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# Performance of Some Selected Forage Plant Species in Sandy Loam Soil at Esunnot Area of Western Kordofan State, Sudan

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***Abstract*—** *The study was conducted at Esunnot area of west Kordofan State during 2014 and 2015 seasons. The objective of this study was to evaluate the performance of six forage species (Vigna trilobata, (philpisara) Vigna unguiculata – L (cowpea) Clitoria ternatea, Sorghum bicolor–L (Abu-sabien), Cenchrus ciliaris-L, (Haskaneet Naeim), Pennisetum americanum (Arose Elrimal) in sandy loam soil under rain- fed condition. The forage species were arranged in Randomized Complete Block Design (RCBD) with six treatments and four replications. Germination tests were conducted. Tractor and chisel plough were used for land preparation. The forage plant species were sown in the same sowing date and the seeds were broadcasted manually in each plot. Weeding was done after three weeks from sowing date. Field measurements (height, density, fresh weight and dry weight) were done at 50% flowering stage. M- STAT- Statistical package was used for statistical analysis. Duncan multiple range tests were used for means separation. Combined analysis for the two seasons was done. Association of Official Analytical Chemist (A O A C) method was used for proximate chemical analysis. Crud protein, crud fiber, organic matter, dry matter and ash % were estimated. The study revealed that, the highest plant height was Sorghum bicolor (Abu-sabien), 127.9cm.Clitoria ternatea had the most number of branches with 9 branches. Arose Elrimal showed 9.4ton/ha as the highest plant green weight/ton/ha. And again it showed the highest plant dry weight among all species with 3.8ton/ha. The highest Dry matter content was found in Cenchrus ciliaris (haskaneet naeim) with about 98.1%. The highest organic matter was Clitoriaternatea which showed 91.9%. Vigna ungiculata (Cowpea) showed the highest ash with about 13.6%. And it also showed the highest crude protein about 27.6%. Abu-sabien showed the highest crude fiber about 57.8%.*

***Keywords*—** *Heights, density, fresh and dry weight, organic matter.*

## I. INTRODUCTION

Rangelands play a major role in supplying human population with animal products in the entire land region in the world. Rangelands accounted about 16% of world food production compared to 77% of crop land [1]. The rangelands all over the world are subjected to intensive use due to increasing animal and increase in human demands and over economic activities. These factors cause severe rangelands deterioration [2] (Abdalla, 2008). In Sudan over thousand years grazing has been one of the major land use activities and continues to remain an important activity. Often grazing has been poorly managed and has led to reduce vegetation cover [3]. Grazing can change plant species composition manipulate some plant and ecosystem process and alter levels and rate of plant growth [4]. Native rangelands do not always provide the maximum usable forage of which they are capable. Furthermore, heavy and indiscriminate grazing or other factors may cause modification to the natural vegetation where only low value species remain. In other cases bush fires occurring on rangelands where herbaceous plant are few in number leave an area without sufficient vegetative cover to protect it from erosion. For these and other reasons improvement practices have been developed to increase forages production without waiting for nature to restore the area to its potential [5].

The important source of livelihood income of rural people existing in arid and semi-arid area was animal husbandry; the main problem found in these areas is the lack of forage due to the extreme climate and soil conditions [6]. There are many types of plants that are exist in these rangelands; some of these plants that grow in natural rangeland have grazing importance, thus contributing significantly to the range animal feeding. These plants need to be studied in details taking in to consideration their productivity, nutritional value and knowledge of the possibility of cultivating them [7]. Accordingly this research comes as an attempt to investigate the performance of some selected range plant species in the sandy loam soil of Esunnot rangeland of West Kordofan State.

