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Seed germination behaviour and seedling attributes of *Buchanania lanzan* (Spreng.) in South-Eastern Rajasthan

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Abstract

The present investigation entitled “Seed Germination behaviour and seedling attributes of *Buchanania lanzan* (Spreng.) in South-Eastern Rajasthan” was carried out during April 2019 to October 2019 at Department of Forest Biology and Tree Improvement, College of Horticulture and Forestry, Jhalawar. The experiment was laid out in Randomized Block Design with twelve plus trees and two concentrations (2.5%, 5%) with a total of twenty four treatments and tree replications. Result revealed that minimum number of days for first seed germination (8.67 days), highest seed germination percentage (68.89) and survival percentage (90.30) were significantly observed in treatment, T₁₃. Significantly, increased in the seedling growth attributes like collar diameter (4.02 mm), seedling height (27.28 cm) and number of leaves (14.20) were also recorded maximum in treatment, T₁₃.

Keywords: germination behaviour, seedling attributes, *Buchanania lanzan*, Rajasthan

1. Introduction

Chironji is small to medium sized nearly evergreen tree with a small crown and short trunk generally attaining a height up to 18 m and girth up to 1.5 m. Chironji (*Buchanania lanzan*) belong to the family Anacardiaceae. It bears flowering in the month of January-February and ripen in April-May. Chironji is an important fruit tree of agro-forestry and social forestry. Chironji adopts great significance due to its miscellaneous uses and ability to withstand adverse ecological conditions. In India, the distribution occurs in the state of Rajasthan, Chhattisgarh, Madhya Pradesh, Jharkhand, Gujarat, Odisha and also found in dry deciduous forests of India. Tewari *et al.* (2001) [17] reported that Chironji is not cultivated as regular plantation. It is found growing as stray plantation in natural habitat. The oily kernels are the most important part and are used in preparation of puddings. The kernel is highly nutritious and rich in protein (25-30%) and yield sweet oil, which can be used to substitute olive and almond oil (Joshi *et.al.* 2017) [8]. The fruit of Chironji is most important minor forest based product which is commonly used by local people and it also base of their income source. Fruit yield per plant is 13.20 kg during 9th year of orchard life under rainfed conditions of hot semi – arid ecosystem (Singh *et. al.*, 2018) [16]. Mesocarp of fruit is edible by children (Munde *et. al.*, 2003) [13]. Collection and selling of minor forest based produce; especially Chironji (one of the important multi-purpose forest species) brings income to the local inhabitants (Narayan *et.al.* 2014) [14]. In India there is only 25% production of Chironji kernels against the requirement. Therefore, there is huge gap between productions of Chironji against demand (Chauhan *et. al.*, 2018) [4]. Chironji seeds are recalcitrant in nature and it lose viability soon even after 3 months of harvesting. Such seeds may require special treatments like stratification, scarification, soaking in water, growth regulators etc., for overcoming dormancy. Pre-sowing treatment with chemicals like GA₃, KNO₃ and thiourea (Rajamanickram *et. al.*, 2002) [15] improve the seed germination of Chironji.

2. Materials and Methods

The present investigation was carried out at College of Horticulture and Forestry, Jhalawar (Rajasthan), under the supervision of the Department of Forest Biology and Tree Improvement, College of Horticulture and Forestry, Jhalawar (Agriculture University Kota) during April 2019 to October 2019. The experimental design was Randomize Block Design with twelve plus trees and two concentrations of H₂SO₄ (2.5% and 5%) with a total of twenty

four treatments. Nursery bed was prepared of a bed size of 20 m x 1 m and white polythene bags were filling with Soil, Sand

and FYM in the ratio of 3:1:1. After pre sowing treatment, seeds were sown in polythene bags.

