



Effects of Different Organic Seed Pretreatments on Germination and Early Seedling Development of Mung Bean [*Vigna radiata* (L) Wilczek]

Anita Bhandari^{1,a,*}, Tirth Narayan Yadav^{1,b}, Abhisek Shrestha^{1,c}

¹Agriculture and Forestry University, Faculty of Agriculture, College of Natural Resource Management, Bardibas, Madhesh Province, Nepal.

*Corresponding author

ARTICLE INFO

ABSTRACT

Research Article

Received : 25.07.2025
Accepted : 29.08.2025

Keywords:
Aloe vera
Leaf extracts
Moringa
Mung beans
Osmo priming

The productivity of mung beans [*Vigna radiata* (L) Wilczek] is harshly affected by patchy plant stands due to uneven seed germination. Seed priming can improve crop emergence and establishment, which are thought to be the primary causes of crop success. Thus, the aim of the study was to investigate the effect of priming agents on mung beans. The experiment was carried out at the Horticulture Lab of College of Natural Resource Management, Bardibas, Mahottari, Nepal. This research consisted of 6 treatments (T1; control, T2; 5 % cow urine solution, T3; tap water, T4; 5 % Moringa leaf extract solution, T5; 5 % Neem leaf extract solution, and T6; 5 % Aloe Vera sap solution) with 3 replications and laid out in a complete randomized design (CRD). The seeds were soaked for 24 hours in Osmo priming solution and dried for 2 hours at room temperature before sowing. The germination and seedling development parameters (i.e. speed of germination, germination %, root length, shoot length, dry weight, seed vigor index 1, seed vigor index 2) were recorded and analyzed. The data revealed that all germination parameters of mung beans were highly affected by seed priming. The highest germination % (85.55 %), fresh weight (0.3737 g), dry weight (0.02563 g), seed vigor index 1 (1942) and seed vigor index 2 (2.192) were observed in 5% Aloe Vera sap solution. Highest speed of germination (22.75 seeds/day) was observed in 5% cow urine solution followed by 5% Aloe Vera sap solution i.e. (22.43 seeds/day). The highest root length (5.04 cm) was recorded in 5% Neem leaf extract solution and shoot length (19 cm) in 5% Moringa leaf extract solution, followed by 5% Aloe Vera sap solution, i.e., (18.46 cm). Seed priming using aloe vera sap solution was found effective in mung beans to increase germination, crop establishment, seed and seedling vigor.

^a aneetaxetri02@gmail.com

^b <https://orcid.org/0009-0002-2047-8442>

^b tirth.narayan369@gmail.com

^b <https://orcid.org/0009-0000-3684-3147>

^c ashrestha@afu.edu.np

^c <https://orcid.org/0000-0001-7316-3802>



This work is licensed under Creative Commons Attribution 4.0 International License

Introduction

Mung bean [*Vigna radiata* (L) Wilczek.] is an important pulse crop mainly cultivated in the Terai and mid-hill of Nepal. It is an important source of dietary protein for people of the Terai in Nepal. Rice-wheat cropping system is the main cropping pattern in Nepal. Wheat harvest in March is followed by rice transplanting in July. Land stays fallow for about 90 to 100 days. Farmers sow mung beans to improve soil fertility during this period (Darai et al., 2017). Seed germination is a critical stage in the growth of plants, playing a vital role in determining the success of crop production and overall agricultural output. The process of seed germination involves the activation of metabolic processes within the seed, leading to the emergence of a seedling (Ali & Elozeiri, 2017).

However, despite its importance, issues such as low germination rates and inconsistent seedling establishment continue to pose significant challenges in various crops,

including mung beans (Khan et al., 2008). Patchy plant stand due to uneven germination is one of the major constraints in mung bean production (Khan et al., 2008), and enhanced emergence and establishment of the mung bean crop are the most important factors contributing to the crop yield (Nandan et al., 2021).

