Oxygen Nanobubble Technology Accelerates Chickpea Germination & Early Root Development

Case Study: IIT Ropar Trial

Location:

IIT Ropar, Punjab, India

Application:

Chickpea Seed Germination

Unit installed:

NanoAqua Oxygen Nanobubble Generator

Results:

- Higher Dissolved Oxygen
- 18–20 Hours First Germination
- Up to 16% Higher Germination Rate
- 20–30% Longer Root Development

Background

In a controlled trial conducted in collaboration with IIT Ropar, Nanokriti evaluated the impact of oxygen-enriched nanobubble water on chickpea (Cicer arietinum) seed germination and early root development. Chickpea is an important agricultural crop where rapid seed germination and healthy early root development are essential for successful crop establishment. Two samples were set up simultaneously under identical ambient temperature, relative humidity, light, and climate conditions, with the only variable being the type of water used. By replacing standard Deionised/Milli-Q water with oxygen nanobubble water generated by the Nanokriti NanoAqua system, dissolved oxygen (DO) levels increased significantly, accelerating initial germination, increasing total emergence rates, and improving early root elongation over a 6-day monitoring period. The primary objective was to evaluate the physiological effects of oxygen nanobubbles on seed germination, dormancy breaking, and early seedling establishment under controlled environmental conditions.

Intervention

A Nanokriti NanoAqua Oxygen Nanobubble Generator was used to generate oxygen nanobubble water from Deionised/Milli-Q water supplied with pure oxygen. Nanobubble size distribution (<200 nm) and number concentration (>1 × 10^8 nanobubbles/mL) were validated using Nanoparticle Tracking Analysis (NTA).

Uniform, healthy chickpea seeds were surface-sterilised, rinsed with sterile distilled water, and placed in sterile Petri dishes lined with wetted filter paper. The Control Group was wetted with standard Deionised/Milli-Q water, while the Treatment Group received Nanokriti Oxygen Nanobubble Water. Radicle emergence was recorded every 6–12 hours, and first germination time, overall germination rate, radicle & root length, and seedling development metrics were recorded on Day 6.

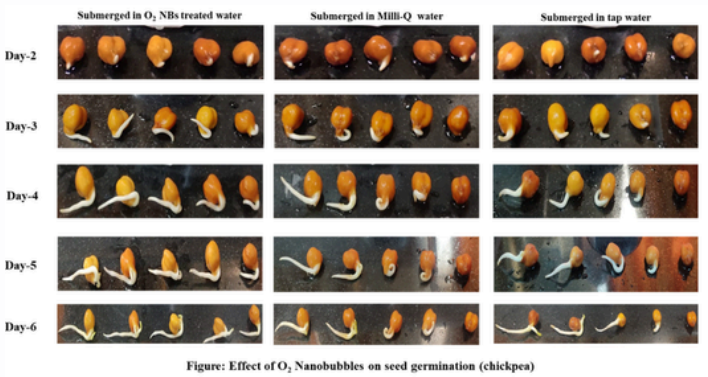

Figure: Effect of O_2 Nanobubbles on seed germination (chickpea)

Mechanism

Unlike conventional water, oxygen nanobubbles remain suspended for extended periods, increasing dissolved oxygen availability around germinating seeds. The enhanced oxygen delivery accelerates seed metabolism, promotes faster germination, and supports improved radicle emergence and early root development. These physiological improvements contribute to stronger seedling establishment under controlled environmental conditions.

Results & Key Findings:

The trial demonstrated significant physiological improvements across every measured parameter when using Nanokriti Oxygen Nanobubble Water. The treatment water achieved a Dissolved Oxygen (DO) concentration of 20 mg/L compared to 8 mg/L in the control Milli-Q water, representing a +150% increase in available oxygen. This increased oxygen availability led to a rapid onset of germination, with seeds treated using oxygen nanobubble water reaching First Germination Time in 18-20 hours, compared to 25–28 hours for the control group. By Day 6, the Overall Germination Rate for the Nanokriti treatment reached 87–96%, outperforming the control group's 70–80% by a +16% gain. Additionally, early root vigor was substantially enhanced, with the treatment group exhibiting a 20–30% increase in radicle and root length over the baseline control, establishing a noticeably superior root architecture.

Figure: Seed germination of green gram

Conclusion

The trial conducted with IIT Ropar validates that integrating the Nanokriti NanoAqua Oxygen Nanobubble Generator into seed hydration workflows significantly accelerates chickpea germination times, improves total emergence percentages, and boosts early root development.

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