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EFFECT OF POTTING MIXTURE AND WATERING ON EARLY GROWTH OF *Acacia seyal* Del. and *Acacia sieberiana* D.C. IN A SEMI-ARID ENVIRONMENT OF NIGERIA

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ABSTRACT

A study was conducted at the Botanical Garden of Usmanu Danfodiyo University, Sokoto to determine the effect of potting mixture and watering regime on early growth of *Acacia seyal* and *A. sieberiana*. Three different potting media [Sand only (SO), Sand + Goat manure (SGM) and Sand + Cowdung (SCD)] and two watering regimes (once and twice daily) were applied as treatments. The growth parameters measured were collar diameter (CD), height (HT) and number of leaves (NL). The experiment was laid out in a randomized complete block design (RCBD) with five treatment replicates. At 12 weeks after germination (WAG), SO was found to induce higher ($P<0.05$) height growth (40.73cm) than SGM (34.9cm) and SCD (29cm), but SGM gave the highest CD (3.84mm) and NL (55) for *A. sieberiana*. SO at 12WAG for *A. seyal* gave higher ($P<0.05$) CD (4.4mm) and HT (37.57cm), but lower NL (65). The 65 and 67 NL induced by SO and SGM respectively were the same, but higher ($P<0.05$) than 32 induced by SCD. Watering twice daily gave mean values of 4.27 and 3.97mm CD, 38.38 and 40.93cm HT and 75 and 67 NL for *A. seyal* and *A. sieberiana* at 12WAG in the same order, and these values were higher ($P<0.05$) than those for watering once daily. Mixture of sand and goat manure and watering twice daily would enhance early growth of the *A. seyel* and *A. sieberiana*.

Keywords: Potting Mixture; Cowdung; Watering regime; Growth

INTRODUCTION

Acacia seyal and *Acacia sieberiana* have many uses for local communities, particularly in cottage industry, feeds for animals, folk medicine, firewood, gum etc. Acacias are grown primarily for gum and medicinal values. They also play a secondary role in agricultural systems. For example, an estimated 17,000 tones of gum-Arabic is produced in Nigeria, annually which is the second largest production in Africa apart from Sudan (Folorunsho *et al.*, 2002). These species are endowed with features that give them potentials for ecosystem stabilization, anti-desertification and for production of high quality gum-Arabic (Awodola and Okoro, 1986).

In recent years, high-trade in gum-Arabic and other uses of the species threatened their natural population (Folorunsho *et al.*, 2002). The natural population, which is

becoming low, has been traced to poor seed germination and seedling survival (Nautiyal *et al.*, 2002). Poor yield of the species in the semi-arid region of Nigeria may be attributed to inadequate silvicultural information regarding the species. Hence, to adequately integrate Acacias with the other semi-arid trees for the control of desertification and for the production of their valuable products, there is urgent need to determine their specific silvicultural characteristics. Most soils in semi-arid zones are marginal and deficient in nitrogen and phosphorus, which are principal elements required for plant growth and development (Shinkafi, 2000).

Water is a significant factor in dry land forest nursery and it is critical to tree growth and development in the tropics (Awodola and Nwoboshi, 1993). Water is required by plants for the manufacture of carbohydrates and as a means for transportation of foods and mineral elements. Various vital processes in plants such as cell division, cell elongation, stem as well as leaf enlargement and chlorophyll formation depend on plant water availability (Price *et al.*, 1986). As noted by Levy and Krikum (1983), insufficient water in plants below a critical level is usually demonstrated by changes in all structures leading to the death of the plants. For each ton of vegetative growth, hundreds of tons of water may be consumed by the growing plant particularly in dry climates. As observed by Awodola (1984), reduction in relative water contents affects physiological processes and hence plant growth. Similarly, too much water in excess of plant need may retard physiological processes in plants by influencing the soil-water balance (Komer *et al.*, 1979). Huang *et al*. (1985) reported root to shoot ratio to be 3.5 times higher in water stressed plants.

Since poor growth performance of the species on the field is a major constraint to high yield in the semi-arid region, identifying efficient nursery management practice through adequate supply of water and fertilization is crucial. The objective of the study therefore is to investigate the influence of watering regime and growing media on the early growth of *Acacia seyal* and *Acacia sieberiana* in the semi-arid environment of Sokoto.