Table 1: Details of the different treatment combinations

Treatments	Treatment combinations
T ₁	PT ₁ C ₁
T ₂	PT ₂ C ₁
T ₃	PT ₃ C ₁
T ₄	PT ₄ C ₁
T ₅	PT ₅ C ₁
T ₆	PT ₆ C ₁
T ₇	PT ₇ C ₁
T ₈	PT ₈ C ₁
T ₉	PT ₉ C ₁
T ₁₀	PT ₁₀ C ₁
T ₁₁	PT ₁₁ C ₁
T ₁₂	PT ₁₂ C ₁
T ₁₃	PT ₁ C ₂
T ₁₄	PT ₂ C ₂
T ₁₅	PT ₃ C ₂
T ₁₆	PT ₄ C ₂
T ₁₇	PT ₅ C ₂
T ₁₈	PT ₆ C ₂
T ₁₉	PT ₇ C ₂
T ₂₀	PT ₈ C ₂
T ₂₁	PT ₉ C ₂
T ₂₂	PT ₁₀ C ₂
T ₂₃	PT ₁₁ C ₂
T ₂₄	PT ₁₂ C ₂

Note: - PT₁, PT₂.....PT₁₂ = Plus Trees, C₁ = Conc. of H₂SO₄ 2.5%, C₂=Conc. of H₂SO₄ 5%

Survey and demarcation of plus tree of Chironji

The fruits of twelve plus trees from three different villages namely Acharpura, Aamkho and Baith of Shahbaad tehsil (Baran District) were collected for the present investigation. Following parameters were recorded for seedling growth and attributes:

Tree parameters

1. GPS Locations of trees
2. Diameter at breast height (cm)
3. Clear bole height (m)
4. Total tree height (m)
5. Branching angle
6. Bark thickness (mm)
7. Taper
8. Straightness of bole
9. Disease defect

Table 2: Scoring/points for each traits as per given score

Straightness	Score
Crooked	1
Less crooked	2
Nearly straight	3
Straight	4
Taper	Score
Steep taper	1
Moderate taper	2
Near cylindrical	3

Table 2: Plus tree parameters

PT	GPS (N)	GPS (E)	Village	DBH (cm)	Bole height (m)	Total height (m)	BA	Bark thickness (mm)	Taper score	SS	DD
PT ₁	25°10'14"	77°08'34"	Acharpura	66.55	3.50	9.60	45°	1.00	3	3	No
PT ₂	25°10'11.29"	77°08'50.43"	Acharpura	43.70	3.00	6.00	30°	1.10	3	3	No
PT ₃	25°10'11.29"	77°08'50.43"	Acharpura	48.70	3.00	5.50	90°	1.20	3	3	No
PT ₄	25°10'11.29"	77°08'50.43"	Acharpura	61.70	2.60	6.00	45°	0.90	3	2	GM
PT ₅	25°10'11.12"	77°08'50.60"	Acharpura	47.15	2.40	6.00	70°	1.00	3	4	No
PT ₆	25°10'10.54"	77°08'50.60"	Acharpura	61.65	2.20	5.50	50°	1.00	3	3	No
PT ₇	25°10'11.12"	77°08'50.60"	Acharpura	90.20	1.70	5.90	75°	1.00	3	3	No
PT ₈	25°10'10.85"	77°09'28.89"	Baith	50.10	2.00	6.50	70°	1.10	3	4	No
PT ₉	25°10'10.85"	77°09'28.89"	Baith	45.90	2.30	6.00	45°	1.00	3	3	No
PT ₁₀	25°10'30.79"	77°08'55.09"	Aamkho	60.10	2.50	7.00	80°	0.80	3	4	No
PT ₁₁	25°09'22"	77°10'55"	Aamkho	45.20	3.00	6.50	70°	1.00	3	3	No
PT ₁₂	25°09'20"	77°10'60"	Aamkho	46.90	2.40	6.00	45°	1.10	3	3	GM

Note- PT- Plus trees, BA- Branching angle, DD- Disease defects, SS- Straightness Score, DBH- Diameter at breast height, GM- Gummosis

