



International Journal of Research in Agronomy

E-ISSN: 2618-0618
P-ISSN: 2618-060X
© Agronomy
NAAS Rating (2026): 5.20
www.agronomyjournals.com
2026; 9(8): 1273-1275
Received: 22-05-2026
Accepted: 25-06-2026

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Effect of resorcinol on seed germination and seedling vigor on lobia (*Vigna unguiculata* L.)

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DOI: <https://www.doi.org/10.33545/2618060X.2026.v9.i8p.6415>

Abstract

Early seedling establishment is a critical physiological stage influencing the productivity and subsequent growth of Lobia (*Vigna unguiculata* L.). The present laboratory study evaluated the efficacy of Resorcinol as a phenolic priming agent for improving early seedling establishment and vigor. The experiment was conducted in the month of May 2026 at S.B.S. Government PG College, Rudrapur, using a Factorial Completely Randomized Design (FCRD) with three replications. Seeds were primed with 0.1 μ M Resorcinol for 24 hours, and germination and early seedling growth parameters were evaluated over a four-day experimental period. Seedling vigor index (SVI) and Seedling tolerance index (STI) were also determined. The results revealed clear differences between the control and Resorcinol-treated seeds. The unprimed control recorded 100% germination, a mean seedling length of 1.93 cm, and an SVI of 193, indicating high inherent seed viability and vigor. Resorcinol at 0.1 μ M recorded 94.44% germination, a mean seedling length of 1.45 cm, an SVI of 137, and the highest STI of 105, indicating comparatively better tolerance under the experimental conditions. The findings suggest that low-dose Resorcinol seed priming can support early seedling establishment and may have potential as a physiological growth-modulating treatment. It is also reported interaction with auxin metabolism, including possible protection of endogenous indole-3-acetic acid (IAA) from oxidative degradation, may contribute to its growth-regulating effects. However, this mechanism requires further biochemical validation. Overall, pre-sowing seed priming with 0.1 μ M Resorcinol may be considered a promising approach for improving seedling establishment and uniformity in Lobia, although further studies under field conditions are required to confirm its effectiveness and potential effects on final crop yield.

Keywords: Seed priming, resorcinol

Introduction

In the contemporary era of global agriculture, leguminous crops have emerged as foundational pillars of resilient agricultural systems. Legumes, belonging to the family Fabaceae, possess the unique evolutionary advantage of symbiotic nitrogen fixation, thereby enriching soil fertility while providing an indispensable source of plant-based proteins, dietary fibers, and essential micronutrients (Jukanti *et al.*, 2012; Singh, 2020) ^[7,9]. Among the diverse spectrum of pulse crops, Lobia (*Vigna unguiculata* L.) occupy a pivotal role in the agro-economies of developing nations across the semi-arid tropics and subtropics. Lobia (black-eyed pea or cowpea) is a versatile, warm-season crop originating from Sub-Saharan Africa. It is a high protein nutrient-dense fodder and soil-covering green manure (Abebe & Alemayehu, 2022) ^[1]. Despite their inherent genetic resilience and nutritional supremacy, the agronomic potential of *Vigna unguiculata* is frequently undermined during the most precarious phase of their life cycle i.e seed germination and early seedling establishment (Horn & Shimelis, 2020) ^[5].

In erratic environmental conditions, seeds of *V. unguiculata* frequently fail to achieve uniform emergence. To mitigate these agronomic bottlenecks, seed priming the controlled hydration and physiological advancement of seeds prior to sowing has been widely adopted. Despite the high genetic yield potential of *Vigna unguiculata* L. farmers consistently face challenges with sub-optimal seedling vigor. Traditional hydro-priming (soaking in water) often fails to provide the necessary biochemical momentum to overcome environmental stressors. The primary physiological bottleneck lies in the rapid enzymatic degradation of endogenous growth hormones

