

Effects of seed size and germination percentage with different treatments in *Bauhinia racemosa*

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ABSTRACT

Bauhinia racemosa commonly called **sonpatta tree** is an important member of *Bauhinia* genus. Among several species of *Bauhinia* this species has many traditional and ethno-medical uses. It is an economically important and nutritious species. In the present study, various uses and different *Bauhinia* species were compared. Seeds from different locations of *Bauhinia racemosa* were tested for their size as well as germination behaviors using different treatments including the use of plant growth regulators.

Keywords: *Bauhinia racemosa*; Caesalpiniaceae; Germination percentage; Mean germination time; Average germination value; Pre-germination treatments; Bidi leaf tree; Ebony; Medicinal values; Traditional uses; Snake repellent.

1. Introduction

Bauhinia is very important genus of Caesalpiniaceae in tropics with around 300 species (Willis, 1973). Seedling morphology of 9 Indian species of *Bauhinia* viz. *B. acuminata*, *B. diphylla*, *B. malabarica*, *B. purpurea*, *B. retusa*, *B. rufescens*, *B. tomentosa*, *B. vahlii* and *B. variegata* have been described (Das and Paria, 1999).

Bauhinia racemosa Lam belonging to family caesalpiniaceae. It is small crooked bushy tree with drooping branches, found throughout India ascending to an altitude of 1650 meters in the western Himalayas. It is known as Banraj in Bengali, Asundro in Gujarati, Jhinjeri, Kachnal, Ashta in Hindi, Banne in Kannada, Katapuli in Malayalam, Apta in Marathi, Ombaroda in Oriya, Yugmapatra, Yamdapatrakah, Kanchini, Ashmanlaka & Svetakanchana in Sanskriti, Araivatta-atthi in Tamil, Ari in Telugu and Kosundra in Punjabi. It is also called as “sonpatta tree” as it is considered as gold for its medicinal values. In Punjab it is called askosundra, in Tamil as Atti, Kokku mandari and Tatakhi, in Telugu as Tella are hettu, in Urdu as Kachnaar and in English as mountain ebony.

Bauhinia racemosa Lam. distributed in Pakistan, India, Sri Lanka, Burma and China. It is useful species for filling blanks in forest plantings and help in preventing soil erosion. In the United States of America, the trees grow in coastal California, Florida, Hawaii, Louisiana and Texas (Panda *et al.*, 2015).

Botany- It is a broad-leaf tree which may height of plant is small, branchy deciduous tree with a short unbranched trunk, grows in warm climate. Its stem is bluish-black, rough, pinkish-red inside turning brown on exposure. It has rough surface with vertical cracks. Young twigs are hairy. Its leaves are simple, bilobed alternate, stipules small caduceous green in colour. Its flowers are white or pale yellow in colour, terminal or leaf-opposed raceme. They are bisexual, 5-10 cm long and 7.5 to 12.5 cm in diameter, its fruit pods are blackish-brown in colour. Its seeds are 12 to 20 glabrous dark reddish brown or black in colour with 7-8 mm long. Its flowering season is March to June and fruiting season is November to December.

Nutritional importance- The seeds of *Bauhinia racemosa* are rich in calcium, potassium, magnesium, zinc, manganese and iron. In its seeds glutelins is predominated whereas albumins and globulins is less. In *Bauhinia*

racemosa, essential amino acids like isoleucine, lysine, phenylalanine and tyrosine are high whereas the contents of sulphur amino acids are limiting in the seed proteins. The fatty acids, linolic acid and palmitic acid are relatively higher in the seed lipids (Davey *et al.*, 2011; Gupta *et al.*, 2004; Nirmal *et al.*, 2011).

Economic importance- The plant is used for making Bidis and therefore commonly called as Bidi leaf tree. It is planted for its value as well for its extreme beauty, the looks beautiful when in bloom and it blooms for several months. Its flowers are white coloured and important in apiculture. The plant is useful as fodder for goats, sheep and cattle. Tree also yields fiber and glum. Bark is used for tanning and dyeing. The wood is hard and heavy thus used to make plough, yokes and also used as fuel (Gupta, *et al.*, 2004; Kumar *et al.*, 2011).