Seed preparation

First of all, medium size phenotypically superior trees were selected from different villages, namely Acharpura, Aamkho and Baith of shahbaad tehsil of Baran district of Rajasthan. Collected fruits were brought to the laboratory and stored it in refrigerator for the periods of nine months. In the month of

the April it was soaked in normal water for three days and then after 3 days soaking, fruits were clean by hand, and then seeds were separated from detached pulp through proper washing. Then after seeds were treated with Conc. H₂SO₄ (2.5% and 5%) for 10 minutes and thereafter seeds were washed by hands in proper flow of water. The observations

were recorded daily on germination parameters. The date of first plumule emergence was recorded and computing the difference between date of sowing and plumule emergence was recorded as a number of days taken for germination. The germination percentage was calculated by using below formula:

$$\text{Germination percentage (\%)} = (\text{Number of seed germinated} / \text{Number of seed sown}) \times 100$$

The survival percentage of Chironji seedling was calculated at the end of the experiment (180 Days after sowing) using below formula:

$$\text{Survival percentage (\%)} = (\text{Number of seedling survived} / \text{Number of seed germinated}) \times 100$$

3. Result and Discussion

Number of days for first seed germination (days)

A perusal of data presented in the Table 3 reveals the minimum days were taken for first seed germination under the T₁₃ (8.67 days) which was at par with T₁₄ (9.00 days), T₁₉ (9.00 days), T₁₅ (9.33 days), T₂₂ (9.33 days) and T₁₈ (9.67 days). The maximum days were taken in T₇ (12.67 days). Kiran *et al.* (2000) [10] recorded seeds of *Givotia rottleriformis* significantly early seed germination when seeds soaked with 500 ppm GA₃ for 1 hour. Bhuse *et al.* (2001) [2] reported that treating the seeds of *Cassia angustifolia* with H₂SO₄ for 12 minutes gave highest germination of 72 per cent within 14 days. Khosh-Khui (2007) observed that stratification of scarified seeds positively affected germination rate. In *Quercus semecarpifolia* seeds germinated best in 10 days stratification but as duration of stratification increased the

germination rate deteriorated.

Germination percentage

A perusal of data presented in the Table 3 reveals that the maximum germination percentage after 30 days after sowing was recorded under T₁₃ (68.89) which was found at par with T₁₄ (66.67), T₂₂ (64.44), T₂₃ (62.96), T₁₇ (62.22), T₂₀ (62.22), T₂₁ (62.22), T₁₅ (62.22), T₁₆ (61.11), T₂₄ (60.00), T₁₉ (60.00), T₁₈ (57.58), T₂ (57.78), and the minimum germination percentage was observed in T₁₂ (40.00). These results are in conformity with the report of Fadimu *et al.* (2014) [5] recorded the germination of stony fruits of Hog plum (*Spondias mombins*) in 60% concentrated H₂SO₄ for 25 minutes gave the highest seed (75%) germination. Similar findings have been reported by Joshi *et al.* (2017) [8] in *Buchmania lanzan*. They reported that maximum seed germination (68.33%) when the seeds were treated with 5% H₂SO₄ for 10 minutes.

Survival percentage

A review of data presented in the Table 3 exposes that the maximum survival percentage was recorded under T₁₃ (90.30) which was found at par with T₁₄ (89.93), T₂₁ (89.63), T₁₅ (89.26), T₂₀ (89.26), T₂₂ (89.26), T₁₈ (88.43), T₂ (88.43), T₁ (87.37), T₂₃ (86.30), T₂₄ (86.30), T₉ (85.51), T₃ (85.93) and the minimum survival percentage was observed in T₁₁ (80.16). Similar findings have been reported by Gupta (2002) [6] reported that H₂SO₄ treatment (up to 20%) increased the germination rate (84-86%) and resulted in better seedling survival (80%) in *Asparagus racemosus* when sown in the field. Narayan *et al.* (2014) [14] also reported that 88.00% survival in *Buchmania lanzan* after one month of germination in Conc. H₂SO₄ (5%) for 10 minutes soaking.

