

Original Research Article

<https://doi.org/10.20546/ijcmas.2021.1001.399>

Germination of Indian Blackberry [*Syzygium cuminii* (L.) Skeels] as Affected by Pre-Sowing Seed Treatment

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ABSTRACT

Keywords

Germination, Indian blackberry, Propagation, Seed-treatment, Soaking

Article Info

Accepted:
20 December 2020
Available Online:
10 January 2021

In an effort to improve and promote the propagation of Indian blackberry [*Syzygium cuminii* (L.) Skeels] an experiment was conducted at COA- Umedganj, Kota (Raj.) during the year 2019 and the effect of different pre-sowing seed treatments on seed germination was investigated. The experiment consisted of 14 treatments including control, water soaking for 12 hours and 24 hours, hot water soaking at 50⁰ C for 15 and 30 min., soaking in the solutions of GA₃ at 100 ppm, 150 ppm and 200 ppm, Thiourea at 0.5%, 1.0% and 1.5% and KNO₃ at 0.5%, 1.0% and 1.5% respectively. The results indicated that all the seed treatments had significantly improved seed germination as compared to the control. Among different seed treatments, GA₃ 200 ppm (T₇) was found significantly most effective and resulted in minimum days taken to initiation of seed germination (7.33 DAS), minimum days taken to 50 percent of seed germination (12.33 DAS), minimum span of seed germination (13.67 days), maximum germination percentage (89.33%), maximum germination rate index (72.99 %/day) and maximum coefficient of velocity of germination (75.10).

Introduction

Indian blackberry [*Syzygium cuminii* (L.) Skeels] also known as *jamun* is an evergreen multipurpose tree and an underutilized minor fruit of great medicinal and nutritional importance. It belongs to the genus *Syzygium* and the family Myrtaceae, consisting of over 75 different species. It has originated from Indonesia and India, now growing abundantly in Southern Asia (Periyathambi, 2007) and easily thriving in tropical to sub-tropical

climate. It is also known as Black Plum, Damson plum, Duhat Plum, Java Plum, Portuguese plum, Jambolan plum, etc. in different countries. It is commonly grown in India, Malaysia, Myanmar, Pakistan, Afghanistan and Bangladesh. The tree is evergreen, tall, growing up to a height of 15 to 30 m and grows throughout India for its edible fruits, shade, fuel, timber and as windbreaks in open fields. Maximum numbers of *jamun* trees are found scattered throughout the tropical and subtropical

regions of the country including the Nilgiri and Himalayan region up to an altitude of about 1200 meters. It can be found growing in wild and semi wild in the states of Punjab, Haryana, Rajasthan, Gujarat, Maharashtra, Bihar, Madhya Pradesh, Chhattisgarh, Karnataka, Jharkhand, Tamil Nadu and Andhra Pradesh. It can be grown in wide range of soils and can grow well even under salinity and water logged conditions. The fruits of *jamun* are tasty and pleasantly flavoured, and have gained tremendous importance and recognition in recent past for its incomparable medicinal and nutritional properties. The fruits are good source of iron, minerals, sugars and proteins. The fruit contains about 83.70 - 85.80 g moisture, 0.70 - 0.13 g protein, 0.15 - 0.30 g fat, 0.30 - 0.90 g crude fibre, 14.00 g carbohydrate, 0.32 - 0.40 g ash, 8.30 - 15.00 mg calcium, 35.00 mg magnesium, 15.00 - 16.20 mg phosphorus, 1.20 - 1.62 mg iron, 26.20 mg sodium, 55.00 mg potassium, 0.23 mg copper, 13.00 mg sulphur, 8.0 IU vitamin A, 0.01 - 0.03 mg thiamine, 0.009 - 0.01 mg riboflavin, 0.20 - 0.29 mg niacin, 5.70 - 18.00 mg ascorbic acid, 7.00 mg chlorine and 3.00 mg folic acid, per 100 g of edible portion (Baliga *et al.*, 2011). In association to its dietary use, all parts of the tree and most importantly the seeds are used to treat a range of ailments, the most important being diabetes mellitus. Different parts of the *jamun* have also been reported for their antioxidant, anti-inflammatory, neuropsychopharmacological, anti-microbial, anti-bacterial, anti-HIV, anti-leishmanial and antifungal, anti-diarrheal, anorexia-genic, gastro-protective, diuretic properties and having nitric oxide scavenging, free radical scavenging and radio-protective activities (Shahnawaz *et al.*, 2010).