Ethno medicinal uses- It is useful plant as medicine. Its bark is useful in headache, malaria, dysentery, diarrhea, fever, skin disease, tumors and skin disorders etc in traditional Ayurvedic system. Its leaves are used for urinal discharge, fever, headache, skin diseases tumors, diarrhea, etc., in traditional systems. Its flowers are useful in cough, bronchitis, its fruits are used in astringent to the bowels, it fiber is useful for stitching wounds (Kirtikar & Basu, 1975; Jain, 1964; Anonymous, 1985; Nadkarni & Nadkarni, 2000).

Traditional uses- Plant is used as traditional medicine and used in the treatment of various disorders. Its stem bark is an astringent and it is used to treat headache, fever, and skin diseases and is useful for the treatment of malaria, dysentery and diarrhea.

Its leaves are sweetish and pungent, refrigerant, antipyretic, astringent, vermifugal, cure biliousness, urinary discharge, thirst headache, quanta fever, vatta, anal fistula, tuberculous alonds, skin disease, the oat trouble, disease of blood, good in chronic dysentery and diarrhea (Ushie *et al.*, 2019).

Stem bark of *Bauhinia racemes* is kept in house as snake repellent. Leaves of this plant chewed by people and air are blown in patient's ear, after a gluers of water is given to the patient to cure scorpion bite.

For the treatment of jaundice, water extract of its bark, leaves & roots are taken two times daily after meal for 2-4 weak in Jargon region. In dholes and Nan durbar district of Maharashtra leaves of the plants *B. racemes*, *Aloe vera* and *P. murex* crouched together and mixed water is given to animals 3 times a day can relieve food poisoning in cattle (Rahman *et. al.*, 2015).

Marketed formulation- *M. asanumas* is formulations for the second month of pregnancy. Each tablet contains Ashmentak (*Bauhinia racemosa*) leaf extract, Black sesame (*Sesum indicum*) seed extracts manjishtha (*Rubia cordifolia*) stem extract and shatavari *Asparagus racemosa* root extorts 60 mg each (Rahman *et. al.*, 2015).

Botanical Description

| S.No. | Name of species | Common Names | Description |
|-------|---------------------------------|---|---|
| 1. | <i>Bauhinia variegata</i> Linn. | Hindi: Kachnar Bengali: Raktakanchan | <i>Bauhinia Variegata</i> (Fabaceae) is a valuable medicinal plant. Kachnar is a medium-sized deciduous tree, bark dark brown, nearly smooth, young shoots brown-pubescent. Flowers large, fragrant, white or |

| | | | |
|----|---------------------------------|--|---|
| | | | purplish, appearing when the tree is leafless. It is distributed in sub- Himalayan tract and outer Himalayas of Punjab. |
| 2. | <i>Bauhinia purpurea</i> Linn. | <p>Hindi: Gairal, Kakiar, Katniar, Khairwal, Koilari, Koinar, Sona</p> <p>Sanskrit: Raktapushpakovidara</p> <p>Marathi: Atmatti, Deva Kanchana</p> <p>Tamil: Kalavilaichi, Mandarai</p> <p>Telugu: Boroda, Debokanjoro</p> <p>Burma: Mahahlegani</p> | A medium-sized, evergreen ornamental tree, found throughout India, ascending to an altitude of 1300 m in the sub-Himalayan tract. Bark dark grey or brown pink to pale yellow inside; leaves rigidly sub-coriaceous, glabrous, and shallowly cordate; flowers terminal and axillary short-peduncled, few-flowered corymbs; pods firm, flat, glabrous, 12-15 seeded. |
| 3. | <i>Bauhinia semla</i> | <p>Hindi: Semla</p> <p>Marathi: Koilar</p> <p>Telugu: Nirpa</p> <p>Punjab: Kural</p> | A medium-sized deciduous tree, found throughout the greater part of India, ascends to an altitude of 1500 m in the western Himalayas. Leaves rigidly coriaceous, broader than long, glabrous below, usually deeply cordate; flowers yellow, in ample terminal panicles; pods hard flat, glabrous, 6, 8 seeded. |
| 4. | <i>Bauhinia tomentosa</i> Linn. | <p>Gujrati: Chanpo</p> <p>Hindi: Kachnar</p> <p>Marathi: Aptu</p> <p>Tamil: Iruvaji</p> <p>Telugu: Adavimandaramu</p> | An erect shrub, found in the plains Southward of Delhi, in the peninsular region and in West Bengal. Leaves broader than long, coriaceous, pubescent below; flowers with a distinct odour, usually axillary, pendent and half open, yellow with a maroon dot at the base of the central petal; pods distinctly stalked, glabrous, 6-10 seeded. |

1.1. Study objective

The main objective of the study was to increase awareness about different *Bauhinia* species and also to study in detail about seed size and their relation with germination parameters using different treatments.