Table 3: Effect of Sulphuric acid and plus tree on seed germination, germination percentage and survival percentage.

Treatments	First seed germination (days)	Germination percentage (%)	Survival percentage (%)
T ₁	10.67	53.33	87.37
T ₂	11.00	57.78	88.43
T ₃	12.00	51.11	85.93
T ₄	12.00	42.22	83.81
T ₅	12.33	46.67	84.87
T ₆	11.33	44.44	84.40
T ₇	12.67	44.44	84.72
T ₈	10.67	44.44	84.92
T ₉	10.00	46.67	85.51
T ₁₀	12.00	42.22	83.61
T ₁₁	11.33	44.44	80.16
T ₁₂	12.33	40.00	83.01
T ₁₃	8.67	68.89	90.30
T ₁₄	9.00	66.67	89.93
T ₁₅	9.33	62.22	89.26
T ₁₆	10.00	61.11	86.30
T ₁₇	10.33	62.22	89.10
T ₁₈	9.67	57.78	88.43
T ₁₉	9.00	60.00	88.80
T ₂₀	10.00	62.22	89.26
T ₂₁	10.67	62.22	89.63
T ₂₂	9.33	64.44	89.26
T ₂₃	11.00	62.96	86.30
T ₂₄	10.67	60.00	86.30
S _{Em} (±)	0.44	4.15	1.84
C.D.	1.26	11.86	5.25

Collar diameter of seedlings

Data pertaining to the collar diameter of seedlings at 30, 60,

90,120,150 and 180 days after sowing are presented in Table 4. These was significant increase in collar diameter of

seedling as number of days increased from 30 to 180 days after sowing. The maximum collar diameter was observed in T₁₃ (4.02 mm) which was found at par with T₁₄ (3.93 mm), T₁₈ (3.90 mm), T₂₃ (3.88 mm), T₂₁ (3.86 mm) T₁₅ (3.85 mm), T₁₉ (3.83 mm), T₂₀ (3.82 mm), and T₁₆ (3.81 mm) and the minimum collar diameter was observed in T₁₂ (2.95 mm). The result are in conformity with the findings of Kumar and Khare (2014) [11], who reported highest 6.04 mm with an average 3.12 mm stem diameter of one year old Chironji seedling at nursery stage.

Height of the seedlings

A perusal of data relating to the height of the seedlings at 30, 60, 90,120,150 and 180 days after sowing are presented in Table 5. As the number of days increased from 30 to 180 days after sowing. There was significant increase in height of the seedling. The maximum average height of the seedlings were recorded in the treatment T₁₃ (27.28 cm). However the minimum height of the seedlings were recorded under the treatment T₉ (13.47 cm) at 180 days after sowing. Similar findings have been reported by Joshi *et al.* (2017) [8] in *Buchnanian lanzan*. They reported maximum seedling height

(30.31 cm) when the seeds were treated with H₂SO₄ (5%) for 10 minutes soaking. Narayan *et al.* (2014) [14] reported that the maximum seedling height in *Buchnanian lanzan* (2.75 cm) within one month when the seeds were treated with H₂SO₄ (5%) for 10 minutes soaking.

Number of leaves per plant

The data pertaining to number of leaves per plant are presented in Table 6. The number of leaves per plant increased significantly from 30 to 180 days after sowing. The maximum average number of leaves per plant (14.20) was observed under the treatment T₁₃ (P₁C₂) as compared to other treatments, however it was found at par with the treatment H₂SO₄ (5%) for 10 minutes soaking under T₁₄ (13.13), and the minimum number of leaves per plant was observed under T₆ (7.67) and T₇ (7.67) at 180 days after sowing. Similar findings have been reported by Amira *et al.* (2013) [1] in *Cassia fistula*. They recorded the maximum number of leaves (37.40 and 40.20) with treatment of seed scarified with H₂SO₄ (36N) for 2 minute. Mabundza *et al.* (2010) [12] reported that scarification of seeds of *Tamarindus indica* (L.) with 95% H₂SO₄ for 5 minutes improved number of leaves.

