International Journal of Latest Research in Engineering and Technology (IJLRET)
ISSN: 2454-5031
www.ijlret.com || Volume 11 - Issue 12 || December 2025 || PP. 01-06

Enhancement of Germination and Crop Performance with the Help of Seed Priming

Pratibha Yadav[1*], Priti Uikey[2] and Sharad Singh Lodhi[3]
[1, 2, 3]*Mata Jijabai Govt PG Girls College, Indore, Madhya Pradesh, India*
[*]*Corresponding Author*

Abstract: The present study evaluates the effectiveness of natural seed priming agents—banana peel water, onion extract, aloe vera water, cow urine, and normal water—on the germination and early seedling vigor of five Indian wheat (Triticum aestivum) varieties: Malavraj HI 8737, Shree Ram Super 303, Pusa Purna 1544, HD 3385, and Lokwan. The objective was to explore eco-friendly, low-cost alternatives to synthetic seed treatments to enhance seed performance and support sustainable agricultural practices. Seeds from each variety were soaked for 8 hours in the respective priming solutions, air-dried, and placed in Petri dishes lined with moist tissue paper. Germination parameters—including germination percentage, speed, root and shoot length, and seedling vigor index—were recorded daily over a 10-day period under controlled conditions. Significant differences were observed across treatments and varieties.

Results revealed that Pusa Purna 1544 and Lokwan responded most favorably, particularly under banana peel water, onion extract, and aloe vera treatments, which led to early germination and higher seedling vigor. Malavraj HI 8737 showed the least responsiveness, especially under cow urine and control treatments. Among the treatments, banana peel water was the most effective, followed by aloe vera water, onion extract, normal water, and cow urine.

In conclusion, natural priming agents such as banana peel water, aloe vera water, and onion extract significantly enhance germination and early growth in certain wheat varieties. These treatments present viable, sustainable alternatives for smallholder and organic farmers. Further field-level studies are necessary to validate these findings across diverse agro-climatic zones.

Keywords: Seed priming, Natural priming agents, Germination, Seedlingvigor, Banana peel water, Onion extract, Aloe vera water, Cowurine, Sustainable agriculture, Organic seed treatment.

1. Introduction

Wheat (*Triticum aestivum*) is one of the most important staple crops cultivated across the globe and holds a particularly significant place in India's agricultural economy. As the second-largest producer of wheat in the world, India depends heavily on this crop to meet the nutritional demands of its growing population. Wheat is not only a vital source of calories but also a significant provider of essential nutrients. It contains a rich array of components including carbohydrates, proteins, dietary fiber, iron, magnesium, zinc, and various B-complex vitamins such as thiamine, riboflavin, niacin, and folic acid (Farooq et al., 2006). These nutritional attributes make wheat a cornerstone of food security in the country.

The productivity of wheat, like any other crop, depends substantially on seed quality, environmental conditions, and the agricultural practices employed. Among the pre-sowing treatments aimed at improving seed performance, seed priming has emerged as an effective and sustainable technique (Basra et al., 2003; Chauhan et. al 2025). Seed priming is a controlled hydration process in which seeds are soaked in a solution for a specific period and then re-dried to their original moisture content before sowing. This method initiates the early metabolic processes required for germination without actual radicle emergence. As a result, primed seeds often show faster and more uniform germination, improved seedling vigor, and better tolerance to biotic and abiotic stresses (Farooq et al., 2006).

Natural seed priming agents have recently gained attention as eco-friendly, cost-effective alternatives to chemical-based treatments. In the present study, a variety of natural substances were utilized for seed priming, including banana peel water, onion extract, aloe vera gel water, cow urine, and plain water. Each of these agents is known to be rich in bioactive compounds that could potentially enhance seed metabolism and growth:

- **Banana peel water** is a good source of potassium, phosphorus, and calcium—nutrients essential for plant development (Saxena et al., 2017).
- **Onion extract** contains sulfur compounds, vitamins, and antioxidants that may boost seed health and vigor (Kumar & Singh, 2018).
- **Aloe vera** is rich in enzymes, amino acids, and plant hormones like gibberellins and auxins, which promote root growth and stress tolerance (Patel et al., 2020).

- **Cow urine**, traditionally used in organic farming, contains nitrogen, phosphorus, potassium, urea, and beneficial microbes (Sharma et al., 2016).
- **Plain water**, while lacking biochemical complexity, serves as a control to evaluate the relative effectiveness of other priming solutions (Farooq et al., 2006).

The study also aims to explore how these priming agents interact with different wheat genotypes, given that varietal response plays a crucial role in determining the success of any agronomic intervention (Choudhary et al., 2019; Yadav & Meena, 2021).

