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Screening of baobab collection for rootstock selection

Kenneth Fafa Egbadzor^a, Cephas Setugah^a, James Gakpo^a and Matthias Kleinke^b

^a *Department of Agricultural Sciences and Technology, Ho Technical University, Ghana*

^b *Faculty of Life Sciences, Rhine-Waal University of Applied Sciences, Kleve, Germany*

Introduction

Baobab (*Adansonia digitata* L.) is an economically valuable yet underutilized indigenous fruit tree in sub-Saharan Africa, particularly in West Africa where it features prominently in rural diets. Underutilization of baobab is largely due to its undomesticated nature (Jansen et al., 2020). Known for its massive size and multipurpose utility, baobab has attracted interest from pharmaceutical, cosmetic, and research sectors for its diverse uses (Kamatou et al., 2011; Sanchez et al., 2010).

Baobab fruit pulp is exceptionally rich in vitamin C, nearly ten times that of oranges (De Ancos et al., 2020), while methanolic extracts from roots, bark, and leaves show potent antiviral and antimicrobial properties (Asogwa et al., 2021). Seedlings develop tubers which are consumed as vegetables and all edible parts contain minerals and phytochemicals.

Baobabs in the Volta Region of Ghana are targeted for domestication to enhance livelihoods (Egbadzor et al.). Baobab fruits are widely harvested and sold across Africa and the tree's benefits have spurred interest in its cultivation (Mugangavari et al., 2021). However, its long juvenile phase before fruiting poses a challenge. Grafting has been shown to reduce the juvenile period, with successful trials using one to two-year-old rootstock in Kenya (Anjarwalla et al., 2017) and four-month-old seedlings in Ghana (Egbadzor et al., 2020).

The present study aims to identify fast-growing baobab accessions from natural populations in the Volta Region, with the goal of optimizing nursery practices and enhancing cultivation efficiency. Specifically, the research evaluates seedling growth rates across different accessions, using plant height, leaf count, and stem girth as indicators. The findings are expected to inform the selection of superior rootstocks, thereby shortening the time to economic maturity.

Material and Methods

The experiment was conducted on the field at Ho Technical University, specifically, 3°45'N, 8°45'N). A Randomized Complete Block Design with nine baobab accessions replicated four times (40 seedlings per replicate) yielded 1,440 seedlings were used. Seed dormancy was broken by soaking seeds in concentrated sulphuric acid for six hours, followed by rinsing and sprouting on paper-lined petri dishes. Pre-germinated seeds were planted 2–3 cm deep in nursery bags and managed with standard practices.

Data Collection and Analysis: Growth data was collected weekly from 10 randomly selected seedlings per treatment from week 6 to 11. This includes leaf count, plant height (cm) and stem girth (mm). Data collected were processed using Microsoft excel (version 2019) and IBM SPSS software (version 22). All data collected were subjected to one-way analysis of variance.

Results and Discussion

Plant height: Results of the data analysis are presented in Table 1. There were significant differences in plant height among the accessions from week six through week eleven. Accession 3 (25.02 cm) performed better than all the other accessions in terms of plant height in week six but was not significantly different from some accessions including 8 and 9 (23.65 cm and 23.02 cm) respectively. At the end of week eleven, accession 8 performed better than all the other accessions with an average height of 59.55 cm. It (accession 8) was significantly taller than all the other accessions in week 11 in exception of accessions 5, 7, and 9. Accession 1 was shorter than all the accessions at week 11, however, its height was not significantly shorter than that of accessions 2,3, 4, and 6. This shows that there are genotypic differences in the baobab accessions evaluated in terms of growth in height.

Number of leaves: Average number of leaves that developed on the baobab accessions varied significantly from week six to eleven and ranged from 10.9 to 13.3 in week six (Table 1). Accession 2 had more leaves than all the other accessions at week six. The accessions performed differently in terms of number of leaves from week to week and accession 8 became the best performer in week eleven with an average of 22.8 leaves which was significantly different from all the other accessions except accessions 2, 3, and 6. Variation in the number of leaves could affect growth potential of the different accessions. Egbadzor *et al*, (2023) also observed that seedling grown in soilless medium under full sunlight developed more leaves than those in soil under shade, confirming that both genetic makeup and environmental conditions influence leaf production. In the present study, all seedlings were raised under uniform nursery conditions which eliminates environmental variability as the main cause of variability observed. Therefore, the early differences in leaf number are likely due to genetic factors.

