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Effect of different plant growth regulators and chemicals on seed germination and seedling growth of acid lime (*Citrus aurantifolia* Swingle) cv. PDKV lime

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Abstract
The present investigation entitled " Effect of different plant growth regulators and chemicals on seed germination and seedling growth of acid lime (*Citrus aurantifolia* Swingle) cv. PDKV lime." was executed in shade net of Horticultural Research cum Instructional farm under Pt. Kishori Lal Shukla College of Horticulture and Research Station, Rajnandgaon in year 2021-2022. The results revealed that seeds treated with GA_3 90 ppm recorded minimum days required for initiation of germination (22.00), highest germination percentage (83.88%), maximum height of plant (23.23 cm), no. of leaves per plant (25.07), length of seedling (39.22 cm), root length (16.48 cm) and survival percentage (86.56%). Whereas NAA 90 ppm (T_7) was found maximum in diameter of plant stem (3.10 mm). The minimum values of the all parameters were generally manifested under Treatment T_1 (seeds were soaked in distilled water) control. Therefore it can be concluded that the T_4 (seed soaking with GA_3 at 90 ppm) was found best over rest of the treatments under study which significantly recorded desirable values of seed germination and seedling growth of acid lime.

Keywords: GA3, NAA, thiourea, KNO_3, acid lime, plant growth regulators

Introduction
Acid lime is the third important Citrus fruit crop in India after mandarin and sweet orange. Acid lime is also known as Kagzi lime, Sour lime, Key lime and Mexican lime. It belongs to the Rutaceae family. Commercial limes are grown in tropical and sub tropical areas. Fruits of acid lime possess great therapeutic and nutritional value. It is a rich source of Vitamin-C (Chadha, 2003) [3]. In India major lime producing states are Andhra Pradesh, Maharashtra, Gujarat, Karnataka, Tamil Nadu, Assam, Bihar, Rajasthan, Madhya Pradesh and other states. The total area and production of acid lime in India are 317 thousand ha and 3717 thousand MT (Anonymous, 2020) [1].

Seed germination is slow and erratic hence kagzi lime is mainly propagated by seed. The presence of growth inhibitors and physical resistance of the seed coat to radical protrusion are two probable causes of seed germination. During germination, gibberellic acid is involve conversion of carbohydrates to sugar as well as the creation of several hydrolytic enzymes like as amylase, protease and others that destroy the stored food supplies in the embryo and endosperm. Gibberellic acids have a crucial function in seed germination and seedling growth Panda *et al*. (2018) [15].

NAA is commonly used in horticultural crops. The effect of NAA can perceive in cell elongation and apical formation. Naphthalene acetic acid works through direct effect on cell wall components, effects on permeability across the plasma membrane, function as co-enzyme or co-enzyme components and activation of specific protein which leads to an increase in cell wall flexibility and extension. It is often utilized to produce auxin like reactions in cell growth, cell division and roots at low concentration (Krishnamoor, 1981) [12].

Potassium is an essential nutrient that influences the majority of biochemical and physiological processes that govern plant development and metabolism. It also helps plants survive when they are exposed to a various biotic and abiotic stress (Kant and Kafkafi, 2002) [10].

Thiourea is a nitrogen and sulfur containing compound and is being increasing explored for its growth promotion role under different environmental perturbations. Ever since thiourea has been known as stimulator of germination by reliever of seed dormancy. The stimulatory action of thiourea in various physiological processes of plant is well known.

Thiourea promoted growth in cytokinin in callus tissue in the absence of kinetin (Mayer and Poljakoff, 1958) [13].

Materials and Methods

The experiment was conducted during the year 2021-2022 in shade net of Horticultural Research cum Instructional farm, Department of Fruit Science, Pt. Kishori Lal Shukla College of Horticulture and Research Station, Rajnandgaon (C.G.). The experiment design applied was Completely Randomized Design (CRD) with three replication and thirteen treatments. The treatments includes, T_1 (Control), T_2 (GA_3 30 ppm), T_3 (GA_3 60 ppm), T_4 (GA_3 90 ppm), T_5 (NAA 30 ppm), T_6 (NAA 60 ppm), T_7 (NAA 90 ppm), T_8 (Thiourea 0.5%), T_9 (Thiourea 1.0%), T_{10} (Thiourea 1.5%), T_{11} (KNO_3 1%), T_{12} (KNO_3 1.5%) and T_{13} (KNO_3 2%).

