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VEGETATIVE ASSESSMENT OF SOME SELECTED ACCESSIONS OF *Albizia lebbeck* SEEDLINGS

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ABSTRACT

*Albizia lebbeck*is a multipurpose, fast-growing tree species widely grown in the tropical region, belonging to the family of Leguminosae with several economic opportunities, from timber production and livestock fodder to agroforestry and traditional medicine. This study investigated the vegetative(shoot and root traits) of *Albizia lebbeck* accessions seedling originating from diverse locations within the Zaria region. The experiment consisted of 20 accessions arranged in Randomized Complete Block Design replicated three times. Each replication contained 20 pots, with five seeds per pot. The soil used comprised a mixture of field and sandy soil supplemented with N.P.K (20:10:10) fertilizer at 20g per pot to enhance the nutrients level of the soil for growth and development. Data was collected on shoot height, number of branches, primary root length, number of lateral root branches, shoot dry weight, root dry weight, and total biomass weight.A wide range of traits values were observed within all measured parameters. Positive correlations were found between several traits, such as shoot height and biomass, root and shoot traits, and lateral root branches with other traits. The results highlighted only significance difference of genetic diversity in plant height among *Albizia lebbeck* accessions, indicating varying adaptation.Although other traits did not show significant variation, the substantial variation within these traits suggests the presence of natural diversity within the population. This diversity can be harnessed for various applications, such as in forestry and horticulture. Further research is required to assess genetic diversity using a larger number of accessions from diverse provenances.

KEYWORDS: Accessions; Assessment; Seedling; Some selected; Vegetative.

INTRODUCTION

Albizialebbeck is a multipurpose, fast-growing tree species which is native to Asia and widely cultivated and naturalized in other tropical and subtropical regions. The English names for *Albizialebbeck* include *lebbeck*, lebbek tree, flea tree, frywood, koko and woman's tongue tree (Ali, 2012). It was introduced to Sudan and used as an ornamental or shade tree across the country landscape, including roads, parks, and dwellings (Lavania and Tiwari,2019).

It widely spread worldwide, and the tree has large leaves and fragrant clusters of green-yellow flowers and long seed pods. The tree can grow to 18–30 m in height with a trunk diameter of 50 cm to 100 cm at maturity. The leaves are 7 to 15 cm long with one to four pairs of pinnae, and each pinna has 6 to 8 leaflets. The flowers are white with numerous stamens and very fragrant. The fruit pods are 15 to 30 cm long and 2.5 to 5.0 cm broad, containing six to twelve seeds (Krishnakumar *et al*. 2015).The leaves are bi-pinnate with 3 - 11 pairs of bright green, oblong to elliptic-oblong leaflets, asymmetrical 1.5 - 6.5 cm long x 0.5 - 3.5 cm broad entire, glabrous folding at night, the bright colour of leaflets changes into duller glaucous green on maturity, when young, leaflets are nyctinasty, but fixed in older leaves (Krishnakumar *et al*., 2015).

The tree has a variety of uses emanating from its various parts. The flowers, bark, fruits, roots, and stems are all used for medicine. A paste of leaves is used to treat skin problems. It is also known for treating respiratory problems, including allergies. Furthermore, other parts of the plants are used to treat eye problems, purify blood, and promote health in teeth. Most importantly, ethanol extract from its pods is effective against some forms of cancer (Verma *et al*., 2013).+It is also used for environmental management, forage, and as wood. It is also cultivated as a shade and ornamental tree in Northern Nigeria. It is an excellent fuelwood and charcoal species, and the wood is suitable for construction, furniture, and veneer. The tree is used to produce timber and its wood has a density of 0.55 - 0.66 g/cm3 or higher (John and Parrotta, 2019).

Even where it is not native, some indigenous herbivores are liable to utilize it as a food resource. For example, the goats and sheep have been observed to be feeding on its seedpods during the seeds collection within the study area of (Chitra and Balasubramanin, 2016).The leaves are nutritious as they contain proteins, calcium, phosphorus, and amino acids. It is one of the most promising fodder trees which has leaves during a large part of the rainy season, and digestibility of the twigs is considerably higher than that of most fodder trees. The concentration of crude protein is about 20% for green leaves, 13% for leaf litter, and 10% for twigs.

