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INFLUENCED OF SEED WEIGHT ON EARLY GROWTH OF *Acacia senegal* (Linn) Willd (Gum Arabic) SEEDLINGS

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ABSTRACT

Seed weight has enormous influence on the germination rate and growth performance of many species which necessary is for productivity and sustainability. Study was carried out to examine the effects of seed weight on germination and early growth of *Acacia senegal* (Linn) Willd (Gum Arabic) seedlings. The work was conducted in the Forestry nursery of Department of Forestry and Wildlife, Federal University Dutse, Jigawa state. Complete Randomized Design (CRD) was employed with three (3) treatments of twenty replications (20) making sixty samplings. The seed weights used were classified into three groups: Heavy seeds (1g and above), Medium seeds (0.5-0.9 g) and Light seeds (0.1- 0.4g). Germination counts and early growth parameters were assessed. Data were subjected to Analysis of Variance (ANOVA) at 0.05 probability level and descriptive statistics such as bar chart was used. It is interesting to note that the study found that heavy seeds (1g) had an earlier germination rate and better early growth performance compared to intermediate-weight (0.5 - 0.9g) and light-weight (0.4 - 0.1g) seeds. The heavy seeds showed the best overall performance, according to the results. Heavy seeds showed the best performance. Therefore, heavy weight seeds were recommended for planting, plantation establishment and nursery studies.

Keywords: *Acacia senegal*, Early Growth, influenced, Seedlings and Seed weight

INTRODUCTION

Acacia senegal commonly called Gum Arabic belongs to the family Fabaceae (Jibo *et al.*, 2018a). It nurtures comfortably on two different kinds of soils which are sandy and loamy – clay soil, it endures pH of 5 – 8 (Ampitan *et al.*, 2022; Ilu *et al.*, 2020; Jibo *et al.*, 2018a). Gum Arabic actively produced good vigour in a drained soil with rainfall which ranges between 200 to 800mm annually. This plant attracts frost and adapt to heat (Jibo *et al* 2018b; El-fadi 1997). *A. senegal* produces quality gum used in textile, drug production, production different colour for making ink, cosmetic and food. Litterfall decomposed to attain fertility of sandy soil and erosion control (International Center for Research in Agroforestry, 1992). Mainly, flora and bark part of the plant applied to treat Gastritis disorders, Haemorrhage, Ophthalmic, Colds and Diarrhoea while the flowers are savoured by honeybees (Bello and Ambursa, 2006). It controls sand dunes, fixes atmospheric nitrogen, source of fuelwood and fodder production (Abdullahi, 2012).

Acacia senegal adapts to the drought in its locations, play important role in ecological balancing, reducing desertification with high value for gum arabic in the semi-arid area (Fagg and Steward, 1993). Gum Arabic is a bye product that derivative from *Acacia senegal* and *Acacia seyal* from sub-Saharan desert. *T*he product called Gum Arabic was recognised and traded by the first merchant of the exudate which were the Arabs. Gum Arabic trading has been existence for centuries due the offers a source of income for numerous poor smallholders or traveling labourers (Unanaonwi, 2009). Minimum output emanated from the species for its economic value and ecological importance in the Savanah zones of Nigeria may be ascribed to insufficient information regarding its morphological and silvicultural requirements (Jibo and Barker, 2020). Therefore, in order to produce high quantity of these product and use quality seeds for growth of the species. There is need to evaluate, understand and describe the characteristics of the species in terms of physical and silvicultural importance (Isah *et al.*, 2013).

Cultivation and stands of Gum Arabic trees at high level are commonly found in Yobe and Borno state (Fakuta *et al.*, 2013). Food reserve in the seeds influences the initial growth, rate of survival, seedlings growth and also maximize seed weight (Agboola, 1995).

Seed weight is commonly assumed to be biologically significant in the life forms of plants trait, because it impacts both dispersal ability and seedlings formation (Anjusha *et al.*, 2015).

A number of Acacia species' seeds have poor germination rates or delayed germination because of thick, tough, or wax-coated seed coverings that prevent the growing embryo from absorbing oxygen and water (Demel, 1996; Kyari *et al.*, 2017).

Nursery technologist gives slight or no consideration to the sizes and weights of the seeds before sowing which possibly influence the germination rate and yield of production. Therefore, the present study investigated the effect of seed weight as its influenced germination and early growth of seedlings in a semi-arid environment in view of enhancing performance and recommending best seed weight in terms of germination and seedlings vigour.

