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EFFECT OF SOWING DEPTH ON GERMINATION AND GROWTH OF GUM ARABIC (*ACACIA SPECIES)*

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ABSTRACT
The study was carried out to determine the effect of sowing depth on the germination and growth of (*Acacia species*). The materials for the experiment consisted of top soil, river sand, cow dung and polythene bags. Polythene bags measuring 7.5 cm x 20 cm were filled with potting mixture consisting of top soil, river sand and cow dung in a ratio 2:2:1. The filled polythene bags were laid out in a randomized complete block design (RCBD) with each treatment having 25 polythene replicated four times. Two seeds were sown per pot at a depth of 1cm, 2cm, 3cm and 4cm, respectively, and were later thinned to one seeding per pot. It was observed that seed germination was faster with 1cm and 2cm sewing depth followed by 3cm while 4cm depth delayed seed germination. At 1 month after sowing (1MAS), seeds of (*Acacia species*) were statistically unaffected regardless of sowing depths. However, at 2, 3 and 4 months after sowing, seedling of (*Acacia Seyal*) significantly gave superior seedling height compared to (*Senegalia Senegal*). At 1, 2 and 3 MAS, *Acacia species* though statistically similar significantly increased seedling height and number of primary branches compared to 4cm sowing depth. Shallow sowing depths of 1 and 2cm of (*Acacia species*) seeds favored seed emergence and seedlings growth characters.

Keywords: Germination, Gum Arabic, Nursery, Seedlings, Sowing depths.

INTRODUCTION
Gum arabic is the exudates obtained from stems and branches of *Senegalia senegal* or closely related *Acacia* that belong to the family Fabaceae (Dorthe, 2000). In Nigeria, high concentrations of natural stands of *S. Senegal* that produces grade one gum Arabic are predominantly found in north-eastern part of the country though the cultivated and some wild forms occur in north western states from Kebbi, Sokoto, Zamfara, Katsina, Kano, Jigawa down to north east especially around, latitude 10^0 30^0N to 12^0 00 N (FDA 2002). The volume of international trade on gum arabic ranges from 50,000-60,000 tons/annum (International Trade Center [ITC], 2009). In Nigeria, production figure for 2002 and 2004 was estimated at 16,071 and 17,206 tons, respectively (Raw Material Research and Development Council [RMRDC], 2004) in 2008, the figure dropped to about 12,000 tons from record high 21,767 tons recorded in 2003 (Okoro, 2009). A ton of Nigerian raw gum arabic valued USD 1,500 in 2005, USD 3,000 in 2008 but dropped to USD 1,600 in 2011 owing to global economic recession (ITC, 2011). The *S. Senegal* grade one gum arabic is a multifunctional food additive used in confectionery, pharmaceuticals, food and beverages, brewing among others (Anderson, 1993). The plant is useful for afforestation in the arid and semi-arid regions with desertification problems, soil reclamation, and wind breaks (Duke, 1981). The leaf litters form an excellent source of nitrogen and organic matter which helps to improve soil structure and fertility, and when in association with microbial symbionts restores soil N through nitrogen fixation (Ojiekpon, *et al.*, 2007). The *Acacia species* genus has about 11,000 – 12,000 identified species that produce gum of various grades (Dondain and Philips, 1999). These species include *S. Senegal, Acacia seyal, Acacia nilotica,* and *Acacia leata* etc. the best quality gum is obtained

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from *S. senegal* (NAERLS, 1996). The level of success recorded in seedling production exercise depends on agronomic practices employed and this cannot be achieved unless efforts are made for good germination of seed. According to Robert (1976), germination is the resumption of growth of the embryo and its development into an independent seedling. The reason why seeds of *Acacia species* take longer period before germination apart from dormancy is sowing depth. Hence, the need to undertake a study to determine the effect of sowing depth on the germination and growth of *Acacia species* seedling.

MARTERIALS AND METHOD

Experimental Site and Design

The experiment was conducted at the Rubber Research institute of Nigeria, Gum Arabic Sub-station, Gashua, Yobe State (12^0 45$^{'}$ N, 11^0 00$^{'}$ E and 369m above sea level) in the Sahal Savanna ecological zone of Nigeria in 2014 and 2015. The potting mixtures used were top soil, River sand and cowdung in a ratio 2:2:1. Four different sowing depths were considered for the study: 1cm, 2cm, 3cm and 4cm with two Acacia Species (*S. senegal* and *Acacia seyal*). The experiment was laid out in Randomized Complete Block Design (RCBD) replicated four times. The seeds of *Acacia species* were collected from the Sub-station plantation, top soil was collected from arable farm at the experimental site, and river sand from sand Vendor while cowdung was sourced from cattle Fulani Settlement around the Sub-Station. Polythene bags of size 7.5 x 20cm were used for the study. Prior to seed sowing, polythene bags were watered morning and evening for two days. Two seeds were sown in the polythene bags and were later thinned to one seedling per polythene bag. Seedlings were watered morning and evening for four months except on the days with rain fall. Weeding was carried out forth nightly to ensure weed free *Acacia species* seedlings. Four plants were sampled per treatment and data was collected on days to germination, seedlings height, stem diameter, and number of primary branches.

