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Original Research Article

Effect of Seed Priming Methods on Germination of Indian Jujube (*Ziziphus mauritiana. LAM*) in Northern Guinea Savanna Ecological Zone of Nigeria

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Abstract: Effect of seed priming methods on germination of Indian Jujube (*Ziziphus mauritiana. LAM*) In Northern Guinea Savanna Ecological Zone of Nigeria was studied at the Federal College of Forestry Mechanization, Afaka-Kaduna Nursery. The treatments consisted of Boiled water (100ºC) for 10 minutes, 15 minutes and 20 minutes; diluted sulphuric acid (H_2S0_4) soaking time for 10minutes, 15 minutes and 20 minutes; Seed scarification (sand papering and cracking) and control. Ten (10) seeds from each of the treatments were sown in germination box containing sterilized river bank sand and replicated three (3) Times. The experimental design adopted was a Completely Randomized Design (CRD). Data from germination were analyzed using descriptive statistics and Analysis of Variance (ANOVA) at 0.05 level of probability. Results revealed that the seed of Indian jujube (*Ziziphus mauritiana*) seeds scarified showed a significant germination percentage (95.20±7.34) than any other methods, followed by soaking in sulphuric acid (H_2S0_4) for 20minutes (77.60±7.34) then, soaking in hot water for 20 minutes which gave (47.67±14.68). However, the seeds in the control were significant (P>0.05) lower in germination percentage (3.20±7.34) than any other methods applied. Therefore, it is concluded that for effective, sustainable and fast multiplication of germination of Indian jujube (*Ziziphus mauritiana*) seeds in the tree nursery scarification methods should be adopted.

Keywords: Seed Priming, Guinea Savanna, germination, Multiplication, Sustainable.

INRODUCTION

Many seeds have difficulty in germination such that their propagation is adversely affected by seed coat dormancy leading to poor growth potential [1]. In several species, seeds germinate rather slowly, and at times even fail to germinate [2]. This is because the seeds easily loose viability exhibited through the evolution of an oxygen and water to the embryo [3]. One of the major problems associated with afforestation programmes in the tropics is the fact that most tropical forest tree seeds exhibit one form of dormancy or another [4]. The conditions necessary to allow seeds to break dormancy and germinate can be highly variable among species, within a species, or among seed sources of the same species [5]. Hard seed coat, type and sizes have been identified by [6] as some attributes which affect germination and growth of indigenous species and sometimes, This poor germination ability may be due to seeds dormancy or insect attack, some of such indigenous plant includes *Ziziphus mauritiana* (Magarya) among others However, if stored for a long time most seed lose their viability, since they are not normally sown, until sometimes after collection, so pre-germination treatment is important to prevent wasting time and money in sowing seeds with poor germination ability. The pre-treatment of these species seeds are necessary to enhance accessibility of water and oxygen into the seeds and to obtain optimum germination and improved performance for plantation establishment.

Indian jujube *(Ziziphus mauritiana*) is a shrub or small thorny tree belonging to the family *Rhamnaceae*. The tree that can grow to a height of 3-15 m. Deciduous or almost evergreen, Indian jujube has an erect or spreading habit [7-9]. It has a deep taproot [10]. The trunk is around 40 cm in diameter, covered with a dark grey or dull black, irregularly fissured bark [7]. The branches are numerous and drooping. The twigs are tomentose. The spines are solitary or borne in pairs at the base of the leaves, 5 to 7 mm long [11]. In cultivated Indian jujube, the spines may be absent [12]. The leaves are simple, alternate, ovate, and 2-9 cm long with 3 conspicuous longitudinal veins. The upper surface of the leaves is

dark glossy green and the lower one is densely hairy [11, 10]. This dense silky underside helps distinguish Indian jujube from Chinese jujube (*Ziziphus jujuba* Mill.) [10]. The fruit skin may be smooth or rough, glossy, yellowish to reddish or blackish. The flesh is white, juicy, slightly acid to sweet, turning mealy when fully ripe [11]. The stone is single, central, hard, oval or oblate, with a rough surface. It contains 2 elliptic, brown seeds, 6 mm long [10].Indian jujube can be grown in semi-arid and arid regions as it thrives under very dry conditions. In the Sahelian zone, Indian jujube is one of the most persistent trees, like *Acacia raddiana* and *Balanites aegyptiaca* [13].