The fruit seeds were collected from PDKV, Akola, Maharashtra. The fruit seeds were pulped manually to extract the seeds. The extracted seeds were washed 2-3 times in clean water. The cleaned seeds were thoroughly dried and subjected to floating test by immersing in water. The heavy seeds which sink in water were selected for the experiment. Seeds soaked in different PGR and chemical solutions were made (GA_3 and NAA 30, 60 and 90 ppm and Thiourea 0.5% 1.0% and 1.5% KNO_3 1%, 1.5% and 2%) for 12 hours.

Seeds sown in polythene bags which properly filled and following observations were recorded. They were days required for initiation of germination, germination percentage, height of plant, number of leaves per plant, diameter of plant stem, length of seedling, root length and survival percentage.

Results and Discussion

Germination Parameters

1. Days required for initiation of germination

The data regarding days required for initiation of germination is presented in Table 1. Significantly, minimum days taken for germination was under treatment T_4 (22.00) with GA_3 90 ppm. The maximum days taken for initiation of germination was in treatment T_1 30.33 with (control). The reason may be due to involvement of GA_3 induces different emergence processes in the seed such break dormancy, cell division, cell expansion and it enhanced physico-chemical composition of protoplasm, respiration and nucleic acid metabolism etc. The present investigation were in agreement with the results of Pratibha *et al.* (2015) [16], Tandon *et al.* (2019) [18].

2. Germination Percentage (%)

The data pertaining germination percentage is displayed in Table 1 which shows the significant effect of GA_3 on seed germination percentage and it was noted that highest germination percentage was in treatment T_4 under GA_3 90 ppm with (83.88%). The lowest germination percentage was recorded in treatment T_1 (control) with (60.55%). The promotive effect of GA_3 on seed germination might be due to its participation in the activity of alpha amylase which catalyses the starch conversion into simple carbohydrates and chemical energy is liberated which is used in the activation of embryo. The results obtained in present investigation are in agreement with the findings of Jadhav *et al.* (2019) [7], Yadav *et al.* (2020) [21].

3. Growth Parameters

Observation related to growth parameters including height of plant, No. of leaves per plant, length of seedling, root length and survival percentage revealed that GA_3 90 ppm had shown superior effect. Diameter of plant stem found superior in NAA 90 ppm.

4. Height of plant (cm)

The data belonging to height of plant presented in Table 1. The maximum height of plant (5.07 cm, 16.36 cm and 23.23 cm) at 60, 90 and 120 DAS were noted in treatment T_4 when seeds were treated with GA_3 90 ppm. The minimum height of plant (2.62 cm, 10.03 cm and 12.60 cm) were found under treatment T_1 (control) at 60, 90 and 120 DAS respectively. The increase in height might be due to additional gibberellic acid which activates the α- amylase and digested the available carbohydrate into simple sugar so that energy and nutrition were easily available to faster growing seedlings and also it is well known for inter nodal cell elongation, thereby increased the height of plant. The present investigation are in agreement with the results Kalabandi *et al.* (2003) [9], Jaiswal *et al.* (2018) [8], Jadhav *et al.* (2019) [7], Yadav *et al.* (2020) [21].

5. Number of leaves per plant

The data pertaining number of leaves per plant presented in Table 2. The data of number of leaves recorded at 60, 90 and 120 DAS. It was found that maximum number of leaves per plant (7.15, 18.41 and 25.07) were recorded under T_4 (GA_3 90 ppm). However minimum number of leaves per plant (4.75, 11.76 and 12.80) were recorded under T_1 (control) at 60, 90 and 120 DAS respectively. This might be due to the process is generally emphasized by the diffusion of GA_3 to the shoot apex, which enhanced cell division and cell growth, apparently leading an increased in number of new leaves. The present investigations are in agreement with the results of Khatana *et al.* (2015) [11], Meshram *et al.* (2015) [14], Dilip *et al.* (2017) [4], Harsha *et al.* (2017) [6].

