Effect of different growing media and varying levels of gibberellic acid on seed germination and vigour of acid lime (*citrus aurantifolia* swingle.) cv.kagzi lime

Abstract

The present investigation **"Effect of different growing media and varying levels of gibberellic acid on seed germination and vigour of acid lime (*Citrus aurantifolia* Swingle.) cv.Kagzi lime"** was laid out on the experimental siteof Department of Horticulture, Sam Higginbottom University of Agriculture Technology & Sciences, Naini, Pryagraj (UP),during 2023. The present investigation was carried out in randomized block design with 13 treatment which were replicated thrice. The treatments were **T_0** (Control), **T_1** (Sand + FYM + GA3 150mg/l), **T_2** (Sand + FYM + GA3 200mg/l),**T_3** (Sand + FYM + GA3 250mg/l),**T_4** (Sand + Vermicompost + GA3 150mg/l),**T_5** (Sand + Vermicompost + GA3 200mg/l),**T_6** (Sand + Vermicompost + GA3 250mg/l),**T_7** (Sand + Coco peat + GA3 150mg/l),**T_8** (Sand + Coco peat + GA3 200mg/l),**T_9** (Sand + Coco peat + GA3 250mg/l),**T_{10}** (Sand + Coco peat + Vermicompost + GA3 150mg/l),**T_{11}** (Sand + Coco peat + Vermicompost + GA3 200mg/l),**T_{12}** (Sand + Coco peat + Vermicompost + GA3 + 250mg/l). On the basis of our experimental findings it can be concluded that the treatment T4 (Sand + Vermicompost + GA3 150mg/l) Was found to be best in the terms of germination percentage growth parameters and survival percentage of Acid lime.

Keywords: FYM, Vermicompost, Coco peat, GA3, kagzi lime.

Introduction

The cultivation of acid lime (*Citrus aurantifolia* Swingle), commonly known as Kagzi lime, is of significant economic importance in many tropical and subtropical regions worldwide. This citrus fruit is esteemed for its tart flavor, aromatic qualities, and versatility in culinary and medicinal applications. Maximizing the yield and quality of acid lime crops is a primary concern for growers, necessitating research into various factors influencing seed germination and plant vigor. *Citrus aurantiifolia,* commonly known as acid lime, is a small evergreen tree belonging to the Rutaceae family. This research is justified by several reasons. Understanding the optimal conditions for seed germination and seedling vigor is crucial for enhancing the productivity and quality of acid lime crops. By examining the influence of different growing media, such as soil, vermicompost or coco peat, on seed germination and vigor, this research can provide valuable insights into selecting the most conducive substrate for acid lime cultivation.

Growing media play an important role in germination of seed. It is a substrate that provides the required elements and physical support to the seed. Media should also have good water holding capacity, drainage and other physical and chemical properties. During seed germinations, the role of GA3 in the induction of synthesis of α- amylase and other hydrolytic enzymes among monocots and certain dicots is well documented. GA3 appears mainly to induce the activity of the gluconeogenic enzymes during early stages of seed germinations **(Suthar *et al.*,2021).**

Farmyard manure (FYM), often referred to as "green manure," is a traditional organic fertilizer derived from decomposed animal waste, primarily from cattle, horses, sheep, or poultry. It is a valuable source of nutrients, organic matter, and beneficial microorganisms, making it an essential component of sustainable agriculture and soil management practices. FYM is rich in essential plant nutrients such as nitrogen (N), phosphorus (P), potassium (K), and micronutrients like calcium, magnesium, and sulfur **Bhatt *et al*. (2023).**

Vermicompost is an organic fertilizer and soil amendment produced through the decomposition of organic materials by earthworms, typically species such as Eisenia fetida and Lumbricus rubellus. This process, known as vermicomposting, yields a nutrient-rich, humus-like material prized for its ability to improve soil health and enhance plant growth. The vermicomposting process begins by providing a suitable habitat for earthworms, often in containers or specialized vermicomposting systems **Hakeem *et al.* (2021)**.

Materials and Methods

The present investigation **"Effect of different growing media and varying levels of gibberellic acid on seed germination and vigour of acid lime (*Citrus aurantifolia* Swingle.) cv.Kagzi lime"** was laid out on the experimental site of Department of Horticulture, Sam Higginbottom University of Agriculture Technology & Sciences, Naini, Pryagraj (UP),during 2023. The present investigation was carried out in randomized block design with 13 treatment which were replicated thrice. The treatments

were **T_0** (Control), **T_1** (Sand + FYM + GA3 150mg/l), **T_2** (Sand + FYM + GA3 200mg/l),**T_3** (Sand + FYM + GA3 250mg/l),**T_4** (Sand + Vermicompost + GA3 150mg/l),**T_5** (Sand + Vermicompost + GA3 200mg/l),**T_6** (Sand + Vermicompost + GA3 250mg/l),**T_7** (Sand + Coco peat + GA3 150mg/l),**T_8** (Sand + Coco peat + GA3 200mg/l),**T_9** (Sand + Coco peat + GA3 250mg/l),**T_{10}** (Sand + Coco peat + Vermicompost + GA3 150mg/l),**T_{11}** (Sand + Coco peat + Vermicompost + GA3 200mg/l),**T_{12}** (Sand + Coco peat + Vermicompost + GA3 + 250mg/l). Seeds were kept in GA3 solutions for 18 hours. The research work was carried out the objective of growing media and gibberellic acid on germination and survival percentage of kagzi lime. Data was analyzed using OPSTAT.