Indian jujube is a multi-purpose tree mainly grown for its fruits. It starts bearing fruits 6-8 years after planting, and yield increases until the tree is 15-20 years old [9]. The fruit is edible and can be eaten fresh, dried like dates, candyied, salted or pickled [11, 9]. It can be processed into flour meal, paste, juice, syrup or an alcoholic beverage [11]. It is a good source of carotene, vitamins A and C, and fatty oils [7]. Young leaves are edible and are cooked as a vegetable in Indonesia. Fruits and bark are used to make dye and medicinal preparations [7,9]. Indian jujube wood is reddish, fine-textured, hard and durable. It can be used in rural house construction, posts and tool manufacturing. It makes excellent firewood. The Indian jujube tree hosts lac insects, and is also fodder for the tasar silkworm that makes high-prized silk in India [7]. It is a minor source of pollen for bees [7]. A potential agroforestry species, this thorny tree can grow to provide windbreaks and living fences. It is browsed by livestock and its leaves are nutritious fodder for sheep and goats [14, 7, 9].

However, to perpetuate all these uses of the species, some measures must be taken in view of the degrading vegetation due to deforestation, agricultural and pastoral pressure on forested land. The measures to be taken include; identifying, collecting seeds, pre-testing the seeds, preparing the potting mixture, sowing and watering of seeds, tending the seedlings in the nursery, site preparation and seedling plantation [15]. In arid and semi-arid regions, desert encroachment due to excessive deforestation led to dwindling agricultural field coursed by the resultant poor soil status [16]. Consequently, the land is no longer able to meet the upsurge in demand for forest products, food, fodder, fuelwood and other minor forest products. Therefore, there is an urgent need to enlighten the local people for quick move towards methods of pre germinating, raising and tending of indigenous species so that most of them will not go into extinction because their population is already being threatened by anthropogenic activities in varies degrees. Meanwhile the neglect of these species leads to loss of information on more efficient methods of pretreating indigenous seeds to induce quick germination of tree species for plantation establishment.

The major objective of the study is to determine the effect of different seed priming methods on germination of Ziziphus mauritiana. In Northern Guinea Savannah Ecological zone of Nigeria.

MATERIALS AND METHODS

The study was carried out in the nursery of the Federal College of Forestry Mechanization, Forestry Research Institute of Nigeria, Afaka- Kaduna, Kaduna state, Nigeria. It lies between latitude $10^{o}\,37^{1}$ North and longitude $7^{o}\,47^{1}$ East [17]. The college is situated in the Northern Savannah ecological zone on 613m above sea level. The average annual temperature is 25.2 °C, 77.3 °F. Rainfall is approximately 100cm annually with the lowest mean monthly relative humidity reaching up to about 29%. It is an open woodland with tall grasses of about (1m -3m) in height usually with broad leaves [18].

Treatments and Experimental Design

Treatments consisted of Boiled water (100ºC) for 10 minutes, 15minutes and 20 minutes; diluted sulphuric acid (H_2S0_4) soaking time for 10minutes, 15minutes and 20 minutes; Seed scarification and control. Ten (10) seeds each were soaked in Three (3) Treatments arranged in Completely Randomized Design (CRD). Ten (10) seeds from each of the treatments were sown in germination box containing sterilized river bank sand and replicated three (3) Times.

Procedure for experimentation

Experiment 1 (Hot Water Treatment)*:*

Water was boiled for 100ºC and seeds were added to the boiled water and allowed it to soak for three different times 10, 15, and 20 minutes. Then the seeds were removed and allowed to cool.