The specific objectives of the study are to:

i. determine the effect of seed weight on germination
ii. determine the effect of seed weight on the early growth of the species

MATERIALS AND METHODS

Description of the study area

The study was carried out in the nursery site of the Department of Forestry and Wildlife Management, Federal University Dutse, Dutse Jigawa State. Dutse is a city located in Northern Nigeria. It is the capital city of Jigawa State. It is the home to Federal University Dutse, Dutse established in 2011. Dutse is located on latitude 11º42 '04"N, 9º20'31"E and longitude 11º.70 '11ºN, 9.3º41'94" E. There is little rainfall throughout the year, precipitation of 743mm falls annually. The average temperature is 26.5ºC (Salami *et al.*, 2020). Soil is well known to be fertile ranging from sandy – loamy, pH ranges from 6.07-6.72, nitrogen content ranges from 0.63 to 1.64gkg^{-1}, phosphorus 6.25 to 12.04mg/kg and potassium ranges from 0.18 to 0.63 cmolkg^{-1} respectively. Sunshine hours showed that the town enjoys 10-11 hours of sunshine depending on the season (Jibo *et al*, 2023; Salami *et al.*, 2021 Salami *et al.*, 2019).

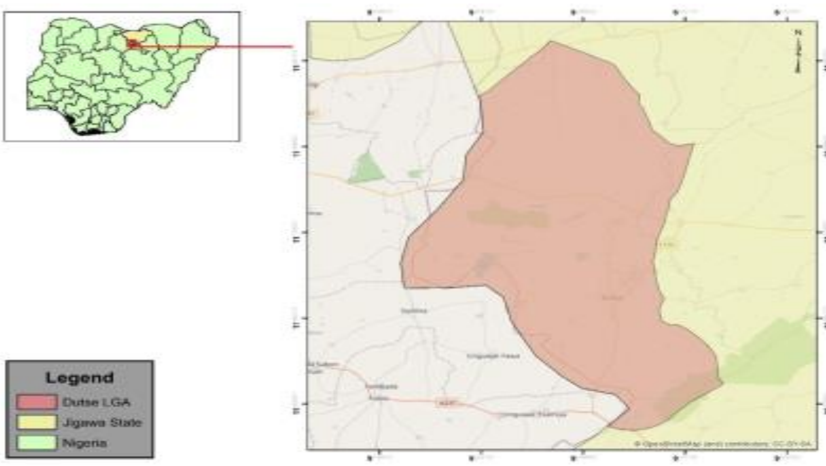

Fig. 1. Map of the study area

Figure 1: Showing the map of Dutse
Adapted from: (Salami *et al*., 2022).

Seeds collection

A. Senegal seeds were collected from Federal University Dutse, Department of Forestry and Wildlife Management Seed bank. The seeds were weight by electronic weighing balance into three (3) different classes. First class large seeds were range from (1g and above), second class seeds were ranged from (0.5-0.9 g) and third class were seeds ranged from (0.1-0.4g). Measurements were carried out in the Laboratory of the department

Sowing

Seed dormancy was treated at the room temperature of 27 °C for twenty-four hours in the cold water to suppress seed dormancy (Jibo *et al.*, 2018a). Seeds sown in poly bags of 9cm by 5cm in sizes filled with top soil (2 portions), river sand (2 portions) and poultry manure (1 portion) (2:2:1). It was kept moist throughout the experimental period (12 weeks). The germination counts were calculated on a weekly basis as maximum mean daily germination (total percentage of full seed germination divided by the number of weeks elapsing since sowing date).

Seedlings growth assessment

The radicle of 2 mm was taken for a seed that germinated. Study was carried out for twelve weeks for early growth assessment. The morphological characteristics measured were stem diameter; shoot height, root lengths, root dry weight and shoot dry weight. The stem diameter and shoot height were measured every two weeks for 12 weeks starting from one month after sowing. Stem diameter was determined using veneer calliper and shoot height was measured using meter rule.

Experimental design and layout

Complete Randomised Design was applied for the study. There was wide variation in seed weight, which permitted the categorization of seeds into 3 distinct weight classes, 3 distinct weight classes, heavy seeds (1g and above); medium (0.5-0.9 g) and light seeds (0.1-0.4g). Three treatments and twenty replications were used for the experiment.

