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Growth Attributes as Characteristics of High Gum Yield *Hashab* Trees (*Acacia senegal* L.) in *Shikan* Locality, North Kordofan, Sudan

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ABSTRACT

This research was conducted in *Shikan* locality, North Kordofan, Sudan during 2018/2019. It identified growth attributes as characteristics of high gum yield h*ashab* trees (*Acacia senegal* L.) based on growth attributes and producer's experiences. Seventy seven *hashab* trees from nine villages were purposively selected. Quantitative data including diameter, height and crown diameter were collected. Descriptive statistical analysis in Statistical Packages for Social Sciences (SPSS version 16.00) and correlation analysis were done. The results found that the mean diameter, number of main stems, height, and age crown were of high gum yield *hashab* trees were (9.2±3.6cm), (4±1m), (6.6±3.7 stems) and (11.6±5.0 years) respectively. The largest diameter and the highest trees were recorded in *Umhglig Albiraimia* village were (13.1±3.2cm) and (8.3±2.8m) respectively, while the highest number of main stems was found in *Umgawawa* village (5 stems). The average yield of high gum yield hashab trees was 7.6±2.1 kg/tree/season while the highest yield was 10 kg/tree/season as recorded in *Eldemokeya* area. The study concluded that there was similarity among *hashab*

trees however; high gum yield hashab trees could be phenotypically identified by experience. The study recommends investigating relation between phenotypic characteristics and genetic sources of high gum yield *hashab* trees.

Key words: Gum yield, gum productivity, *Acacia senegal,* Kordofan, Sudan

1. INTRODUCTION

Acacia senegal L. (Willdenow) is a multipurpose sub-Saharan tree species that produces gum arabic. Its distribution area is from Senegal to Sudan but it could be found also in southern Africa and in the Indian subcontinent. *Acacia senegal* is present markedly in the western part of the country and it has a high capacity to adapt with drought (Eisa *et al.*, 2008). It significantly contributes to the country exports and increase revenue of the communities. Hashab trees (Hashab) are well stablished in Kordofan, Darfur, western White Nile and in the central clay plains (Ahmed 1986; Badi et al. 1989; Awouda 1990; Hussein and Sulieman 1999). Ballal *et al.* (2005a) in the Sahelian zones of Sudan, and Dione (1996) in Senegal showed that gum production occurs only during the dryseason, when the trees shed their leaves. *A. senegal* in Sudan grows naturally in the gum belt (Latitude10° and 14° N). This broad ecological region represents a complex and diverse environment with regard to climate, soils, vegetation, animals and human activities (Ballal 1991). *Acacia senegal* (L.) produces high quality qum arabic which significantly contributed to the livelihood of the people (Fadl and Sheikh 2010). There is about 80% of (Fadl and Sheikh 2010).Besides gum Arabic production, the tree the world contribution from gum gain from *Acacia senegal* beside that the species is well known for combating desertification, reestablishment of a vegetation cover in degraded areas, sand dune fixation and control wind erosion. The species is also well known to improve soil fertility (Eisa *et al.*, 2008). Ballal *et al.* (2005a) found that gum productivity was positively correlated with intensity of tapping, rainfall, and temperatures at tapping time. Late tapping reduced the production of gum. Ballal *et al.* (2005a and b), and Raddad and Luukkanen (2006) showed a positive relationship between gum yield and rainfall in the season preceding tapping and/or between gum yield and soil water content at the end of the rainy season. A significant positive relationship was addressed between the second picking and the total gum productivity. The second gum picking expressed a decisive factor in gum production, hence it could be as an indicator for total gum yield prediction in followed seasons (Raddad et al. 2006). The main objective of this research is to identify general characteristics of high yielding *hashab* trees (HGYHTs) in Shikan locality-North Kordofan State, Sudan, and to examine growth attributes of high yielding *hashab* tree.

2. MATERIALS AND METHODS

2.1 Study area

This research was conducted at Shikan Locality, North Kordofan, Sudan. Shikan is located in the south-western part of North Kordofan State between latitudes (12º 25′, 13º 45′) North, and longitude (29º35′ 30º-30′) East. The area is approximately 8312 square kilometers and is equivalent to 2 million acres, most of which are suitable for agriculture and grazing. The population is 672380 inhabitants (2016), of which about 441326 people live in Elobeid city and represent 66% of the total population in Sheikan, and about 34% live in the Stateside. The communities of 9 villages responded to this study are *Drisso*, *Alkara, Demokeya, Alsunt Elgarbi, Umhigleeg Albraimia, Umgawawa, Abokhrais, Farag Allah and Altaloshi*. The main activity of this population is agriculture, gum arabic production and cattle breeding.

