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Seed Morphology and Germination of Ipil-Ipil (*Leucaena leucocephala* (Lam.) De Wit.) under Different Conditions at Nursery Stage in Bangladesh

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Abstract: The morphological characteristics of the fruits and seeds, germination and seedling growth performance of Ipil-Ipil (*Leucaena leucocephala* (Lam.) de wit.) were studied under different conditions in the nursery. The average length (cm), breadth (cm) and number of seed per fruits varied from (19.71±0.08); (2.11±0.03) and (20.08±0.61) as well as seeds, the length (cm), breadth (cm), thickness (cm) and dry weight per seeds (g) ranges from (0.83±0.03); (0.55±0.014); (0.169±0.04) and (0.059±0.002). The rate of untreated seed germination was tried in the polybag, seed tray and seedbed. The highest germination was found in polybag under peat with cowdung mixture about (66%) and lowest germination was found in seedbed in all rooting media.

Key words: Ipil-Ipil, morphological characteristics, fruit, seed, germination, Bangladesh

INTRODUCTION

Bangladesh, a densely populated country (834 persons km⁻²) with an area of about 14.4 million ha and a population of 123.1 million^[1], is one of the poorest countries in the world. About 5000 species of angiosperms are reported to occur in Bangladesh. Over a hundred different plant species are cultivated as agricultural crops^[2]. The wild plant resources are rich in the species diversity and generally found in the natural forests. The forest cover is about 14.85% of the land area of the country^[1]. Sixty-eight woody legumes in the forestry, 130 species of fiber yielding plants both wild and cultivated and 29 life support plant species in the waterlogged areas have been reported^[2]. Village forest contribute 89 and 80% of the countries total fuel wood and saw or ply logs supply, respectively^[3]. These forests that are unevenly distributed are the sources of various forest products and the reported productivity 0.5-2.5 m³ha⁻¹yr⁻¹ of these forests are extremely low^[4]. Despite a very low per capita consumption of fuel wood 0.06 m³, timber 0.018 m³,^[5] the supply from the forest is inadequate and far beyond the demand. There remains a wide gap (5 million m³) between the supply and demand of forest products^[4]. On the other hand the demand for good quality wood is very high in Bangladesh and insufficient availability of fuel wood and good quality wood species have been the main cause of damage to forest in many

areas and threat to environment and energy. To minimize different problems related to production forestry in Bangladesh forestry experts suggest utilizing such type of species that has multipurpose uses. From the situation, Bangladesh Forest Department introduced *Leucaena leucocephala* in August 1977 from the Philippines^[6]. The original sources of introduction here are not recorded. It was introduced in Bangladesh as a fast growing fuel wood species. Mostly planted by the side of highways and railway track in North Bangal^[7]. In our country, now it is planted in all the districts, but will not tolerate flooding or acidic soils. It also naturalised in the districts of Patuakhali and Khulna^[8]. It grows as a shrub about 5 m to 6.5 m tall. The species has been extensively planted on the coastal embankments in Chittagong and Noakhali Districts^[9]. In Bangladesh, the species is planted all the districts as an agroforestry species, roadside or ornamental. *Leucaena leucocephala*, a nitrogen-fixing legume with high nitrogen contents and fast decomposing leaf materials, significantly increased maize growth and yield^[9]. Due to its multipurpose production and wide range of ecological amplitude Ipil-Ipil has got the popularity for plantation in the homestead as well as marginal land plantations. There is a lot of information about the species but most of them were based on the literature rather than the site specific research based one. So the study was aimed to generate scientific knowledge on locally available soil for domestication all over the

country. Side by side it attempts to explore the germination potential in different conditions of the nursery for better production in practice.

MATERIALS AND METHODS

Seed source and collection: Seeds of *Leucaena leucocephala* were collected from different region of Khulna districts during October in Bangladesh. The ripe fruits were collected directly from the matured trees and dried for a week in the open sun. The seeds were then separated from the pods by hand and dried again in the sun for another week. The collected seeds were checked to remove the discolored damaged seeds.

