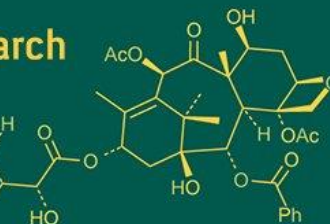
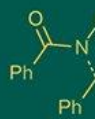


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## Standardization of GA3 concentration and soaking duration for improved seed germination in drumstick (*Moringa oleifera* L.) cv. odc-3 under shade-net conditions

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### Abstract

He studies titled "Evaluation of various concentrations of GA3 and soaking time on seed germination and seedling growth of drumsticks cv. ODC-3 under shade-net condition" was conducted during 2024-2025 at Jagdalpur under Mahatma Gandhi University of Horticulture and Forestry, Durg (C.G.). Eight treatments with three replications were evaluated to assess the effect of GA3 levels and soaking durations on germination. The maximum days taken to start germination were recorded in T<sub>5</sub> (6.13 days), while T<sub>3</sub> (4.89 days) and T<sub>8</sub> (4.77 days) were at par with each other and the minimum days were noted in T<sub>4</sub> (4.22 days). The maximum days for 50% germination were observed in T<sub>5</sub> (7.09 days), with T<sub>3</sub> (5.78 days) and T<sub>8</sub> (5.82 days) remaining at par, while the minimum duration was recorded in T<sub>4</sub> (5.34 days). The maximum germination percentage was obtained in T<sub>4</sub> (80.43%), followed by T<sub>3</sub> (76.92%) and T<sub>8</sub> (75.92%), while the minimum percentage was recorded in T<sub>5</sub> (61.26%).

**Keywords:** *Moringa oleifera* L., GA<sub>3</sub>, seed germination, soaking duration, shade- net condition

### 1. Introduction

Drumstick (*Moringa oleifera* L.), belonging to the mongeneric family Moringaceae is one of the best useful trees with a variety of potential uses. Drumstick commonly known as 'horseradish tree', 'miracle tree' or 'tree of life' is native to the sub-Himalayan tracts of India, Pakistan, Bangladesh and Afghanistan (Paliwal *et al.*, 2011) <sup>[1]</sup>.

Gibberellic Acid (GA<sub>3</sub>) is the most important growth regulator, which breaks seed dormancy, promotes germination, hypocotyls growth and cell division in cambial zone and increases the size of leaves. GA<sub>3</sub> stimulates hydrolytic enzymes that are needed for the degradation of the cells surrounding the radicle and thus speeds germination by promoting seedling elongation growth of cereal seeds (Rood *et al.*, 1990) <sup>[2]</sup>.

*Moringa* is a highly nutritive plant that is widely used to treat human malnutrition due to micronutrient shortages in many African countries (Fuglie, 2001) <sup>[4]</sup>. Drumstick is an important food commodity which has received enormous attention as the 'natural nutrition' of the tropics. *Moringa* has many medicinal properties. Almost all parts, viz., root, bark, gum, leaf, pod, flower, seed and seed oil have been used for treatment of various inflammation and infectious diseases along with cardiovascular, gastrointestinal, haematological and hepatorenal disorders (Siddhuraju and Becker, 2003) <sup>[3]</sup>.

### 2. Material and Method

#### 2.1 Experimental site

The experiment was carried out at the Research-cum-instructional farm Jagdalpur, Bastar District during the 2024-25 season in a Completely Randomized Design (CRD) with 8 treatments and 3 replications at the bearing stage.

#### 2.2 Germination parameters

##### 2.2.1 Days taken to start germination

The number of days required for the first seedling to emerge was noted. Daily observations were made and the appearance of the first foliage leaf was taken as the indicator of initial

germination. All data were recorded following standard procedures and analyzed statistically as per the experimental design.

2.2.2 Days taken to 50% germination

The days required for achieving fifty percent seedling emergence were documented. Observations were taken daily, considering the appearance of the first foliage leaf as the reference point. The data were collected as per standard methods and analysed statistically according to the design.

