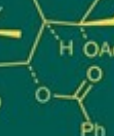
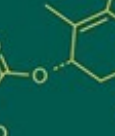
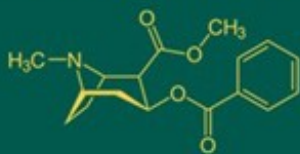


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## Influence of $GA_3$ priming on seed germination and seedling survival of *Moringa* (*Moringa oleifera* L.)

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**ABSTRACT**

The present investigation entitled "Influence of  $GA_3$  Priming on Seed Germination and Seedling Survival of *Moringa* (*Moringa oleifera* L.)" was undertaken at the Research cum Instructional Farm, College of Horticulture and Research Station, Hathani, Bilaspur (C.G.) during Winter season 2025-26. The experiment was conducted on variety PKM-1 under Completely Randomized Design (CRD) comprising 11 treatments with varying concentrations of gibberellic acid (5, 7.5, 10 and 12 ppm) and water along with two soaking durations (12 and 24 hours), replicated thrice. Among the treatments,  $T_{10}$  (seeds soaked in 12 ppm  $GA_3$  for 24 hours) proved significantly superior with respect to germination parameters, recording minimum days to start germination (6.47 days), minimum days to 50% germination (8.56 days), maximum germination percentage (70.35%) and maximum survival percentage (78.48%), which remained statistically at par with  $T_9$  (seeds soaked in 10 ppm  $GA_3$  for 24 hours).

**Keywords:** *Moringa oleifera*, Gibberellic acid ( $GA_3$ ), Seed priming, Germination, Survival percentage

**Introduction**

*Moringa* (*Moringa oleifera* L.), which is commonly referred to as Drumstick tree, horseradish tree, miracle tree or sahan is a valuable multipurpose tree species belonging to the family Moringaceae, with a chromosome number of  $2n = 28$ . Owing to its remarkable nutritional, therapeutic and economic potential, it is extensively cultivated across tropical and subtropical regions of the world. All parts of the moringa plant such as leaves, pods, flowers, seeds and roots, is endowed with considerable nutritional and therapeutic value. Tender pods are widely used as a vegetable for culinary purposes in soups, curries and pickles, while leaves and flowers are consumed as leafy vegetables, as well as in the form of health supplements and herbal tea. *Moringa* leaves are a powerhouse of nutrients, rich in protein, essential amino acids, vitamins and minerals. Reports reveal that moringa foliage possesses many times more vitamin C than orange, more calcium and protein than milk, more potassium than banana, more iron than spinach and more vitamin A than carrot. Due to this exceptional nutritional profile, moringa is viewed as exceptionally beneficial for addressing malnutrition and enhancing food security, particularly among children and expectant mothers (Fahey, 2005) [1]. Seed priming is an effective pre-sowing technique to improve germination, seed vigour and seedling establishment. It involves controlled hydration of seeds to activate pre-germinative metabolism including enzyme activation, nucleic acid synthesis, repair of cellular damage and mobilization of reserves without radicle emergence, resulting in rapid and uniform germination. Among various methods, hormonal priming is highly effective. Gibberellic acid ( $GA_3$ ) improves germination, breaks dormancy and promotes seedling growth by stimulating  $\alpha$ -amylase activity, which enhances reserve mobilization, embryo growth and weakening of tissues enclosing the radicle to facilitate its protrusion (Bewley *et al.*, 1994) [2]. Hence, the present investigation was undertaken to study the influence of  $GA_3$  Priming on Seed Germination and Seedling Survival of *Moringa* (*Moringa oleifera* L.)"

**Materials and Methods**

The present investigation was undertaken at Research cum Instructional Farm at College of Horticulture and Research Station, Hathani, Bilaspur (C.G.) during Winter season of 2025-26. During the crop period, maximum and minimum temperatures ranged from 29.3-37.1 °C and 13.1-20.8 °C, respectively. Morning (RH-I) and evening (RH-II) relative humidity varied from 70.9-93.6% and 31.7-58.0%, with bright sunshine hours of 6.0-9.7 hours. Rainfall was negligible (0.3-0.7 mm), while pan evaporation increased from 2.8 to 6.2 mm day<sup>-1</sup>. Overall meteorological conditions were favourable for crop growth although low rainfall and increasing evaporation during later crop stages necessitated supplementary irrigation to prevent moisture stress.