Table 1: Sampling layout

Seed Weight	Heavy seeds (1g and above)	Medium seeds (0.5-0.9 g)	Light seeds (0.1-0.4g).
Replication	20	20	20

Data analysis

One-way ANOVA were used to compare between the weight class and all the growth parameters to be assessed. All analyses were performed using the statistical software MINITAB® Release 16.12.0). Descriptive statistics such as bar chart was also applied for the study**.**

RESULTS AND DISCUSSION

Results

Seed Germination

The effects of seed weight on seed germination (Figure 1) shows that overall germination of seeds was 28 of heavy-weight seeds (1g), 18 of intermediate-weight seeds (0.5-0.9g) and 10 of light-weight seeds (0.4-0.1g) germinated. Germination began on the 2nd day for all seeds and ended on 9th day for light-weight seeds and on the 11th day for the heavy-weight seeds and intermediate-weight seeds.

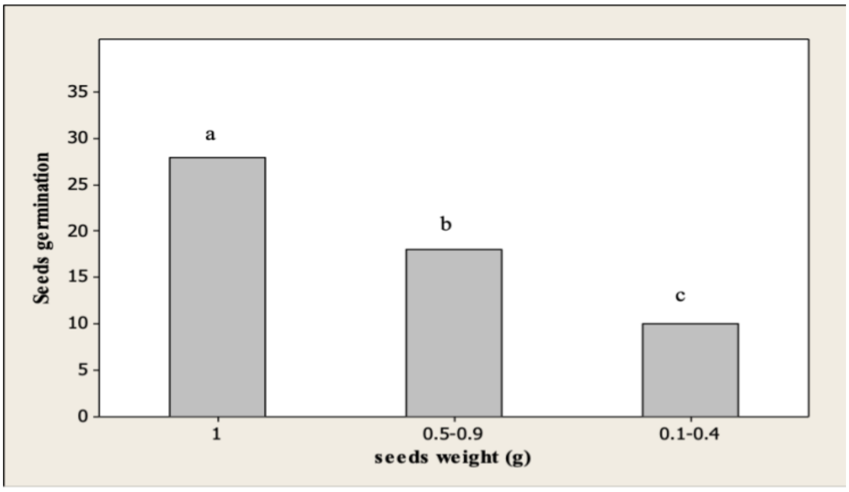

Figure 1: Showing the seed germination count of the species

Mean (±SE) seed germination on the effect of seed weight of *A Senegal*, means with different letters are significantly different within treatments after a Tukey test (P< 0.05).

Shoot height (cm).

The mean shoot height of all seedling in each treatments were presented in Figure 2, The Mean shoot lengths of *A. senegal* for the treatment, shows a significant difference ($F_{2, 27}$= 66.50, P<0.001). The mean shoot length of heavy-weight seeds (1g) were 11.8 cm, and 5.7 and 4.7 for the intermediate-weight seeds (0.5-0.9g) and 10 of light-weight seeds (0.4-0.1g).

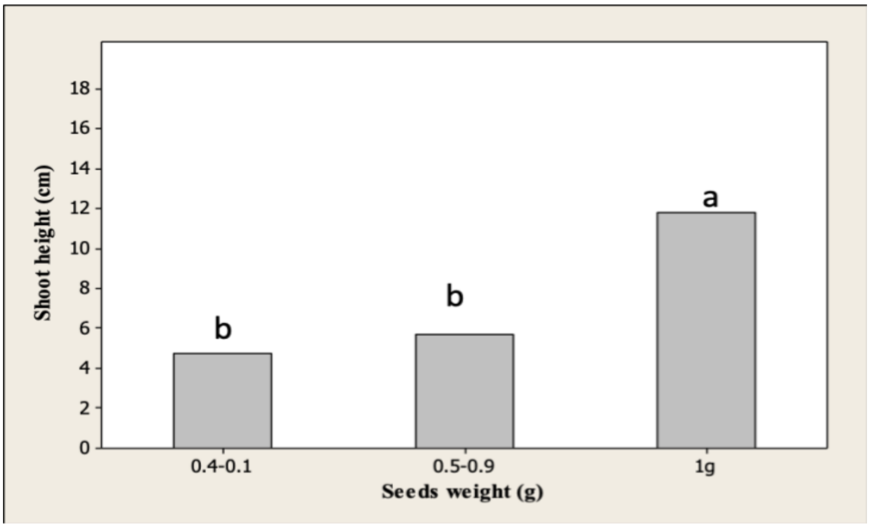

Figure 2: Showing the shoot height (cm) of the species

Mean (±SE) shoot height on the effect of seed weight of *A Senegal*, means with different letters are significantly different within treatments after a Tukey test (P< 0.05).