Priming is a crucial process that facilitates the metabolic activities required for germination to initiate even before the actual germination process begins (Singh et al., 2015). Seed priming activates various metabolic pathways that prevent seeds from decaying, breaks dormancy, and fosters systemic resistance to both biotic and abiotic stressors (Pawar & Laware, 2018). The pre-germination treatment plays a significant role in preparing seeds for optimal growth and development (Nawaz et al., 2013). One common method of priming involves soaking seeds in various solutions that possess high osmotic potential (Srimathi et al., 2021). The enhancement of seed

can be achieved through the approach of priming, along with strategic field management practices, to optimize seed germination (Singh et al., 2015; Sher et al., 2019). There are several methods of seed priming in recent times (i.e. hydro priming, Osmo priming, PGR priming, chemical priming, and so on.) (Pawar & Laware, 2018; Sher et al., 2019).

Botanical priming represents a groundbreaking initiative, with a diverse range of botanical extracts being thoroughly explored for their effects on seed and seedling characteristics. In recent times, the application of local botanicals has emerged as a prominent area of study, particularly among researchers, due to their significant advantages in enhancing plant growth, boosting yield, and improving the quality attributes of seeds (Bhatishwar et al., 2020). Botanical seed treatment is liquid formulation (Gunasekar et al., 2017; Srimathi et al., 2021). It has a positive effect on early and uniform seed germination, growth and development, and enhances the capacity of seedlings to resist pests and diseases during the early crop stage. Limited studies have been conducted on the effects of these specific botanical extracts on mung beans under local conditions, so the experiment was conducted to explore the potential of botanical extracts to enhance mung bean germination.

Materials and Methods

Description of Experimental Site

The experiment was carried out in the year 2024 at the Horticulture Lab of College of Natural Resource Management-Bardibas, Mahottari, Nepal. This college is in the inner Terai region of Nepal, known for its unique geographical features. Situated at (26.9439953, 85.8841419), the college enjoys a strategic location within the country. The area where the experiment was carried out is approximately 225 meters above sea level, providing researchers with a diverse range of environmental conditions to study.

Description of Experimental Materials

The botanical priming materials selected are abundantly available in the local region and have a well-established history of implementation by farmers for both pest management and medicinal applications. The unique chemical profiles of these botanicals are believed to be instrumental in promoting the germination and vigor of mung bean seedlings. The study featured six distinct treatments. They are;

- T1 = no priming/dry seeds (control),
- T2 = 5% cow urine solution,
- T3 = hydro priming,
- T4 = 5% Moringa leaf extract solution,
- T5 = 5% Neem leaf extract solution, and
- T6 = 5% *Aloe vera* sap solution.

A careful selection of three botanicals was made for the preparation of extracts designated for use as seed priming substances. The young leaves of Moringa (*Moringa oleifera*), Neem (*Azadirachta indica*), and *Aloe vera* were collected for the formulation of their respective extract solutions. Mung bean seeds were treated with various

Osmo priming solutions for a period of 24 hours under laboratory conditions. After Osmo priming, the seeds were subjected to sieving and subsequently air-dried at room temperature for two hours to minimize moisture content before they were sown. Sowing of seeds utilizing a Completely Randomized Design (CRD) featuring three replications performed in a germination tray.

Preparation of plant leaf extract

The young leaves of the selected plants were carefully harvested, and using a mortar and pestle, the foliage was thoroughly crushed to obtain its liquid extract, which was subsequently employed to prepare the priming solution. A precise volume of 5 ml of the leaf extract was dissolved in 100 ml of distilled water, yielding a 5 % leaf extract solution. This solution was then filtered through muslin cloth to eliminate any suspended materials and leaf residues.

Preparation of Cow urine solution

The fresh 5 ml of cow urine was added in 100ml of water to prepare 5 % cow urine solution.