Table 4: Effect of Sulphuric acid and plus trees on Collar diameter (mm) of seedlings.

Treatment	Collar dia. 30 days(mm)	Collar dia. 60 days(mm)	Collar dia. 90 days (mm)	Collar dia. 120 days (mm)	Collar dia. 150 days (mm)	Collar dia. 180 days (mm)
T ₁	0.55	1.44	1.62	1.98	2.34	3.45
T ₂	0.71	1.41	1.59	1.78	2.35	3.17
T ₃	0.75	1.44	1.66	1.78	2.76	3.09
T ₄	0.72	1.33	1.54	1.82	2.36	3.55
T ₅	0.55	1.39	1.58	1.74	2.18	3.03
T ₆	0.73	1.63	1.75	2.51	2.71	3.42
T ₇	0.75	1.45	1.66	1.75	2.15	3.17
T ₈	0.75	1.66	1.75	1.86	2.14	2.97
T ₉	0.66	1.69	1.75	1.96	2.79	3.28
T ₁₀	0.77	1.52	1.65	1.78	2.14	3.18
T ₁₁	0.66	1.66	1.74	1.91	2.80	3.30
T ₁₂	0.70	1.36	1.64	1.78	2.15	2.95
T ₁₃	0.96	1.84	2.54	2.75	3.76	4.02
T ₁₄	0.83	1.79	2.16	2.51	3.06	3.93
T ₁₅	0.66	1.58	1.83	2.19	2.91	3.85
T ₁₆	0.81	1.64	1.83	1.89	2.88	3.81
T ₁₇	0.72	1.77	1.85	2.14	2.82	3.79
T ₁₈	0.77	1.75	1.79	2.12	3.16	3.90
T ₁₉	0.81	1.62	1.75	2.14	2.88	3.83
T ₂₀	0.82	1.75	1.87	2.19	2.93	3.82
T ₂₁	0.79	1.78	1.87	2.16	2.95	3.86
T ₂₂	0.89	1.82	1.88	2.13	2.85	3.76
T ₂₃	0.82	1.77	1.84	2.14	2.80	3.88
T ₂₄	0.76	1.50	1.76	1.96	2.24	3.14
SEm(±)	0.04	0.04	0.06	0.09	0.08	0.07
C.D.	0.10	0.10	0.16	0.24	0.22	0.21

Table 5: Effect of sulphuric acid and plus trees on Height of the seedling (cm).

Treatment	Height at 30 days (cm)	Height at 60 days (cm)	Height at 90 days (cm)	Height at 120 days (cm)	Height at 150 days (cm)	Height at 180 days (cm)
T ₁	1.73	3.10	5.69	11.73	14.07	19.73
T ₂	1.77	2.94	5.83	11.49	13.57	17.27
T ₃	1.70	2.59	5.33	10.41	13.01	15.36
T ₄	1.73	2.85	4.68	10.60	13.25	15.03
T ₅	1.69	2.72	6.40	11.65	13.16	15.14
T ₆	1.67	2.90	4.53	11.55	12.92	15.25
T ₇	1.68	2.59	4.73	11.26	12.85	14.91
T ₈	1.65	2.84	3.81	10.47	11.69	14.66
T ₉	1.74	2.79	4.47	10.86	11.74	13.47
T ₁₀	1.75	2.92	3.95	11.79	12.80	15.06