(auxins) during the critical lag phase of germination. While the independent application of synthetic auxins is known to stimulate growth, there is a distinct lack of comparative literature detailing how these auxins interact with phenolic synergists to optimize germination kinetics across different legume species. Seed germination is a complex, triphasic physiological process. It commences with Phase I (rapid imbibitions of water), transitions into Phase II (a metabolic lag phase involving DNA repair, enzyme synthesis, and mobilization of reserves), and culminates in Phase III (radicle protrusion driven by cell elongation) (Bewley, 1997) ^[2]. Due to this uneven germination competition for light, water, and nutrients increases as well as delayed emergence prolongs the seed's exposure to soil-borne pathogens and unpredictable abiotic stresses, ultimately culminating in poor initial field stands and significant irreversible yield penalties (Horn & Shimelis, 2020) ^[5]. Use of exogenous plant growth regulators (PGRs) provides a more profound biochemical intervention (Kaya *et al.*, 2006; Taiz & Zeiger, 2010). Resorcinol (1, 3-benzenediol) is a dihydroxy phenol that possesses a unique biochemical capability, and acts as a competitive inhibitor of the IAA-oxidase enzyme. When Resorcinol is co-applied with synthetic auxins during the priming process, it effectively functions as an auxin-protector (De Klerk *et al.*, 2011) ^[3]. Sakina *et al.*, (2023) ^[8] observed that the foliar application of resorcinol and biochar has the ability to improve tomato. Phenolics operate as robust antioxidants, scavenging free radicals that catalyze the destructive peroxidase reactions during the germination phase (Denaxa *et al.*, 2022) ^[4]. The main objective of this study was to devise an optimized hormonal priming protocol that enhances the early seedling vigor of *Vigna unguiculata* L. (Lobia) by the use of Resorcinol.

Materials and Methods

The present investigation was undertaken to evaluate the effect of Resorcinol (0.1 μ M) on seed germination and early seedling vigor of Lobia (*Vigna unguiculata* L.). The experiment was conducted during 2025–26 in the Botany Laboratory of S.B.S. Government P.G. College, Rudrapur, Uttarakhand using a Factorial Completely Randomized Design (FCRD) with three replications. The experimental site is located at approximately 28.9595° N latitude and 79.3844° E longitude, at an altitude of about 217 m above mean sea level. The germination experiment was carried out under controlled laboratory conditions (Fig. 1). The temperature was maintained at approximately 25 °C, with relative humidity ranging between 75–80%. A 12 hours light and 12 hours dark photoperiod was maintained throughout the experimental period. The germination test was conducted following standard procedures recommended by the International Seed Testing Association (ISTA, 2015) ^[6].

For the work, certified, disease-free, and uniform-sized seeds of Lobia were procured from a recognized local agricultural research station. Analytical Reagent (AR) grade Resorcinol ($C_6H_6O_2$) was used as the seed-priming agent. Distilled/double-distilled water was used for preparation of the treatment solution. Surface sterilization of seeds was carried out using mercuric chloride ($HgCl_2$) under appropriate laboratory safety procedures. The selected Lobia seeds were surface sterilized and subsequently subjected to seed priming with 0.1 μ M Resorcinol for 24 hours. An untreated seed lot maintained under identical conditions was used as the control. Following priming, the seeds were placed under controlled laboratory conditions for germination and early seedling development. Observations were recorded during the experimental period from 12 to 16 May 2026. Exactly 1000mg (1gm) Resorcinol was accurately weighed using a digital

analytical balance. Resorcinol was dissolved directly in distilled water. The volume of each was made up to 1000mL (1 Liter) using double-distilled water in a volumetric flask to treat the selected seeds.

The experiment was initiated by surface sterilization of the Lobia seeds using 0.1% mercuric chloride ($HgCl_2$) solution for 2 minutes to minimize contamination by surface-borne microorganisms. Following sterilization, the seeds were thoroughly washed four to five times with double-distilled water to remove residual mercuric chloride. The sterilized seeds were subsequently soaked in the respective treatment solution containing 0.1 μ M Resorcinol for exactly 24 hours at room temperature. An equivalent set of untreated seeds soaked in distilled water for the same duration was maintained as the control. After completion of the priming period, the seeds were removed from the treatment solutions and air-dried under laboratory conditions to remove excess surface moisture. The primed and control seeds were then uniformly placed in pre-sterilized glass Petri dishes (9 cm diameter). Each Petri dish was lined with two layers of sterile filter paper, which were adequately moistened with distilled water. An equal number of seeds was placed in each Petri dish to maintain uniform experimental conditions. All Petri dishes were subsequently transferred to a seed germination incubator maintained under the predetermined experimental conditions of approximately 25°C temperature, 75 - 80% relative humidity, and a 12 hours light/12 hours dark photoperiod. Germination and early seedling growth were monitored throughout the experimental period, and observations were recorded at regular intervals.