Data collection and analysis

Different parameters are studied during the present study. The detailed collection, entry, and analysis of data regarding various parameters obtained from seedlings that are 20 days in age. The data collected was entered and processed in Microsoft Excel 2016. Statistical analysis was performed using GENSTAT (18th Edition). Mean comparisons were made using the Least Significant Difference (LSD) test at 1 % and 5 % significance levels, and the Duncan's Multiple Range Test (DMRT) at the 5 % level. The data collected are calculated using different formulas for Germination percentage (G %), speed of germination (SoG), root length (RL), shoot length (SL), Fresh weight (FW), dry weight (DW), and seed vigor index (SVI) are as follows;

$$1. \text{ SoG} = \frac{G_1}{1} + \frac{G_2}{2} + \dots \dots \dots + \frac{G_n}{n}$$

Where;

SoG = Speed of germination or Germination Rate means the time taken for maximum germination by the seeds sown.

G = number of seeds germinated on respective days
1, 2, n = day 1, 2, n respectively

$$2. \text{ G \%} = \frac{\text{no. of germinated seeds}}{\text{total no. of seeds sown}} \times 100$$

3. Root and shoot length: 20 days old, 5 seedlings from each experimental unit were measured using a ruler, and the average of them was recorded for further analysis

4. Fresh and Dry weight: Seedlings' weight was measured just after taking root, and shoot length and then oven-dried at 102-105°C for 12 hours, and the dry weight was measured using a digital weighing balance

$$5. \text{ SVI1} = \text{G\%} \times \text{seedling length}$$

$$6. \text{ SVI2} = \text{G\%} \times \text{dry wt. of seedling}$$

Here, SVI = seed vigor index, which indicates the vigorousness of the seedling.

Result

Seed priming is a pre-sowing treatment which allows pre-germination metabolic activities to begin without actual radicle emergence. This process enhances seed performance in terms of germination rate, uniformity, and seedling vigor. The effect of seed priming on seed physiology and seedling establishment were studied in a present experiment.

Speed of Germination (SoG)

Speed of germination of different seed priming treatments showed significant variation among each other (Table 1). The speed of germination ranges from a minimum of 11.61 in control to a maximum of 22.75 in T2 (5 % cow urine solution) followed by T6 (22.43), T4 (21.8), and T3 (21.62). There is no statistically significant difference in T2, T3, T4, T5 and T6.

Germination Percentage

There was a significant difference among the germination percentages of different treatments ($P < 0.001$). The germination percentage ranged from 36.66 % to 85.55 %. T6 (5 % *Aloe vera* sap solution) had the highest germination with 85.55 % followed by T2 (5 % cow urine

solution) with 80 %, and minimum germination was observed in the control (36.66 %).

Root and Shoot Length

Root and shoot length were significantly affected by the different treatments of seed priming. The maximum root and shoot length were recorded on T5 (5.04 cm) and T4 (19 cm), followed by T2 (4.773 cm) and T6 (18.46 cm), respectively. Minimum root and shoot length were found in T4 (3.697 cm) and T3 (13.28 cm) respectively.

Fresh and Dry Weight of Seedling

Seed priming created a difference in fresh and dry weight of the seedlings. The fresh weight of seedlings ranged from maximum 0.3737 g in T6 to minimum 0.2550 g in T4. The dry weight of T 6 was recorded maximum with 0.02563 g, and significant differences were present within the different treatments ($P < 0.01$).

Seed Vigor Index

The seed vigor index of seedling of various treatments had shown significant difference among them at $P < 0.001$. T6 had the highest seed vigor index (SVI), both SVI1 (1942) and SVI2 (2.192), meanwhile, control had the least seed vigor index with SVI1 (607) and SVI2 (0.799).

Table 1. Effects of Different Organic Seed Pretreatments on Germination and Early Seedling Development Parameters of Mung Bean [*Vigna radiata* (L) Wilczek.] (2024).