Pods and seeds are rich sources of dry matter, nitrogen-free extract (available carbohydrate) and mineral elements. It was also observed that its seeds could be an important protein supplement while pods as an important source of micronutrients. The tree could be used as a component for feed formulation (Hassan *et al*. 2007). In vitro digestibility is about 45% for mature leaves, 70% for young leaves and 40% for twigs. Leaves, flowers, and pods fall to the ground

gradually during the dry season and can be browsed on the ground. The shallow root system makes it a good soil binder and is recommendable for soil conservation and erosion control (Satoh and Parolin, 2013).

Seedlings develop a long, stout taproot at an early age, up to 70 cm after 4 months. They are drought-tolerant and require only minimal weeding during the first months after planting. Adult trees generally develop wide-spreading lateral root systems and a deep taproot, particularly in well-drained soils or in semi-arid conditions. In studies on conducted young trees up to 17 cm stem diameter, the proportion of tree biomass contained in roots was found to be inversely proportional to both tree size and soil moisture holding capacity and ranged from 40 to 70% of total tree biomass (John and Parrotta, 2019).

Despite its importance, the species is becoming scarce worldwide due to its deep seed dormancy, constraints at the seedling shoot stage and root traits. The tree species has been given priority as one of the species for conservation to enhance its contribution to the health and livelihood of communities.(Lavania and Tiwari,2019).There is also need to plant more of this tree crop for restoration of degraded land, raw materials to the industries, provide feeds for animals, and medicine. Having appreciated how it is being used, it is important to document the diversity in shoot and root trait of accessions growing around Zaria district to utilize it maximally. The aim of this study is to assess the vegetative traits of Albizia lebbeck from diverse around Zaria and estimate the level of associations between its accessions.

MATERIALS AND METHOD

The experiment was conducted at the screen house of the Institute for Agricultural Research (I.A.R.) Ahmadu Bello University, Samaru Zaria (Latitude:11.16, N 11°9'52.13268 and Longitude of 7.632, E 7°37'57.38448 with an altitude of 683m above mean sea level) in the northern Guinea savanna ecological zone of Nigeria. Zaria has a tropical wet and dry or savanna climate. The mean annual temperature is 27.7ºC, receives about 89.92 mm of rainfall and has 128.23 rainy days (35.13% of the time) annually (Abaje and Oladipo, 2019).

Twenty accessions were collected from twenty different locations around Zaria local government area of Kaduna state, Nigeria. The experiment was laid in a Randomized Complete Block Design (RCBD) consisting of 20 accessions (treatments) in three replications. Each replication contained 20 pots, making a total of 60 pots for all three replications. Five similar seeds were sown per pot based on their location, and a total of 300 seeds were sown directly without any pre-treatment in 50 by 42 cm (diameter and height) pots. Each pot comprised of field and sandy soil at an equal proportion of field soil: sandy soil (1:1). Both types of soil were mixed with the 60 grams of N.P.K (20:10:10) fertilizer. The seeds were sown at 3–4 cm depth and covered with a thin layer of soil and pots were labelled appropriately. The pots were perforated to create pore spaces for easy water draining. Watering was performed every day in the morning to keep the soil surface moist. Any emerged weeds were removed by hand from the pots during the experiments. The plants were harvested manually by carefully uprooting the plants from the ground. At the end of the experiment, seedlings were uprooted and separated into roots and shoots. The primary root length, number of lateral root branches, roots dry weight, shoot dry weight, presence of nodules, total plant dry weight per pot and number of plants harvested from each pot were measured. Plant parts were then placed into respective envelopes for five days to dry, and both shoots and roots were dried for 120 hours under ambient condition in the screenhouse. Then, the roots and shoots were weighted on a weighing balance. Data collected were analyzed using variance analysis, mean separation and correlation analyses performed in R software.

RESULTS

The analysis of variance (ANOVA) for seedling root and shoot traits of *Albizialebbeck*, evaluated in the screenhouse, revealed significant differences ($P \leq 0.01$) among the genotypes for only plant height out of all the traits measured.