6. Diameter of plant stem (mm)

The data regarding to diameter of plant stem at 120 DAS presented in Table 3. Naphthalene Acetic Acid showed significant effect on diameter of plant stem at 120 DAS. The maximum diameter of plant stem was recorded in treatment T_7 which was (3.10 mm) with NAA 90 ppm. The minimum diameter of plant stem was observed in treatment T_1 control with (2.02 mm). Further, it is clear from the data that NAA exhibited maximum diameter of plant stem as compared other plant growth regulators and chemicals. The increase in diameter of plant stem might be due to the cell expansion rather than cell division and supply of nutrient elements. The present findings are supported by Jaiswal *et al.* (2018) [8], Jadhav and Deshmukh (2019) [7].

7. Length of seedling (cm)

The data pertaining length of seedling at 120 DAS presented in Table 3. Significantly, maximum length of seedling (39.22 cm) was noted in treatment T_4 (GA_3 90 ppm). However the minimum length of seedling (19.34 cm) was recorded under T_1 control. The increase in seedling length might be due to the reason that externally applied GA_3 stimulates growth by increasing cell multiplication and elongation which results in better growth unless the endogenous amount of GA_3 synthesized by acid lime seedlings may not be sufficient. The findings are in consonance with the report of Gurung *et al.* (2014) [5], Vachhani *et al.* (2015) [19], Harsha *et al.* (2017) [6].

8. Root length (cm)

The observations regarding root length presented in Table 3 which shows the significant effect of GA_3 in root length at 120 DAS. The maximum root length (16.48cm) was recorded in treatment T_4 (GA_3 90 ppm). Whereas minimum root length (7.83cm) was noted in treatment T_1 control. The increased in root length might be due to enhancing water mobilization and nutrient uptake and transportation results in increased production of photosynthetic products and their translocation to photosynthetic products and their translocation to various parts of the plant. Also GA_3 might have stimulated the quantity of auxin in the roots which increases the number of secondary and fibrous roots and tap root length, root initiation and root growth through high nutrient uptake. These results are in confirmly with findings of Vachhani *et al*. (2015) [19], Dilip *et al*. (2017) [4], Panda *et al*. (2018) [15].

9. Survival Percentage (%)

The data pertaining survival percentage at 120 DAS showed in Table 3. Significantly, maximum survival percentage (86.56%) was recorded under treatment T_4 (GA_3 90 ppm). Whereas minimum survival percentage (63.53%) was recorded in treatment T_1 control. The higher survival percentage may be due to the quick germination of seeds which bettered acclimatization and settlement. A higher germination percent and higher vigour index under GA_3 treatment may also contributes to the increased survival percent. These findings are supported by the results of Vishwakarma (2013) [20], Brijwal and Kumar (2014) [2].

Table 1: Effect of different plant growth regulators and chemicals on days required for initiation of germination, germination percentage (%) and height of plant (cm)

Notation	Treatments	Days required for initiation of germination	Germination Percentage (%)	Height of plant (cm)		
				60 DAS	90 DAS	120 DAS
T_1	Control	30.33	60.55	2.62	10.03	12.60
T_2	GA_3 30 ppm	24.33	81.01	4.47	14.45	20.76
T_3	GA_3 60 ppm	23.66	82.33	4.56	15.70	22.35
T_4	GA_3 90 ppm	22.00	83.88	5.07	16.36	23.23
T_5	NAA 30 ppm	26.66	79.77	4.29	14.30	20.23
T_6	NAA 60 ppm	24.66	80.99	4.50	14.53	21.61
T_7	NAA 90 ppm	23.33	82.77	4.95	15.64	22.56
T_8	Thiourea 0.5%	29.00	66.02	3.16	11.37	17.86
T_9	Thiourea 1.0%	28.66	68.22	3.84	11.91	18.06
T_{10}	Thiourea 1.5%	27.99	70.99	3.94	12.43	18.13
T_{11}	KNO_3 1%	27.00	76.44	4.19	13.53	18.80
T_{12}	KNO_3 1.5%	26.33	77.33	4.25	14.53	19.43
T_{13}	KNO_3 2%	25.66	78.55	4.80	15.44	22.26
	SE(m) ±	0.59	0.86	0.14	0.35	0.44
	C.D. at 5%	1.73	2.52	0.42	1.04	1.29
	CV (%)	3.91	1.96	5.98	4.47	3.86