These varieties exhibit diverse genetic characteristics and physiological behaviors, especially under different environmental and management conditions. Studying their responses to natural seed priming treatments will help identify specific genotype-treatment combinations that optimize seed performance and crop productivity (Choudhary et al., 2019).

The central hypothesis of this research is that natural priming agents can positively influence seed germination, root-shoot development, and early seedling vigor across various wheat varieties. By comparing these treatments under controlled conditions, the experiment seeks to determine which agent or combination thereof delivers the most beneficial outcomes. The key parameters evaluated include germination percentage, germination speed, root and shoot length, and seedling vigor index (Yadav & Meena, 2021). These indicators provide a comprehensive picture of seed quality and potential field performance.

Seedling vigor, in particular, is a critical determinant of crop success. Vigorous seedlings are more likely to establish quickly, outcompete weeds, resist diseases, and tolerate environmental stresses such as drought or salinity (Basra et al., 2003). Enhancing seedling vigor through natural, low-cost inputs could thus serve as a highly effective strategy for small and marginal farmers.

Moreover, the use of natural seed priming agents aligns with the goals of sustainable agriculture. In light of growing concerns about soil degradation, water scarcity, and chemical overuse, organic and nature-based farming practices are gaining renewed importance. If proven effective, these treatments could become part of an integrated seed management strategy that is both environmentally friendly and economically viable (Farooq et al., 2006; Sharma et al., 2016).

2. Materials

2.1. Seed Material

The experimental study was conducted using five popular wheat (***Triticum aestivum***) varieties commonly grown in India. As shown in Table 1

Table 1: Popular wheat varieties grown across India was used in the research

S. No	Name of Variety	Quality
1.	**Malavraj HI 8737**	Known for its adaptability to semi-arid zones and high yield potential
2.	**Shree Ram Super 303**	Appreciated for its disease resistance and grain quality
3.	**Pusa Purna HI 1544**	Valued for early maturity and consistent yield
4.	**HD 3385**	Recognized for robustness and grain weight
5.	**Lokwan**	A traditional variety popular in central India for its taste and grain quality.

These varieties were chosen due to their wide cultivation, varied genetic backgrounds, and adaptability to different agro-climatic zones. Healthy, uniform, and disease-free seeds were selected to ensure consistency and accuracy in the results.

2.2. Seed Priming Agents

Five natural seed priming treatments were used to investigate their effect on seed germination and early seedling growth:

1. **Banana water extract**
2. **Onion water extract**
3. **Aloe vera water extract**
4. **Normal water (hydropriming control)**
5. **Cow urine**

Each priming solution was prepared fresh before treatment to ensure the effectiveness of its bioactive compounds.

Methods:

The experiment was conducted under controlled laboratory conditions using **Petri dishes** and **tissue paper** as a germination medium.

- A total of **25 Petri dishes** were used—five for each priming treatment.
- **Five beakers**, one for each priming agent, were used to soak the seeds.
- A **measuring cylinder** was employed to ensure equal volume (typically 100 ml) of priming solution for each treatment.
- Clean and dry **tissue paper** was used to line each Petri dish to maintain consistent moisture during germination.

Steps Followed:

1. **Seed Priming Treatment:**
   - Seeds of each wheat variety were soaked in their respective priming solutions (banana water, onion water, aloe vera water, normal water, and cow urine) for a fixed duration, typically **8 hours** at room temperature.
   - After soaking, seeds were removed, gently air-dried to remove excess moisture, and immediately placed in Petri dishes for germination.
2. **Seed Placement:**
   - For each priming agent, **five Petri dishes** were prepared—one for each wheat variety.
   - A double layer of tissue paper was placed in each dish, and it was moistened using the same priming solution used for soaking.
   - **Ten seeds** of the respective wheat variety were placed evenly on the moistened tissue paper in each dish.
   - The Petri dishes were labelled clearly and covered to prevent moisture loss.
3. **Observation and Data Collection:**
   - The Petri dishes were kept in a well-lit, ambient environment.
   - Daily observations were made from **Day 1 to Day 10** to assess the **germination percentage**, **germination speed**, and **seedling Vigor**.
   - Germinated seeds were counted every 24 hours.
   - Growth parameters such as **root length**, **shoot length**, and overall **seedling strength** were recorded on the 10th day.

3. Results and Discussion

Experiment 1: Germination effects on wheat varieties with the mixture of Banana water and normal water.