Table 1: Mean squares of ANOVA for Seedling Shoot and Root Traits of Accessions of *Albizialebbeck* Evaluated in the Screenhouse in 2022

SOV	DF	NOB	PHT	PRL	NLRB	RDW	SDW	TBW
Rep	2	31.85	1620.48	22.87	2010.12	123.92	622.79	1130.57
Gen	19	13.19	439.76**	7.85	144.22	4O.64	287.61	438.60
Error	38	9.34	175.99	5.63	111.62	40.50	240.55	365.24

DF = degree of freedom; GEN = genotype; REP = replication, SOV = source of variation; NOB = number of branches; PHT = plant height; PRL = primary root length, NLRB = number lateral root branches; RDW = root dry weight; SDW = shoot dry weight; TBW = total biomass weight.

The mean performance of *Albizialebbeck* accessions for shoot and root traits evaluated in the screenhouse in 2022 revealed wide ranges between the genotypes in relation to the traits measured (Table 2). The plant height ranged from 30 to 82 cm for IAR-Albizia-009 and IAR-Albizia-017, with an average height of 61 cm. The number of branches ranges from 12 to 19 for IAR-Albizia-009 and IAR-Albizia-012; the average branch number was 15.75. similarly, the primary root length (PRL) ranges from 19.00 to 25.5 cm for IAR-Albizia-008 and IAR-Albizia-014, and the average PRL of 21.19 cm. The number of lateral root branches ranges from 36.50 to 66.67 for IAR-Albizia-015 and IAR-Albizia-004, with of averaging 45.24. The shoot dry weight ranges from 16.17 to 60.30 g for IAR-Albizia-009 and IAR-Albizia-004, with an average SDW of 32.81 g. The root dry weight ranges from 6.02 to 22.02 g for IAR-Albizia-008 and IAR-Albizia-001, with an average of 12.04 g. The total biomass weight ranged from 22.50 to 74.68 for IAR-Albizia-009 and IAR-Albizia-004, averaging 44.51 g.

Table 2: Mean Performance of *Albizialebbeck A*ccessions Evaluated for Variation in Seedling Shoot and Root Traits in the Screenhouse in 2022

Genotype	NOB	PHT	PRL	NLRB	SDW	RDW	TBW
IAR-Albizia-001	17. 33	62.33	23.00	51.33	52.17	22.02	67.52
IAR-Albizia-002	13.67	53.00	20.50	45.00	25.80	8.33	34.13
IAR-Albizia-003	16.00	68.00	20.17	38.00	32.57	11.98	44.55
IAR-Albizia-004	18.00	75.55	22.00	66.67	60.30	14.38	74.68
IAR-Albizia-005	14.00	70.58	19.50	47.50	30.37	12.45	42.82
IAR-Albizia-006	14.33	56.50	21.83	53.83	29.07	11.27	40.33
IAR-Albizia-007	19.33	56.00	20.17	46.00	33.53	14.48	48.02
IAR-Albizia-008	14.67	49.67	19.00	39.00	21.23	6.02	27.25
IAR-Albizia-009	12.00	29.83	21.50	42.67	16.17	6.33	22.50
IAR-Albizia-010	16.00	56.17	22.67	46.50	29.93	11.43	41.37
IAR-Albizia-011	13.67	47.00	20.67	39.33	26.47	13.43	39.90
IAR-Albizia-012	19.00	67.33	20.83	50.67	32.47	11.95	44.42
IAR-Albizia-013	15.67	65.33	22.33	45.52	37.00	11.57	48.57
IAR-Albizia-014	17.67	76.20	25.50	48.50	42.80	17.87	60.67
IAR-Albiziza-015	13.67	54.17	19.00	36.50	29.97	9.35	39.32
IAR-Albizia-016	15.67	65.83	20.17	43.00	35.50	14.30	49.80
IAR-Albizia-017	16.33	82.17	20.00	43.33	30.43	9.05	39.48
IAR-Albizia-018	18.33	72.17	23.00	43.00	31.17	10.35	41.52
IAR-Albizia-019	13.00	54.05	20.00	40.00	29.45	13.20	42.65
IAR-Albizia-020	16.67	68.33	22.00	38.50	29.73	11.02	40.75
Minimum	12.00	29.83	19.00	36.50	16.17	6.02	22.50
Maximum	19.00	82.16	25.50	66.67	60.30	22.02	74.68
Mean	15.75	61.46	21.19	45.24	32.81	12.04	44.51
CV	19.4	21.6	11.2	23.3	47.2	52.9	42.9

NOB = number of branches; PHT = plant height; PRL = primary root length, NLRB = number lateral root branches; RDW = root dry weight; SDW = shoot dry weight; TBW = total biomass weight.