2. Material and methods

Seeds of *Bauhinia racemes* were collected and after proper cleaning and drying they were stored for further analysis. Seed length, width and thickness were recorded for 100 seeds of each seed lot. The seed germination tests

were performed in seed germination Laboratory of Silviculture and Forest Management, ICFRE- Arid Forest Research Institute, Jodhpur. With the help of seed counter machine seeds per kilogram were calculated. Laboratory test on the germination response of seeds to pre-germination treatments of Hot water, GA₃ (500 and 1000 ppm) and IBA GA₃ (500 and 1000 ppm) compared to untreated seeds (control).

Soaking Hundred seeds in hot water for 15 min. Twenty seeds were also soaked in GA₃ (500 and 1000 ppm) and IBA GA₃ (500 and 1000 ppm) for 6 hours. All the pre-treated and untreated seeds were rinsed thoroughly in distilled water and were placed in germination tray. The experiment was carried out at room temperature in the laboratory. Seeds were considered germinated upon plumule emergence. The number of seeds that germinated was recorded while the percentage seed germination was calculated. The following procedure was made for different parameters determinations-

2.1. Formulas for various calculations

2.1.1. Germination percentage

GP (Germination percentage) = (Total number of seeds germinated/total number of seeds tested) × 100

Final Germination Percentage (FGP %) = Final no. of seeds germinated in a seed lot × 100

The higher the FGP value, the greater the germination of a seed population [Scott et al. (1984)].

2.1.2. Mean germination time

MGT (Mean germination time) = total (daily germination) × 1 days/total seed sowing

Mean Germination Time (MGT day) = $\sum f \cdot x / \sum f$

f = Seeds germinated on day x

The lower the MGT, the faster a population of seeds has germinated [Orchard (1977)].

- First Day of Germination FDG day = Day on which the first germination event occurred

Lower FDG values indicate a faster initiation of germination [Kader (1998)].

- Last Day of Germination LDG day = Day on which the last germination event occurred Lower LDG values indicate a faster ending of germination [Kader (1998)].

- Germination Rate Index GRI (%/day) = $G1/1 + G2/2 + \dots + Gx/x$

G1 = Germination percentage × 100 on the first day after sowing, G2 = Germination percentage × 100 on the second day after sowing.

2.1.3. Average Mean germination time

AVG MGT (Average Mean germination time) = Total MGT/Total number of days.

2.1.4. Germination Value

GV (Germination Value) = (Total MGT/total germination) × (GP%/10).

2.1.5. Average Germination Value

AVG GV (Average Germination Value) = Total GV/Total number of days.

3. Result

Seeds of *Bauhinia racemosa* were collected from laxmangarh; Salasar highway and forest nursery, Nagaur, after seed cleaning and drying then were stored for further analysis. Seed length, seed width & thickness was recorded seed analysis shows mean length was 8.20 mm in forest nursery, Nagaur seedlot while it was 8.47 mm in laxmangarh Salasar highway seed lot. Mean width was 5.95 mm in forests nursery, Nagaur seedlot and Balaji Highway seedlot mean seed width was 6.34. The mean thickness was 3.35 mm in forests nursery, Nagaur seedlot while it was 3.58 mm in Laxmangarh Salasar Balaji highway seed lot.

Under laboratory condition seed germination with hot water, GA₃ 500 ppm, and GA₃ 1000 ppm treatment along with control was recorded. Under control condition germination was found as 35 percent in forest nursery Nagaur seed lot while it was 80 percent in Laxmangarh Salasar Balaji highway seed lot.