Table 2: Effect of different plant growth regulators and chemicals on number of leaves per plant at 60, 90 and 120 DAS

Notation	Treatments	Number of leaves per plant		
		60 DAS	90 DAS	120 DAS
T_1	Control	4.75	11.76	12.80
T_2	GA_3 30 ppm	6.46	16.86	22.25
T_3	GA_3 60 ppm	6.75	17.93	24.42
T_4	GA_3 90 ppm	7.15	18.41	25.07
T_5	NAA 30 ppm	6.38	16.53	22.33
T_6	NAA 60 ppm	6.43	16.65	23.34
T_7	NAA 90 ppm	6.91	17.51	24.36
T_8	Thiourea 0.5%	5.56	13.43	19.33
T_9	Thiourea 1.0%	5.91	13.72	20.36
T_{10}	Thiourea 1.5%	6.17	14.49	20.41
T_{11}	KNO_3 1%	6.24	15.67	20.95
T_{12}	KNO_3 1.5%	6.27	15.76	21.54
T_{13}	KNO_3 2%	6.58	17.43	24.04
	SE(m) ±	0.19	0.40	0.30
	C.D. at 5%	0.55	1.19	0.88
	C.V. (%)	5.24	4.45	2.43

Table 3: Effect of different plant growth regulators and chemicals on diameter of plant stem (mm), length of seedling (cm), root length (cm) and survival percentage (%) at 120 DAS

Notation	Treatments	Diameter of plant stem (mm) at 120 DAS	Length of seedling (cm) at 120 DAS	Root length (cm) at 120 DAS	Survival Percentage (%) at 120 DAS
T_1	Control	2.02	19.34	7.83	63.53
T_2	GA_3 30 ppm	2.60	34.43	14.73	78.16
T_3	GA_3 60 ppm	2.69	36.46	15.86	84.82
T_4	GA_3 90 ppm	2.85	39.22	16.48	86.56
T_5	NAA 30 ppm	2.88	32.26	14.51	77.68
T_6	NAA 60 ppm	2.99	35.53	14.29	81.46
T_7	NAA 90 ppm	3.10	38.63	15.73	82.46
T_8	Thiourea 0.5%	2.27	27.16	10.89	67.96
T_9	Thiourea 1.0%	2.36	28.26	11.44	71.66
T_{10}	Thiourea 1.5%	2.40	29.53	11.61	72.46
T_{11}	KNO_3 1%	2.48	31.36	13.72	73.93
T_{12}	KNO_3 1.5%	2.56	35.16	14.23	74.90
T_{13}	KNO_3 2%	2.75	38.42	15.64	80.56
	SE(m) ±	0.09	0.33	0.35	0.79
	C.D. at 5%	0.26	0.98	1.02	2.32
	C.V. (%)	6.05	1.78	4.53	1.79

Conclusion

- In case of germination parameters viz. days required for initiation of germination and germination percentage. GA_3 90 ppm (T_4) was observed best and significantly took less time for germination and maximum for germination percentage.
- In case of growth attributes found significant and recorded maximum height of plant, number of leaves per plant, length of seedling, root length, and survival percentage when seeds were treated with GA_3 90 ppm (T_4) solution.
- Seeds treated with NAA 90 ppm (T_7) have shown maximum and significant effect on diameter of plant stem.

It can be concluded that in different pre sowing treatments seeds soaked with GA_3 at 90 ppm (T_4) solution for 12 hours had show better effect in seed germination and most of the growth parameters of acid lime.