Site and environmental condition

Physical environments: Khulna district is situated between the latitudes of 22° 12' and 23° 59' N and between 89°14' to 89°45' E. The total area of the district is 4394.46 km² of which 59.79 km² is riverine^[10]. The study area is under Batiaghata thana of this district.

Climatic conditions: Like other parts of Bangladesh, the climate of Khulna is sub-tropical in nature and there are three main reasons such as winter, summer and monsoon. The winter begins in November and ends in February. Here winter is relatively mild and the temperature fluctuation is low. The temperature ranges from a minimum of 7.22-12.77°C in winter to a maximum of 23.88-31.11°C in summer. Occasionally the temperature might be as high as 36.66°C or more and the mean monthly temperature is 28°C. The summer is from March to June and the monsoon starts in July and continues until October^[11]. This monsoon period (June-October) is characterized by heavy rainfall under the influence of southwest monsoon wind. During the experiment, the average temperature, rainfall and humidity were 24.77 °C, 64.31 mm and 78.1%, respectively.

A number of rivers are flown through this thana. All the rivers are subjected to ebb and tide all the year round. The salinity in these rivers is extreme in the irrigation season. During the rainy season the salinity is almost nil.

But with the start of dry season, the salinity gradually increase and reach to maximum during April to May. As the dams protect the areas, saline water cannot invade into the agricultural fields and homesteads^[12]. There are four soil series identified in the Batiaghata thana. A brief description of the different series is given Table 1.

Study of morphological characteristics: During the study, 25 fruits and seeds were selected randomly for measurement. The external characteristics of the fruits and seeds were carefully observed and the breadth, length and weight of fruits and seeds were measured by wooden scale and slide caliper.

Experimental design: Randomized Complete Block Design was used for measuring the effect of media and containers on germination. In the experiment, three types of containers and media were used. Transparent polybag (10×15 cm²), plastic seed-tray (24.5 cm dia.) and open seedbed (They are indicated as C₁, C₂ and C₃, respectively). In every container, three types of media peat soil+cowdung (3:1 ratio), soil+cowdung (3:1 ratio) and soil+peat soil (1:1 ratio) were used (They are indicated as m₁, m₂ and m₃, respectively).

Materials used: In the experiment, untreated seeds were used to assess the effect of container and media on germination. To test the interaction between media and container, in each container all types of media were used to prepare the germination bed. For each media, 4 replications were used to assess the internal variability of the species. For each replication 25 seeds were considered. Each seed was dibbled in each polybag and 25 bags were separated as a replication. Similarly, 25 seeds were sown in each seedbed (18" × 18") and plastic tray as replications. The germination of each day was recorded during two months after sowing.

Data analysis: The analysis of variance (ANOVA) was carried out to test the effect of media and containers on germination and growth performance. For significant treatments, Least Significant Difference (LSD) was made.

Table 1: Physical and chemical properties of the soil series of Batiaghata Thana

Soil series	Land class	Soil texture	pH value	Organic content (%)	Drainage condition
Gopalpur	High	Clay loam	7.3	2.5	Slightly poorly drained
Isshardi	Medium high-high	Clay	6.5	2.1	Poorly drained
Bazoa	Medium high-high	Clay loam	5.4-7.3	2.41	Poorly drained
Barisal	Medium high	Clay	4.9-7.6	2.35	Poorly drained

Source: Anonymous^[12]

Table 2: Cumulative germination percentage of *Leucaena leucocephala*

Days	Polybag			Plastic tray			Seedbed		
	m ₁	m ₂	m ₃	m ₁	m ₂	m ₃	m ₁	m ₂	m ₃
1	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0
5	2	1	1	0	0	0	0	0	0
10	30	27	35	29	22	24	16	13	12
15	49	40	44	39	38	35	29	20	24
20	55	52	50	49	44	42	32	32	28
25	57	56	52	50	48	51	43	33	34
30	60	57	54	55	50	54	46	38	38
35	64	59	55	58	51	55	46	40	39
40	64	61	59	61	53	57	48	42	43
45	66	62	60	62	54	58	49	44	43
50	66	62	60	62	55	58	49	44	43
60	66	62	60	62	55	58	49	44	43

m₁, m₂ and m₃ shows the cumulative germination (4 replications). Where, m₁= Peat+cowdung; m₂= Soil+cowdung and m₃= Soil+peat