MATERIALS AND METHODS

Study Area

The study was conducted in the permanent site of Usmanu Danfodiyo University, Sokoto. Sokoto State is located in the extreme northwest corner of Nigeria between latitudes 11^{o}6' and 13^{o}9'N and longitudes 3^{o}7' and 6^{o}9'E (Kowal and Kassan, 1978). The climate is mainly semi-arid, characterized by low rainfall usually between 400 and 700mm annually (SSG, 2010) occurring between May and October with peak in August. The dry season starts from October and ends in May, and maximum temperature ranges from 19^{o} to 38^{o}C while the minimum temperature is between 13^{o} and 21^{o}C (SSG, 2010). The soil is of sedimentary basement complex type and is sandy (sand fraction over 75%) with little organic matter content, and the soil pH ranges from 6 to 7, which is maintained by low level of production characteristics of Sudan Savanna (Kowal and Kassan, 1978). Humidity is recorded to be below 40% in the dry season (November – May), but can rise up to 70% during the wet season (Kowal and Kassan, 1978). There are two main wind regimes in the area; one that comes from the southern part of the country, called tropical moist air mass, which starts from June and ends in September, it is this wind that brings rains; while the second wind comes from Sahara and is called continental air mass (SSG, 2010). The vegetation of Sokoto is typically Sudan savanna with intensive grass cover interspersed by few trees and shrubs.

Experimental Procedure

Polythene bags with average sizes of 23cm height and 6.5cm diameter were used as seedling containers. Three different potting mixtures (potting media) were used to examine the effect of fertilizer on growth performance of the two species (*A. seyel* and *A. sieberiana*). These were sand only (SO), sand + goat manure (SGM) in the ratio of 2:1 and sand + cowdung (SCD) also in the ratio of 2:1 as recommended by Weber (1977). Two seeds were sown in each polythene bag and, after germination, only one seedling was maintained for the experiment. Five replicates were used for each treatment and the experiment was laid out in a randomized complete block design (RCBD). Thirty polythene bags were involved in the whole experiment. These were divided into two groups of 15 bags each for the watering trial. The first group was watered once daily and the second twice daily.

Data Collection and Analysis

Data on growth parameters: plant height (HT, cm) collar diameter (CD, mm) and number of leaves (NL) were collected fortnightly. The instruments for measurement were meter rule for height, Venier caliper for collar diameter and the number of leaves was counted manually on each seedling.

Data collected were analyzed using descriptive statistics and analysis of variance (ANOVA) using Statistical Analysis System (SAS) (Anthony *et al.,* 1976) and Duncan's New Multiple Range Test (DNMRT) was used to separate the means (Duncan, 1955).

RESULTS AND DISCUSSION

Effect of Potting Mixture on Early Growth of *A. sieberiana* and *A. seyal*

The results (Table 1) showed that for *A. sieberiana*, there was no significant difference ($P>0.05$) between sand only and sand + goat manure on collar diameter at two, four, eight, 10 and 12WAG and on number of leaves at eight and 10WAG. Statistical difference was also not observed ($P>0.05$) between sand only and sand + goat manure media on collar diameter at 10WAG, on height at 10 and 12WAG and on number of leaves at eight, 10 and 12WAG for *A. seyal* (Table 2). Potting media promoted the early growth of *A. sieberiana* because collar diameter at six WAG, height at four, six, eight, 10 and 12 WAG and number of leaves at four and six WAG were found to be significant ($P<0.05$) across the treatments and the highest values came from SO (Table 1). The results also indicated significant differences ($P<0.05$) between the three potting media on collar diameter at four, six, eight, 10 and 12WAG, height at two, four, six and eight WAG and number of leaves at two, four and six WAG for *A. seyal*; SO gave the highest ($P<0.05$) values of these parameters (Table 2). Apart from the NL at 12WAG of *A. sieberiana*, the treatment (SCD) gave lower ($P<0.05$) CD, HT and NL at two to 12WAG for the two species compared to SO and SGM. These results were found on seedlings that were only three months old (April to June 2010), and the organic manure used might have just started to decompose while the nutrients in sand only could have been exhausted. The two trees under investigation showed high germination and early growth performance with SO This might be associated with the ability of the species to grow on wide variety of sites and

under varying environmental conditions. The findings agree with Onyekwelu and Olabiwonnu (2010), who recorded better but non-significant growth of *Moringa oliefera* seedlings raised in forest topsoil and river sand, but contrast with Agbogidi *et al.* (2007), who reported a significant effect of potting media on seed germination and early growth of *Dacryodes edulis* seedlings, Yadessa *et al.* (2000) and Yadessa *et al.* (2002) who reported that growth performance was not affected by pot size, but by the growing medium, and Yadessa *et al.* (2000) who also reported better response of tree species to potting mixture containing farmyard manure.

