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Contribution of Some Browse Trees in Providing Fodder for Livestock in Semi-arid Area of Al-Baja Rangeland, White Nile State-Sudan

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Abstract

The study aimed to identify the main source of browse fodder. Two transects were established with 1000 meters long. The near individual method was used to determine tree density. The diameter of twigs at browsing point, browsing level, crown area, twig diameter, and fodder productivity were estimated. SAS statistical program was used to analyze the data. There were a high significant differences according to the browsing level (BL), P< (0.0006). The stem diameter was significantly affected by the tree species, P< (0.001), the biggest stem diameter was *Acacia seyal* (22.73 cm) followed by *Acacia tortilis* var *tortilis* was (17.82 cm).

Keyword: *browse, browsing level, twig diameter, density, fodder.*

1. Introduction:

The arid and semi-arid area includes land that has an imbalance between precipitation and losses through evaporation. The maximum forage productivity of rangeland in this area depends on the amount of water, (Squires and Karami, 2015). Rangeland in arid and semi-arid areas are characterized by great variation in feed production, as forage is available in large quantities during the rainy season as a result of the growth of and annuals plant species includes grasses and forbs. But these plants dry out in a short period of the year, not exceeding three months, and disappear completely. At the long dry season occurred in this rangeland, livestock depends mainly on fodder trees which were found in arid area. The browse shrubs and trees are obviously essential for livetock, especially in the arid and semi-arid zones, (Hassan *et al*, 2015). Fodder trees are important feed sources for livestock in Africa, (Franzel *et al*, 2014). Fodder trees and shrubs are vital sources of animal feed in Sudan, particularly in arid and semi-arid areas, (Abdalla *et al*, 2017). The rangeland of Al-Baja area are characterized by a long period of dry season during the year due to the disappearance of annual plants that represent the majority of the vegetation composition in these rangeland, and hence the grazing animals in this period depend completely on browsing trees. Therefore, it must be identified the most important tree species that contributed or providing browse fodder for grazing animals and the amount of available browse productivity in Al-Baja area. There are many tree species grown naturally in Habeela rangeland of Al-Baja area namely, *Acacia tortilis* var *tortilis*, *Acacia seyal*, *Caparis* *decidua*, *Balanitis aegypitica* and *Zizphus spina-chrciti*. The study aimed to estimate the contribution of selected fodder trees on livestock feeding in Habeela rangeland of Al-Baja area, White Nile State, Sudan.

2. Material and Methods:

2.1 The Study Area:

The study was carried out ear Habeela village, Al-Baja area at El Duim locality, White Nile State. The study area located at latitude 14˚ 04' 19" north and longitude 032˚01' 45" east. Al-Baja area lies within the semi-arid zone. The vegetation cover of Al-Baja area was dominated by *Acacia tortilis*, *Acacia seyal*, *Balanites aegyptica* and *Ziziphus spina-christi*, while the understory was dominated by *Aristida spp*, *Eragrostis spp*, *Dactyloctenium aegyptium* and *Cenchrus spp*, (El Hag, 2004, cited by Abdelsalam, 2008).

2.2 Study Concept:

The concept of this study was to know the main trees species that had a vital role in providing animal feeding in the dry season at Al-Baja rangeland and estimate the quantity of fodder comes from these species.

2.3 Sampling Procedure:

The starting point was chosen randomly, and then the baseline was established using compass and GPS at East and West direction. Two line transects of one kilometer were established in angle of 180˚ South with distance 50 meters between each other.

2.4 Trees Density Determination:

Trees density was determined by using near individual method. The nearest tree in each sites of line transect was recorded and measured the distance from the point of transects. The interval between each readings was 20 meter along transect. The following formulas were used to determine the density:

$\bar{D} = \frac{\Sigma D}{n}$ (Equation 1).

$d = \frac{10000}{D^{-2}}$ (Equation 2).

Relative density = $\frac{number\ of\ species\ distances}{all\ distance\ number}\ X\ total\ tree\ density$ (Equation 3).

Where:

- $\bar{D}$ = the mean distance.
- D = distances.

- n= number of samples.
- d= total tree density (tree/ha).

2.5 Determine the Twig Diameter:

The diameter of twig at browsing point was determined by using virnier to measure the twigs that were consumed by browsing animal at past browsing season.

2.6 Browsing Level:

The browsing level is main factor to determine the available browse of fodder trees. It was determine based on the dominant animals browsed the trees at past season.

2.7 Crown Area:

According to Lazim and Dawelbait (2014), the crown area was calculated as circle. Measured the crown diameter by projected the edges of crown and measuring the length of one axis through the crown center.