2.2.3 Germination percent (%)

Germination was monitored visually by counting the number of germinated seedlings at seven-day intervals, with the final count taken on the 25th day. A drumstick seed was considered germinated when the stalk emerged above the soil surface. The recorded data were analyzed using analysis of variance and represented graphically. Germination percentage was calculated using the following formula-

$$G \text{ (}\% \text{)} = \frac{T \text{ (number of germinated seeds)}}{T \text{ (total number of seeds)}} \times 100$$

3. Result and Discussion

3.1.1 Days taken for start germination

As presented in Table 4.1.1 the maximum days taken to start germination were recorded in T<sub>5</sub> (6.13 days), while T<sub>3</sub> (4.89 days) and T<sub>8</sub> (4.77 days) were at par with each other and the minimum days were noted in T<sub>4</sub> (4.22 days). The minimum time taken in T<sub>4</sub> may be due to the promotive effect of GA<sub>3</sub>, which accelerates metabolic activation, weakens seed coat resistance and promotes early radicle emergence. In contrast, the maximum duration observed in T<sub>5</sub> could be because water soaking alone does not sufficiently activate the enzymes required for early germination, resulting in delayed initiation. Our recorded values match those documented by Patel *et al.* (2017), Hota *et al.* (2018), Katoriya (2019) and Shreehari *et al.* (2022) [5, 6, 7, 8].

Table 1: Effect of different PGR on days taken for start germination

|    | Treatment                            | Days taken for start germination |
|----|--------------------------------------|----------------------------------|
| T1 | Seed soaking 24 hours @ water        | 5.69                             |
| T2 | Seed soaking 24 hours @ 5 PPM, GA3   | 5.30                             |
| T3 | Seed soaking 24 hours @ 7.5 PPM, GA3 | 4.89                             |
| T4 | Seed soaking 24 hours @ 10 PPM, GA3  | 4.22                             |
| T5 | Seed soaking 48 hours @ water        | 6.13                             |
| T6 | Seed soaking 48 hours @ 5 PPM, GA3   | 5.70                             |
| T7 | Seed soaking 48 hours @ 7.5 PPM, GA3 | 5.22                             |
| T8 | Seed soaking 48 hours @ 10 PPM, GA3  | 4.77                             |
|    | C.D. at 5%                           | 0.53                             |
|    | SE(m)                                | 0.18                             |
|    | SE(d)                                | 0.25                             |
|    | C.V.                                 | 5.28                             |

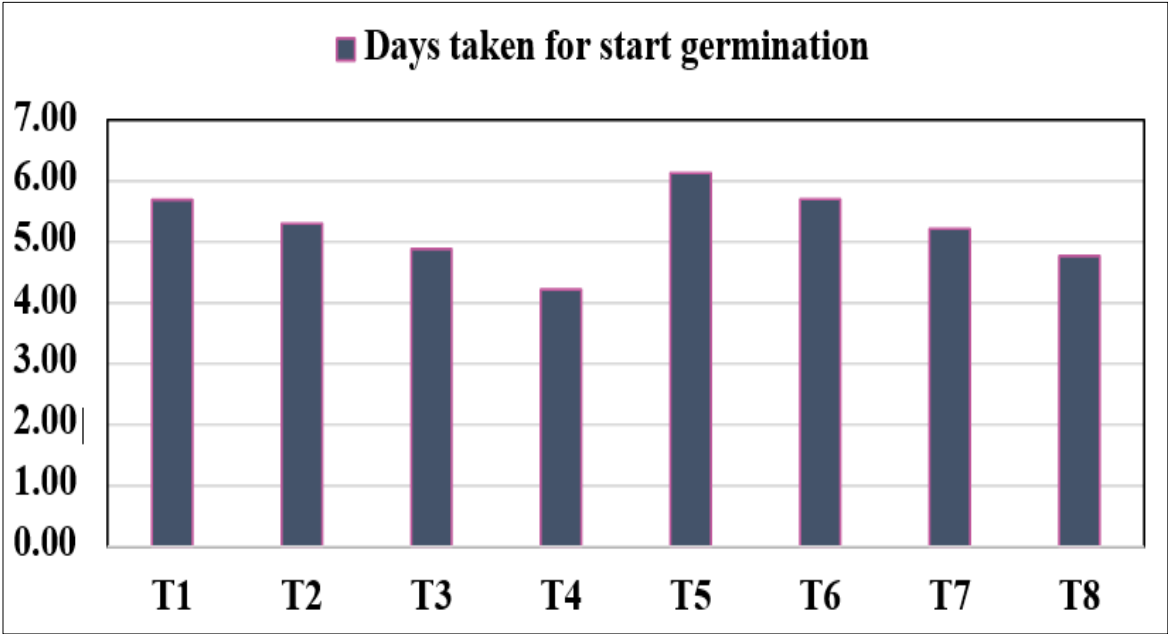


Fig 1: Effect of different pgr on days taken for start germination

3.1.2 Days taken to 50% germination

As shown in Table 4.1.2 the maximum days for 50% germination were observed in T<sub>5</sub> (7.09 days), with T<sub>3</sub> (5.78 days) and T<sub>8</sub> (5.82 days) remaining at par, while the

minimum duration was recorded in T<sub>4</sub> (5.34 days). The minimum time for 50% germination in T<sub>4</sub> indicates that GA<sub>3</sub> effectively enhances embryo growth and speeds up cell elongation, allowing a larger proportion of seeds to

germinate earlier. However, maximum time in T<sub>5</sub> suggests that seeds lacked hormonal support, leading to slow biochemical activation and ultimately delayed attainment of