RESULTS AND DISCUSSION

Morphological characteristics

Fruits: The color of the fruits of *Leucaena leucocephala* was chocolate. The fruits (pods) of the species were flat dehiscent legumes that support the findings of Matin and Rashid^[13]. Different sizes of fruit (pods) were observed. Average length, breadth and thickness were found 19.71±0.84, 2.11±0.03 and 0.16±0.08 cm, respectively. 20.08±0.61 seeds fruit⁻¹ were found. Average weight of each fruit was found as 2.01±0.05 g. Similar results were observed by Rezia^[7], Matin and Rashid^[13]. The result related to fruit length and width does not support the literature of Parrotta^[14] but result related to seeds kg⁻¹ supports the same literature.

Seeds: The color of seeds of *Leucaena leucocephala* was reddish brown. There are different sizes of seeds. Average dry weight of each seed was found 0.059±0.002 gm (17000 seeds kg⁻¹). The average length, breadth, thickness were 0.83±0.03, 0.55±0.14 and 0.169±0.04 cm, respectively. The results were also similar to Dijkman^[15], von Carlowitz^[16], Matin and Rashid^[13].

Seed germination: Germination initiated after 5 days in polybag, seven days in seed bed and 6 days in plastic trays under different media and container upto 45, 47 and 41 days, respectively (Table 2). Banik^[17] observed similar result. The starting and cease period of germination was not similar to Matin and Rashid^[13]. The cause of the differences may be due to the seasonal variations as well as rooting media. According to Banik^[14] the sowing period of *L. leucocephala* was March to April. For all types of containers, highest germination was observed in m₁ media. For poly bag, plastic tray and seedbed, the rates were found 66, 62 and 49%, respectively and the lowest germination was observed in m₃ media. For polybag and seedbed, the rates were 60 and 43% respectively. Similarly in plastic tray the lowest germination was found in m₂

media (55%). The differences of germination in various media might be due to the causes of availability of water in soils, presence of soil bacteria and fungi that has a role for digestion of seed coat. Agboola *et al.*^[18] observed similar results of *Tectona grandis*. According to Teles *et al.*^[19] the germination percentage in *L. leucocephala* were found 32.7% in control and >90% in treatments. From another study untreated seeds of *L. leucocephala* showed 6-51% germination success^[20]. According to Ruiz and Febles^[21] seeds of *L. leucocephala* sowing in October showed the poorest development. The present results did not support Matin and Rashid^[13] for the germination in different rooting conditions. The probable cause of these differences may be due to seasonal variation as well as the different types of media.

According to Agboola *et al.*^[18] soil type had no significant effect on germination of *Leucaena leucocephala*. So LSD test was carried out for containers. Polybag showed highest germination percentage, but had no significant difference from plastic tray as well as Seedbed had lowest germination percentage and significantly different from polybag and plastic tray. The highest germination in poly bag might be due to the presence of higher moisture in soil. Because the germination started in dry season and there could be water deficiency. Though similar quantity of water was given in all the containers, the soil of plastic tray and seedbed's dried more quickly for large open surface area. From the situation, poly bag retain more moisture than others.

For better management of a species in specific site scientific information based on the field experiment is very much essential for the practitioners. For better germination rate polybag is the best option where as seed tray is better than seed bed (direct seeding). For best media teat with cowdung mixture is found best. The results suggest that seasonal variations, in respect of environmental factors showed good relation with the growth and development of the species in all conditions.

So for practical use, the following recommendations can be made:

- For better germination percentage and higher growth performance of seedlings, media prepared with peat and cowdung at 3: 1 ratio can be used for large-scale plantation.
- Polybag could be recommended as a rooting container for higher percentage of seed germination for raising large-scale plantations.

Due to some practical constraints, full investigation into the effect of different factors on germination could not be done. So, the result of this study should be taken with caution. Further long-term study including different parameters is recommended.

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