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Growth, vigour and survival of acid lime (*citrus aurantifolia*) cv. Kagzi using nutrients and bio-stimulants enriched media

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ABSTRACT

To analyze the plant establishment, vigour, survival and vegetative growth of acid lime c.v. Kagzi and to standardize the doses of different inorganic fertilizers and bio-stimulants combinations, an experiment was carried out during the year 2023-2024 in a shad house, Fruit Research Station, Imaliya, Department of Horticulture, JNKVV, Jabalpur. The experimental field was laid out in a Factorial Completely Randomized Design (FCRD) with 18 treatments of different inorganic fertilizers and bio-stimulants combinations and three replications. On the basis of the observation obtained in the present investigation, it is concluded that among the inorganic fertilizers, the treatment F_1 (NPK (19:19:19) @ 1%) followed by Urea phosphate (17:44:0) @ 1% (F_4), among bio-stimulants, treatment B_2 (Krishi shakti) followed by B_1 (Sagarika) separately was proved superior over rest of the treatment. The treatment F_1B_2 (NPK (19:19:19) @ 1% + Krishi shakti) in combination was proved superior over rest of the treatment for the parameters like maximum seedling height (16.65, 20.15 and 24.15 cm), number of leaves (17.46, 22.46 and 26.46), stem girth (2.13, 2.53 and 2.90 mm), number of branches (1.06, 4.20 and 7.20), survival percentage (100, 96 and 96%) at 60, 90 and 120 DAP. The treatment combination F_1B_1 (NPK (19:19:19) @ 1% + Sagarika) was found next best treatment in this respect.

Keywords: Acid Lime, Bio-Stimulants, Inorganic fertilizers, Krishi shakti, Sagarika

INTRODUCTION

Citrus is one of the most important fruits of the world and it is cultivated widely in the tropical and sub-tropical regions throughout the globe, having many species. Acid Lime (*Citrus aurantifolia*) is one of the commercially important citrus species grown in India besides Mandarin orange (*Citrus reticulata*), sweet orange (*Citrus sinensis*), lemon (*Citrus limon*), grapefruit (*Citrus paradisi*) and pomelo (*Citrus maxima*). It belongs to the family Rutaceae with chromosome number 2n=18. It is also known as Kagzi lime, Mexican lime or Pati lime (Prajapati *et al.,* 2017). In India, Kagzi lime is commercially propagated through seeds as it is true to type due to a high degree of nucellar embryony (39–60%). Kagzi lime seeds are recalcitrant in nature. The recalcitrant seeds impose serious storage problems due to their desiccation and chilling sensitivity. Citrus seeds were successfully stored for up to 90 days at 4°C to 7°C, ensuring their viability and achieving good germination. June is the month when ripe fruits devoid of shriveled seeds provide high-quality seeds (Joshi *et al.,* 2015).

In Kagzi, 98 % of the lime is polyembryonic, meaning that a single seed often produces more than two seedlings. To satisfy the growing demand of the cultivators in the shortest amount of time, greater and faster seed germination and the generation of the highest number of seedlings are vitally necessary in seed propagated plants (Dilip *et al.,* 2017). However, the percentage of limes that germinate in Kagzi varies from 27% to 58%. The Kagzi lime takes three weeks for it to germinate. Heavy mortality among seedlings in the main nursery stage is the most significant issue with Kagzi lime propagation. Because it contains particular inhibitory substances that prevent early seed germination, the lime seed coat functions as a barrier. The growth of Acid Lime seedlings is very slow in the nursery as well as in the field. In fact, many complaints from cultivators for the slow growth of seedlings under field conditions are being reported. Therefore, to fulfil the increasing demand for quality planting material, Nurserymen has to produce a greater number of vigorous and healthy buddable seedlings in the shortest possible time with minimum cost. It is therefore, highly essential to accelerate the seedling growth of promising rootstocks species with NPK fertilization or bio-stimulants alone or in combination (Yadav, 2021).