2.8 Stem Diameter:

The stem diameter was determined measuring stem diameter of trees at the breast highest by using the caliper.

2.9 Browse Fodder Productivity:

Twig counted method was used to determine browse fodder productivity or tree biomass productivity. Each selected tree was divided into four quarters, and then all twigs between ground and browsing level with diameter equal or less than diameter at browsing point were counted. Three twigs form each tree species were harvested and oven dried at 105C˚ for 48 hours and weighted to get the means of twig weight. Browse fodder biomass calculated by the following:

- Tree biomass = twig weight* twig number = kg/tree
- Total biomass of tree species = tree biomass* relative density of tree species = kg
- Fodder productivity Σ tree biomass = kg/ha

2.10 Data Analysis:

The data were analyzed using SAS statistical program to analysis the variation ANOVA, and Duncan procedure was used to test the means of variable among the selected tress.

3. Results and Discussion:

3.1 Trees Density:

According to the results shown in table 1there are three dominant species were found in Habeela rangeland at Al-Baja area such as *Acacia tortilis*, *Ziziphus spina-christi* and *Acacia seyal*, its densities were 71, 67 and 65 trees / ha, respectively. It observed that the three tree species are conceder as fodder trees that provide fodder for livestock at the dry season, when fodder is scarce. The total tree density was about 220 trees / ha in the study area. Reasonable density is considered in the arid area and semi-arid rangeland. Density is one of the important characteristics that directly affect fodder trees yield. Elfeel and Elmagboul, (2016) found that the density affected positively on fodder and stems production of *Leucaena leucocephala*.

Table (1) the relative density of tree species (tree/ha).

Tree species	**Relative density (tree/ha**
Acacia tortilis	71
Ziziphus spina-christi	67
Acacia seyal	65
Balanites aegyptiaca	17
Total	**220**

- ha = hectare (10000m²)

3.2 Variation between Tree Species on Diameter of Twigs at Browsing Point and Browsing Level:

The results represents in Table 2 indicated that there were no significant differences between the tree species among twig diameter at browsing point. While there were high significant differences between three tree species interims of browsing levels, (BL), P< (0.0006). The result shown in Table 3 explains the variation among tree species according to their browsing level. The highest browsing level was found 2.82 and 2.80 for *A.tortilis* and *A.seyal* respectively, compared to 2.15 meters was found for *Z. spina-christi*. This result reflects differences of tree height grown in the range sites which helps the different kind of animals to reach the browse in different browsing levels. Abdalla, *et al* (2015) reported that, the tree height could be a suitable parameter for predicting the total browse productivity. Browsing level is conceder as the main factor that affected the available browse. This result contracted with Abdalla *et al* (2017), who found that the available browse depend mostly on browse level. Also Hassan *et al* (2015) reported that the twig diameter conceder as a major and best indicator of biomass production for *Acacia seyal*.

Table (2) Diameter of twigs at browsing point (DBP) and browsing level (BL).

Source	DF	Anova SS		Mean Square		F Value		Pr > F	
		DBP	BL	DBP	BL	DBP	BL	DBP	BL
Tree	2	0.6564	1.734	0.3282	0.8672	0.91	14.67	0.43NS	0.0006**
Rep	2	0.19	0.0136	0.095	0.0068	0.26	0.12	0.77NS	0.892NS

** Means there are a high significant difference at alpha > 0.05.

NS Means there are not significant differences at alpha > 0.05.

DBP diameter at browsing point. BL browsing level

Table (3) Variations of twig diameters at browsing point and browsing level among different trees.

Trees name	Means	
	DBP	BL
A.tortilis	2.85a	2.82a
Z. spina-christi	2.45a	2.15b
A.seyal	2.86a	2.80a

Means with the same letter are not significantly different at alpha > 0.05.

3.3 Crown and Stem Diameter:

Results showed in Table (4) revealed that there are significant differences between the means of crown and stem diameter among the different trees. *A.seyal* had a biggest crown diameter which was reach 9.51 meter compared to 8.6 and 6.57 meter for *A.tortilis* and *Z. spina-christi* respectively. Stem diameter was significantly affected by tree species, *A.seyal* recorded the biggest stem diameter (22.73), followed by *A.tortilis* (17.8) while *Z. spina-christi* had smallest stem diameter. This variation may attribute to the genotypes of the different species and their growth habitats. The increased diameter of the crown is a good indicator of the distribution of tree fodder, which makes it available to the animal. It can also it may useful in predicting tree biomass productivity. Buba (2013) suggested that the use of crown length as predictor variable.