Jamun is propagated by seeds as well as vegetatively. But problem in plants raised by seeds is that they usually show a high level of heterogeneity with a long juvenile phase and

seedling plants bear fruits of variable size and quality and come into bearing after 8 to 10 years. Therefore, method of vegetative propagation is now being commercially used to perpetuate elite seedling clones. Also the time required to grow *jamun* seedlings to a suitable size for grafting may take as long as one year and seedlings are also vulnerable to mortality thereby involving much cost and risk in obtaining healthy seedlings and their subsequent maintenance till graftable stage (Llanes *et al.*, 2005). Therefore, shortening the time required to reach a graftable maturity is considered very important and it can be achieved by enhancing the seedling growth by enhancing germination. Several efforts have been put forth for enhancing germination by use of chemicals and growth regulators like gibberellic acid, Thiourea, KNO₃, etc. besides soaking in water and hot water, with varied success. As this fruit crop has gained importance due to its medicinal and nutritive value, the orchardists demand plants of early bearing, dwarf statured with high yield potential. Therefore, in order to promote and meet the growing demands of planting material (grafts), it becomes important to produce more number of healthy and vigorous growing rootstocks in a shorter possible time with minimum cost involved. Keeping this in view, an experiment was conducted to accelerate the seed germination and subsequent seedling growth of Indian blackberry with pre-sowing seed treatments.

Materials and Methods

An experiment was conducted at COA-Ummadganj, Kota (Raj.) during the year, 2019 with an objective to investigate the effect of pre-sowing seed treatments on seed germination of Indian blackberry [*Syzygium cuminii* (L.) Skeels]. The experiment consisted of 14 different pre-sowing seed treatments including control (T₀), water soaking for 12 hours (T₁), water soaking for

24 hours (T₂), hot water soaking at 50⁰ C for 15 minutes (T₃), hot water soaking at 50⁰ C for 30 minutes (T₄), soaking seeds in solutions of GA₃ at 100 ppm (T₅), 150 ppm (T₆) and 200 ppm (T₇), Thiourea at 0.5% (T₈), 1.0% (T₉), and 1.5% (T₁₀) and KNO₃ at 0.5% (T₁₁), 1.0% (T₁₂) and 1.5% (T₁₃) for 10 minutes. The experiment was laid out in a Completely Randomised Design and was replicated thrice. The seeds were extracted freshly and sown in black polybags of size 25 x 13 x 10 cm which were filled with potting mixture containing sand, soil and vermicompost in the ratio of 1:2:1 respectively. Sufficient perforations were made in the polybags to facilitate proper aeration and drainage. Thereafter, pre-treated and untreated seeds were sown manually in the polybags @ one seed per bag, 2-2.5 cm deep. Light watering was done using a rose cane immediately after sowing of seeds and thereafter as and when required in order to maintain optimum moisture levels in polybags. In order to protect *jamun* seedlings from weeds, fungal diseases, insects and pests, a proper plant protection schedule was also adopted, keeping same for all the treatments.

Data collection and analysis

Germination was recorded daily until the complete cessation of germination and daily germination percentages was summed up to obtain cumulative germination for each treatment in each replication and observations *viz.*, days taken to initiation of seed germination (DAS), days taken to 50 per cent of seed germination (DAS), span of seed germination (days) germination percentage (%), germination rate index (per cent/day) and coefficient of velocity of germination were calculated and subjected for statistical analysis (Panse and Sukhatme, 1967). Standard formulae were used for the calculation of germination parameters:

1. Percentage of seed germination was calculated by the following formula:

$$\text{Germination percentage} = \frac{\text{Total number of seeds germinated}}{\text{Total number of seeds sown}} \times 100$$

2. The germination rate index (GRI) was calculated using the following formula (Kader, 2005):

$$\text{Germination Rate Index} = \frac{G_1}{1} + \frac{G_2}{2} + \frac{G_3}{3} + \dots + \frac{G_x}{x}$$

Where ‘G1’ is Germination percentage × 100 at the first day after sowing, ‘G2’ is Germination percentage × 100 at the second day after sowing, and similarly, ‘Gx’ is Germination percentage × 100 at the xth day after sowing.

3. The coefficient of velocity of germination (CVG) was calculated using the following formula (Kader, 2005):

$$\text{Coefficient of velocity of germination} = \frac{(N_1 + N_2 + N_3 + \dots + N_x)}{N_1T_1 + N_2T_2 + N_3T_3 + \dots + N_xT_x} \times 100$$

where, ‘N’ is number of seeds germinated each day and ‘T’ is number of days after sowing corresponding to N.