Fig. 1: Layout of experimental field

MATERIAL AND METHODS

The experiment was conducted during February to June, 2024 in the Fruit Research Station, Imalia, Department of Horticulture, JNKVV, Jabalpur. The seeds were obtained from the fresh Acid Lime fruits that were harvested from same mother plant. Seedlings have been grown and maintained in seed bed for 30 days. The seedlings of uniform size were selected and transplanted in the polybags (9×6 inch). The application of inorganic fertilizers and bio-stimulants combination were given at monthly interval to the seedlings from March to April. For preparing of 1% NPK (19:19:19), 1% mono potassium phosphate (00:52:34), 1% potassium nitrate (13:00:45), 1% urea phosphate (17:44:00) and 1% potassium sulphate (00:00:50) solution, each individual was taken @10 g and dissolve it in distilled water. For preparation of Panchagavya @ 10 ml/L, Sagarika @ 3 ml/L and Krishi Shakti @ 10 ml/L were dissolved in distilled water. The application of inorganic fertilizers and bio-stimulants was made in solution form to ensure uniformity in application. Observation on the seedling height, number of leaves, stem girth, number of branches, survival percentage, fresh weight of shoot, dry weight of shoot, length of primary root, length of secondary root, fresh weight of roots and dry weight of roots at 60, 90 and 120 DAP.

(a) Seed (b) Sowing (c) Seedlings

Fig. 2: Preparation of acid lime seedlings

Table 1: Effect of nutrients and bio-stimulants enriched media on seedling height (cm)

Factor- F (Inorganic fertilizers)	60 DAP	90 DAP	120 DAP
(Control) Soil: Sand: FYM (F_0)	12.26	15.87	19.87
NPK (19:19:19) @ 1 % (F_1)	15.68	19.32	23.32
Mono potassium phosphate (0:52:34) @ 1 % (F_2)	13.58	17.08	21.08
Potassium nitrate(13:0:45) @ 1 % (F_3)	13.96	17.46	21.46
Urea phosphate (17:44:0) @ 1 % (F_4)	14.36	17.85	21.85
Potassium sulphate (0:0:50) @ 1 % (F_5)	13.11	16.61	20.61
SEm (±)	0.124	0.098	0.100
CD (5%)	0.357	0.282	0.286
Factor – B (Bio-Stimulants)			
Panchagavya @10 ml/L (B_0)	13.54	17.12	21.12
Sagarika @ 3ml/L (B_1)	13.76	17.31	21.31
Krishi Shakti @10ml/L (B_2)	14.16	17.66	21.66
SEm (±)	0.088	0.070	0.071
CD (5%)	0.252	0.200	0.202
Treatment Combinations			
T_1 (F_0 B_0)	11.98	15.55	19.55
T_2 (F_0 B_1)	12.05	15.81	19.82
T_3(F_0 B_2)	12.75	16.24	20.24
T_4(F_1B_0)	14.85	18.75	22.75
T_5(F_1B_1)	15.55	19.05	23.05
T_6(F_1 B_2)	16.65	20.15	24.15
T_7(F_2 B_0)	13.42	16.92	20.92
T_8(F_2 B_1)	13.55	17.05	21.05
T_9(F_2 B_2)	13.77	17.27	21.27
T_{10}(F_3 B_0)	13.85	17.36	21.36
T_{11}(F_3 B_1)	14	17.50	21.50
T_{12}(F_3 B_2)	14.02	17.52	21.52
T_{13}(F_4 B_0)	14.25	17.75	21.75
T_{14}(F_4 B_1)	14.41	17.90	21.90
T_{15}(F_4 B_2)	14.41	17.91	21.91
T_{16}(F_5 B_0)	12.91	16.41	20.41
T_{17}(F_5 B_1)	13.04	16.54	20.54
T_{18}(F_5 B_2)	13.39	16.89	20.89
SEm (±)	0.216	0.170	0.173
CD (5%)	0.618	0.489	0.495

RESULT AND DISCUSSION

Effect of inorganic fertilizers

The maximum seedling height (15.68, 19.32 and 23.32 cm), number of leaves (16.17, 21.17 and 25.17), stem girth (2.08, 2.48 and 2.85 mm), number of branches (0.73, 3.33 and 6.17) and survival percentage (98, 96 and 95%) was recorded under F_1 i.e., NPK (19:19:19) @ 1%, followed by treatment F_4 i.e., urea phosphate (17:44:00) @ 1% with seedling height (14.36, 17.85 and 21.85 cm), number of leaves (14.53, 19.53 and 23.53), stem girth (1.99, 2.39 and 2.77 mm), number of branches (0.42, 2.68 and 4.95) and survival percentage (97 %, 94 % and 91%) while the minimum seedling height (12.26, 15.87 and 19.87 cm), number of leaves (11.37, 16.37 and 20.45), stem girth (1.67, 2.07 and 2.47 mm), number of branches (0.06, 2.23 and 4.37) and minimum survival percentage (89, 81 and 72 %) was recorded under F_0 i.e. (Control) Soil: Sand: FYM. Application of inorganic fertilizers showed maximum seedling height, number of leaves per seedling, stem girth, number of branches per seedling and survival % due to the fact that nitrogen is the builder of protein and is the main constituents of the protoplasm in plants. Thus, with an increase in nitrogen supply through

