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Effect of biostimulants on seed germination of rough lemon (*Citrus jambhiri* Lush) seedlings

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Abstract

Rough lemon (*Citrus jambhiri* Lush) is an important citrus rootstock widely used for its vigorous growth and adaptability. However, delayed and uneven seed germination limits uniform seedling production in nurseries. The present investigation was conducted during January-May 2025 to study the effect of different biostimulants on seed germination and seedling growth of rough lemon. Seeds were soaked for 24 hours in various biostimulants including *Trichoderma*, *Azotobacter*, *Pseudomonas*, Cow urine, Cow dung, Coconut water, Panchagavya, Bijamrit and water (control). Among the treatments, *Azotobacter* recorded earliest germination, highest germination percentage and superior seedling growth parameters such as plant height, root length and vigour index, followed by *Trichoderma*. Cow urine (100%) resulted in delayed germination and poor growth. The study indicates that *Azotobacter* seed soaking is an effective, economical and eco-friendly method for improving rough lemon seedling quality.

Keywords: *Citrus jambhiri*, biostimulants, seed soaking, germination

1. Introduction

Citrus is one of the most economically important fruit crops of the world, belonging to the family Rutaceae, and is extensively cultivated in tropical and subtropical regions due to its high nutritional, medicinal, and commercial value. Citrus fruits are rich sources of vitamins, antioxidants, organic acids, and dietary fibre, contributing significantly to human nutrition and global horticultural trade. India ranks among the leading citrus-producing countries, where citrus cultivation plays a vital role in livelihood security and agro-based industries. Successful citrus production largely depends on the availability of healthy, vigorous, and uniform planting material, which in turn is influenced by the quality of rootstocks used.

Rough lemon (*Citrus jambhiri* Lush) is one of the most widely used citrus rootstocks owing to its rapid growth, high vigour, deep root system, and broad adaptability to diverse soil and climatic conditions. It exhibits tolerance to drought, salinity, and soil alkalinity and is compatible with several commercially important citrus scion cultivars. Owing to these favourable characteristics, rough lemon is extensively propagated through seeds in citrus nurseries. However, despite its importance, seed germination and early seedling growth in rough lemon often show variability under nursery conditions, resulting in poor seedling stand and lack of uniformity.

Seed germination in rough lemon is influenced by several biotic and abiotic factors. Physiological constraints such as seed dormancy, thick seed coat, and the presence of high phenolic compounds can restrict water imbibition and delay radicle emergence. Additionally, poor seed viability due to improper storage, microbial infections, and unfavourable environmental conditions such as low soil temperature, inadequate moisture, and poor aeration further reduce germination percentage. These factors collectively affect seedling emergence, vigour, and uniform growth, thereby lowering nursery efficiency and increasing the cost of rootstock production.

In recent years, the use of biostimulants has gained considerable attention as an eco-friendly and sustainable approach to enhance seed germination and early seedling growth. Biostimulants include a diverse group of substances and microorganisms such as seaweed extracts, humic and fulvic acids, amino acids, beneficial microbes, and plant growth-promoting rhizobacteria.

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These inputs act by stimulating physiological and biochemical processes in plants, enhancing nutrient uptake, improving enzymatic activity, promoting cell division, and regulating endogenous plant growth hormones. Application of biostimulants has been reported to improve seed vigour, accelerate germination, enhance root and shoot development, and increase stress tolerance in several horticultural crops.

Despite the proven benefits of biostimulants in many crops, limited information is available regarding their role in improving seed germination and early growth of rough lemon rootstock. Considering the importance of uniform and healthy rootstock seedlings for successful citrus propagation, there is a need to evaluate the effectiveness of different biostimulants under nursery conditions. Therefore, the present investigation was undertaken to study the effects of biostimulants on seed germination and early seedling growth of rough lemon, with the aim of identifying suitable treatments for improving germination percentage, seedling vigour, and overall nursery performance.

2. Materials and Methods

2.1 Experimental Site

The experiment was conducted at the Department of Horticulture during January 2025. Seeds of rough lemon were extracted from rough lemon fruits freshly harvested from the orchard at Fruit Research Station, Imaliya, Jawaharlal Nehru Krishi Vishwavidyalaya, Jabalpur.

2.2 Seed selection and Treatment

Healthy and bold seeds were then selected and subjected to seed soaking for 24 hours in different biostimulant solutions namely *Trichoderma*, *Azotobacter*, *Pseudomonas*, Cow urine (100%), Cow urine (50%), Cow dung (100%), Cow dung (50%), Coconut water, Panchagavya, Bijamrit and water as Control. Treated seeds were shade dried and sown in polythene bags filled with soil and vermicompost (1:1).