Varierties Name	**Malavraj HI 8737**	**Shree Ram super 303**	**Pusha purna 1544**	**HD 3385**	**Lokwan**
Treatment of banana water: Normal water 1:2	Least Growth	Third Highest Growth	**Fastest Growth**	Third Highest Growth	Second Highest Growth

Observations:

- Pusa purna 1544 showed the fastest germination and highest seedling growth, indicating strong positive response to the banana peel extract.
- Lokwan ranked second, displaying high seedling vigor and consistent early growth.
- HD 3385 and shree ram super 303 both showed moderate performance.
- Malavraj hi 8737 showed the least growth, indicating low sensitivity or tolerance to this priming agent.

Interpretation:

Banana water is rich in potassium, phosphorus, and natural sugars. these nutrients likely stimulated early metabolism and energy availability, particularly benefiting pusapurna 1544. however, malavraj hi 8737 appears less responsive to this nutrient-rich priming solution.

Experiment 2: Germination effects on wheat varieties with the mixture of Onion water and normal.

Varieties Name	**Malavraj HI 8737**	**Shree Ram super 303**	**Pusha purna 1544**	**HD 3385**	**Lokwan**
Onion water: Normal water 1:2	Least Growth	Third Highest Growth	Second Highest Growth	Third Highest Growth	**Fastest Growth**

Observations:

- Lokwan responded the best with fastest germination, possibly due to high antioxidant or sulfur compound tolerance.
- Pusa purna 1544 and hd 3385 showed good responses, ranking second and third respectively.
- Shree ram super 303 had moderate results.
- Malavraj hi 8737 again had least growth.

Interpretation:

Onion extract contains antioxidants and antimicrobial compounds, which may have stimulated enzyme activation. lokwan's top performance suggests robust adaptability to sulfur-containing compounds. poor results in malavraj suggest sensitivity or weaker enzyme activation pathways.

Experiment 3: Germination effects on wheat varieties with the mixture of Aloe vera water and Normal water.

Varieties Name	**Malavraj HI 8737**	**Shree Ram super 303**	**Pusha purna 1544**	**HD 3385**	**Lokwan**
Aloe vera water: Normal water 1:2	Least Growth	Third Highest Growth	**Fastest Growth**	Third Highest Growth	Second Highest Growth

Observations:

- Pusa Purna 1544 again showed the fastest growth, followed closely by Lokwan.
- Shree ram super 303 and HD 3385 performed moderately.
- Malavraj HI 8737 again showed least growth.

Interpretation:

Aloe vera is known to contain auxins, gibberellins, and enzymes that promote growth and stress tolerance. its effects were most pronounced on pusapurna 1544 and lokwan, indicating these genotypes may have a higher response to phytohormones and bioactive molecules**.**

Experment 4: Germination effects on wheat varieties with the mixture of Cow urine and Normal water.

Varieties Name	**Malavraj HI 8737**	**Shree Ram super 303**	**Pusha purna 1544**	**HD 3385**	**Lokwan**
Cow Urine: Normal water 1:2	**No germination**	**Least Growth**	**Fastest Growth**	**No germination**	**No germination**

Observations:

- Pusa Purna 1544 was the only variety to show strong and fast germination.
- Lokwan and Shree ram super 303 showed minimal or delayed germination.
- Malavraj HI 8737 and HD 3385 showed no germination at all**.**

Interpretation:

Cow urine, though rich in nitrogen and organic compounds, may have been too concentrated or acidic for most varieties. Pusa purna 1544's resilience suggests higher tolerance to organic nitrogen. lack of germination in other varieties indicates potential toxicity or unfavorableph balance at the used ratio.

Experiment 5: Germination effects on wheat varieties with Normal water.

Varieties Name	**Malavraj HI 8737**	**Shree Ram super 303**	**Pusha purna 1544**	**HD 3385**	**Lokwan**
Normal Water	Least Growth	Fourth Highest	Second Highest	Third Highest	**Fastest Growth**

Observations:

- Lokwan exhibited the fastest growth and highest germination rate under normal water, indicating strong natural vigor and adaptability even without enriched priming agents.
- Pusa purna 1544 showed second highest growth, suggesting good inherent seed vigor and moderate reliance on external priming inputs.
- HD 3385 followed with third highest growth, showing an average performance.
- Shree ram super 303 ranked fourth, indicating lower natural germination efficiency under plain water.
- MalavrajHI 8737 displayed the least growth, confirming its consistently poor germination behavior without external stimulation.

Interpretation:

Normal water (hydropriming) served as a baseline control to evaluate how each variety performs without any added bioactive compounds. the results show clear genetic differences in seed vigor:

- Lokwan's top performance highlights its suitability for low-input farming systems or stress-prone environments, where nutrient-rich priming solutions may not always be available.
- Pusa purna 1544, while performing well here, showed even better results in enriched treatments, indicating it benefits from but does not require bio-enhancers.
- Malavraj hi 8737 consistently underperformed, showing that it may require specific or stronger priming techniques to activate germination metabolism effectively.