Table 2: Effect of nutrients and bio-stimulants enriched media on leaves per seedling

Factor- F (Inorganic fertilizers)	60 DAP	90 DAP	120 DAP
(Control) Soil: Sand: FYM (F_0)	11.37	16.37	20.45
NPK (19:19:19) @ 1 % (F_1)	16.17	21.17	25.17
Mono potassium phosphate (0:52:34) @ 1 % (F_2)	12.95	17.95	21.95
Potassium nitrate(13:0:45) @ 1 % (F_3)	13.82	18.82	22.82
Urea phosphate (17:44:0) @ 1 % (F_4)	14.53	19.53	23.53
Potassium sulphate (0:0:50) @ 1 % (F_5)	12.20	17.20	21.20
SEm (±)	0.156	0.155	0.150
CD (5%)	0.447	0.446	0.431
Factor – B (Bio-Stimulants)			
Panchagavya @10 ml/L (B_0)	13.13	18.13	22.17
Sagarika @ 3ml/L (B_1)	13.45	18.45	22.45
Krishi Shakti @10ml/L (B_2)	13.94	18.94	22.94
SEm (±)	0.110	0.110	0.106
CD (5%)	0.316	0.315	0.305
Treatment Combinations			
T_1 (F_0 B_0)	10.80	15.80	20.03
T_2 (F_0 B_1)	11.53	16.53	20.53
T_3(F_0 B_2)	11.80	16.80	20.80
T_4(F_1B_0)	15.40	20.40	24.40
T_5(F_1B_1)	15.66	20.66	24.66
T_6(F_1 B_2)	17.46	22.46	26.46
T_7(F_2 B_0)	12.86	17.86	21.86
T_8(F_2 B_1)	12.86	17.86	21.86
T_9(F_2 B_2)	13.13	18.13	22.13
T_{10}(F_3 B_0)	13.53	18.53	22.53
T_{11}(F_3 B_1)	13.93	18.93	22.93
T_{12}(F_3 B_2)	14.00	19.00	23.00
T_{13}(F_4 B_0)	14.33	19.33	23.33
T_{14}(F_4 B_1)	14.46	19.46	23.46
T_{15}(F_4 B_2)	14.80	19.80	23.80
T_{16}(F_5 B_0)	11.86	16.86	20.86
T_{17}(F_5 B_1)	12.26	17.26	21.26
T_{18}(F_5 B_2)	12.46	17.46	21.46
SEm (±)	0.270	0.269	0.260
CD (5%)	0.774	0.772	0.746

application of inorganic fertilizer. The synthesis of amino acids in plants is accelerated, which might have been indirectly exhibited by enhanced growth. The result is in accordance with the findings of Silas *et al.* (2023) in sweet orange, Gowtham *et al.* (2024) in crossandra and Chakrawarti *et al.* (2025) in lentil.

Effect of bio-stimulants

The maximum seedling height (14.16, 17.66 and 21.66 cm), number of leaves (13.94, 18.94 and 22.94), maximum stem girth (1.91, 2.31 and 2.71 mm), number of branches (0.36, 2.76 and 5.15) and survival percentage (95, 93 and 87%) was recorded under B_2 (Krishi shakti), followed by treatment B_1 (Sagarika) with seedling height (13.76, 17.31 and 21.31 cm), number of leaves (13.45, 18.45 and 22.45), stem girth (1.89, 2.29 and 2.67 mm), number of branches (0.27, 2.54 and 4.89) and survival percentage (94, 90 and 85 %) whereas, the minimum seedling height (13.54, 17.12 and 21.12 cm), number of leaves (13.13, 18.13 and 22.17), stem girth (1.86, 2.26 and 2.66 mm), number of branches (0.23, 2.45 and 4.72) and survival percentage (94, 89 and 84%) was recorded under B_0 (Panchagavya @ 10 ml/L) at 60, 90 and 120 days after planting, respectively. It may be due to the fact that the bio-stimulant (Krishi Shakti) is a microbial bio-stimulant consortium that introduces beneficial