Stem diameter

The mean stem diameter in each treatment are presented in (Figure 3) was 3.1 of heavy-weight seeds (1g), 1.8 of intermediate-weight seeds (0.5-0.9g) and 1.0 of light-weight seeds (0.4-0.1g). The mean shoot diameter of *A. senegal* for the treatments, shows a significant difference ($F_{2, 27}$= 37.99, P <0.001).

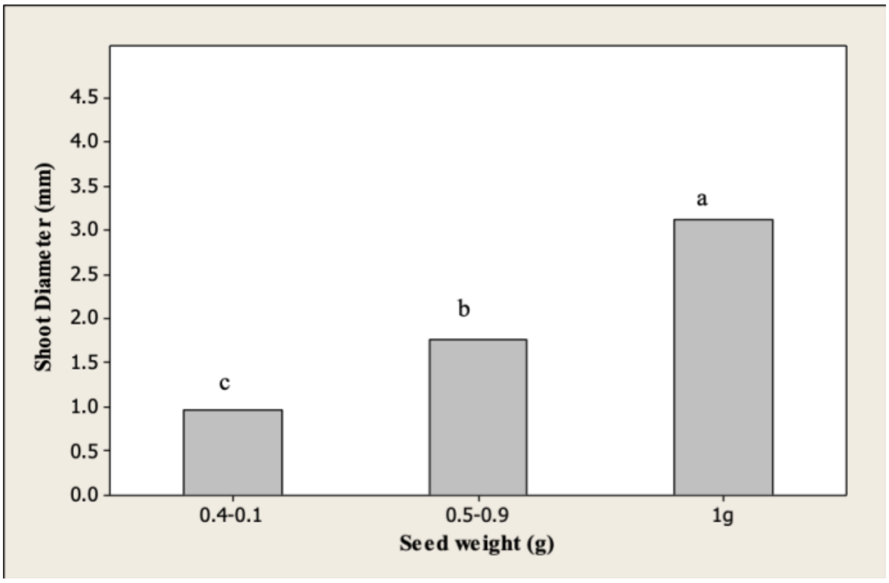

Figure 3 Showing the stem diameter (cm) of the species

Mean (±SE) shoot diameter on the effect of seed weight of *A Senegal.* Means with different letters are significantly different within treatments after a Tukey test (P< 0.05).

Root Length (cm)

Analysis of variance of the root length (Figure 4.4) showed that mean root lengths were greater 23.1 in (1g) heavy-weight seeds, for 23.1 and 18.1 intermediate-weight seeds (0.5-0.9g) and 1.0 of light-weight seeds (0.4-0.1g) respectively. There were significantly different between treatments ($F_{2, 27}$=7.71, P<0.002).