Results and Discussion

The data presented in Table 1 and 2 revealed that the seed germination parameters of Indian blackberry *viz.*, germination percentage (%), days taken to initiation of seed germination, days taken to 50 per cent of seed germination, span of seed germination (days), germination rate index (per cent/day) and coefficient of velocity of germination have increased significantly with application of different seed treatment as compared to control. Significantly maximum seed germination (89.33%), maximum germination rate index (72.99 per cent/day), maximum

coefficient of velocity of germination (75.10) minimum days taken to initiation of seed germination (7.33 DAS), minimum days taken to 50 per cent of seed germination (12.33 DAS) and minimum days required to complete the span of seed germination (13.67 days), were recorded for the seeds treated with GA₃ 200 ppm (T₇) as compared to their respective minimum and maximum values in untreated seeds i.e., control (T₀). These results were in consonance with the findings of Palepad *et al.*, (2017) in custard apple, Dilip *et al.*, (2017) in Rangpur lime, Rai *et al.*, (2018) in *khirni*, Patil *et al.*, (2018) in *jamun*, Hota *et al.*, (2018) in *jamun*, Patel *et al.*, (2018) in tamarind.

The sharp increase in the germination percentage with application of GA₃ might be due to the fact that during germination, gibberellic acids induce the synthesis of hydrolytic enzymes like α -amylase and proteases and these enzymes degrade the stored food reserves present in the endosperm or embryo of the seed. This degradation of complex carbohydrate and storage protein into simple sugar mobilizes the energetic reserves from the endosperm to growing points thus providing the required nourishment and energy to the embryo, thereby, enhancing seed germination (Hota *et al.*, 2018).

Gibberellins (GA₃) are also reported to have weakened the endosperm layer that restricts the embryo growth, not only this it also mobilizes the energetic reserves from the endosperm to the embryo (Taiz and Zeiger, 2006). Also the reduction in the days taken to initiation of seed germination, days taken to 50 per cent of seed germination and span of seed germination might be due to the rapid mobilisation of energy resulting in active and faster embryo growth due to application of GA₃. The increased value of GRI and CVG suggests the stimulatory effect of GA₃ in

rapidity of germination. The results also revealed that increasing concentrations of GA₃ also increased these characteristics owing to the invigoration of the physiological processes (Gurung *et al.*, 2014). The stimulatory effects of GA₃ in enhancing the germination of seeds and production of healthy and vigorous seedlings are in agreement with the findings of Gurung *et al.*, (2014) in passion fruit, Palepad *et al.*, (2017) in custard apple, Dilip *et al.*, (2017) in Rangpur lime, Patel *et al.*, (2018) in tamarind, Patil *et al.*, (2018) in *jamun*, and Hota *et al.*, (2018) in *jamun*.

Besides this, the other seed treatments also significantly increased the germination suggesting the superiority of these treatments in improving seed germination as compared to control. The possible fact for better germination in water soaking over control may be due to the fact that the soaking of seeds in water stimulates and produces enzymes like amylase and lipase (Hartman *et al.*, 1997) which activates storage materials in seeds and initiate the emergence process like breaking down the seed dormancy, hydrolysis metabolism of growth inhibitors, imbibitions and activation of enzymes (Ajouri *et al.*, 2004).

The results coincided with the findings of Bhavya *et al.*, (2017) in *karonda* and Patil *et al.*, (2018) in *jamun*. Further the hot water treatments were also found significantly better over control for increasing germination because it might have increased the seed coat permeability for gases and water exchange and release of inhibitors (Sharma *et al.*, 2008) which reflected from the increased germination. The results were in close conformity with the findings of Rushdy (2017) in *Leucaena leucocephala*, Patil *et al.*, (2018) in *jamun*, Mohammad *et al.*, (2019) in flamboyant.

Table.1 Effect of pre-sowing seed treatment on days taken to initiation of seed germination, days taken to 50 per cent of seed germination and span of seed germination of Indian blackberry [*Syzygium cuminii* (L.) Skeels]

Treatments	Days taken to initiation of seed germination (DAS)	Days taken to 50 per cent of seed germination (DAS)	Span of seed germination (days)
T ₀ - Control	12.67	30.00	38.00
T ₁ - Water soaking for 12 hours	9.00	20.00	21.67
T ₂ - Water soaking for 24 hours	8.00	19.00	17.67
T ₃ - Hot water soaking at 50 ⁰ C for 15 min.	11.67	28.67	37.00
T ₄ - Hot water soaking at 50 ⁰ C for 30 min.	12.67	25.00	35.33
T ₅ - GA ₃ 100 ppm	8.33	15.00	16.67
T ₆ - GA ₃ 150 ppm	8.00	14.67	15.00
T ₇ - GA ₃ 200 ppm	7.33	12.33	13.67
T ₈ - Thiourea 0.5%	12.33	24.00	27.33
T ₉ - Thiourea 1.0%	11.67	23.33	26.00
T ₁₀ - Thiourea 1.5%	11.00	22.33	24.33
T ₁₁ - KNO ₃ 0.5%	12.33	21.67	25.00
T ₁₂ - KNO ₃ 1.0%	12.00	21.00	24.33
T ₁₃ - KNO ₃ 1.5%	11.67	20.33	17.33
SEm±	0.46	0.78	1.15
CD (p = 0.05)	1.34	2.25	3.35