The number of branches (NOB) exhibited a significant ($p < 0.05$) positive correlation with various traits: total biomass weight ($r = 0.63$), shoot dry weight (SDW, $r = 0.62$), root dry weight (RDW, $r = 0.58$), number of lateral root branches (NLRB, $r = 0.48$), primary root length (PRL, $r = 0.29$), and plant height (PH, $r = 0.60$). Plant height (PH) in seedlings demonstrated a significant ($p < 0.05$) positive correlation with biomass weight ($r = 0.60$), SDW ($r = 0.58$), RDW ($r = 0.46$), and NLRB ($r = 0.28$) (Figure 4.1).

Additionally, a significant positive correlation was observed between PRL and several traits, including biomass weight ($r = 0.31$), SDW ($r = 0.29$), RDW ($r = 0.36$), and NLRB ($r = 0.46$). The number of lateral root branches displayed a significant ($p < 0.05$) correlation with biomass weight ($r = 0.61$), SDW ($r = 0.58$), and RDW ($r = 0.56$). Root dry weight showed a significant ($p < 0.05$) positive correlation with both biomass weight ($r = 0.82$) and SDW ($r = 0.72$), while SDW exhibited a highly significant ($p < 0.05$) positive correlation with biomass weight ($r = 0.98$) (Figure 4.1).