Treatments	SoG	RL	SL	G%	FW	DW	SVI1	SVI2
1	11.61b	4.563bc	11.93d	36.66e	0.3040b	0.02180b	607d	0.799d
2	22.75a	4.773ab	14.96bc	80.00ab	0.3060b	0.02267b	1578bc	1.812ab
3	21.62a	4.243c	13.28cd	50.00d	0.3023b	0.02287b	876d	1.143d
4	21.80a	3.697d	19.00a	72.22bc	0.2550b	0.02197b	1641b	1.585bc
5	17.00a	5.040a	16.32ab	63.33c	0.2963b	0.02293b	1349c	1.450c
6	22.43a	4.250c	18.46a	85.55a	0.3737a	0.02563a	1942a	2.192a
G. Mean	19.53	4.428	15.66	64.63	0.3062	0.02298	1332	1.466
Sem	2.168	0.071	0.546	2.444	0.01217	0.000382	55.2	0.051
LSD (0.05)	6.679	0.2186	1.681	7.529	0.03751	0.001177	170	0.157
CV%	19.2	2.8	6	6.5	6.9	2.9	7.2	6
Significance level	*	***	***	***	***	**	***	***

Note: LSD = Least Significant Difference; CV% = Coefficient of Variation; SoG = Speed of Germination; G% = Germination Percentage; RL = Root Length of Seedling; SL = Shoot Length of Seedling; FW = Fresh weight of seedling; DW = Dry Weight of Seedling; SVI = Seedling Vigor Index; SEM (\pm) = Standard Error of Mean; Means followed by the same letter(s) within each column are non-significantly different at 5% level of significance by DMRT; the star '*', '**' and '***' in the F-test indicate the probability level at < 0.05 , < 0.01 and < 0.001 respectively.

Discussion

The rate of germination of seeds was affected by the enzymes activated during seed germination (Ghassemi-Golezani et al., 2014). (Dissanayaka et al., n.d.) reported that the presence of iron, urea and uric acid in cow urine can change the seed coat permeability, which helps to break dormancy of the seed in soyabean. Çavuşoğlu et al. (2016) suggested that highest germination observed due to large number of microbes presents in plant extracts and microbes are effective in inducing plant growth as they secrete plant growth promoters (auxins, abscisic acid, gibberellic acid, cytokines, and ethylene) (Bhateshwar et al., 2020) and enhance seed germination and increase the speed of germination (Nandan et al., 2021). Pre-sowing treatment of seed activates the seed metabolism before germination (Pawar & Laware, 2018) and helps to establish early in the field (Ghassemi-Golezani et al., 2014). Seed priming with *Aloe vera* increased the seedling height in

onion was reported by (Singh, 2017). Moringa leaf extract has various antioxidants and Phyto-hormones which stimulate the physiology of the seed when priming (Mantja et al., 2023). Bio-chemical analysis of moringa leaf extract found a higher concentration of GA₄ than other hormones. At higher concentration and/or priming for longer duration, the moringa leaf extract has an allelopathic effect on germination, development and dry matter accumulation in seedlings of mung-bean (Kamanga et al., 2025).

Similar results were obtained on chickpea (Kundururu et al., 2024). Seed priming can stimulate or activate the enzymatic activities of the seed, which initiate seed physiology and help to ensure good germination and seedling dry matter content, which makes the seedlings more vigorous. Pre-sowing seed priming can increase the seed coat permeability, which induces the absorption of water and other biochemicals into the seed (Masuthi et al.,

2015), which ultimately increases the seedling establishment and its vigor. (Gunasekar et al., 2017) had also recorded the similar outcome on SVI1 and SVI2 on black gram [*Vigna mungo* (L.) Hepper] when prime the seeds with *Aloe vera*.