Experiment 2 (Acid treatment)

The seeds were soaked in diluted sulphuric acid (H_2S0_4) for three different periods (10, 15, and 20minutes). After the soaking the seeds were removed, washed and rinsed in running tap water to remove any remaining acid.

Experiment 3 (Scarification Treatment)

Mechanical scarification was done by carefully filling the seeds with sand paper until the seeds begins to crack. Caution must be taken while carrying out this scarification process not to damage the embryo of the seeds.

Experiment 4 (Control):

Indian jujube (Ziziphus mauritiana) seeds sown without any pre-germination treatment served as control.

Data Collection

Seeds Germination was monitored for fourty days (40 days) and data were collected on Days of emergence (Number of days taken for first emergence), rate of germination (Number of seeds germinated) and germination percentage. Percentage seed Germination (PG) and Germination Rate (GR) were estimated with the following equations:

$$GP = \frac{SG}{TS} \times 100 \quad \text{................................ equation (1)}$$

Where:

GP = Germination percentage
SG = Seed germinated
TS = Total number of seed germinated

$$GR = \frac{GP}{T} \quad \text{...equation (2)}$$

Where:

GR = Germination rate
GP = Germination percentage
T = Time taken

Data Analysis

Data from germination were analyzed using descriptive statistics and Analysis of Variance (ANOVA) with SPSS statistical package [19] and means were compared using Least Significant Difference (LSD) test at (P>0.05) level.

RESULTS AND DISCUSSION

Effect of hot water treatment on Indian jujube (*Ziziphus mauritiana*) germination:

The percentage germination of seeds soaked in 100^{o}C hot water (Table-1) for 20 minutes was significantly higher and gave percentage germination of (47.67±14.68) than those of all other hot water treatment of 10 minutes and 15minutes. The seed treated with hot water at 100ºC for 10minutes gave germination percentage of (32.33±7.34) and for 15minutes gave (37.64±7.34). The results from this work is in agreement with the finding of [20] who noted that hot water is the most effective way of improving seed coat permeability in seeds of Leucaena leucocephala. But contrary to the work of [21] who stated that seeds of Calliandra prototricensis failed to germinate in hot water. However [22], reported that soaking of Azadrachta indica seeds for one and two hours resulted in increasing rate of seeds germination supporting the work of [23] on the seeds of Adansonia digitata.

Table-1: **Germination of Indian Jujube *(Ziziphus mauritiana)* in Hot Water**

Treatment (Minutes)	Mean Number of Days for First Emergence	Mean Number of Seeds Germinated	Germination Percentage
10	15.00±0.00^a	0.3233	32.33±7.34^c
15	16.83±0.65^a	0.3764	37.64±7.34^c
20	15.00± 0.00^a	0.4767	47.67±14.68^c
SE ±	0.00		0.00

Mean with the same letters along the same column are not significant different from each other (P>0.05)

Effect of sulphuric acid treatment on Indian jujube (*Ziziphus mauritiana*) germination*:*

The percentage germination of seeds treated with 20 minutes, soaking of H_2S0_4 was significantly higher (P> 0.05) for (77.60±7.34) than those for 10 minutes, that had (72.10±11.34) and for 15 minutes which gave (75.20±12.34) (Table-2) Twenty (20) minutes soaking in H_2SO_4 gave the highest germination percentage of 77.66±7.65, though there were no significant differences between the other 2 level (10, 15) which gave 72% and 75% respectively. This result is in accordance with the work of [24] on *Enterolobium cyclocarpum, Pilostigma reticulatum* and [25] on *Adansonia digitata* who noted that treatment with acid significantly promoted germination of the seeds. This finding is also similar to prior reports of [26] that acid treatment of seeds removes the waxy layer of the seed coat by chemical decomposition of the seed coat components that, the faster the rate of germination. While [1] also observed that treatment with sulphuric acid for six (6) to twelve (12) hours led to germination of more than 90% of seeds within twenty (20) days of sowing.