### Experimental design

The experiment was laid out in a Completely Randomized Design (CRD) with three replications. A total of eleven treatments were tested and these were randomly allocated within each replication. Seedlings were raised in 495 polybags (10 × 12 inch) filled with growing media soil: sand: vermicompost (2:1:1) treated with

*Trichoderma viride*. GA<sub>3</sub> solutions (5, 7.5, 10 and 12 ppm) were prepared by dissolving GA<sub>3</sub> in 95% ethanol and making volume to 1 liter with distilled water. All cultural operations, including irrigation, inter-cultural practices and plant protection measures, were followed uniformly to ensure healthy seedling growth. Observations were recorded from five randomly selected seedlings per treatment in each replication.

**Table 1.** Details of treatment combination

| Treatment Notation | Treatment Details                    |
|--------------------|--------------------------------------|
| T <sub>0</sub>     | Control                              |
| T <sub>1</sub>     | Seed Soaking in water for 12 hours   |
| T <sub>2</sub>     | GA <sub>3</sub> 5 ppm for 12 hours   |
| T <sub>3</sub>     | GA <sub>3</sub> 7.5 ppm for 12 hours |
| T <sub>4</sub>     | GA <sub>3</sub> 10 ppm for 12 hours  |
| T <sub>5</sub>     | GA <sub>3</sub> 12 ppm for 12 hours  |
| T <sub>6</sub>     | Seed Soaking in water for 24 hours   |
| T <sub>7</sub>     | GA <sub>3</sub> 5 ppm for 24 hours   |
| T <sub>8</sub>     | GA <sub>3</sub> 7.5 ppm for 24 hours |
| T <sub>9</sub>     | GA <sub>3</sub> 10 ppm for 24 hours  |
| T <sub>10</sub>    | GA <sub>3</sub> 12 ppm for 24 hours  |

**Statistical analysis:** The experimental data were subjected to analysis of variance (ANOVA) appropriate for a Completely Randomized Design (CRD) using OPSTAT software. The significance of treatment effects was tested at the 5% probability level, and treatment means were compared using the Critical Difference (CD) test wherever the F-test was found significant.

## Results and Discussion

### Days taken to start germination

The number of days required for initiation of germination in moringa was significantly influenced by concentration of gibberellic acid and the soaking duration. It is clearly evident from the Table 2, earliest germination (6.47 days) was recorded in T<sub>10</sub> (seeds soaked in 12 ppm GA<sub>3</sub> for 24 hours) followed by T<sub>9</sub> (10 ppm GA<sub>3</sub> for 24 hours) (6.64). In contrast, maximum days to emergence (10.48) was recorded in T<sub>0</sub> (control), which was statistically significant compared to all other treatments. The accelerated germination following GA<sub>3</sub> priming may be ascribed to its role in alleviating seed dormancy, enhanced hydrolytic enzyme activity and improved mobilization of reserve food materials for embryo growth. Similar promotive effects of GA<sub>3</sub> on germination were reported by Rahman *et al.* (2020) [3] in cucumber. Results also indicated that the seed soaked in different concentrations of GA<sub>3</sub> for 24 hours was found superior over seed soaked in the same concentrations of GA<sub>3</sub> for 12 hours.

### Days taken 50% germination

Data revealing number of days taken to 50% germination was recorded for various treatments and further presented in Table 2. A similar trend was observed for days taken to 50% germination, whereas Treatment T<sub>0</sub> (control) took maximum period (13.86 days) to attain 50% germination, while T<sub>10</sub> (GA<sub>3</sub> 12 ppm, 24 hours) required

the least period (8.56 days) closely followed by T<sub>9</sub> (10 ppm GA<sub>3</sub> for 24 hours) (8.78). Non-significant differences observed among treatments T<sub>1</sub> and T<sub>6</sub>. Likewise, treatments T<sub>4</sub>, T<sub>5</sub> and T<sub>8</sub> were also found to be statistically at par, indicating no significant variation among them. Overall, higher concentrations of GA<sub>3</sub> combined with longer soaking hours outperformed across concentrations. Similar findings were reported by Katoriya *et al.* (2021) [4].