With hot water treatment germination was 70 percent in forest nursery, Nagaur seed lot while it was 75 percent in Laxmangarh Salasar Balaji highway seedlot. GA₃ 500 ppm treated seeds shows 50 percent germination in forest nursery, Nagaur seedlots while it was found 85 percent in Laxmangarh Salasar Balaji highway seed lot. GA₃ 1000 ppm treated shows that it's more connotation is not useful. It was found 45 percent in forest nursery, Nagaur seed lot and 75 percent in Laxmangarh Salasar Balaji highway.

Overall germination was in the range of 35 percent in control seed lot of forest nursery, Nagaur while it was 85 percent in GA₃ 500 ppm treated seed lot of Laxmangarh Salasar Balaji highway. Total MGT was lowest in 82.55 in control treatment of forest nursery, Nagaur seed lot of while highest was in GA₃ 500 ppm treated seed lot of Laxmangarh Salasar Balaji highway.

Total GV value was lowest 883.97 in control-treated Seed lot of forest nursery, Nagaur while highest was 3520.40 in GA₃ 500 ppm treated seed lot of Laxmangarh Salasar Balaji highway.

Average MGT 3.75 in control treatment of forest nursery, Nagaur seed lot while it was 9.00 in GA₃ 500 ppm seed lot of Laxmangarh Salasar Balaji highway seed lot. The average GA value was 40.18 in control treatment of forest nursery, Nagaur seed lot while it was 160.01 in GA₃ 500 ppm treated seed lot of Laxmangarh Salasar Balaji highway.

4. Discussion

Based on data from Tables 1 & 2 it is observed that seed size parameters were different in various locations and it depends on various climatic, edaphic and genetic factors. Germination percentage with different treatments was different in seed lots. GA₃ was found effective in breaking dormancy and enhancing germination.

5. Conclusion

Based on different seed lots germinations and their effects with different treatments were found to provide a hypothesis to choose better seed lots. However, there was no direct relation between seed size and germination.

Factors such as geographical and seasonal variations play an important role in finding seedlots for better germination. *Bauhinia racemosa* plant has traditional and pharmacological uses. Plants need more research on its uses to discover different aspects of this plant.

6. Future Suggestions

As the study suggests, there is no direct linkage between seed size and germination of seed. Similarly, germination varies in different locations and treatments which suggests not only edaphic or climatic variation but genetic makeup of species is responsible for such variation. A detailed in-depth study of seeds from various locations based on different agroclimatic zones as well as the reproductive biology of species is needed.

Declarations

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Competing Interests Statement

The authors declare no competing financial, professional, or personal interests.

Consent for publication

The authors declare that they consented to the publication of this study.

Authors' contributions

All the authors took part in the literature review, analysis, and manuscript writing equally.

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Table 1. Effect of Seed Size on Germination in *Bauhinia racemosa*

| S. No. | Location | GPS | Date of Collection | Seed Analysis | | | Germination Percentage | | | |
|--------|--|---------------|--------------------|------------------|-----------------|---------------------|------------------------|------------|-------------------------|--------------------------|
| | | | | Mean Length (mm) | Mean Width (mm) | Mean Thickness (mm) | Control | Hot Water | GA ₃ 500 PPM | GA ₃ 1000 PPM |
| | | | | | | | | | | |
| 1 | Laxmangarh-Salasar Balaji Highway | N27°81'536" | 13/05/2022 | 8.47 | 6.34 | 3.58 | 80 | 75 | 85 | 75 |
| | | E74°00'808 | | | | | | | | |
| 2 | Luv-KhushVatika, Near Forest Nursery, Nagaur | N27°22'94.55" | 12/06/2023 | 8.20 | 5.95 | 3.35 | 35 | 70 | 50 | 45 |
| | | E73°67'51.90" | | | | | | | | |
| | Mean ± S.D. | | | 8.33 ± 0.19 | 6.14 ± 0.27 | 3.46 ± 0.16 | 57.5± 31.81 | 72.5± 3.53 | 67.5± 24.74 | 60± 21.21 |