Results and Discussion

The effect different growing media and varying levels of gibberellic acid on seed germination of kagzi lime is very obvious and consistent. There was significant difference among the different treatments. Among the treatment applied the maximum seed germination percentage was obtained in the treatment T_4 (Sand + Vermicompost + GA_3 150mg/l) with 85.07 % followed by treatment T_5 (Sand + Vermicompost + GA_3 200mg/l) with 83.12 % which was statistically superior over control T_0 (Control) with 72.36 %. The results are in conformity with the findings of **(Farooqui *et al.* 1991)** in sapota.

The effect different growing media and varying levels of gibberellic acid on seed vigor index of kagzi lime is very obvious and consistent. There was significant difference among the different treatments. Among the treatment applied the maximum seed vigor index was obtained in the treatment T_4 (Sand + Vermicompost + GA_3 150mg/l) with 1538 followed by treatment T_5 (Sand + Vermicompost + GA_3 200mg/l) with 1408 which was statistically superior over control T_0 (Control) with 1055. Together, GA3 and vermicompost synergistically promote acid lime seed germination by regulating cellular processes, ensuring optimal conditions for germination, and providing essential nutrients and growth-promoting substances.

The maximum plant height of kagzi lime was recorded in treatment T_4 (Sand + Vermicompost + GA_3 150mg/l) with (33.92) cm followed by treatment T_5 (Sand + Vermicompost + GA_3 200mg/l) with (33.82) cm and the minimum plant height was recorded in T_0 (control) with (23.01) cm. Gibberellic acid (GA3) plays a crucial role in increasing the plant height of acid lime at the cellular level. GA3 is a plant growth regulator that primarily stimulates cell elongation and division. At the cellular level, GA3 interacts with specific receptors in the cell membrane, initiating signal transduction

pathways that activate genes responsible for cell elongation. Similar result was obtained by **Chaudhary *et al.* (2019)**.

The maximum Number of leaves of kagzi lime was recorded in treatment T_4 (Sand + Vermicompost + GA_3 150mg/l) with (16.87) followed by treatment T_5 (Sand + Vermicompost + GA_3 200mg/l) with (15.53) and the minimum Number of leaves was recorded in T_0 (control) with (11.53) . At the cellular level, GA3 interacts with receptors on the cell membrane, initiating signaling cascades that activate transcription factors responsible for leaf primordia formation. Additionally, GA3 stimulates the expression of genes encoding proteins crucial for leaf growth and expansion. By promoting cell division and expansion, GA3 facilitates the formation of new leaves. A similar finding was reported by **Choudhary and Chakrawar (1982)** in Rangpur lime.

The maximum Plant spread of kagzi lime was recorded in treatment T_4 (Sand + Vermicompost + GA_3 150mg/l) with (8.08 and 7.76) cm followed by treatment T_5 (Sand + Vermicompost + GA_3 200mg/l) with (8.97 and 8.09) cm and the minimum Plant spread was recorded in T_0 (control) with (4.17 and 4.19) cm. At the cellular level, organic manure improves soil structure and nutrient availability, facilitating better root penetration and lateral root growth, which contribute to increased plant spread. Together, GA3 and organic manure synergistically promote cellular processes that enhance plant spread, leading to healthier and more vigorous acid lime plants with increased lateral expansion. Similar result was obtained by **Chaudhary *et al.* (2019)**.

The maximum stem diameter of kagzi lime was recorded in treatment T_4 (Sand + Vermicompost + GA_3 150mg/l) with (9.28) mm followed by treatment T_5 (Sand + Vermicompost + GA_3 200mg/l) with (9.09) mm and the minimum Stem Diameter was recorded in T_0 (control) with (8.25) mm. Gibberellic acid (GA3) and organic manure play integral roles in increasing the stem diameter of acid lime at the cellular level. GA3, a plant growth regulator, promotes cell elongation and division, influencing stem thickness. At the cellular level, GA3 interacts with receptors on the cell membrane, initiating signaling pathways that activate genes responsible for cell expansion and secondary growth. Organic manure, such as compost or vermicompost, enriches the soil with nutrients and beneficial microorganisms, supporting robust root development and overall plant vigor. A

similar result was obtained by **Bhardwaj *et al.* (2008)** in seedling growth of papaya.