Analytical Techniques

The data were subjected to analysis of variance. Fisher's test was used to test for significant difference among treatment means as described by Snedecor and Cochran (1987) Treatment means were compared using Duncan's multiple range test DMRT (Duncan, 1955). The data was analyzed using the general linear model procedure of statistics analysis system software version (SAS Institute, 2000).

RESULTS AND DISCUSSION

Sowing seeds of *Acacia species* at 1 and 2cm depths though statistically similar significantly reduced days to emergence compared to other sowing depths Table 1. The outstanding germination recorded for seed sown at depth 1 and 2cm may be connected to the less energy required from plumule and cotyledons of the germinated seeds to appear above the soil level. Ojiekpon (1998) also reported that *S. senegal* seeds sown between 1.0 cm and 2.5 cm depths gave a very good germination rate.

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Table 1: Days to Emergence of *S. senegal and A. Seyal species* as affected by Sowing Depth in the Nursery

Year	**2016**	**2017**
Sowing depth (cm) SD:		
1	4.62a	4.61a
2	5.79a	5.78a
3	8.66b	8.66b
4	8.40b	8.40b
SE±	0.80a	0.841
LS:	**	**
Specie (SPP):		
S. senegal	5.76a	5.75a
A. seyal	7.97a	7.98a
SE ±	0.572	0.572
LS:	*	*
Interaction:		
SD x SPP	NS	NS

Note: Means followed by the same letters with a column of a treatment group are not significant different statistically at 5% level of probability using DMRT * and ** significant at 5% and 1% level significant NS = not significant, SPP = species, SD = sowing depth.

The sowing depths 3 and 4cm through statistically similar delayed seed germination. This means that *A. species* seeds sown at a depth of more than 3cm may delay germination beyond eight day after sowing. This result confirmed the finding of Azam-Ali *et al.* (2006) who reported that sowing depth of more than 3cm caused poor germination of *Calligonum species.* Also, days to germination between the *Acacia species* showed significant difference with *S. senegal* having the least days to germination compared to *A. seyal*. The delay in germination of *A. seyal* could be due to its hard seed coat which results in temporary dormancy and influences the germination process (Aref, 2000). At 1 month after sowing (1 MAS), seedlings of *S. species* were statistically the same regardless of sowing depth. However, at 2, 3 and 4 MAS, seedling of *A. seyal* significant gave superior seedlings height compared to *A. senegal* Table 2.

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Table 2: Seedling Height of *A. species* as affected by Sowing Depths at four different Sampling Stages in the Nursery

Year	**2016**				**2017**			
Month	**June**	**July**	**August**	**September**	**June**	**July**	**August**	**September**
Treatment	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Sowing depth (cm) SD:								
1	13.94a	26.11a	34.78a	46.14ab	13.44a	26.11a	34.78a	46.14ab
2	13.75a	26.28a	26.22a	53.66a	13.75a	26.28a	35.22a	53.65a
3	11.71a	22.57a	32.48a	41.96b	11.71a	22.59a	32.48a	4.96b
4	2.88b	14.20b	21.24b	33.60b	2.88b	14.20b	21.24b	33.60b
SE ±	1.279	2.722	3.687	5.968	1.279	2.722	3.637	5.968
LS:	**	**	**	**	**	**	**	**
***A. species* (SPP):**								
S.senegal	9.99	14.20b	17.71b	24.25b	9.99	14.20b	17.71b	24.25b
A. seyal	11.14	30.38a	44.65a	63.439	11.14	30.38a	44.65a	63.43a
SE ±	0.094	1.925	2.592	4.219	0.904	1.925	2.592	4.21a
LS:	NS	**	**	**	**	**	**	**
Interaction:								
SD x SPP	NS	NS	NS	NS	NS	NS	NS	NS

Note: Means followed by the same letter within a column of a treatment group are not significant different statistically at 5% level of probability using DMRT. ** Significant at 1% NS= not significant.