Table 3: Effect of nutrients and bio-stimulants enriched media on Stem girth (mm)

Factor- F (Inorganic fertilizers)	60 DAP	90 DAP	120 DAP
(Control) Soil: Sand: FYM (F_0)	1.67	2.07	2.47
NPK (19:19:19) @ 1 % (F_1)	2.08	2.48	2.85
Mono potassium phosphate (0:52:34) @ 1 % (F_2)	1.86	2.26	2.66
Potassium nitrate(13:0:45) @ 1 % (F_3)	1.92	2.32	2.72
Urea phosphate (17:44:0) @ 1 % (F_4)	1.99	2.39	2.77
Potassium sulphate (0:0:50) @ 1 % (F_5)	1.81	2.21	2.61
SEm (±)	0.007	0.007	0.005
CD (5%)	0.020	0.020	0.015
Factor – B (Bio-Stimulants)			
Panchagavya @10 ml/L (B_0)	1.86	2.26	2.66
Sagarika @ 3ml/L (B_1)	1.89	2.29	2.67
Krishi Shakti @10ml/L (B_2)	1.91	2.31	2.71
SEm (±)	0.005	0.005	0.004
CD (5%)	0.014	0.014	0.011
Treatment Combinations			
T_1 (F_0 B_0)	1.66	2.06	2.46
T_2 (F_0 B_1)	1.68	2.08	2.48
T_3(F_0 B_2)	1.68	2.08	2.48
T_4(F_1B_0)	2.03	2.43	2.82
T_5(F_1B_1)	2.10	2.50	2.83
T_6(F_1 B_2)	2.13	2.53	2.90
T_7(F_2 B_0)	1.84	2.24	2.64
T_8(F_2 B_1)	1.85	2.25	2.65
T_9(F_2 B_2)	1.90	2.30	2.70
T_{10}(F_3 B_0)	1.91	2.31	2.71
T_{11}(F_3 B_1)	1.92	2.32	2.72
T_{12}(F_3 B_2)	1.93	2.33	2.73
T_{13}(F_4 B_0)	1.94	2.34	2.74
T_{14}(F_4 B_1)	2.00	2.40	2.76
T_{15}(F_4 B_2)	2.02	2.42	2.80
T_{16}(F_5 B_0)	1.79	2.19	2.59
T_{17}(F_5 B_1)	1.81	2.21	2.61
T_{18}(F_5 B_2)	1.83	2.23	2.71
SEm (±)	0.012	0.012	0.009
CD (5%)	0.035	0.034	0.027

microorganisms into the soil, increases the availability of elements like phosphorous, potassium etc. to the crop, produces plant hormones that help in crop growth and prevents the crop from developing major diseases like blight and wilt. The results are in accordance with the findings of Aja and Al-Abbasi (2021) in Acid Lime, Bagul *et al.* (2018) in Papaya cv. Red Lady [maximum dry weight of shoots (2.00 g)] and Khan *et al.* (2022) in Black gram.

Table 4: Effect of nutrients and bio-stimulants enriched media on Branches per seedling

Factor- F (Inorganic fertilizers)	60 DAP	90 DAP	120 DAP
(Control) Soil: Sand: FYM (F_0)	0.06	2.23	4.37
NPK (19:19:19) @ 1 % (F_1)	0.73	3.33	6.17
Mono potassium phosphate (0:52:34) @ 1 % (F_2)	0.17	2.43	4.66
Potassium nitrate(13:0:45) @ 1 % (F_3)	0.24	2.53	4.82
Urea phosphate (17:44:0) @ 1 % (F_4)	0.42	2.68	4.95
Potassium sulphate (0:0:50) @ 1 % (F_5)	0.11	2.32	4.55
SEm (±)	0.007	0.072	0.037
CD (5%)	0.021	0.205	0.107
Factor – B (Bio-Stimulants)			
Panchagavya @10 ml/L (B_0)	0.23	2.45	4.72
Sagarika @ 3ml/L (B_1)	0.27	2.54	4.89
Krishi Shakti @10ml/L (B_2)	0.36	2.76	5.15
SEm (±)	0.005	0.051	0.026
CD (5%)	0.015	0.145	0.075
Treatment Combinations			
T_1 (F_0 B_0)	0.06	2.16	4.26
T_2 (F_0 B_1)	0.06	2.26	4.40
T_3(F_0 B_2)	0.06	2.26	4.46
T_4(F_1B_0)	0.53	2.76	5.30
T_5(F_1B_1)	0.60	3.03	6.02
T_6(F_1 B_2)	1.06	4.20	7.20
T_7(F_2 B_0)	0.13	2.40	4.60
T_8(F_2 B_1)	0.20	2.43	4.60
T_9(F_2 B_2)	0.20	2.46	4.79
T_{10}(F_3 B_0)	0.20	2.50	4.80
T_{11}(F_3 B_1)	0.26	2.53	4.80
T_{12}(F_3 B_2)	0.26	2.56	4.86
T_{13}(F_4 B_0)	0.40	2.63	4.86
T_{14}(F_4 B_1)	0.40	2.69	4.98
T_{15}(F_4 B_2)	0.46	2.72	5.00
T_{16}(F_5 B_0)	0.06	2.28	4.50
T_{17}(F_5 B_1)	0.13	2.33	4.56
T_{18}(F_5 B_2)	0.13	2.34	4.60
SEm (±)	0.012	0.124	0.064
CD (5%)	0.036	0.356	0.185