50% germination. The observed data are similar to the findings of Hota *et al.* (2018) and Katoriya (2019) [6, 7].

**Table 2:** Effect of different PGR on Days taken to 50% germination

|    | Treatment                            | Days taken to 50% germination |
|----|--------------------------------------|-------------------------------|
| T1 | Seed soaking 24 hours @ water        | 6.55                          |
| T2 | Seed soaking 24 hours @ 5 PPM, GA3   | 6.14                          |
| T3 | Seed soaking 24 hours @ 7.5 PPM, GA3 | 5.78                          |
| T4 | Seed soaking 24 hours @ 10 PPM, GA3  | 5.34                          |
| T5 | Seed soaking 48 hours @ water        | 7.09                          |
| T6 | Seed soaking 48 hours @ 5 PPM, GA3   | 6.57                          |
| T7 | Seed soaking 48 hours @ 7.5 PPM, GA3 | 6.30                          |
| T8 | Seed soaking 48 hours @ 10 PPM, GA3  | 5.82                          |
|    | C.D. at 5%                           | 0.38                          |
|    | SE(m)                                | 0.12                          |
|    | SE(d)                                | 0.18                          |
|    | C.V.                                 | 3.46                          |

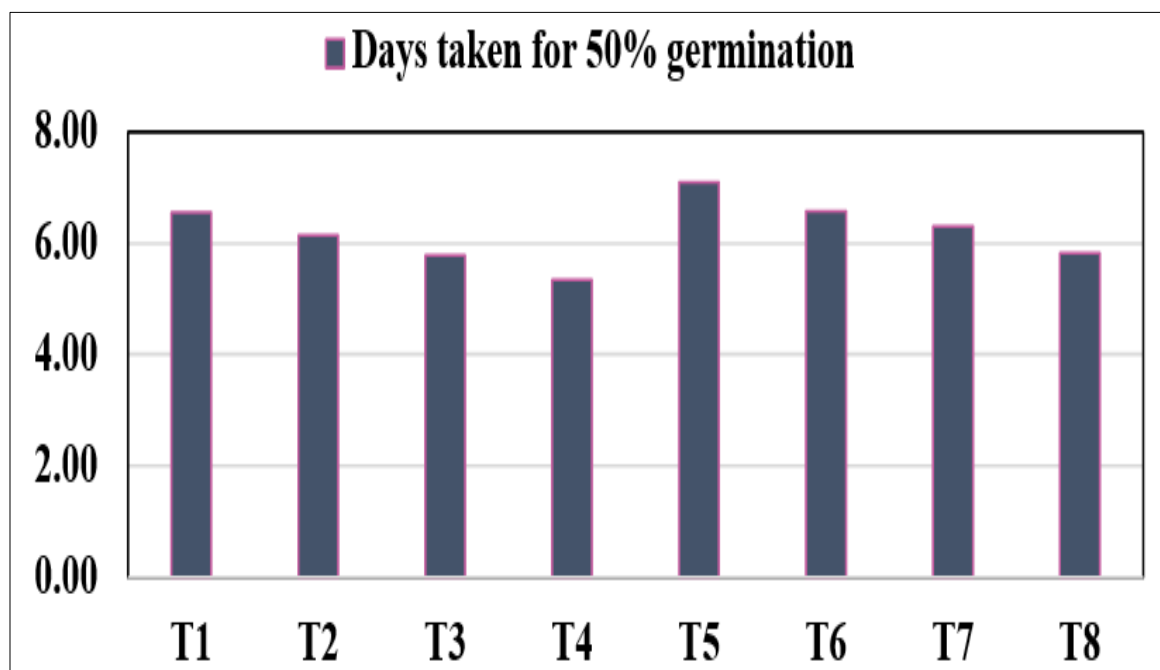


**Fig 2:** Effect of different pgr on days taken for 50% germination

### 3.1.3 Germination percentage

As per Table 4.1.3 the maximum germination percentage was obtained in T<sub>4</sub> (80.43%), followed by T<sub>3</sub> (76.92%) and T<sub>8</sub> (75.92%), while the minimum percentage was recorded in T<sub>5</sub> (61.26%). The maximum germination observed in T<sub>4</sub> may be attributed to the positive role of GA3 in breaking seed dormancy, improving embryonic activity and