T ₁₁	1.69	2.87	4.99	10.47	13.25	15.76
T ₁₂	1.73	2.60	4.98	10.47	12.65	14.77
T ₁₃	1.96	3.37	7.77	14.28	18.61	27.28
T ₁₄	1.86	3.21	7.15	13.29	17.59	24.57
T ₁₅	1.76	2.94	6.03	12.23	14.40	19.06
T ₁₆	1.79	2.95	6.05	12.81	14.45	17.44
T ₁₇	1.76	2.94	6.68	12.74	14.06	16.03
T ₁₈	1.73	2.95	5.68	12.68	14.44	17.11
T ₁₉	1.73	2.82	5.69	12.30	14.66	17.02
T ₂₀	1.71	2.93	4.75	11.85	12.77	14.86
T ₂₁	1.75	2.94	5.97	12.07	12.96	16.29
T ₂₂	1.87	3.16	6.92	13.02	15.22	20.66
T ₂₃	1.79	2.94	5.63	11.66	14.23	17.51
T ₂₄	1.77	2.87	5.77	11.60	12.32	15.76
SEm(±)	0.04	0.06	0.23	0.36	0.40	0.48
C.D.	0.12	0.17	0.66	1.01	1.15	1.37

Table 6: Effect of Sulphuric acid and plus tree on number of leaves of the seedlings.

Treatment	Number of leaves at 30 days	Number of leaves at 60 days	Number of leaves at 90 days	Number of leaves at 120 days	Number of leaves at 150 days	Number of leaves at 180 days
T ₁	2.23	3.33	4.47	5.80	7.10	8.87
T ₂	2.33	3.27	4.47	5.60	7.53	8.80
T ₃	2.60	3.33	4.07	5.10	7.07	8.43
T ₄	3.00	3.63	4.63	5.50	6.47	8.43
T ₅	2.53	3.33	4.50	5.33	6.33	8.10
T ₆	2.53	3.63	4.13	5.57	6.43	7.67
T ₇	2.53	3.43	5.27	6.47	6.90	7.67
T ₈	3.13	3.73	5.53	6.37	7.00	7.93
T ₉	3.47	4.03	5.33	6.33	7.40	8.07
T ₁₀	3.47	3.47	5.27	6.47	7.37	8.43
T ₁₁	2.13	3.27	5.73	6.73	7.20	8.53
T ₁₂	3.27	4.17	4.77	6.60	7.67	8.40
T ₁₃	5.67	6.67	7.97	10.83	12.53	14.20
T ₁₄	5.53	6.30	7.07	8.93	10.47	13.13
T ₁₅	3.93	4.07	5.03	6.37	8.07	9.23
T ₁₆	3.27	4.07	5.23	6.00	7.00	8.40
T ₁₇	2.87	4.23	5.53	6.53	7.53	8.20
T ₁₈	2.87	3.87	5.53	6.70	7.50	8.60
T ₁₉	2.60	3.67	5.93	6.80	7.53	8.07
T ₂₀	3.43	4.40	5.93	6.53	7.67	8.83
T ₂₁	4.07	4.47	5.43	7.13	8.10	8.70
T ₂₂	4.87	5.80	6.67	8.07	9.67	11.60
T ₂₃	4.07	4.90	5.93	6.87	7.37	8.43
T ₂₄	3.87	4.43	5.63	6.80	7.87	8.93
SEm(±)	0.26	0.22	0.24	0.29	0.37	0.37
C.D.	0.74	0.64	0.68	0.81	1.04	1.06

Conclusion

The present investigation can be concluded that the minimum number of days for first seed germination, seed germination percentage, survival percentage, seedling growth attributes like seedling height (cm), number of leaves and collar diameter (mm) were found higher in T₁₃ (PT₁C₂). Then, the current study conclude that treatment T₁₃ performed best results for *Buchanania lanzan* (Spreng.) under South-Eastern Rajasthan. Therefore, T₁₃ (Acharpura village, GPS (N) 25°10'14" GPS (E) 77°08'34") may be used for superior germplasm and seed multiplication and quality planting materials for future investigation and propagation for Chironji.

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