Table 1: Effect of potting mixture on growth parameters of *A. sieberiana*

Parameter	Sand only Mean ±SD	Sand + Goat manure Mean ±SD	Sand + Cowdung Mean ±SD
CD2WAG	2.10^{ab} ± 0.31	2.19^{a} ± 0.19	2.00^{b} ± 0.00
CD4WAG	2.64^{a} ± 0.40	2.66^{a} ± 0.40	2.12^{b} ± 0.18
CD6WAG	3.16^{a} ± 0.36	2.89^{b} ± 0.49	2.29^{c} ± 0.35
CD8WAG	3.18^{a} ± 0.43	3.18^{a} ± 0.51	2.44^{b} ± 0.38
CD10WAG	3.42^{a} ± 0.68	3.47^{a} ± 0.69	2.80^{b} ± 0.40
CD12WAG	3.60^{a} ± 0.74	3.84^{a} ± 0.92	3.03^{b} ± 0.44
HT2WAG	12.10^{a} ± 3.78	7.86^{b} ± 2.86	8.22^{b} ± 2.29
HT4WAG	20.96^{a} ± 6.65	13.12^{b} ± 4.92	10.40^{c} ± 2.31
HT6WAG	29.80^{a} ± 5.35	19.55^{b} ± 5.55	13. 41^{c} ± 4.01
HT8WAG	36.41^{a} ± 6.94	26.11^{b} ± 6.62	19.93^{c} ± 6.77
HT10WAG	38.37^{a} ± 6.75	32.11^{b} ± 10.33	24.86^{c} ± 6.74
HT12WAG	40.72^{a} ± 7.84	34.90^{b} ± 13.65	29.00^{c} ± 7.33
NL2WAG	9.80^{a} ± 2.63	7.35^{b} ± 1.50	7.15^{b} ± 1.57
NL4WAG	20.00^{a} ± 7.02	13.50^{b} ± 5. 06	9.55^{c} ± 2.33
NL6WAG	33.44^{a} ± 11.57	24.65^{b} ± 12.63	13.85^{c} ±5.90
NL8WAG	40.56^{a} ± 14.09	39.70^{a} ± 24.43	27.00^{b} ± 11.12
NL10WAG	48.33^{ab} ± 22.26	51.45^{a} ± 28.00	38.63^{b} ± 17.55
NL12WAG	49.78^{a} ± 27.96	55.15^{a} ± 32.40	45.53^{a} ± 23.52

Means having same letter in the same row are not significantly different ($P<0.05$).

Table 2: Effect of potting mixture on growth parameters of *A. seyal*

Parameter	Sand only Mean ±SD	Sand + Goat manure Mean ±SD	Sand + Cowdung Mean ±SD
CD2WAG	2.60[a]± 0.00	2.05[b]± 0.15	2.03[b]± 0.11
CD4WAG	3.67[a]± 0.39	2.71[b]± 0.48	2.06[c]± 0.19
CD6WAG	4.00[a]± 0.46	3.26[b]± 0.72	2.44[c]± 0.41
CD8WAG	4.04[a]± 0.51	3.55[b]± 0.87	2.78[c]± 0.42
CD10WAG	4.11[a]± 0.54	3.47[a]± 0.69	3.03[c]± 0.33
CD12WAG	4.40[a]± 0.49	3.72[b]± 0.95	3.30[c]± 0.46
HT2WAG	8.22[a]± 1.41	5.89[b]± 2.91	2.63[c]± 0.49
HT4WAG	16.35[a]± 3.86	10.13[b]± 4.93	3.97[c]± 1.35
HT6WAG	23.12[a]± 4.82	16.55[b]± 6.19	4.98[c]± 2.14
HT8WAG	29.21[a]± 9.73	24.15[b]± 5.99	7.74[c]± 3.50
HT10WAG	33.57[a]± 11.88	30.41[a]± 9.99	16.0 4[b]± 4.26
HT12WAG	37.57[a]± 14.89	32.11[a]± 12.08	22.39[b]± 7.02
NL2WAG	8.00[a]± 1.95	6.45[b]± 1.23	4.65[c]± 0.67
NL4WAG	25.70[a]± 10.95	12.95[b]± 5.36	6.68[c]± 1.00
NL6WAG	45.30[a]± 18.94	28.35[b]± 14.55	10.16[c]± 4.43
NL8WAG	53.14[a]± 17.10	48.00[a]± 24.56	17.26[b]± 6.41
NL10WAG	63.00[a]± 33.30	65.89[a]± 35.86	26.58[b]± 6.69
NL12WAG	65.14[a]± 35.22	67.17[a]± 37.28	32.42[b]± 12.31

Means having same letter in the same row are not significantly different (P<0.05).