enhancing overall seed viability. On the other hand, the minimum germination in T<sub>5</sub> might be due to lower metabolic efficiency and inadequate activation of germination-related enzymes when only water soaking is applied. The observed data are similar to the findings of Hota *et al.* (2018), Katoriya (2019), Shreehari *et al.* (2022) and Nedunchezhiyan *et al.* (2023) [6, 7, 8, 9].

**Table 3:** Effect of different PGR on Germination percentage

|    | Treatment                            | Germination percentage |
|----|--------------------------------------|------------------------|
| T1 | Seed soaking 24 hours @ water        | 68.75                  |
| T2 | Seed soaking 24 hours @ 5 PPM, GA3   | 72.77                  |
| T3 | Seed soaking 24 hours @ 7.5 PPM, GA3 | 76.92                  |
| T4 | Seed soaking 24 hours @ 10 PPM, GA3  | 80.43                  |
| T5 | Seed soaking 48 hours @ water        | 61.26                  |
| T6 | Seed soaking 48 hours @ 5 PPM, GA3   | 66.51                  |
| T7 | Seed soaking 48 hours @ 7.5 PPM, GA3 | 71.33                  |
| T8 | Seed soaking 48 hours @ 10 PPM, GA3  | 75.92                  |
|    | C.D. at 5%                           | 6.56                   |
|    | SE(m)                                | 2.17                   |
|    | SE(d)                                | 3.07                   |
|    | C.V.                                 | 5.24                   |

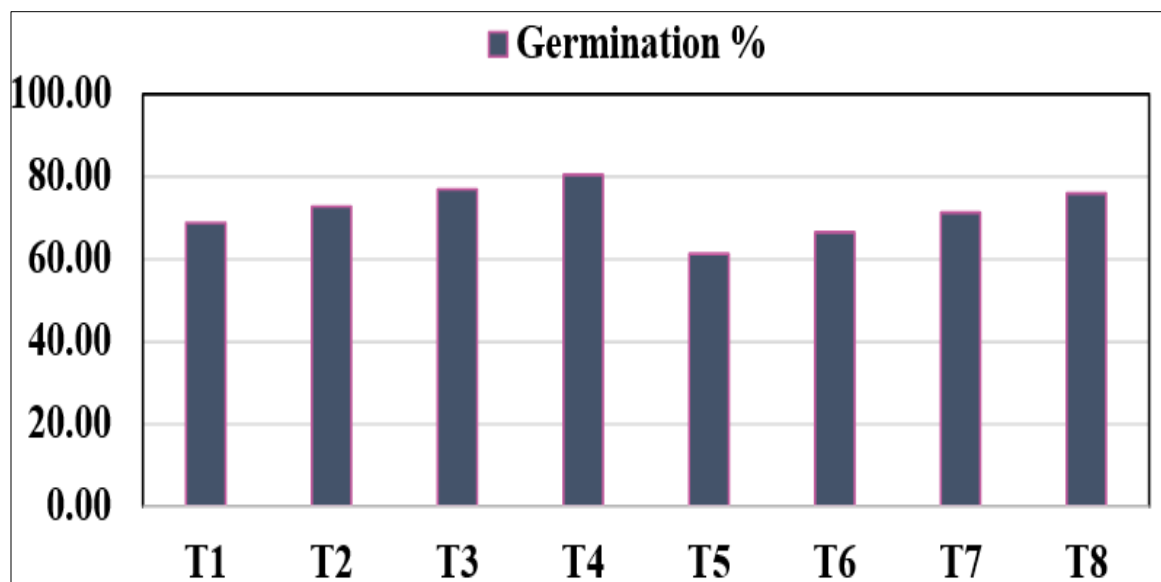


Fig 3: Effect of different pgr on germination percentage

### Conclusion

Treatment T<sub>4</sub> proved most effective by recording early germination, minimum days to 50% germination, and the highest germination percentage. Treatments T<sub>3</sub> and T<sub>8</sub> showed moderate performance, while T<sub>5</sub> resulted in delayed germination and the lowest Germination percentage. Hence, T<sub>4</sub> is recommended for better and faster seed germination.

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