Interaction effect of inorganic fertilizer and bio-stimulants

The interaction of different inorganic fertilizers and bio-stimulants had shown a significant effect on seedling height, number of leaves, stem girth, number of branches and survival percentage. The maximum height (16.65, 20.15 and 24.15 cm), number of leaves (17.46, 22.46 and 26.46), stem girth (2.13, 2.53 and 2.90 mm), number of branches (1.06, 4.20 and 7.20) and survival percentage (100, 96 and 96%) was recorded under F_1B_2 (NPK (19:19:19) @ 1% + Krishi shakti), followed by F_1B_1 (NPK (19:19:19) @ 1% + Sagarika) with seedling height (15.55, 19.05 and 23.05 cm), number of leaves (15.66, 20.66 and 24.66 cm), stem girth (2.10, 2.50 and 2.83 mm), number of branches (0.60, 3.03 and 6.02) and survival percentage (97, 96 and 96%) whereas, the minimum seedling height of (11.98, 15.55 and 19.55 cm), number of leaves (10.80, 15.80 and 20.03), stem girth (1.66, 2.06 and 2.46 mm), number of branches (0.06, 2.16 and 4.26) and survival percentage (87, 74 and 68 %) recorded under F_0B_0 (Soil: Sand: FYM + Panchagavya) at 60, 90 and 120 days after planting, respectively. It may be due to the presence of macronutrients (N, P, K, Ca and S) and other micronutrients (Zn, Cu, Mn) that they could have been causes for increased vigour of seedlings, which increase growth parameters of seedlings with the

Table 5: Effect of nutrients and bio-stimulants enriched media on Survival per cent of seedling (%)

Factor- F (Inorganic fertilizers)	60 DAP	90 DAP	120 DAP
(Control) Soil: Sand: FYM (F_0)	89	81	72
NPK (19:19:19) @ 1 % (F_1)	98	96	95
Mono potassium phosphate (0:52:34) @ 1 % (F_2)	93	92	86
Potassium nitrate(13:0:45) @ 1 % (F_3)	97	92	88
Urea phosphate (17:44:0) @ 1 % (F_4)	97	94	91
Potassium sulphate (0:0:50) @ 1 % (F_5)	93	90	82
SEm (±)	0.409	1.064	0.659
CD (5%)	1.174	3.052	1.890
Factor – B (Bio-Stimulants)			
Panchagavya @10 ml/L (B_0)	94	89	84
Sagarika @ 3ml/L (B_1)	94	90	85
Krishi Shakti @10ml/L (B_2)	95	93	87
SEm (±)	0.289	0.752	0.466
CD (5%)	0.830	2.158	1.336
Treatment Combinations			
T_1 (F_0 B_0)	87	74	68
T_2 (F_0 B_1)	90	81	70
T_3(F_0 B_2)	90	88	77
T_4(F_1B_0)	97	96	92
T_5(F_1B_1)	97	96	96
T_6(F_1 B_2)	100	96	96
T_7(F_2 B_0)	93	92	85
T_8(F_2 B_1)	93	92	85
T_9(F_2 B_2)	93	92	87
T_{10}(F_3 B_0)	97	92	88
T_{11}(F_3 B_1)	97	92	88
T_{12}(F_3 B_2)	97	92	88
T_{13}(F_4 B_0)	97	92	88
T_{14}(F_4 B_1)	97	93	91
T_{15}(F_4 B_2)	97	96	92
T_{16}(F_5 B_0)	93	88	81
T_{17}(F_5 B_1)	93	88	81
T_{18}(F_5 B_2)	93	92	84
SEm (±)	0.709	1.843	1.141
CD (5%)	2.033	5.286	3.274