## II. MATERIAL AND METHODS

### *A. Study Area:*

Esunnut area is located at the Southern Eastern part of the West Kordofan State. Its surrounded from the southern eastern part by Eldalanj and Elgooze localities of South Kordofan state and from the east, south, west, north and northern west its surrounded by Abu zabad, Lagawa, Elfula, Elnuhood and Elodaia localities of west Kordofan State; respectively. It lies at the low rainfall woodland savannah zone. The area is estimated to be about 8400 kms and it extended from Eldabkar town east up to Rijil binaia village near Elfula (the capital of



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West Kordofan State). It lies at low rainfall wood land savannah area. The climate is divided into three distinct seasons. During November up to March the weather is cool, the daily temperature range between 17° - 32°C. This is followed by dry summer (April to June), and the temperature range between 23° - 34°C. The rainy season starts in June or July up to August and October. Long term records (30 years) indicate that the area has an annual rainfall of about 518.5 mms. The growing season (rainy season) is characterized by warm temperatures, and high relative humidity. Its population estimated to be about 163000 inhabitancies [8].

To evaluate the performance of the six selected forage plant species under the rain - fed condition in sandy loam soil, germination tests were conducted for all the six species. Tractor and chisel plough were used for land preparation. The forage species were sown in the same sowing date in the two seasons of 2014 and 2015 and the seeds were broadcasted manually in each plot. The samples were arranged in Randomized Complete Block Design (RCBD) with six treatments (Forage species) and four replications). Weeding was done after three weeks from sowing dates. Field measurements were carried out at 50% flowering stages. Heights, density, Fresh weight, dry weight, were obtained. M-STAT- Statistical package was used for statistical analysis. Duncan multiple range tests were used for means separation. Combined analysis for the two seasons was done. Association of Official Analytical Chemist (A O A C) method was used for proximate chemical analysis [9]. Crude protein, Crude fiber, Organic matter, dry matter and ash % were estimated.

## III. RESULTS

### *A. Plant Heights:*

Results in table (1 and 2) show that there were highly significant differences in the heights of the forage species in the two seasons ( 2014 -2015) these were (*Vigna trilobata*, (philpisara) (28.7cm and 29.7cm), *Clitoria ternatea***,** ***(***Clitoria) (26.3cmand 29.3cm), *Cenchrus ciliaris-L* (Haskaneet Naeim) (45.9cm and 46.9cm), *Vigna ungiculata* – L (cowpea) (38.8cm and 40.1cm), *Pennsetum americanum* (Arose Elrimal) (84.3cm and 86.1cm), and *Sorghum bicolor–L* (Abu-sabien), (126.9cm and 128.9cm ).

### *B. Yield Parameters:*

The study shows that, there were highly significant differences between the forage plant species in the fresh weight in the two seasons 2014 and 2015 (tables 1 and 2 ) these were, (2.9t/ha and 3.2t/ha),(0.6t/ha and 0.6t/ha), (1.3t/ha and 1.3t/ha), (4.1t/ha and 4.4t/ha), (9.3t/ha and 9.5t/ha) and (6t/ha and 6.1t/ha), for (philpisara, Clitoria, Haskaneet Naeim, Cowpea, Arose Elrimal and Abu-sabien ), respectively. It also found that, there were highly significant differences in the dry matter for the same species these were (0.6t/ha and 0.7t/ha), (0.3t/ha and 0.4t/ha), (0.6 t/ha and 0.6t/ha), (0.8t/ha and 0.8t/ha), (3.7 t/ha and 3.8t/ha) and (2.2 t/ha and 2.2t/ha), respectively.

### *C. Chemical Analysis for the Six Species:*

Table (3) showed that, there were highly significant differences regarding all the parameters concerning the chemical analysis. The dry matter of the six forage species recorded (97.1, 96.2, 98.1, 97.3, 95.3 and 96.4) for philpisara, Clitoria, Haskaneet Naeim, cowpea, Arose Elrimal, Abu-sabien, respectively. Organic matter recorded (88.6%, 91.9%, 86.8%, 83.8%, 87.7% and 88.6%). The ash recorded (9.1, 4.3, 11.3, 13.6, 7,6 and 7.8), respectively. The crude protein was (24.7, 19.5, 14.6, 27.6, 6.6 and 7.7) and the crude fiber recorded (54.5, 39.7, 48.9, 52.2, 55.5 and 57.8) for the same above forage plant species respectively.