Table (4) Variation of crown and stem diameter among tree species.

rees name	Means	
	Crown Diameter (m)	Stem Diameter (cm)
A.tortilis	8.6ab	17.82b
Z. spina-christi	6.57b	11.97c
A.seyal	9.51a	22.73a

Means with the same letter are not significantly different at alpha > 0.05.

3.4 Crown Area of Tree Species:

Results represent in Figure 1 explains the variation of crown area among trees species. The biggest area of tree crown recorded for *A.seyal* (71 m²) followed by (58.06 m²) and (33.88 m²) for *A.tortilis* and *Z. spina-christi* respectively. Crown area conceders as a good characteristic of browsing fodder trees which is make browse available for browsing animals. Abdalla *et al* (2017) found that there was positive correlation between crown areas and browse fodder productivity. Increase crown area means increase accessibility and availably of browse. This result explains that *A.seyal*, *A.tortilis* and *Z. spina-christi* were most important sources of browse in arid and semi-arid rangeland.

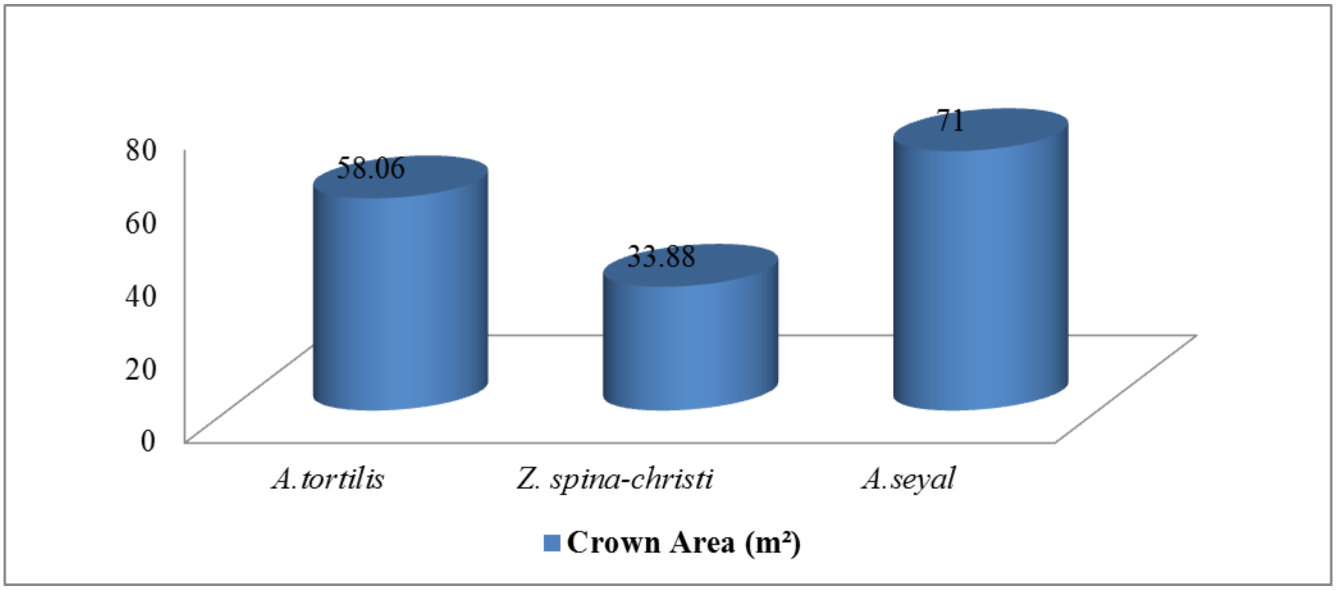

Figure (1) the variation of crown area between tree species.

3.5 Tree Biomass Attributes:

Results in Table 5 reflect the efficiency of tree species in biomass attributes such as twig number/tree, twig weight and tree biomass production. The results revealed that there were no significant differences between tree species interims of twig numbers, twig weight and tree biomass. The number of twig per tree was 265, 229 and 176 for *Z. spina-christi*, *A.tortilis* and *A.seyal* respectively. The mean of twig weight was 8.22, 5.18 and 4.72 g for *A.tortilis*, *A.seyal* and *Z. spina-christi* in that order. The tree biomass of selected species was closely, *A.tortilis* produced 1.82 kg/tree dry matter followed 1.31 kg/tree dry matter for *Z. spina-christi* and 0.83 kg/tree dry matter biomass produced from *A.seyal*. It observed that all tree species a good characteristics according to their biomass attributes such as the high dense of twigs, mean twig weight and single tree biomass production. There was a direct relation between tree fodder production and twig number and weight, when increase twigs number and weight increasing tree fodder productivity. Twig account and twig weight are the main attributes to determine tree biomass productivity of browse trees. Hassan *et al* (2015) indicated that the twig length was good indicator for browse production of browse trees.