Table 2. *Bauhinia racemosa* with Germination Value and Mean Germination Time

| S. No. | Location | GPS | Date of Collection | Germination in Tray | | | | | |
|--------|---|----------------|--------------------|-------------------------|---------------|---------------|----------------|-------------|----------------|
| | | | | Treatments | GP% | Total MGT | Total GV | Average MGT | Average GV |
| 1 | Laxmangarh-Salasar Balaji Highway | N27°81'536" | 13/05/2022 | Control | 80 | 179.3 | 3191.5 | 8.15 | 145.07 |
| | | E74°00'808" | | Hot Water | 75 | 169.9 | 2187.4 | 7.72 | 99.43 |
| | | | | GA ₃ 500PPM | 85 | 198.1 | 3520.4 | 9.00 | 160.01 |
| | | | | GA ₃ 1000PPM | 75 | 171.3 | 2091.2 | 7.78 | 95.05 |
| 2 | Luv-Khush Vatika, Near Forest Nursery, Nagaur | N 27°22'94.55" | 12-06-2023 | Control | 35 | 82.55 | 883.9 | 3.75 | 40.18 |
| | | E 73°67'51.90" | | Hot Water | 70 | 148.6 | 2377.6 | 6.75 | 158.51 |
| | | | | GA ₃ 500 PPM | 50 | 113.75 | 1423.2 | 5.17 | 64.69 |
| | | | | GA ₃ 1000PPM | 45 | 102.9 | 1502.8 | 4.68 | 68.31 |
| | Mean ± S.D. | | | | 64.37 ± 18.40 | 145.8 ± 41.34 | 2147.2 ± 891.9 | 6.62 ± 1.87 | 103.90 ± 45.96 |