### Germination percent (%)

Data pertaining to germination percentage under various treatments are summarized in Table 2 and illustrated in Fig.4. Maximum germination percentage (70.35%) was obtained in T<sub>10</sub> (seed soaked in 12 ppm GA<sub>3</sub> solution for 24 hours) followed by T<sub>9</sub> (69.79 %) and T<sub>8</sub> (65.54%). Whereas, statistically significant and minimum germination percentage (53.21%) recorded in treatment T<sub>0</sub> (control) closely followed by treatment T<sub>1</sub> (55.77%) and T<sub>6</sub> (55.83%). However, irrespective of GA<sub>3</sub> concentration, seeds soaked for 24 hours consistently exhibited significantly higher germination than those soaked for 48 hours. Similar findings were reported by Katoriya *et al.* (2021) [4].

### Survival percentage of seedling

The data pertaining to survival percentage as influenced by different concentrations of GA<sub>3</sub> and soaking durations are presented in Table 3, revealed a significant increase with increasing GA<sub>3</sub> concentration under both soaking durations. The maximum survival percentage (78.48%) was recorded in T<sub>10</sub> (GA<sub>3</sub> @ 12 ppm for 24 hours), which was statistically at par with T<sub>9</sub> (GA<sub>3</sub> @ 10 ppm for 24 hours) registering 77.85% survival. Whereas, the minimum survival percentage (58.71%) was observed in T<sub>0</sub> (control), closely followed by T<sub>1</sub> (60.94%) and T<sub>6</sub> (62.28%). There were no significant differences observed among the remaining treatments. The positive influence of GA<sub>3</sub> on seedling survival aligns with earlier reports by Katoriya *et al.* (2021) [4].

**Table 2.** Effect of soaking time and concentrations of Gibberellic acid on Days taken to start germination, days taken to 50% germination and Germination percent (%) of moringa

| Treatment Notation | Treatment details                    | Days taken to start germination | Days taken to 50% germination | Germination percent (%) |
|--------------------|--------------------------------------|---------------------------------|-------------------------------|-------------------------|
| T <sub>0</sub>     | Control                              | 10.48                           | 13.86                         | 53.21                   |
| T <sub>1</sub>     | Seed Soaking in water for 12 hours   | 9.67                            | 12.79                         | 54.63                   |
| T <sub>2</sub>     | GA <sub>3</sub> 5 ppm for 12 hours   | 8.75                            | 11.57                         | 59.77                   |
| T <sub>3</sub>     | GA <sub>3</sub> 7.5 ppm for 12 hours | 8.55                            | 11.31                         | 60.86                   |
| T <sub>4</sub>     | GA <sub>3</sub> 10 ppm for 12 hours  | 7.60                            | 10.06                         | 62.89                   |
| T <sub>5</sub>     | GA <sub>3</sub> 12 ppm for 12 hours  | 7.48                            | 9.89                          | 64.46                   |
| T <sub>6</sub>     | Seed Soaking in water for 24 hours   | 9.47                            | 12.52                         | 55.83                   |
| T <sub>7</sub>     | GA <sub>3</sub> 5 ppm for 24 hours   | 8.38                            | 11.09                         | 61.35                   |
| T <sub>8</sub>     | GA <sub>3</sub> 7.5 ppm for 24 hours | 7.28                            | 9.63                          | 65.54                   |
| T <sub>9</sub>     | GA <sub>3</sub> 10 ppm for 24 hours  | 6.64                            | 8.78                          | 69.79                   |
| T <sub>10</sub>    | GA <sub>3</sub> 12 ppm for 24 hours  | 6.47                            | 8.56                          | 70.35                   |
|                    | SEm (±)                              | 0.20                            | 0.26                          | 1.65                    |
|                    | CD (5%)                              | 0.59                            | 0.76                          | 4.83                    |
|                    | CV (%)                               | 4.25                            | 5.13                          | 4.62                    |