Effect of Watering Regime on Early Growth of *A. sieberiana* and A. *seyal*

Table 3 shows that the two watering regimes (once and twice daily) did not cause any significant change (P>0.05) in number of leaves (NL) at eight WAG for *A. sieberiana* and in height (HT) at four WAG for *A. seyal*. Twice-daily watering gave higher (P<0.05) CD values at four to 12 WAG, HT growth at six to 12 WAG and NL at four to 12 WAG for *A. seyel* compared to watering once-daily (Table 3). As for *A. sieberiana*, watering twice-daily resulted in higher (P<0.05) CD, HT and NL from two to 12 WAG compared to watering once daily. Generally, watering twice daily gave higher values than once daily watering across the treatments for the two species; an evidence of the importance of watering in tree growth, especially in the Sudan Savanna environment. This agrees with the work of Areft and Loutfy (1994), that growth may be more effectively maximized by reducing moisture stress.

Table 3: Effect of watering regime on growth parameters of *A. seyal* and *A. sieberiana.*

Parameter	***A. seyal***		***A. sieberina***	
	Once-daily watering (Wse_1) Mean ±SD	Twice-daily watering (Wse_2) Mean ±SD	Once-daily watering (Wsi_1) Mean ±SD	Twice-daily watering (Wsi_2) Mean ±SD
CD2WAG	2.28^{a}± 0.45	2.17^{b}± 0.36	2.02^{b}± 0.09	2.17^{a}± 0.38
CD4WAG	2.65^{b}± 0.71	3.00^{a}± 0.78	2.29^{b}± 0.30	2.6^{a}±0.44
CD6WAG	3.02^{b}± 0.72	3.48^{a}±0.90	2.62^{b}± 0.42	2.90^{a}±0.61
CD8WAG	3.16^{b}± 0.61	3.69^{a}± 0.94	2.79^{b}± 0.41	3.05^{a}±0.65
CD10WAG	3.28^{b}± 0.56	3.93^{a}± 0.88	2.88^{b}± 0.44	3.54^{a}±0.69
CD12WAG	3.47^{b}± 0.59	4.27^{a}± 0.89	2.96^{b}± 0.50	3.97^{a}±0.71
HT2WAG	6.26^{a}± 3.34	4.89^{b}± 2.40	8.43^{b}± 3.25	10.35^{a}±3.65
HT4WAG	10.32^{a}± 6.09	10.19^{a}± 6.53	13.02^{b}± 6.27	16.63^{a}±6.62
HT6WAG	14.60^{b}± 7.80	15.51^{a}± 9.90	19.28^{b}± 6.92	21.85^{a}±9.42
HT8WAG	18.51^{b}± 8.07	20.54^{a}± 14.44	25.31^{b}± 6.84	29.10^{a}±11.16
HT10WAG	21.47^{b}±6.66	31.35^{a}± 14.25	27.17^{b}± 6.20	35.71^{a}±10.63
HT12WAG	23.10^{b}±6.94	38.38^{a}± 13.45	27.93^{b}± 6.86	40.93^{a}±10.50
NL2WAG	7.03^{a}± 2.33	5.70^{b}± 1.15	7.07^{b}± 1.57	9.03^{a}±2.43
NL4WAG	13.33^{b}± 7.36	17.24^{a}± 13.00	12.37^{b}± 5.88	16.33^{a}±6.95
NL6WAG	22.77^{b}±13.17	33.90^{a}± 24.17	21.36^{b}± 12.03	25.80^{a}±13.70
NL8WAG	32.96^{b}±21.00	44.04^{a}± 25.69	31.89^{a}± 20.11	39.20^{a}±16.45
NL10WAG	35.82^{b}± 18.18	68.26^{a}± 33.25	33.48^{b}± 18.63	57.63^{a}±21.39
NL12WAG	35.82^{b}± 16.74	75.39^{a}± 36.21	31.41^{b}± 17.14	67.20^{a}±25.08

Means having same letter in the same row are not significantly different ($P<0.05$).

CONCLUSION

Potting mixture containing sand only gave the highest height at all ages for *A. sieberiana*, and the highest collar diameter at two, four, six, eight and 12 WAG for *A. seyal.* Twice daily watering gave higher mean growth values in all the parameters measured at 12WAG for the two species, except for number of leaves at eight WAG in *A. sieberiana*. *A. seyal* responded more positively to sand only than *A. sieberiana*, particularly with respect to the number of leaves which has relevance in photosynthesis and wood formation. It is evident from the results that a mixture of sand and goat manure, and watering twice daily, would enhance early growth of the two acacia species

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