Agbogidi O. M *et al.*, [27] noted that soaking of *Dacyodes edulis* seed in sulphuric acid H_2SO_4 reduce the germination period considerable and concluded that it was the best method, though, dangerous. Therefore, when using safety precaution is very important.

Table-2: **Germination of Indian Jujube *(Ziziphus mauritiana)* in Sulphuric Acid (H_2S0_4)**

Treatment (Minutes)	Mean Number of Days for First Emergence	Mean Number of Seeds Germinated	Germination Percentage
10	15.00±0.00[a]	0.721	72.10±11.34[b]
15	16.43 ±1.25[a]	0.752	75.20±12.34[b]
20	12.00± 0.00[ab]	0.776	77.60±7.34[b]
SE ±	0.00		16.00

Mean with the same letters along the same column are not significant different from each other (P>0.05)

Effect of Mechanical Scarification treatment on Indian jujube (*Zizizphus mauritiana*) germination

The germination percentage of all the scarified seeds had germination percentage of (95.20±7.34) (Table-3). *Z. mauritiana* scarified with sand paper overcome dormancy and gave 93.33±5.77 germination. Mechanical scarification on the seeds of *Z. mauritiana* cause early germination (11 days) as against their normal period of dormancy which is 35-40 days. This is in agreement with earlier findings of [20] who observed that mechanical scarification is an efficient way of improving seed coat permeability of *Pterocarpus angolensis* and *Leucaenia leucocephala* seeds**.** Tomlinson H. N *et al***.,** [28] also observed that seed dormancy resulting from an impermeable seed coat may be overcome by peeling off the coat. According to [27], who noted that scarification gave the highest mean percentage germination than either immersion in hot water or sulphuric acid, but there was no significant difference between one scratche with sand paper (96.67%) and two scratches with sand paper (86.67%) on seeds for Acacia sieberiana but Acacia seyel recorded 83.33% and for one and two scratches. This result also agrees with earlier report by [22] on seed germination of Pterocarpus osun when subjected to filling and clipping at their micropyle end. Similarly [22], stated that seeds of Pinus bruatia germination improved when it was rubbed with sandpaper at the micropyle end. Duguma B *et al.,* [20] affirmed that seed scarification is the most effective way of improving seed coat permeability in seed of Leucaenia leucocephala.

Table-3: **Germination of Indian Jujube *(Ziziphus mauritiana)* in Scarification**

Treatment (Minutes)	Mean Number of Days for First Emergence	Mean Number of Seeds Germinated	Germination Percentage
	16.43±1.25[a]	0.952	95.20± 7.34[a]
SE ±	0.734		0.367

Mean with the same letters along the same column are not significant different from each other (P>0.05)

Effect of untreated seed on Indian jujube (*Ziziphus mauritiana*) germination:

The lowest germination percentage was found for seeds in the untreated control which gave 3.20±7.34 (Table-4). This was not in agreement with results of work reported by [29] where they found that control untreated seeds of *Balanitesa egyptiaca* had significantly higher germination then seeds boiled in hot water.

Table-4: **Germination of Indian Jujube *(Ziziphus mauritiana)* in Control**

Treatment (Minutes)	Mean Number of Days for First Emergence	Mean Number of Seeds Germinated	Germination Percentage
	8.42±12.23[b]	0.0323	3.20±7.34[d]
SE ±	8.415		0.367

Mean with the same letters along the same column are not significant different from each other (P>0.05)

CONCLUSION AND RECOMMENDATION

Conclusion

The results of the Indian jujube (Ziziphus mauritiana) seed pre-germination treatment showed that mechanically scarified method improved seed germination. Therefore, Mechanical scarification can be concluded to be the best method of breaking dormancy in *Z. mauritiana* which resulted in an increased germination percentage of 95.20±7.34.

Recommendation

Based on the results above it is recommended that for easy multiplication of seedlings of *Z, mauritiana* for plantations establishment the nursery workers should adopt the use of mechanical scarification method as a pre-sowing treatment to promote and enhance better germination of the species.

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