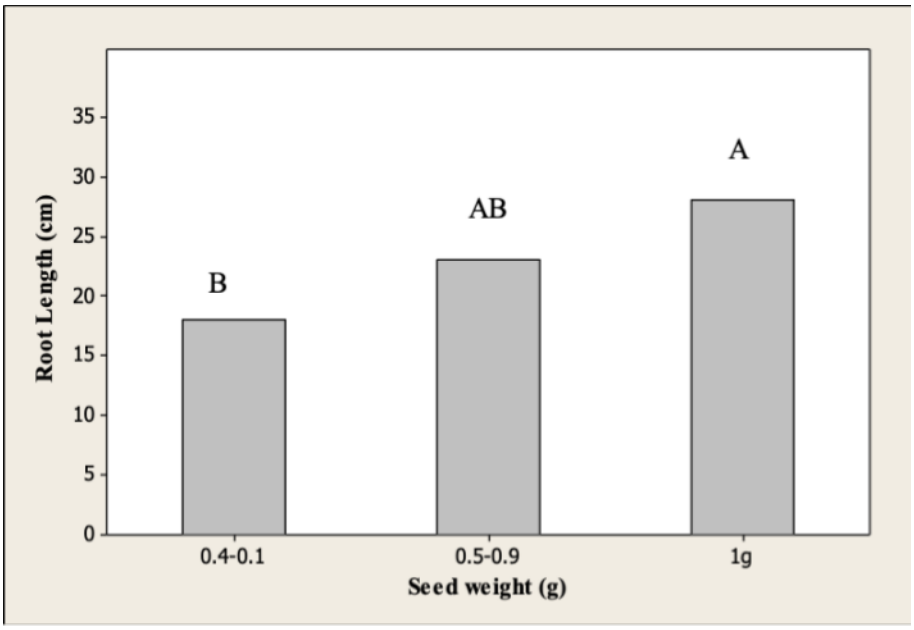

Figure 4: Showing the root length (cm) of the species

Mean (±SE) Root lengths on the effect of seed weight of *A senegal*. Means with different letters are significantly different within treatments after a Tukey test (P< 0.05).

Root dry weight

The mean roots dry weight in each treatment are presented in (Figure 4.5) were 15.0 of heavy-weight seeds (1g), 13.8 of intermediate-weight seeds (0.5-0.9g) and 11.9 of light-weight seeds (0.4-0.1g). The mean roots dry weight of *A. senegal* for the treatments, were not significant difference ($F_{2, 27}$= 1.46, P<0.251).

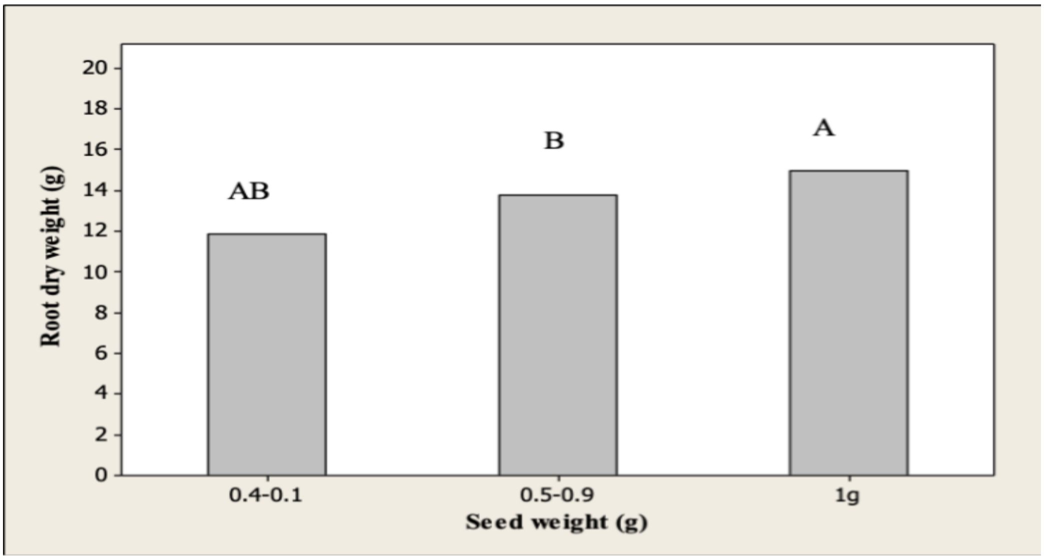

Figure 5: Showing the root dry weight (g) of the species

Mean (±SE) Root dry weight on the effect of seed weight of *A Senegal* Means with different letters are significantly different within treatments after a Tukey test (P< 0.05).

Shoot Dry Weight

Mean shoot dry weight within treatments was significantly different ($F_{2, 27}$ = 7.42, P< 0.003), (Figure 6). Heavy-weight seeds (1g) has a mean of 23.3, the intermediate-weight seeds (0.5-0.9g) has a mean of 14.1 and 1.0 of light-weight seeds (0.4-0.1g) has a mean of 12.8.