Conclusion

The results of the experiment were concluded as seed priming using botanical extract was very effective in increasing the seed germination and seedling establishment of mung beans. Among various treatments, *Aloe vera* sap solution as seed priming agent showed higher seed germination rate, germination percentage, and seed vigor followed by moringa leaf extract solution. Hence, seed sowing of primed seed using botanical extracts like 5% *Aloe vera* sap solution or 5% Moringa leaf extract solution can effectively increase the seed germination and good crop establishment in the case of mung beans, and ultimately increases the yield and productivity of the farmers. Pre-sowing treatments of mung-bean with botanical extracts like *Aloe vera* and Moringa leaf extract were proven cost cost-effective, eco-friendly, economical and yield enhancers for resource-poor farmers. The above results were observed under lab conditions, and for proper validation of the above-mentioned results, farmers field trials should be done.

Declarations

This study was presented at the IV. International Congress of the Turkish Journal of Agriculture - Food Science and Technology (Niğde, TURJAF 2025)

Conflict of Interest

The authors declare that no ethical concerns were compromised during the experiment. The study was conducted in an ecologically sound and environmentally friendly manner. The authors further declare that they have no conflict of interest.

Author's contribution

Anita Bhandari and Tirth Narayan Yadav were responsible for the conceptualization, methodology, investigation, data collection, analysis, interpretation, and preparation of the original draft. Abhisek Shrestha provided supervision and contributed to manuscript review and editing. Special thanks to Ajita Pokhrel for her help during research formulation and data collection.

Acknowledgement

The authors were very thankful to the College of Natural Resource Management, Bardibas, Mahottari, Madhesh Province, Nepal, for providing all the resources for the successful accomplishment of the experiment and support.

References

Ali, A. S., & Elozeiri, A. A. (2017). Metabolic processes during seed germination. *Advances in Seed Biology*, 2017, 141–166. <http://dx.doi.org/10.5772/intechopen.70653>

- Bhateshwar, D. C., Prabha, D., Jangid, D., & Salman, M. (2020). Effect of seed priming with botanicals on plant growth and seed yield of lentil (*Lens culinaris* M.). *International Journal of Current Microbiology and Applied Sciences*, 9(7), 3484–3499. <https://doi.org/10.20546/ijcmas.2020.907.407>
- Çavuşoğlu, D., Tabur, S., & Çavuşoğlu, K. (2016). The effects of *Aloe vera* L. leaf extract on some physiological and cytogenetical parameters in *Allium cepa* L. seeds germinated under salt stress. *Cytologia*, 81(1), 103–110. <http://dx.doi.org/10.1508/cytologia.81.103>
- Darai, R., Sah, R. P., Wagle, B. P., Regmi, D., Subedi, S., & Bahadur, M. (2017). Evaluation of Short Duration and Synchronous Mungbean Genotypes in Maize and Rice-Wheat Based Cropping System in Nepal. *National Summer Crops Workshop*, 17, 297. <http://dx.doi.org/10.59797/jfl.v36.i4.158>
- Dissanayaka, D., Seran, T. H., & Damlathge, T. H. (n.d.). *Effect of Cow Urine and Coconut Water as Seed Priming on Growth and Yield of Soybean*. Retrieved July 23, 2025, from <https://seu.ac.lk/sljot/publication/v6sp/Sp%20Issue%2005-CST%2012.pdf>
- Evidence that Mung Beans Strengthen Nepal's Farm Systems. (2020, May 28). *Cereal Systems Initiative for South Asia (CSISA)*. <https://csisa.org/evidence-that-mung-beans-strengthen-nepals-farm-systems/>
- Ghassemi-Golezani, K., Hassanpour-Bourkheili, S., Bandeh-Hagh, A., & Abriz, S. F. (2014). *Seed hydro-priming, a simple way for improving mung-bean performance under water stress*. <http://dx.doi.org/10.12692/ijb/4.12.12-18>
- Gunasekar, J., Kamaraj, A., & Padmavathi, S. (2017). *Effect of botanical seed priming on seed quality characters in blackgram [Vigna mungo (L.) Hepper] cv. CO 6*. https://www.academia.edu/download/119306390/1383-1387_3845_.pdf
- Kamanga, B. M., Cartmill, D. L., McGill, C., & Clavijo McCormick, A. (2025). Allelopathic Effects of Moringa oleifera Lam. on Cultivated and Non-Cultivated Plants: Implications for Crop Productivity and Sustainable Agriculture. *Agronomy*, 15(8), 1766. <https://doi.org/10.3390/agronomy15081766>
- Khan, A., Khalil, S. K., Khan, A. Z., Marwat, K. B., & Afzal, A. (2008). The role of seed priming in semi-arid area for mung bean phenology and yield. *Pak. J. Bot*, 40(6), 2471–2480.
- Kunduru, S., Chaudhary, A., Kamra, A., Bana, R. S., Kumar, S. N., & Yalamalle, V. R. (2024). Seed priming with *Aloe vera* and *Trichoderma asperellum* improves germination in chickpea under osmotic and temperature stress. *Seed Science and Technology*, 52(3), 265–281. <http://dx.doi.org/10.15258/sst.2024.52.3.04>
- Mantja, K., Syam'un, E., & Faried, M. (2023). Seed priming using moringa leaf extract and application of Tithonia compost on shallot growth. *Jurnal Agronomi Indonesia (Indonesian Journal of Agronomy)*, 51(2), 146–154. <http://dx.doi.org/10.24831/ija.v51i2.45747>
- Masuthi, D., Chavan, M. L., Khaja Rubina, S., Ramangouda, S. H., Abdul Kareem, M., Prabhakar, I., & Haleshkumar, B. (2015). Different priming treatments on germination and viability of cluster bean seeds. *International Journal of Advanced Research*, 3(5), 108–111.
- Nandan, R., Yadav, R. K., Singh, S. P., Singh, A. K., & Singh, A. K. (2021). Effect of seed priming with plant growth regulators on growth, biochemical changes and yield of mung bean (*Vigna radiata* L.). *International Journal of Chemical Studies*, 9(1), 2922–2927. <http://dx.doi.org/10.22271/chemi.2021.v9.i1ao.11673>
- Nawaz, J., Hussain, M., Jabbar, A., Nadeem, G. A., Sajid, M., Subtain, M. U., & Shabbir, I. (2013). Seed priming a technique. *International Journal of Agriculture and Crop Sciences*, 6(20), 1373.