A seed was considered germinated when the radicle protrusion is ≥ 2 mm. by calculating mean germination time the speed and synchronization of the germination was worked out. For seedling morphology (length of radical and plumule) standard millimetre scale and expressed in centimetre (cm) was used on the fourth day of seedling. Data was recorded meticulously from all triplicates over 4 day's observation period. Seedling vigour index (SVI) and seedling Tolerance Index (STI) was calculated by using the following formula (Turner and Marshal (1972).

$$\text{Germination Percentage (GP)} = \frac{\text{Number of germinated seeds}}{\text{Total number of seeds planted}} \times 100$$

$$\text{Mean Germination Time (MGT)} = \frac{\sum ni \sum di}{\sum ni}$$

Seedling Vigour Index (SVI) = germination percentage X total seedling length

$$\text{Seedling Tolerance Index (STI)} = \frac{\text{Mean length of the longest root in treatment} \times 100}{\text{Mean length of the longest root in control}}$$

Results and Discussions

The seed germination was observed after 24 hours in both control and treated sets. The total length of the seedling on fifth day in control and Resorcinol was found to 1.93 $\pm$ 0.50 cm, 1.45 $\pm$ 0.34 cm respectively. The SVI in control and resorcinol was found to be 193 and 137 respectively (Table 1 and Fig. 1). The STI values were observed to be 105.17 in treatments. Experimental data for Lobia across different plant growth regulators categorizes the physiological responses into two distinct pathways: the control, and treatment with resorcinol. The control group as the starting baseline achieves a baseline efficiency of 100% germination with

strong vertical shoot elongation and a healthy root framework. It confirms that under neutral conditions, the seed lot possesses high viability and natural vigor, establishing a clear benchmark for evaluating the chemical treatments.

Resorcinol (0.1µM) as a distinct phenolic compound pathway marks this zone as delivering optimal Root Initiation. It maintains a high germination rate (94.44%) and a strong mean seedling length (1.456cm). Phenolics like Resorcinol often act as auxins protectors by inhibiting IAA-oxidase, thereby preserving natural indole-3-acetic acid levels within the plant tissue to foster steady root development. Low concentrations (0.1µM Resorcinol) support or protect steady growth, while higher chemical concentrations uniformly depress seed germination percentages and reduce total seedling length. Low-dose Resorcinol exposure shows a unique adaptive timeline, suggesting that phenotypic plastic responses to phenolic stresses change significantly across separate experimental exposures.



Fig 1: Plates showing germination of control and treatment on 4th day of seedling

Table 1: Germination % showing temporal growth of Control vs Growth hormone treated seeds of *Vigna unguiculata* L.

Treatment	Germination (%)	Total Seedling Length (Mean ± SE)	Range (Max-Min)	Germination Success (%)	Mean SVI	Mean STI
Control	100.00%	1.93±0.50 cm	2.61-0.95	100.00%	193	-
Resorcinol 0.1 µM	94.44%	1.45±0.34 cm	2.08-0.91	94.44%	137	105

Conclusions

The study revealed that the control maintained 100% germination, with a mean seedling length of 1.93 cm and a Seedling Vigor Index (SVI) of 193, indicating high inherent viability and vigor of the seed lot. Among the Resorcinol treatments, 0.1 µM Resorcinol showed promising performance, maintaining 94.44% germination, a mean seedling length of 1.45 cm, the highest Seedling Tolerance Index (STI) of 105, and an SVI of 137. These findings suggest that low-dose seed priming with 0.1 µM Resorcinol may be an effective approach for promoting uniform germination, early seedling establishment, and improved seedling vigor without causing excessive cellular stress.

The results further indicate that optimizing seedling vigor during the early stages of crop development may enhance plant establishment and improve resilience to subsequent abiotic stresses, potentially contributing to better crop performance and yield. The use of an effective low concentration of Resorcinol may also help reduce dependence on higher concentrations of synthetic growth regulators, thereby lowering input requirements and minimizing the potential risk of chemical residues and environmental contamination. However, further field-based studies are required to validate these findings under diverse environmental conditions and to establish the long-term effects of Resorcinol priming on plant growth, stress tolerance, and final yield.

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