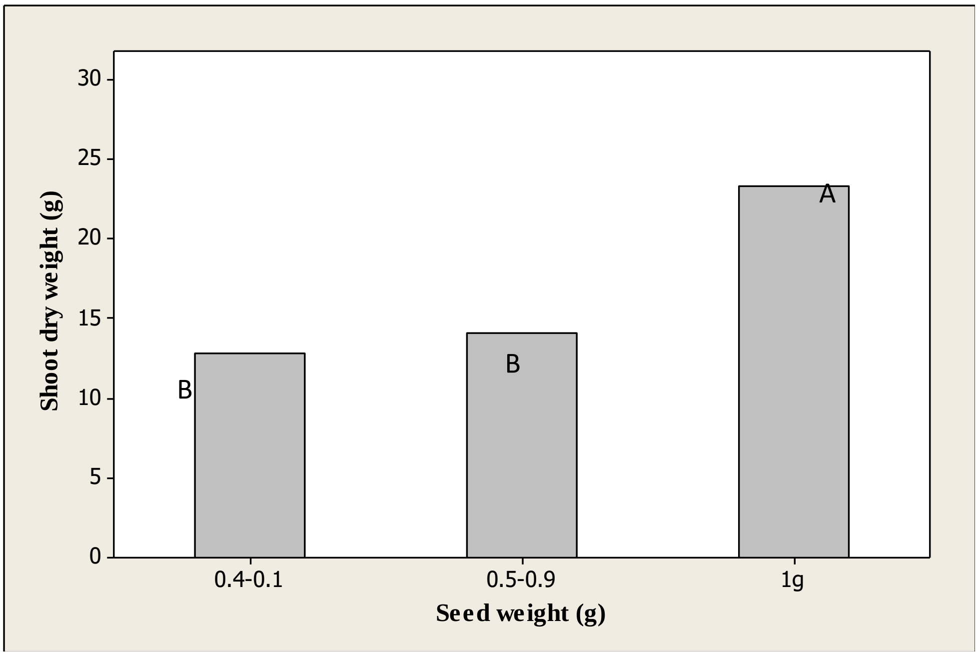

Figure 6: Showing the shoot dry weight (g) of the species

Mean (±SE) shoot dry weight on the effect of seed weight of *A. senegal* Means with different letters are significantly different within treatments after a Tukey test (P< 0.05).

Discussion

Seed weight is a multifaceted trait impacted by numerous genetic and environmental factors such as temperature and humidity during the seed development stage. The result of this study has confirmed that seed weight influenced seed germination. The study showed that heavy seeds germinate quickly and survive better than light seed, this agreed with works of Khan and Shankar (2001). The same results had been reported for many plant species in the same family of *Acacia senegal* and *Prunus jenkinsii* Springer, (1991); Upadhaya *et al.* (2007). Seed weight in *Anacardium occidental* showed a noteworthy effect on seed germination and early growth with large seeds showing greater germination as well as emergence percentages (Zhongqiang *et al.,* 2015). Yisau *et al*. (2023), agreed that large sized of *Anacardium occidentale* seed had significantly gave higher shoot height, leave number, leaf area, stem diameter, total fresh weight, total dry weight, fresh shoot weight and dry shoot weight. Singh *et al.* (2021), also reported that heavy seeds improved growth in shoot height, stem diameter and root length of some forest tree species. Additionally, Owoh *et al.*, (2011) and Mtambalika *et al.,* (2014) observed maximum growth rate in large seeds compared to other seed sizes in *Terminalia ivorensis*, *Gmelina arborea and Afzelia quanzensis* respectively. There was also substantial difference in the average seed weight formed in the progeny that could not be traced to plant size. It seems that seed size plays a crucial role in determining the quality of seedlings, affecting their growth and development. Additionally, it appears that seed size is also a significant factor in the success of plant propagules, as well as their mobility and survival (Harper, 1997). Studies have shown the importance of large seed size to seedling survival and growth. It is interesting to note that Martínez González *et al.* (2021), found that large seeds provide young seedlings with an advantage in coping with environmental stressors. This further highlights the importance of understanding the influence of seed weight on the early growth of plant species, such as *Acacia senegal*. It has been observed that larger sized seeds tend to have better abilities to endure water stress conditions (Venable and Brown, 1988). Bentley *et al.* (1980), found that plants grown from smaller seeds with less resources did not grow as much as those grown from larger seeds. This highlights the important role of seed size and resources in plant growth. That's an interesting finding from Sanderson's study. Seed size would have an impact on germination and growth rate, as reported that many factors can influence the success of seedlings. It would be interesting to see if similar results are found in other species.

CONCLUSION

Seed size plays a significant role in determining the growth, development and early maturity of *Acacia senegal* seedlings. This highlights the importance of using high-quality seeds with a larger size for planting, nursery studies and plantation establishment. the size of the seed has a significant impact on the morphological characteristics of Acacia species. Heavy-size seeds seem to contain more energy which results in better performing seedlings compared to other categories. Seed size is an important factor that affects the germination and early growth performance of plants. It is highly recommended that people involved in nurseries, planting, and gardening should opt for heavy seeds as the whole life cycle of a plant starts with the germination of a seed.

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