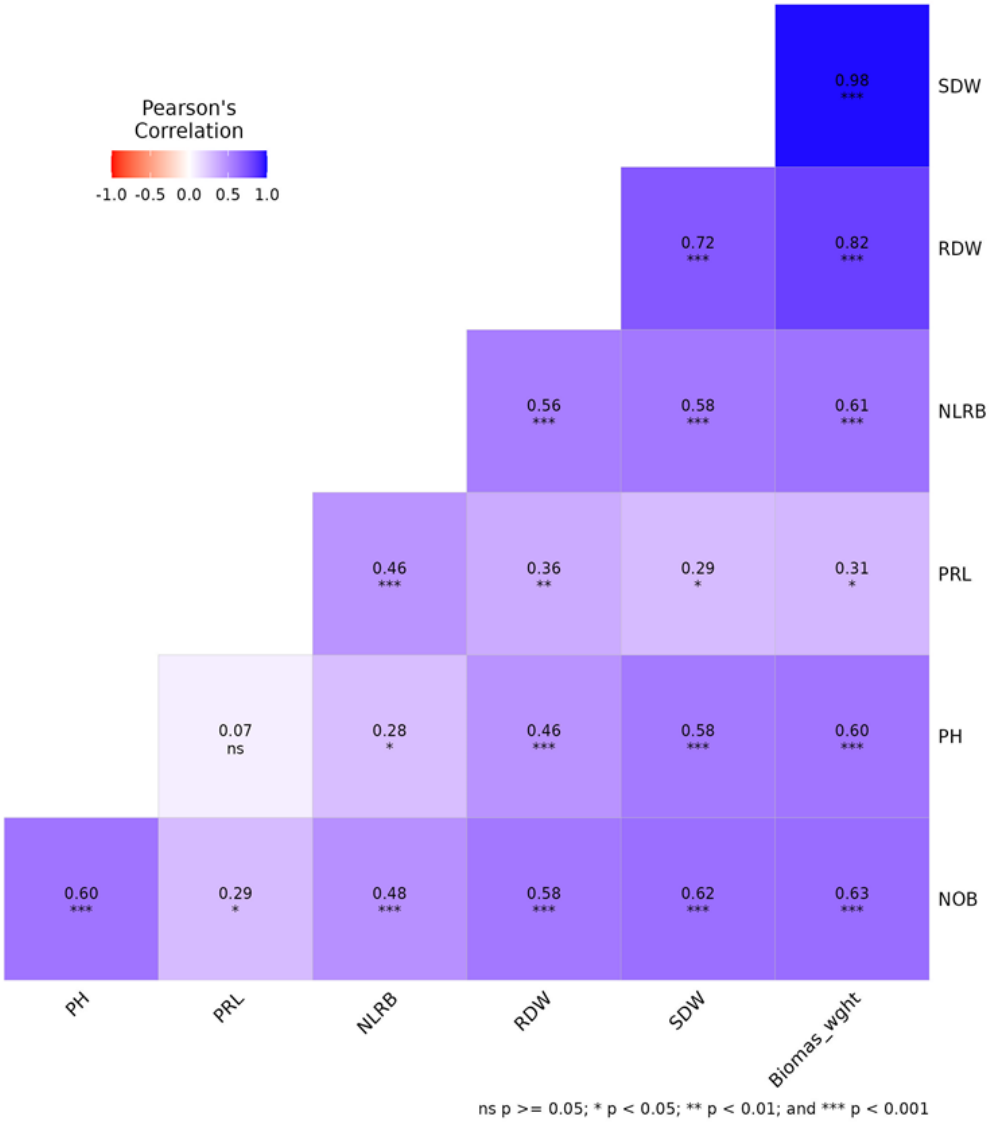

Figure 1: Correlation among Seedling Shoot and Root Traits of *Albizialebbeck* Accessions collected around Zaria

DISCUSSION

The significant difference in PH among the different genotypes of *Albizialebbeck*. indicate that, some genotypes grew taller than others. The lack of significant differences among the accessions in other traits could be attributed to their geographic proximity, as most of them were gathered from the Zaria region. This suggests that, these accessions may share genetic similarities for most traits except plant height. The observed differences in trait values may be the result of random variation as suggested by (Fageria and Moreira, 2011).

Although the significant variation was only in PH, the study also revealed wide ranges in all the measured traits among the different genotypes. This suggeststhat there is still considerable natural variation within the population that could be exploited in future research works. The wide variations observed in other traits, such as NOB, PRL, NLRB, SDW, RDW, and TBW suggest that there is a diverse array of phenotypes within the *Albizialebbeck* accessions under study. This finding can be valuable for researchers and breeders interested in selecting and developing *Albizia lebbeck* varieties with specific traits for various purposes, such as forestry(Kwakye and Stanley, 2022).

The positive correlation (r = 0.63) between the NOB and TBW indicates that its biomass weight tends to increase as a plant produces more branches. This suggests that branch development plays a significant role in determining the

overall growth and weight of the plant (Ogunniyi et al.,2016).

The PH exhibits positive correlations with several other parameters, including TBW, SDW, RDW, and NLRB. This implies that taller plants generally exhibit greater biomass and more extensive development of roots and shoots, aligning with common observations in plant growth studies. While the correlation of PRL with other parameters is somewhat weaker, it still demonstrates positive associations. This suggests that longer primary roots may be linked to higher biomass, SDW, RDW, and LRBB development (Mohammed *et al.*, 2019).

The positive association between the NLRB and TBW, SDW, and RDW implies that plants with more lateral root branches tend to have higher overall weight and increased development of both shoots and roots. Furthermore, the strong positive correlation (r = 0.72) between RDW and SDW indicates a close relationship between root and shoot growth. An increase in RDW corresponds to an increase in SDW. The highly significant correlation (r = 0.98) between SDW and TBW weight suggests that SDW can be an excellent predictor of overall biomass. This means that by measuring SDW alone, researchers can obtain a reliable estimate of total plant biomass. This is especially important where fodder production is an important priority in cultivating this tree plant.

These positive correlations provide valuable insights into plant growth and development
(Suleiman *et al.*, 2018).

Researchers and scientists can draw several implications from this finding. Given the strong correlation between the number of branches and biomass weight, manipulating branching patterns could be a strategy to increase biomass production in specific applications. Plant height appears to be a useful indicator of overall plant development. Taller plants tend to have larger biomass, more extensive root systems, and greater lateral root branch development. Understanding the positive correlation between root dry and shoot dry weights highlights the interconnectedness of root and shoot growth, which can aid in optimizing plant growth in forestry and horticulture and the highly significant correlation between SDW and TBW simplifies data collection. Researchers may be able to accurately predict total biomass by measuring SDW, potentially saving time and resources in biomass estimation (Aliyu, 2017).

CONCLUSION AND RECOMMENDATIONS

In conclusion this study highlights the importance of assessing plant traits in diverse source populations and the information would be valuable for guiding strategies related to the cultivation, conservation, and utilization of *A. lebbeck* in the Zaria region and beyond.It is recommended that further investigations be conducted to explore the underlying factors contributing to the observed uniformity in shoot and root traits among *Albizia. lebbeck* seedlings. Molecular studies, such as genetic analysis, could shed light on the genetic relatedness and potential gene flow among different populations.

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