Overall Comparative Trends of Wheat Varieties under Different Priming Treatments

Variety	**Banana Water**	**Onion Water**	**Aloe Vera Water**	**Cow Urine**	**Normal Water**	**Overall Performance**
Malavraj HI 8737	Least Growth	Least Growth	Least Growth	**No Germination**	Least Growth	**Very Poor** – lowest responder
Shree Ram Super 303	Third Highest Growth	Third Highest Growth	Third Highest Growth	Least Growth	Fourth Highest	**Moderate** – average performer
Pusa Purna 1544	**Fastest Growth**	Second Highest Growth	**Fastest Growth**	**Fastest Growth**	Second Highest	**Excellent** – top responder
HD 3385	Third Highest Growth	Third Highest Growth	Third Highest Growth	**No Germination**	Third Highest	**Moderate** – inconsistent
Lokwan	Second Highest Growth	**Fastest Growth**	Second Highest Growth	No Germination	**Fastest Growth**	**Very Good** – highly adaptable

4. Conclusion

The study investigated the germination responses of five wheat varieties—Malavraj HI 8737, Shree Ram Super 303, Pusa Purna 1544, HD 3385, and Lokwan—under five different hydration treatments: banana water, onion water, aloe vera water, cow urine mixed with normal water, and normal water alone. This comparative experiment aimed to assess the influence of various organic and natural water treatments on seed germination rate and growth patterns. Over a ten-day observation period, detailed records were maintained to monitor the onset and progression of germination in each variety under each treatment.

Across all five experiments, distinct trends emerged with regard to the responsiveness of the wheat varieties to different treatments. Some varieties displayed consistent performance across multiple treatments, while others responded significantly better or worse depending on the specific hydration source. The overall results suggest that certain natural additives can act as germination enhancers, while others may not be suitable for all varieties.

Acknowledgements

I'm extremely grateful to Dr Alka Bajpayi, Prof. & Head of Department Botany for support and supervision

Competing Interests

"Authors have declared that no competing interests exist."

Authors' Contributions

"Pratibha Yadav' designed the study, managed the analyses of the study and wrote the first draft of the manuscript

'Priti Uikey managed the literature searches, Perform the experiment. All authors read and approved the final manuscript."

Sharad Singh Lodhi, managed the analyses of the study

References

[1]. Basra, S. M. A., Farooq, M., & Tabassum, R. (2003). Enhancement of seedling vigor of rice (Oryza sativa L.) by seed priming with plant growth regulators. *Pakistan Journal of Agricultural Sciences*, 40(3), 124–126.

[2]. Choudhary, M., Verma, V. K., & Meena, M. (2019). Seed priming with bio-agents and natural substances enhances wheat seedling growth and vigor. *Journal of Pharmacognosy and Phytochemistry*, 8(4), 194–198.

[3]. Farooq, M., Basra, S. M. A., Wahid, A., & Khaliq, A. (2006). Seed priming improves germination and seedling growth in rice (Oryza sativa L.) under different soil moisture conditions. *Crop and Environment*, 1(1), 1–7.

[4]. Kumar, A., & Singh, R. (2018). Effect of onion extract as natural seed priming agent on germination and early seedling growth of wheat. *International Journal of Agriculture Sciences*, 10(4), 5234–5236.

[5]. Patel, D., Thakur, R., & Sharma, R. (2020). Impact of aloe vera extract as bio-priming agent on seedling vigor in wheat (Triticum aestivum L.). *Plant Archives*, 20(S1), 965–968.

[6]. Saxena, A., Choudhary, K., & Sharma, V. (2017). Use of banana peel extract as seed primer to enhance germination and early growth in maize. *Research Journal of Agricultural Sciences*, 8(1), 37–40.

[7]. Sharma, V., Yadav, R., & Gupta, A. (2016). Effect of cow urine on seed germination and seedling growth in wheat. *International Journal of Advanced Research in Biological Sciences*, 3(6), 34–38.

[8]. Yadav, N., & Meena, R. K. (2021). Comparative efficacy of hydro-priming and bio-priming agents on wheat (Triticum aestivum L.) seed germination and early growth. *Journal of Applied and Natural Science*, 13(1), 56–61.

[9]. Chauhan,R; Sahu,K; Majumder, S.K & Yadav, P (2025). Light as a Key Abiotic Driver in Enhancing Germination and Phytochemicals of Chickpea Cultivars. Environment and Ecology. 43(1),169-174.