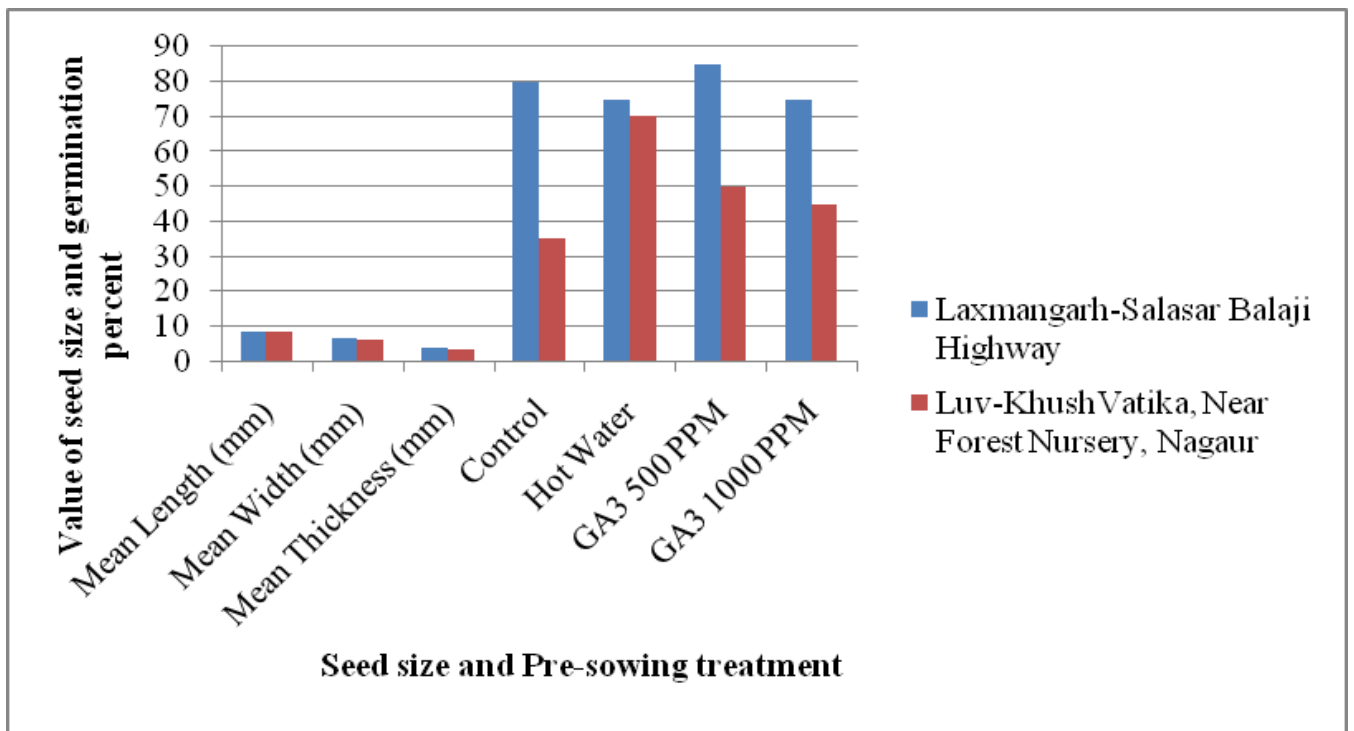


Figure 1. Effect of Seed Size on Germination in *Bauhinia racemosa*

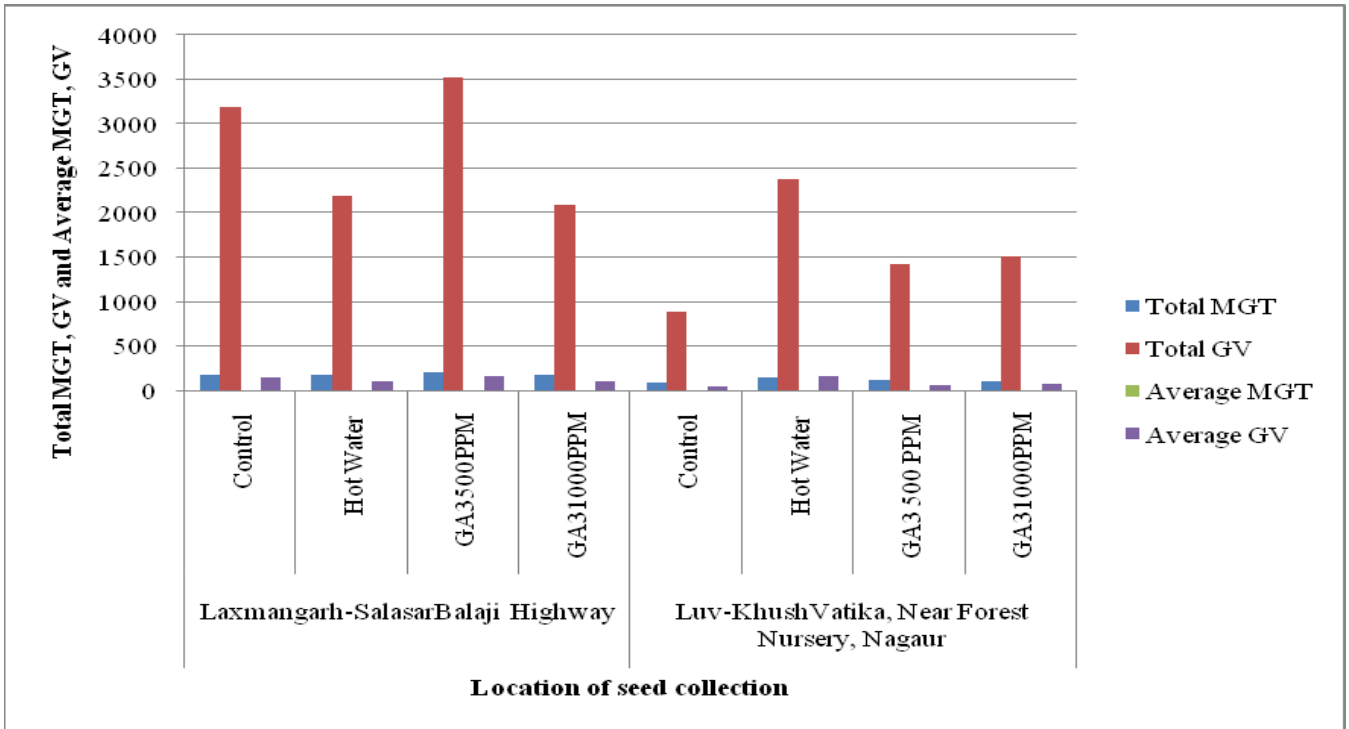


Figure 2. *Bauhinia racemosa* with Germination Value and Mean Germination Time



Figure 3. Seed germination of *Bauhinia racemosa*