TABLE 1. Plant Height (cm), Fresh and Dry Forage Yield (t/ha) of Selected Range Forage Species During the Two Seasons (2014 and 2015):

| Species name | Plant height/cm | | Plant fresh weight t/ha | | Plant dry weight t/ha | |
|---|---|---|---|---|---|---|
| | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 |
| *Vigna trilobata* | 28.7 cd | 29.7 cd | 2.9 d | 3.2 d | 0.6 d | 0.7 d |
| *Clitoria ternatea* | 26.3 d | 29.3 d | 0.6 f | 0.6 f | 0.3 e | 0.4 f |
| *Cenchrus ciliaris* | 45.9 c | 46.9 c | 1.3 e | 1.3 e | 0.6 d | 0.6 e |
| *Vigna unguiculata* | 38.8 cd | 40.1 cd | 4.1 c | 4.4 c | 0.8 c | 0.8 c |
| *Pennisetum americanum* | 84.3 b | 86.1 b | 9.3 a | 9.5 a | 3.7 a | 3.8 a |
| *Sorghum bicolor* | 126.9 a | 128.9 a | 6 b | 6.1 b | 2.2 b | 2.2 b |
| SE± | 4.78 *** | 4.6 *** | 0.04 *** | 0.11 *** | 0.05 *** | 0.02 *** |
| CV % | 16.34 | 15.2 | 1.88 | 5.06 | 7.42 | 2.33 |

- ✓ *** Means highly significant differences
- ✓ Means with the same letters are not significantly different

TABLE 2. Combine Analysis Plant Height (cm), Fresh and Dry Forage Yield (t/ha) of Selected Range Forage Species During 2014 and 2015 Seasons

| Species name | Plant height/cm | Plant fresh weight t/ha | Plant dry weight t/ha |
|---|---|---|---|
| *Vigna trilobata* | 29.2 de | 3.0 d | 0.6 d |
| *Clitoria ternatea* | 27.8 e | 0.6 f | 0.3 e |
| *Cenchrus ciliaris* | 48.4 c | 1.3 e | 0.6 d |
| *Vigna unguiculata* | 39.5 cd | 4.2 c | 0.8 c |
| *Pennisetum americanum* | 85.2 b | 9.4 a | 3.8 a |
| *Sorghum bicolor* | 127.9 a | 6.1 b | 2.2 b |
| SE± | 3.31 *** | 0.06 *** | 0.03 *** |
| CV % | 15.75 | 3.87 | 5.35 |

- ✓ *** Means highly significant differences
- ✓ Means with the same letters are not significantly different.



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TABLE 3. Chemical Analysis for the Selected Forage Species:

| Species name | Dry matter | Organic matter | Ash | Crude protein | Crude fiber |
|---|---|---|---|---|---|
| *Vigna trilobata* | 97.1 [b] | 88 [bc] | 9.1 [c] | 24.7 [b] | 54.5 [c] |
| *Clitoria ternatea* | 96.2 [c] | 91.9 [a] | 4.3 [e] | 19.5 [c] | 39.7 [f] |
| *Cenchrus ciliaris* | 98.1 [a] | 86.8 [d] | 11.3 [b] | 14.6 [d] | 48.9 [e] |
| *Vigna unguiculata* | 97.3 [b] | 83.8 [e] | 13.6 [a] | 27.6 [a] | 52.2 [d] |
| Pannsetum americanum | 95.3 [d] | 87.7 [c] | 7.6 [d] | 6.6 [f] | 55.2 [b] |
| *Sorghum bicolor* | 96.4 [c] | 88.6 [b] | 7.8 [d] | 7.7 [e] | 57.8 [a] |
| SE± | 0.1 *** | 0.2 *** | 0.1 *** | 0.1 *** | 0.2 *** |
| CV % | 0.15 | 0.28 | 1.58 | 0.96 | 0.55 |