At 1, 2 and 3 MAS, sowing depth 1, 2 and 3cm though statistically similar significant increase seedlings height compared to 4cm sowing depth that gave the shortest seedlings egardless of sampling month and year. This result agrees with the finding of Adeogun *et al.* (2012) who reported better seedling growth performance of *Dialiumguineense* seeds at 3cm sowing depth compared to 4 and 6cm depth. The result is also in line with the finding of Umeoko and Ogbonnaya (2016) who reported a decreased in seedling growth performance with increased in sowing depth.

At 1 MAS, sowing depth 1 and 2cm though statistically similar significantly increased number of primary branches compared to other depths, at 3 MAS, depth 1, 2 and 3 cm through similar statistically significant increased number of primary branches compared to the deepest sow of 4 cm Table 3.

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Table 3: Number of Primary Branches of (*Acacia species*) of Gum Arabic as affected by Sowing Depth at different Sampling Stages in the Nursery

Year	**2016**				**2017**			
Month	**June**	**July**	**August**	**September**	**June**	**July**	**August**	**September**
Treatment	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Sowing depth (cm) SD:								
1	1.48a	4.65	7.08a	13.17	1.48a	4.65	7.08a	13.17
2	1.67a	5.46	9.31a	17.50	1.67a	5.46	9.31a	17.50
3	0.67a	3.84	7.54ab	17.69	0.67b	3.84	7.54ab	17.69
4	0.13b	3.46	4.87	10.91	0.13b	3.46	4.87	10.91
SE ±	0.251	0.874	1.086	3.112	0.251	0.874	1.086	3.112
LS	**	NS	**	NS	**	NS	**	NS
***A. species* (SPP):**								
A. senegal	1.84a	3.94	6.43	9.33b	1.84a	3.94	6.43	9.33b
A.seyal	0.13b	3.77	7.97	20.30a	0.177	0.618	0.768	20.30a
SE ±	0.177	0.618	0.768	20.30a	0177	0.618	0.768	20.30a
LS	**	NS	NS	**	**	NS	NS	**
Interaction:								
SD x SPP	**	NS	NS	NS	**	NS	NS	NS

Note: Means followed by the same letter within a column of a treatment group are not significant different statistically at 5% levels of probability using DMRT * and ** significant at 5% and 1% level significant;
NS = not significant, SPP species, SD = sowing depths.

At 2 and 3 MAS, sowing depths 1, 2 and 3 though statistically similar significantly increased stem diameter and number of primary branches compared to 4 cm sowing depth Table 4. However, *A. seyal* produced larger stem diameter and number of primary branches than *A. senegal*. The superior growth performance achieved by *A. seyal* is expected as variability in growth performance of *A. species* has been well documented (Aghughu *et al.,* 2017).

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Table 4: Stem iaDmeter of (*Acacia species*) of Gum Arabic as affected by Sowing Depth at different Sampling Stages in the Nursery

Year			**2016**				**2017**	
Month	**June**	**July**	**August**	**September**	**June**	**July**	**August**	**September**
Treatment	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Sowing depth (cm) SD:								
1	0.39	0.38a	0.49a	0.66ab	0.39	0.38a	0.49a	0.66ab
2	0.41	0.40a	0.52a	0.69a	0.41	0.40a	0.52a	0.69a
3	0.52	0.38a	0.47a	0.60ab	0.52	0.38a	0.47a	0.60ab
4	0.10	0.22ab	0.25b	0.43b	0.10	0.22ab	0.25b	0.43b
SE ±	0.137	0.025	0.044	0.075	0.137	0.0025	0.075	0.075
LS	NS	**	**	**	NS	**	**	**
***A. species* (SPP)**								
A. senegal	0.44	0.34	0.41	0.40b	0.44	0.34	0.41	040b
A.seyal	0.64	13.25	15.92	17.589	0.64	13.25	15.92	17.58a
SE ±	0.097	0.018	0.031	0.053	0.097	0.081	0.031	0.053
LS	NS	NS	NS	**	NS	NS	NS	**
Interaction								
SD xSPP	*	NS	NS	NS	*	NS	NS	NS

Note: Means followed by the same letters within a column of a treatment group are not significant different statistically at 5% levels of probability using DMRT * and ** significant at 5% and 1% level significant NS = not significant, SPP = species SD = sowing depth.

CONCLUSION AND RECOMMENDATION

This study concluded that sowing *Acacia species* at 1 cm hastened seed germination while seeds sown at 2 and 3cm sowing depth significantly caused increased in seedling height stem diameter and number of primary branches. Therefore, sowing *Acacia species* at 2cm depth is recommended for use by farmer in the study area for good germination and seedling growth performance.

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