Table 1: Average height, number of leaves and stem girth of baobab accessions showing levels of significance

Parameter		Accession									F.pr	lsd
		1	2	3	4	5	6	7	8	9		
Plant Height (cm)	Week 6	21.96	22.6	25.02	22.72	24.82	21.3	21.5	23.65	23.02	0.02	2.3
	Week 7	25.62	26.25	29.95	26.9	30.01	26.23	27.23	29.85	27.67	0.02	2.9
	Week 8	26.88	28.15	31.92	28.47	32.68	29.8	31.45	35.39	31.81	0.00	3.7
	Week 9	32.62	32.54	37.27	33.14	38.28	35.14	38.97	44.25	39.29	0.00	5.4
	Week 10	37.37	38.41	44.18	39.84	45.89	40.81	46.89	53.36	47.31	0.00	7.4
	Week 11	42.51	43.54	50.15	44.51	51.69	45.34	53.38	59.55	53.98	0.01	8.6
No. of Leaves	Week 6	10.93	13.3	12	11.53	11.93	12.4	11.75	11.73	11.15	<.001	0.9
	Week 7	12.35	15.57	14.25	13.12	13.8	13.47	14.03	13.88	12.88	0.00	1.3
	Week 8	13.18	16.8	15.75	14.15	15.78	14.5	14.9	15.43	13.05	0.01	1.9
	Week 9	14.43	18.48	17.55	15.38	17.25	16.33	15.95	18.18	14.83	0.01	2.3
	Week 10	15.47	19.5	19.6	15.1	18.07	18.55	18.3	22.05	15.87	0.01	3.7
	Week 11	15.5	20.6	21.37	15.45	18.25	20.4	18.62	22.82	15.92	0.01	4.2
Stem Girth (mm)	Week 6	5.6	6.15	6.45	6.39	5.9	6.70	7.07	6.487	6.87	0.02	0.8
	Week 7	7.09	7.51	7.92	7.32	7.11	7.83	7.99	7.64	7.71	0.02	0.6
	Week 8	8.33	10.2	9.15	8.36	10.06	8.74	8.91	8.96	8.52	0.74	NS
	Week 9	9.41	9.51	10.32	9.61	9.56	9.65	9.83	9.98	9.18	0.32	NS
	Week 10	9.79	11.84	10.84	10.07	10.06	10.56	10.96	10.98	10.02	0.62	NS
	Week 11	10.84	11.39	12.03	11.06	11.44	11.51	11.99	11.93	10.97	0.46	NS

This observation is consistent with the findings of Munthali *et al.* (2012), who found that significant variation in seedling traits such as leaf number, shoot height, and tuber development was primarily driven by genetic differences among accessions.

Stem girth: Significant differences in stem girth among the baobab accessions were observed only during weeks six and seven. From weeks eight to eleven, however, stem girth remained statistically similar across all accessions. The reason for significance differences in the sixth and seventh weeks but not subsequently is difficult to explain. This warrants further investigation. Gurashi and Eltahir (2024) found that young baobab seedlings from various provenances exhibited comparable stem thickness when cultivated under identical conditions. Genetic variation was thus not observed in the growth of their sample. In terms of environmental response, Mukhtar (2016) reported no significant variation in stem girth among baobab seedlings grown under different light conditions. However, Egbadzor *et al.* (2023) observed differences in stem thickness when different media and light conditions were used. Kalinganire *et al.* (2023) also noted that noticeable variation in stem girth tends to emerge only after several months of growth. More screening could be done in search of faster growing baobab among the HTU collection; however, the studied accessions have all exhibited appreciable growth suitable for use as scions.

Conclusions and Outlook

Although variability was observed in the number of leaves and plant height of the baobab accessions, there was no significant difference in the stem girth which could project any of the accessions to be superior rootstock. Nevertheless, several accessions still exist in the genebank which could be evaluated to identify possible superior genotypes as a rootstock. The taller growing and higher leave producing accessions could be suggested for different purposes such as genotypes for leafy vegetable production. Further evaluation is recommended to identify useful accessions from the germplasm collection.

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