- ✓ *** Means highly significant differences
- ✓ Means with the same letters are not significantly different

## IV. Discussion

Abu-sabien has been known as fodder species by the herders for a long time. The higher height of Abu-sabien (127.9cm) among all species may be due to the type of the soil (sandy loam soil). [10] Reported that, the slightly acidic loamy sand produced plant height than the strongly acidic sandy clay loam soil. This type of soil is suitable for sorghum species. Arose Elrimal was shorter than Abu-sabien. That is because it was bred for grain production in the dry areas of Kordofan.

The high weight of Arose Elrimal (9.4 ton/h) and (3.8 ton/h) green and dry fodder, respectively among all the forage species may be due to the performance of pennsetum species in the sandy loam soils. And it also may be due to the fact that it's crossed to be used in low rain fall areas. In spite of the fact that Arose Elrimal was 85cm in crop height compared to about 128cm for Abu-sabien yet it out- yielded Abu-sabien in forage yield. That could be explained by the fact that Arose Elrimal has a thicker juicy stems.

Cowpea out- yielded philpisara in forage yield in this study. This could be attributed to the fact that, this crop is native to the study area (dry land area) and grown by tenants. Cowpea can produce good yields of high quality dry matter. Under dry land conditions, yields of cowpea forage have ranged from 0.5 t DM/ha to over 4 t DM/ha under favourable conditions. Production per season is usually 2 to 3 t DM/ha. Yields of up to 8 t DM/ha have been recorded in irrigated areas [11]. Cowpea does well in association with cereal crops through intercropping. In Africa, cowpea is widely intercropped with maize, sorghum and millet [12]. Farmers may harvest up to 0.4 t/ha of cowpea leaves in a few cuts with no noticeable reduction in seed yield. A potential yield of 4 t/ha of hay can be achieved with good management from a pure stand of cowpea. However, the world average yield of cowpea fodder is 0.5 t/ha (air-dried leafy stems) [10] and [13]. Hence it is adapted to all the soil and climatic conditions. From this result, it is clear that the productivity of forage for the various plant species has increased. This agreed with [14] which mentioned that, the objective of mixed/intercropping of gramminaceous and leguminous forages are to improve herbage quality, .increase biomass production and economies fertilizers besides efficient utilization of land. This result reflects the positive effect of forage mixture cultivation on the productivity of dry and fresh wet. [15] Stated that, the benefits of diversifying forage crops potentially transcend climatic conditions and crop management systems. The high content of dry matter of Arose Elrimal among all species may indicate that, this type of species is the pest type for ruminants forage. The similar observation was mentioned by Range Management Society of India, which stated that, the nutritive value of forage for ruminants is determined by the amount of dry matter consumed, its digestibility and efficiency with which digested nutrients converted to meat or milk.

Regarding the crude protein these results showed that, the percentages of crude protein in all the six forage species is quite enough for the micro-fauna which live in the rumen to analyze the crude protein to be easily absorbed by the animal, this agreed with [15] and [16] who mentioned the same results. The high crude protein content of Philipisara among all species may indicate that this type of crops is suitable for the areas characterized by temperate weather, this agreed with [13] which reported that the percentage of crude protein in the herbage of alpine grasslands is attributed to the preponderance of temperate grasses in the region.

## V. Conclusion and Recommendations

This study concluded that, to optimize the maximum productivity of dry and fresh wet of the forage plant species in sandy loam soils, forge mixture cultivation should be done so as to diversifying forage crops. The study recommends, growing of Aros Elrimal, Haskaneet Naeem, Cowpea and Philipisara in Elsunnot area and other similar environment in sandy loam and under rain-fed condition in order to contribute to filling the gap besides improving quality of forage especially in the dry season. Study of forage quality such as digestible fiber, cellulose lignin and anti-nutritional factors, were suggested.

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