The maximum Leaf area of kagzi lime was recorded in treatment T_4 (Sand + Vermicompost + GA_3 150mg/l) with (10.33) cm^2 followed by treatment T_5 (Sand + Vermicompost + GA_3 200mg/l) with (10.15) cm^2 and the minimum Leaf area was recorded in T_0 (control) with (8.92) cm^2. Organic manure, such as compost or vermicompost, enriches the soil with nutrients and beneficial microorganisms, supporting vigorous plant growth. At the cellular level, organic manure enhances nutrient availability and metabolic processes, facilitating optimal leaf development and expansion. By synergistically promoting cellular processes, GA3 and organic manure enhance leaf area in acid lime plants, resulting in increased photosynthetic capacity and overall plant vigor. Similar results was obtained by **Haribhau *et al.* (2022)** in rangpur lime.

The maximum Chlorophyll Content was obtained in the treatment T_4 (Sand + Vermicompost + GA_3 150mg/l) with 5.44 followed by treatment T_5 (Sand + Vermicompost + GA_3 200mg/l) with 5.07 which was statistically superior over control T_0 (Control) with 3.29. Gibberellic acid (GA3) has a complex effect on chlorophyll. While it can stimulate leaf growth, which could indirectly lead to more chlorophyll production due to more leaf area, high GA3 concentrations can actually decrease chlorophyll content. This is because GA3 may trigger chlorophyll breakdown in favor of other pigments. So, GA3's role in chlorophyll content is dependent on factors like concentration and plant species. Similar result was obtained by **Chaudhary *et al.* (2019)**.

The maximum Survival percentage was obtained in the treatment T_4 (Sand + Vermicompost + GA_3 150mg/l) with 88.72 % followed by treatment T_5 (Sand + Vermicompost + GA_3 200mg/l) with 85.11 % which was statistically superior over control T_0 (Control) with 63.79 %. A winning combination for acid lime survival can be achieved with GA3 and organic manures. GA3, applied before sowing, acts like a germination booster, leading to more uniform and earlier sprouting, giving seedlings a crucial head start. Organic manures, like compost, enrich the soil with vital nutrients like nitrogen and phosphorus, while also improving water retention and aeration. Similar result was obtained by **Prajapati (2013)**, **Joshi *et al*. (2015) in Acid lime and Dilip *et al*. (2017).**

Conclusion

On the basis of our experimental findings it can be concluded that the treatment T4 (Sand + Vermicompost + GA3 150mg/l) Was found to be best in the terms of germination percentage growth parameters and survival percentage of Acid lime.

Table 1: Effect of different growing media and varying levels of gibberellic acid on Seed germination, seed vigour index, plan height, no. of leaves, plant spread, stem diameter, leaf area, chlorophyll content and Survival percentage of kagzi lime.

Symbol	Seed Germination (%)	Seed Vigour Index	Plant height (cm)	No. of leaves	Plant spread		Stem diameter	Leaf area (cm^2)	Chlorophyll Content	Survival percentage
					N-S	E-W				
T_0	72.36	1055	23.01	11.53	4.17	4.19	8.25	8.92	3.29	63.79
T_1	80.45	1203	30.45	13.53	5.49	6.37	8.79	9.18	3.55	74.47
T_2	80.67	1367	32.66	13.49	5.39	6.28	8.44	10.02	3.65	76.57
T_3	82.82	1390	31.32	13.87	6.12	7.6	8.79	9.63	3.73	75.37
T_4	85.07	1538	33.92	16.87	8.08	7.76	9.28	10.33	5.44	88.72
T_5	83.12	1408	33.82	15.53	8.97	8.09	9.09	10.15	5.07	85.11
T_6	81.00	1300	31.09	12.20	7.27	6.21	8.62	9.27	4.63	78.39
T_7	82.67	1242	29.93	14.20	7.69	6.47	8.50	9.21	4.04	80.02
T_8	79.87	1276	32.86	14.53	7.9	6.54	8.75	9.41	3.83	79.58
T_9	81.32	1313	32.26	14.20	6.93	6.78	8.71	9.44	3.68	82.62
T_{10}	79.63	1358	32.32	15.29	5.88	6.69	8.70	9.55	4.00	78.73
T_{11}	80.65	1387	31.64	14.87	7.28	7.49	8.77	10.04	3.87	78.97
T_{12}	82.43	1398	33.45	14.64	7.46	7.13	8.79	9.85	3.97	76.98
F-Test	S	S	S	S	S	S	S	S	S	S
SEd(±)	1.04	36.87	0.059	0.085	0.026	0.024	0.039	0.18	0.220	0.220
CD@5%	2.19	73.74	0.118	0.175	0.054	0.051	0.078	0.453	0.643	0.643
CV	4.16	110.61	0.177	0.255	0.078	0.072	0.117	0.576	0.965	0.965

Disclaimer (Artificial intelligence)

Author(s) hereby declare that generative AI technology have been used during writing or editing of manuscript.

Details of the AI usage are given below:

Chat GPT v.3.5.

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