2.2 Data collection

Field work was conducted where measurements were taken from 77 gum arabic trees of *Acacia senegal*(*hashab*)which are characterized as high yielding trees growing in different areas in *Shikan* Locality. The trees were purposively selected based on producer's knowledge and experiences in gum production. All villages from Shikan were pointed as village known with high gum production of *hashab* gum. From these villages the trees were coordinated and recorded by using GPS device (etrex10).Trees height was measured by using ranging rods while diameter at breast height (DBH) of each tree was measured by caliber. The number of main stems from each tree was counted. Crown diameter was measured by distant tape from two directions. Trees were tapped and the gum produced was weighted.

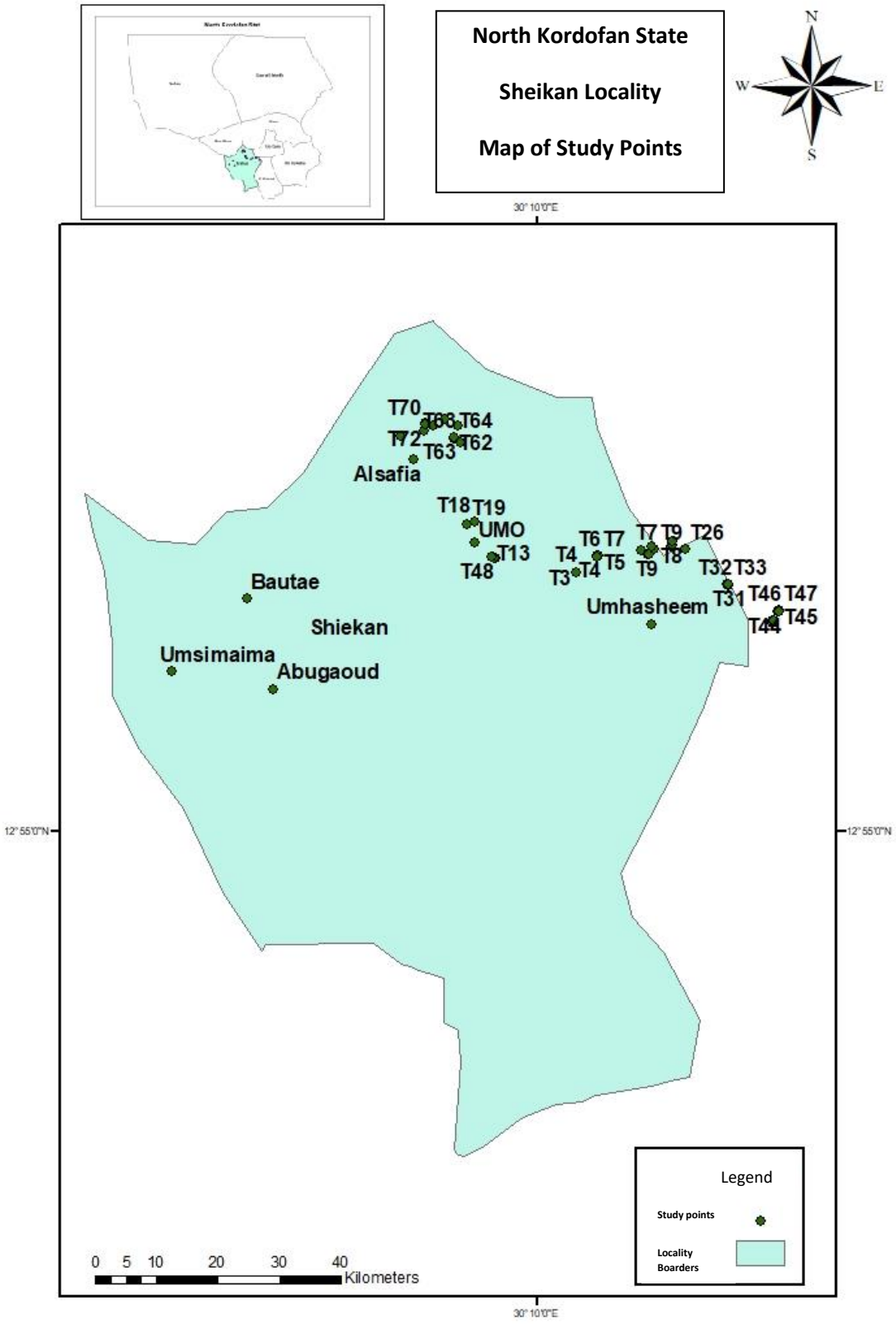

Figure 1: Map showing the points of the study

2.3 Data Analysis

Excel was used in analyzing some data. Descriptive analysis was done where maximum, minimum, mean and standard deviation of tree attributes were measured. The data collected from social survey was analyzed in Statistical Packages for Social Sciences (SPSS), the calculations included frequencies, means and percentages. The results were showed in figures and tables.