References

1. Anonymous. Indian Horticulture Data Base, National Horticulture Board, Ministry of Agriculture, Government of India, Gurgaon, India; c2020.
2. Brijwal M, Kumar R. Studies on the seed germination and subsequent seedling growth of Guava (*Psidium guajava* L.). Indian J. Agric. Res. 2014;47(4):347-352.
3. Chadha KL. Limes and lemons. In Handbook of Horticulture Published by Directorate of Information and publication of Agriculture, ICAR, Krishi Anusandhan Bhavan, New Delhi; c2003. p. 110-021.
4. Dilip WS, Singh D, Moharana D, Rout S, Patra SS. Effect of Gibberellic acid different concentrations at different time intervals on seed germination and seedling growth of Rangpur lime. Journal of Agroecology and Natural Resource Management. 2017;4(2):157-165
5. Gurung N, Swamy GSK, Sarkar SK, Ubale NB. Effect of chemicals and growth regulators on germination, vigour and growth of passion fruit (*Passiflora edulis* Sims.). The Bioscan. 2014;9(1):155-157.
6. Harsha HR, Rao V, Dayamani KJ, Shivanna M. Pummelo (*Citrus maxima* Merill) Seedlings Growth as Influenced by Plant Growth Regulators and Macronutrients. Int. J. Curr. Microbiol. App. Sci. 2017;6(12):1750-1754.
7. Jadhav NG, Tapkeer PB, Deshmukh HS. Effect of growth regulators, chemical and organic wastes on height of seedling, number of seedlings per seed (extent of polyembryony), percent seedling attain buddable diameter and root length (primary and secondary) of Rangpur lime seedlings. Int. J. Chem. Stud. 2019;7(3):3596-3600.
8. Jaiswal SB, Nainwal RV, Supekar SJ, Manel SB. The effect of growth regulators and chemicals on growth of kagzi lime (*Citrus aurantifolia* Swingle.) seedlings. Int. J. Curr. Microbiol. Appl. Sci., Special Issue. 2018;6:940-944.
9. Kalalbandi BM, Dabhade RS, Ghadge PM, Bhagat V. Effect of gibberelic acid, naphthalene acetic acid and potassium nitrate on germination and growth of kagzi lime. Ann. Plant Physiol. 2003;17(1):84-87.
10. Kant S, Kafkafi U, Pasricha NS, Bansal SK. potassium and abiotic stress in plants. In: "Potassium for Sustainable Crop Production".Potash Institute of India; Gurgaon, India; c2002. p. 233-251.
11. Khatana KJ, Jadhav RG, Nehete DS. Influence of GA_3 on germination and growth of acid lime cv. Kagzi lime seed (*Citrus aurantifolia* Swingle) under field as well as net house conditions. Asian. J Hortic. 2015;10(1):11-16.
12. Krishnamor HN. Plant growth substances. Tata M C Grow Publishing Co. Ind, 1981.
13. Mayer AM, Poljakpff-Mayber A. The interaction of thiourea and ascorbic acid in their effect on germination and growth. Bulletin of Research, Israel. 1958;6:103-107.
14. Meshram PC, Joshi PS, Bhoyar RK, Sahoo AK. Effect of different plant growth regulators on seedling growth of acid lime. Research in Environment and Life Sciences. 2015;8(4):725-728.
15. Panda AP, Karna KA, Sinha K. Effect of gibberellic (GA_3) acid on seed germination and growth of kagzi lime (*Citrus aurantifolia* Swingle) International Journal of Chemcial Studies. 2018;6(5):2803-2805.
16. Pratibha C, Teja T, Krishna PM. Effect of chemical treatments on the germination and subsequent seedlings growth of Papaya (*Carica papaya* L.) seeds cv. Pusa Nanha. J. Agric. Eng. Food Tech. 2015;2(3):189-191.

17. Rawat UM, Pandey CS. Effect of seed treatment on germination and survivability of Custard Apple. J. of Plant Development Sci. 2019;11(2):65-71.
18. Tandon K, Gurjar PKS, Lekhi R, Soni D. Effect of Organic Substances and Plant Growth Regulators on Seed Germination and Survival of Tamarind (*Tamarindus indica* L.) Seedlings. Int. J Curr. Microbial. App. Sci. 2019;8(2):2270-2274.
19. Vachhani KB, Gohil JH, Pandey R, Ray NR. Influence of chemicals, PGR's and cow-dung slurry as seed treatment on germiability, growth and development of khirnee (*Manilkara hexandra* Roxb) under net house condition. Trends in Biosci. J. 2014;7(14):1641-1643.
20. Vishwakarma D. Effect of growing media and GA_3 on seed germination, growth and survival of acid lime (*Citrus aurantifolia* Swingle) var. kagzi. M.Sc. (Agri.), Thesis, submitted to Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, 2013.
21. Yadav RK, Jain MC, Mahorkar KD. Effect of growth regulators and chemicals on germination and growth of Rangpur lime seedlings under nursery condition. Int. J Curr. Micro. App. Sci, 2013, 9(3).