interaction of inorganic fertilizer and Bio-Stimulants. The results are in line with the findings of Bagul *et al.* (2018) in Papaya cv. Red Lady, Aja *et al.* (2021) in Acid Lime and Manas *et al.* (2014) in Pungent pepper.

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CONCLUSION

On the basis of the observation obtained in the present investigation , it is concluded that among the inorganic fertilizers, the treatment F1 (NPK (19:19:19) @ 1%) followed by Urea phosphate (17:44:0) @ 1% (F_4), among Bio-Stimulants, treatment B2 (Krishi shakti) followed by B_1 (Sagarika) separately and the treatment F1B2 (NPK (19:19:19) @ 1 % + Krishi shakti) in combination was proved superior over rest of the treatment for the parameters like seedling height (cm), Number of leaves/seedling, stem girth (mm), Number of branches/seedling and Survival %.

REFERENCES

Aja, K.J. and Al-Abbasi, G.B.A. (2021) Study of Foliar Application of Nutritional Solution and Seaweeds Extract on Growth of Limes (*Citrus Aurantifolia*). *In IOP Conference Series: Earth and Environmental Science* **910**(1): 012-121.

Bagul, H.B., Parmar, A.B., Parma, B.R., Pandey, A.K. and Jnanendra, M. (2018) Effect of pre-sowing seed treatments on germination and growth of Papaya (*Carica Papaya* L.) seedlings cv. Red Lady. *The Pharma Innovation Journal* ***7*****:** 95-97.

Chakrawarti, R., Lilhare, S. and Prajapati, G. (2025). Response of potassium and biofertilizers on growth, yield and quality of lentil (Lens culinaris L.). *Annals of Plant and Soil Research* ***27***(1): 137-139.

Dilip, W.S., Singh, D., Moharana, D., Rout, S. and Patra, S.S. (2017) Influence of Gibberellic acid (GA_3) on seed germination and seedling growth of Kagzi Lime. *Journal of Scientific Agriculture* (**1**): 62-69.

Gowtham, S. and Karuppaiah, P. (2024). Effect of different levels of nitrogen in combination with nano urea on growth and yield of crossandra (*crossandra infundibuliformis* l.) cv. lakshmi. *Annals of Plant and Soil Research* ***26***(2): 250-255.

Joshi, P.S., Sahoo, A.K., Bhoyar, R.K. and Meshram, P.C. (2015) Effect of various plant growth promoting substances on seedling growth of Acid Lime. *Trends in Biosciences* **8(**19): 5222-5225.

Khan, P.M.I., Verma, R., Dawson, J. and Singh, M. (2022) Effect of Panchagavya and organic manures on growth and yield of blackgram (*Vigna mungo* L.) *The Pharma Innovation Journal* ***11***(4): 1483-1487.

Manas, D., Bandopadhyay, P.K., Chakravart, A., Pal, S. and Bhattacharya, A. (2014) Effect of foliar application of humic acid, zinc and boron on biochemical changes related to productivity of pungent pepper (*Capsicum annuum* L.). *African Journal Plant Science* **8**(6): 320-335.

Prajapati, D.G., Satodiya, B.N., Desai, A.B. and Nagar, P.K. (2017) Influence of storage period and growing media on seed germination and growth of Acid Lime seedlings (*Citrus aurantifolia* Swingle) Cv. Kagzi. *Journal of Pharmacognosy and Phytochemistry* ***6***(4): 1641-1645.

Silas, V.J. and Kumar, J. (2023) Effect of Different NPK Levels and Chlorophyll Content on Growth and Development of Sweet Orange (*Citrus sinesis* Osbeck). *International Journal of Environment and Climate Change* **13**(12): 522-526.

Yadav, S. (2021) Effect of seed treatment and storage period on germination and seedling growth of Acid Lime (*Citrus aurantifolia* Swingle L.). M.Sc. Thesis, Agriculture University, Kota. 18.