3. RESULTS AND DISCUSSION

3.1 General Characteristics of high gum yielding hashab trees

The characteristics of high gum yielding trees of *Acacia senegal* were showed in table 3.1, number of indicators were used to identify the characteristics of high yielding trees of *Acacia senegal,* such as diameter, height, number of main stems, tree age and crown diameter. The mean diameter, number of main stems, height, age, and mean crown in *Alsunt Elgarbi* were (7.8±2.3cm), (3.7±1.3 stems), (4.7±0.5m), (8.2±2.4 years), (6.8±1.1m) respectively, in *Draisso* the mean values of diameter, number of main stems, height, age, and mean crown were (8.6±2.6cm), (3.6±1.3 stems), (5.8±2.4), (9.7±1.8 years), (6.3±0.9 m) respectively. The mean diameter, number of main stems, height, age, and mean crown in *Demokeya* were (9.9±3.1cm), (2.1±0.7 stems), (7.6±2.4m), (9.5±2.2 years), (6.0±1.3m) respectively. In *Alkara* the mean values of diameter, number of main stems, height, age, and mean crown were not varied from the previous values, the diameter (7.2±3.0 cm), (4.2±1.3stems) were recorded as mean number of main stems, the mean height of trees were (5.8±2.3m), (10.1±2.2 years) as mean age of trees and (6.8±1.5m) was the length of mean crown. The largest dbh and the highest trees were recorded in *Umhglig Albiraimia* (13.1±3.2cm) and (8.3±2.8m) respectively, while the highest number of main stems was found in *Umgawawa* (5.2±2.1stems). Mean number of main stems in *Umhigleeg Albraimia* was (2.9±0.9stems), mean values of diameter, height, age, and mean crown in *Umgawawa* were (8.1±2.0cm), (5.7±1.3m), (7.9±0.9years), (6.2±1.1m) respectively (table 3.1).It is clear that from table 3.1, the diameter of a tree directly proportioning to the age, when the age is big the diameter increased. Height and crown of a tree also went in the same trend (Table 3.1).

Table 3.1: Growth attributes of high gum yielding hashab trees in Shikan locality, North Kordofan, Sudan

		dbh (cm)	No. Main stems	Height (m)	Age (Years)	Mean crown
Alsunt Elgarbi	Mean	7.8±2.3	3.7±1.3	4.7±0.5	8.2±2.4	6.8±1.1
	Max	10.3	5	5.4	10	9.5
	Min	4.4	1	3.9	5	5.2
Draisso	Mean	8.6±2.6	3.6±1.3	5.8±2.4	9.7±1.8	6.3±0.9
	Max	13	5	10	12	8
	Min	3.8	2	3	7	5
Demokeya	Mean	9.9±3.1	2.1±0.7	7.6±2.4	9.5±2.2	6.0±1.3
	Max	15.5	3	10	12	7.8
	Min	5.6	1	4	5	3.9
Alkara	Mean	7.2±3.0	4.2±1.3	5.8±2.3	10.1±2.2	6.8±1.5
	Max	12.9	7.0	10.0	13.0	9.6
	Min	3.6	3.0	4.0	6.0	5.0
Umhigleeg Albraimia	Mean	13.1±3.2	2.9±0.9	8.3±2.8	17.8±1.7	7.5±1.2
	Max	18	4	15	20	9.3
	Min	8.8	2	5	15	5.7
Umgawawa	Mean	8.1±2.0	5.2±2.1	5.7±1.3	7.9±0.9	6.2±1.1
	Max	12.3	9	8	10	8.5
	Min	5.1	3	4	7	4.5