2.3 Experimental Design and Observations

The experiment was laid out in a Randomized Block Design (RBD) with three replications. Observations on germination parameters recorded were days taken for initiation of germination, days taken to 50% germination and germination percentage (%).

Days taken for initiation of germination-Date of emergence of cotyledonary leaves was recorded and calculated from date of sowing.

Days taken to 50% germination: The number of days were counted from the start of germination till 50% germination.

Germination percentage (%): The percentage of total seeds germinated in each treatment was recorded at 30 days after sowing.

$$\text{Germination (\%)} = \frac{\text{No. of germinated seeds}}{\text{Total no. of seeds}} \times 100$$

2.4 Statistical Analysis

The data were subjected to analysis of variance (ANOVA) and treatment means were compared at a 5 percent level of significance.

3. Results and Discussion

Significant differences were observed among treatments for germination and growth parameters. Seeds treated with *Azotobacter* showed the minimum number of days to initiate germination and attain 50% germination, along with the highest germination percentage. *Trichoderma* treatment was statistically at par with *Azotobacter*. While, Cow urine 100% took maximum no. of days to initiate and achieve 50% germination, also the least germination percentage was recorded under Cow urine 100%.

These results are attributed to the effect of *Azotobacter*, for creating conditions that are favourable for seed germination like optimum moisture retention, temperature and secretion of plant growth regulators like gibberellins, vitamins and water absorption. These results are in line with Nainwad *et al.* (2018) ^[6] in Rangpur lime, Karthikeyan *et al.* (2007) ^[4] *Catharanthus roseus* and Khandelwal *et al.* (2024) ^[5] in Ber. The inhibitory effect on germination of seeds treated with Cow Urine 100% may be due to the highly acidic nature of Cow Urine, these were in line with the results given by Bhoi *et al.* (2025) ^[1] in Cowpea.

Table 1: Effect of biostimulants on germination parameters of rough lemon

Treatment	Days to first germination	Days to 50% germination	Germination %
T ₁ - <i>Trichoderma</i>	15.33	18.33	97.24
T ₂ - <i>Azotobacter</i>	14.66	17.66	97.56
T ₃ - <i>Pseudomonas</i>	21.33	24.33	94.37
T ₄ -Cow Urine 100%	27.00	27.34	68.30
T ₅ -Cow Urine 50%	18.66	24.30	88.63
T ₆ -Cow Dung 100%	25.47	26.00	76.51
T ₇ -Cow Dung 50%	22.68	24.66	80.26
T ₈ -Coconut water	17.66	25.66	87.94
T ₉ -Panchgavya	21.33	26.00	83.00
T ₁₀ -Beejamrit	20.00	25.00	85.76
T ₁₁ -Control	18.66	23.33	74.26
SEm(±)	0.419	0.742	0.265
CD @ 5%	1.245	2.204	0.787

Values are means of three replications.

4. Conclusion

Seed soaking with biostimulants significantly influenced germination of rough lemon. Among all treatments, *Azotobacter* proved most effective and can be recommended for raising healthy and uniform seedlings in citrus nurseries, while Cow urine should only be used in diluted form as concentrated Cow urine shows inhibitory effects.

References

- Bhoi R, Panigrahi S, Lalichetti S. Beejamritha elixir: nurturing seeds of green gram and cowpea for flourishing germination. *Agric Sci Dig.* 2025. doi:10.18805/ag.D-6124.
- Chaddha KL. Handbook of horticulture. New Delhi: Indian Council of Agricultural Research; 2001. p. 304-310.
- Choudhary B, Sharma TR, Pandey SK, Singh RB. Effect of seed priming on germination and growth of rough lemon and Rangpur lime seedlings. *Biol Forum Int J.* 2023;15(2):164-169.
- Karthikeyan B, Jaleel CA, Gopi R, Deiveekasundaram M. Alterations in seedling vigour and antioxidant enzyme activities in *Catharanthus roseus* under seed

- priming with native diazotrophs. J Zhejiang Univ Sci B. 2007;8(7):453-457.
5. Khandelwal K, Mishra S, Ripin, Ekka SK. Effect of *Azotobacter* and organic manure on germination and seedling growth of ber (*Ziziphus mauritiana*) cv. Gola. Int J Adv Biochem Res. 2024;8(5):34-38.
 6. Nainwad RV, Kalalbandi BM, Hade SM, Pokharna GS. Effect of different media and bio-inoculants on seed germination of Rangpur lime (*Citrus limonia* Osbeck.). J Pharmacogn Phytochem. 2018;7(5):488-489.