plant Physiol. 2017;219:81-90.
5. Hosseini MS, Zahedi SM, Hoveizeh NF, Li L, Rafiee M, Farooq M. Improving seed germination and seedling growth of guava under heat and osmotic stresses by chemical and hormonal seed treatments. Bragantia. 2020;79(4):512-524.
6. Janhavi R. [Internet]. 2023 [cited 2024 Jan 18]. Available from: https://www.deccanherald.com
7. Kalyani M, Bharad SG, Parameshwar Polu. Effect of growth regulators on seed germination in guava. Int. J Biol Sci. 2014;5(2):81-91.
8. Maiti CS, Wangchu L, Sen SK. Effect of pre-sowing seed treatments with different chemicals on seed germination and seedling growth of jackfruit (*Artocarpus heterophyllus* Lam.). Environ Ecol. 2003;21(2):290-292.
9. Meshram PC, Joshi PS, Bhoyar RK, Sahoo AK. Effect of different plant growth regulators on seedling growth of acid lime. Res Environ Life Sci. 2015;8(4):725-728.
10. Nanda KK, Purohit AN. Effect of gibberellic on mobilization of reserve food and its correlation with extensive growth. Plants. 1965;66:121-125.
11. Prajapati DD. Influence of growth regulators on germination of jackfruit (*Artocarpus heterophyllus* Lam.) seed. M. Sc. Thesis submitted to Navsari Agricultural University, Navsari; c2013.
12. Puja Archana P, Ajay Kumar K, Kamna Sinha. Effect of gibberellic (GA3) acid on seed germination and growth of Kagzi lime (*Citrus aurantifolia* Swingle). Int. J Chem Stud. 2018;6(5):2803-2805.
13. Salisbury FB, Ross CW. Plant Physiology. Delhi: CBS Publishers and Distributors; c1988. p. 319-329.