3.2 Characteristics of high gum yielding hashab trees in Shikan locality, North Kordofan, Sudan

In table 3.1 there are variations in answers regarding the age of trees when producing gum for the first time. According to (41%) of respondents, the trees produce gum Arabic firstly at age of 5 years. Some producers (38%) stated that trees produce gum firstly after 5 years. Very few (5%) mentioned the age of 3 years (table 3.1). This indicated that hashab trees mostly produce gum firstly at

age of five years. However, some trees in some areas behave different. This might be attributed to soil type, rainfall amount and temperature. Regarding the date of tapping, most of respondents (90%) confirmed that the suitable time of tapping hashab trees was in October while (3%) of them said that the perfect time to tap trees is March (summer tapping).This indicated that the most suitable time to tap hashab trees is October while some trees might be not ready to be tapped at that time so it delayed to summer. The process of exudation varied in the period, about (77%) of producers stated that exudation emerges in the first ten days after tapping trees. Low percentage (3%) of respondents said that the exudation happened before the first week after tapping process. The different of exudation period of hashab trees might be due to genetic characteristics or soil factors.

3.3 Gum Productivity of high yielding hashab trees in Shikan locality, North Kordofan, Sudan

The productivity of high yielding hashab trees in the study area was calculated. The average yield of high yielding hashab trees in the area was found 7.55±2.05 kg/tree/season. The maximum yield was 9.95 kg/tree/season and the minimum weight was 5.8 kg/tree/season. Regarding the average yield of some HGYHTs in some villages of research site was also calculated. The highest yield was recorded in *Demokeya* where the tree weighted 9.95 kg/tree/season, followed by *Umgawa*wa village which recorded 9.6 kg/tree/season followed by *Umhegleeg Albraimia* village which scored 6.45 kg/tree/season and *Taloshi* village with a yield of 5.95 kg/tree/season. The lowest yield of high yielding tree was recorded in *Alkara* village which was 5.8 kg/tree/season (Table 3.2, Figure 2).

Table 3.2: Gum yields of high yielding hashab trees in Shikan locality, North Kordofan, Sudan

Calculation	Gum gained
Average	7.55± 2.05kg
Maximum	9.95 kg
Minimum	5.8 kg

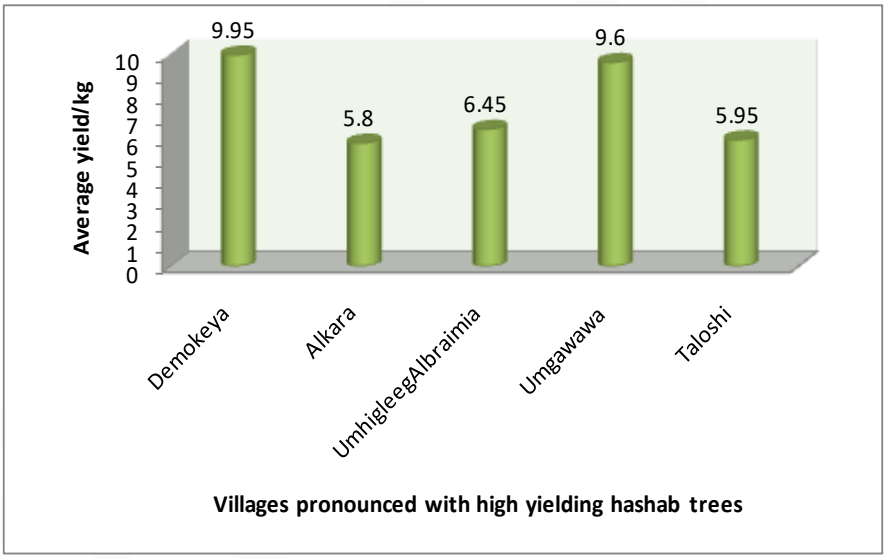

Figure 2 the average yield of high yielding hashab trees per season in some selected village from Shikan locality, North Kordofan, Sudan

4. CONCLUSION AND RECOMMENDATIONS

As conclusion, this research concluded that age of the tree is considered one of the limiting factors for high yielding hashab trees. The highest gum production of could be gain when trees tapped in early October. Hashab trees which tapped in November produced lower gum quantities. Other trees which were tapped in summer produced gum for short period and their gum nodules are always small sized. The average yield of high yielding *hashab* trees in the area was found 7.55±2.05 kg/tree/season. The maximum yield was 9.95 kg/tree/season and the minimum weight was 5.8 kg/tree/season. The highest yield was recorded in *Demokeya* where a tree weighted 9.95 kg/tree/season. As recommendations, attention must be given to the local knowledge; it should be improved and documented. Growth attributes are no enough to characterize a tree as high gum yield, hence genetic

sources of high yielding *hashab* trees might leads to better identifying of superior and high yielding *hashab* trees for domestication, conservation and mass production purposes.

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