**Table 3.** Effect of soaking time and concentrations of Gibberellic acid on survival percentage of seedlings

| Treatment       | Treatment details                    | Survival percentage of seedlings |
|-----------------|--------------------------------------|----------------------------------|
| T <sub>0</sub>  | Control                              | 58.71                            |
| T <sub>1</sub>  | Seed Soaking in water for 12 hours   | 60.94                            |
| T <sub>2</sub>  | GA <sub>3</sub> 5 ppm for 12 hours   | 66.68                            |
| T <sub>3</sub>  | GA <sub>3</sub> 7.5 ppm for 12 hours | 67.89                            |
| T <sub>4</sub>  | GA <sub>3</sub> 10 ppm for 12 hours  | 70.15                            |
| T <sub>5</sub>  | GA <sub>3</sub> 12 ppm for 12 hours  | 71.90                            |
| T <sub>6</sub>  | Seed Soaking in water for 24 hours   | 62.28                            |
| T <sub>7</sub>  | GA <sub>3</sub> 5 ppm for 24 hours   | 68.44                            |
| T <sub>8</sub>  | GA <sub>3</sub> 7.5 ppm for 24 hours | 73.11                            |
| T <sub>9</sub>  | GA <sub>3</sub> 10 ppm for 24 hours  | 77.85                            |
| T <sub>10</sub> | GA <sub>3</sub> 12 ppm for 24 hours  | 78.48                            |
|                 | S.E.(m) ±                            | 1.77                             |
|                 | C.D. (5%)                            | 5.18                             |

## Conclusion

Seed priming with GA<sub>3</sub> significantly enhanced germination, seedling growth, survival and economic returns in moringa over unprimed control. On the basis of results obtained, it may be concluded that seed priming with GA<sub>3</sub> @ 12 ppm for 24 hours (T<sub>10</sub>) may be recommended for obtaining higher germination, vigorous seedling growth, survival and higher profitability of moringa, while T<sub>9</sub> (10 ppm GA<sub>3</sub> for 24 hours) can also be considered as a viable alternative.

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## Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this manuscript.

## Author contributions

Akhil Kumar Rathour conceptualized and conducted the experiment, collected and analysed the data, and prepared the original manuscript. Pushpanjali Pankaj contributed to conceptualization of experimental

design, data interpretation, critical revision of the manuscript and overall supervision of the research work. All authors read and approved the final manuscript.

## References

1. Fahey JW. *Moringa oleifera*: A review of the medical evidence for its nutritional, therapeutic, and prophylactic properties. Part 1. Trees for Life Journal. 2005;1(5):1-15.
2. Bewley JD, Black M. Seeds: Physiology of development and germination (2nd ed.). Plenum Press; 1994.
3. Rahman M, Bahadur M, Pramanik S. Influence of gibberellic acid (GA<sub>3</sub>) on growth, flowering, and fruit yield of cucumber. Journal of Science and Technology. 2020;18(1):33-42.
4. Katoriya RS, Singh KV, Gurjar RPS. Effect of seed priming on drumstick (*Moringa oleifera* L.) seedling growth with different concentrations of gibberellic acid. The Pharma Innovation. 2021;10(11):1817-1821.
5. Anonymous. Area, Production and Productivity of Horticulture Crops in Chhattisgarh. Department of Horticulture and Farm Forestry, Government of Chhattisgarh; 2019-20.
6. Farahzety AM, Singh A, Yap LV. Influence of priming treatments on seed germination and growth characteristics of *Moringa oleifera* seedlings under laboratory and greenhouse conditions. Food Research. 2023;6(Suppl. 4):71-80.

7. Katoriya RS, Kureel MK, Mandloi D, Suryawanshi DK, Lekhi R, Rathore SS. Seed germination of drumstick cv. PKM-1 as effected by different concentrations of gibberellic acid and soaking time. *International Journal of Chemical Studies*. 2019;7(6):739–744.

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