Table.2 Effect of pre-sowing seed treatment on germination per cent (%), germination rate index (per cent/day) and coefficient of velocity of seed germination of Indian blackberry [*Syzygium cuminii* (L.) Skeels]

Treatments	Germination per cent (%)	Germination rate index (per cent/day)	Coefficient of velocity of germination
T ₀ - Control	62.00 (51.94)	17.42 (24.67)	29.53
T ₁ - Water soaking for 12 hours	74.00 (59.34)	41.24 (39.95)	42.77
T ₂ - Water soaking for 24 hours	78.67 (62.49)	45.03 (42.15)	46.77
T ₃ - Hot water soaking at 50 ⁰ C for 15 min.	64.33 (53.33)	21.90 (27.90)	30.53
T ₄ - Hot water soaking at 50 ⁰ C for 30 min.	66.00 (54.33)	24.00 (29.33)	32.60
T ₅ - GA ₃ 100 ppm	86.00 (68.03)	61.01 (51.36)	65.87
T ₆ - GA ₃ 150 ppm	88.00 (69.73)	61.24 (51.50)	66.16
T ₇ - GA ₃ 200 ppm	89.33 (70.93)	72.99 (58.69)	75.10
T ₈ - Thiourea 0.5%	64.67 (53.41)	30.70 (33.65)	37.70
T ₉ - Thiourea 1.0%	66.00 (54.33)	31.50 (34.14)	38.47
T ₁₀ - Thiourea 1.5%	70.00 (56.79)	37.05 (37.49)	41.30
T ₁₁ - KNO ₃ 0.5%	68.67 (55.96)	34.25 (35.82)	39.47
T ₁₂ - KNO ₃ 1.0%	71.67 (57.84)	38.09 (38.11)	42.30
T ₁₃ - KNO ₃ 1.5%	75.67 (60.45)	45.99 (42.70)	50.07
SEm±	1.09	1.90	1.74
CD (p = 0.05)	3.16	5.50	5.05
*The figures in parenthesis () are angular transformed values.			

The significant increase in the seed germination parameters over control with application of KNO_3 at all concentrations can be explained by the fact that KNO_3 stimulates germination by decreasing the endogenous levels of abscisic acid in embryos, also causing vacuolation and cell wall weakening of the aleurone layer (Bethke *et al.*, 2007) and its involvement in the pentose phosphate pathway due to increased oxidation of NADPH to NADP and also in enzymes that have been encoded to provide nutrients for germination. (Finkelstein *et al.*, 2008). The increase in germination can also be due to the accumulation of nitrogen and potassium ions in seeds (Hegazi *et al.*, 2011 and Banik *et al.*, 2015), thereby leading to acceleration in synthesis of amino acids which might have promoted germination and growth of embryo. It is also reported that germination in most species has been significantly enhanced by the application of KNO_3 , but the concentration that achieved maximum germination was species specific (Bhatt *et al.*, 2019). These results were found in agreement with previous studies that reported variation in the concentrations of KNO_3 required for promoting germination among different species (Patil *et al.*, 2018 in *jamun*, Bhatt *et al.*, 2019 in Arabian desert species, Barathkumar, 2019 in *aonla* and Sheoran *et al.*, 2019 in *ber*).

The results also revealed that seed treatment with Thiourea at all concentration significantly enhanced seed germination parameters as compared to control. It is well known fact that Thiourea is a nitrogen and sulphur containing compound which may have acted as a nutrient supplement (Pandey *et al.*, 2013 and Perveen *et al.*, 2015). Hence, at biochemical level, exogenously applied Thiourea might have improved the sugar metabolism and also enhanced the proteins biosynthesis which may have boosted germination and growth in many plant species

irrespective of the growth stage at which it is applied (Wahid *et al.*, 2017). This could have also been due to the fact that Thiourea exhibits cytokinin and gibberellins like activities and antagonize the effect of inhibitors. The results were in accordance with the findings of Vachhani *et al.*, (2014) in *khirni*, Banik *et al.*, (2015) in *karonda* and Rai *et al.*, (2018) in *khirni*.

Thus, taking the above study into consideration, it can be concluded that seeds of jamun treated with GA_3 200 ppm significantly resulted in maximum seed germination, CVG, GRI and minimum days required for initiation and completion of seed germination as compared to control and other treatments.

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How to cite this article:

Harshita Mali, Mool Chand Jain, Rakesh Kumar Yadav, Pooja Sharma and Kuldeep Singh 2021. Germination of Indian Blackberry [*Syzygium cuminii* (L.) Skeels] as Affected by Pre-Sowing Seed Treatment. *Int.J.Curr.Microbiol.App.Sci*. 10(01): 3392-3400.
doi: <https://doi.org/10.20546/ijcmas.2021.1001.399>