Table (5) attributes of biomass of different trees (Twig No, Twig Weight (g) Tree Biomass (kg)

Trees name	Means		
	Twig No./Tree	Twig Weight (g)	Tree Biomass (kg)
A.tortilis	229a	8.22a	1.82a
Z. spina-christi	265a	4.72a	1.31a
A.seyal	176a	5.18a	0.83a

Means with the same letter are not significantly different at alpha > 0.05.

2.6 Fodder Productivity of Browse Trees:

According to results represented in Figure 2 the selected tree species had a good potential for browse fodder productivity. The browse trees production reach about 129.22, 87.77 and 53.95 kg for *A.tortilis*, *Z. spina-christi* and *A.seyal* trees respectively. The total fodder productivity of browse trees in Habeela range site was about 271 kg/ha. This productivity was conceder very important for fulfill the gap of fodder shortage during the long dry season occurred in this area. Franzel *et al* (2014) stated that the fodder trees meet production shortages in times of extreme climatic situations such as droughts. The browse fodder trees productivity had clear contribution in animal feeding specially in arid and semi-arid rangeland. According to Franzel *et al*, (2014), the fodder trees are easy to grow and it can provide fodder to meet forage production shortage in time of drought. Jamala, *et al* (2013) stated that increases the importance of browse trees with increasing aridity and it essential in dry season.

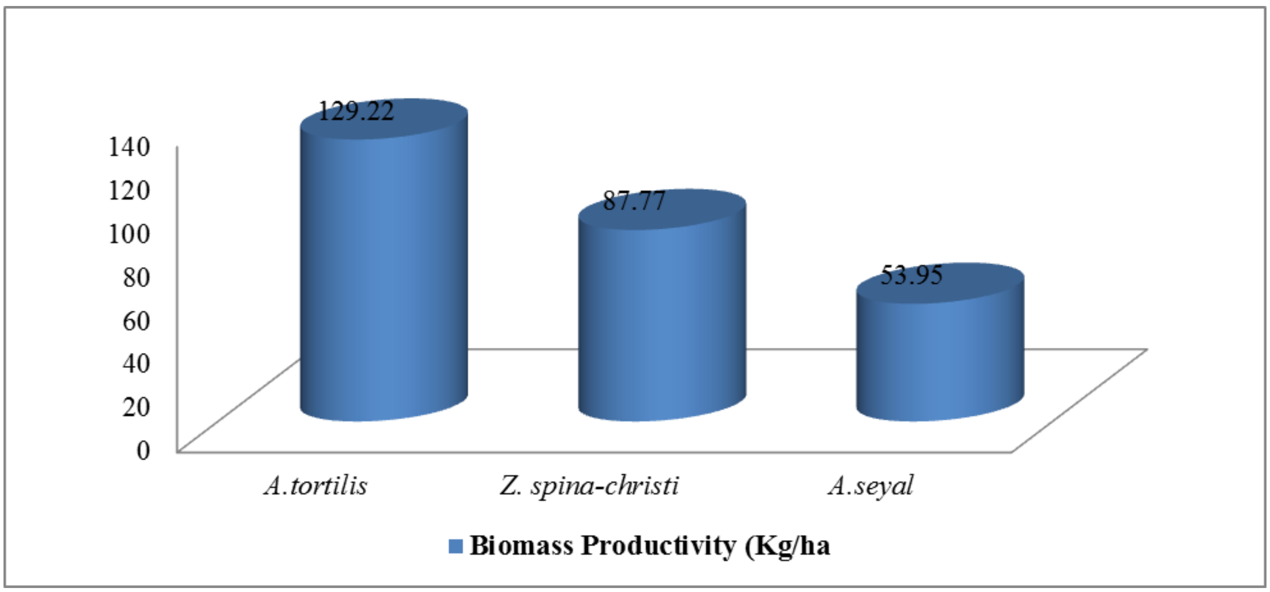

Figure (2) fodder productivity of selected tree species

4. Conclusion:

Based on results which were obtained from this study, it concluded that the browsing level conceder the main factor affecting the availability of browse fodder for browsing animals. Increase the crown area lead to increase the accessibility of browse. The browse fodder produced by the selected trees had significant contribution in livestock feeding at Habeela rangeland of Al-Baja area.

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