- Pawar, V. A., & Laware, S. L. (2018). Seed priming a critical review. *Int. J. Sci. Res. Biol. Sci*, 5(5), 94–101. <http://dx.doi.org/10.26438/ijrsrbs/v5i5.94101>
- Sher, A., Sarwar, T., Nawaz, A., Ijaz, M., Sattar, A., & Ahmad, S. (2019). Methods of Seed Priming. In M. Hasanuzzaman & V. Fotopoulos (Eds.), *Priming and Pretreatment of Seeds and Seedlings: Implication in Plant Stress Tolerance and Enhancing Productivity in Crop Plants* (pp. 1–10). Springer. https://doi.org/10.1007/978-981-13-8625-1_1
- SINGH, G. (2017). *Seed quality enhancement through priming treatments in onion (Allium cepa L.)* [PhD Thesis, HARYANA AGRICULTURAL UNIVERSITY HISAR]. <https://krishikosh.egranth.ac.in/server/api/core/bitstreams/b1b4ef2e-0091-4cbb-8283-39471329c59c/content>
- Singh, H., Jassal, R. K., Kang, J. S., Sandhu, S. S., Kang, H., & Grewal, K. (2015). Seed priming techniques in field crops-A review. *Agricultural Reviews*, 36(4), 251–264. <http://dx.doi.org/10.18805/ag.v36i4.6662>
- Srimathi, S., Gokulakrishnan, J., & Prakash, M. (2021). *Effect of seed priming with botanical leaf extracts on seed quality and yield of maize hybrid, COH (M) 4*. https://angrau.ac.in/downloads/Publications/TheJournalofresearchANGRAU-Jan-March-49_2021.pdf#page=41