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Short note [Nota corta]

EVALUATION OF HERBACEOUS RANGE PLANTS IN EARLY AND LATE RAINY SEASON IN PROTECTED AND OPEN SITES AT BUTANA AREA (ELHWATA) – SUDAN

[EVALUACIÓN DE PLANTAS DE AGOSTADERO EN EPOCA TEMPRANA Y TARDÍA DE LLUVIAS EN SITIOS PROTEGIDOS Y ABIERTOS EN EL AREA DE BUTANA (ELHWATA) – SUDAN]

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SUMMARY

A study was conducted in 2009 to estimate the dry weight yield and nutritive value of grasses and forbs at Butana area. Dry weight of forbs and grasses were higher in late season than in early season. Dry weight of forbs in the protected site was higher than in open site, while the opposite occurred for grasses. Forbs percentages in both protected and open site were higher than that of grasses. Crude protein (CP) in forbs decreased due to maturity from 22.4% to 20.2% in early rainy season and from 22.6% to 17.1% in late rainy season in open and protected site respectively. However, CP content of grasses for the same periods and site were 14.8% and 13.3 %, and 17.4% and 14.4%. CP content of pasture decreased and ash content increased ($P<0.001$) with increasing maturity of plants. NDF in forbs ranged from 53% to 43.1% and from 44.1% to 48%, ADF varied from 49% to 42.2% and from 46.1% to 45.3% and ADL ranged from 19.2 % to 15.7% and from 12.8 to 17.5% in early and late period of season in open and protected sites, respectively. Increases in NDF, ADF and ADL in early season in open site may be due to selective grazing of animals while in late season in protected site particularly ADL 17.5% might be due to maturity lignifications. NDF and ADF in grasses were higher than in forbs while ADL was lower. The study confirmed that animals prefer forbs to grasses as indicated by the decrease of forbs in open site compared with that of protected site.

Key words: Forbs; grasses; nutritive value; maturity.

RESUMEN

Se estimó el rendimiento y valor nutritivo de pastos y arbustos en el área de Butana. El peso seco de los arbustos y pastos fue mayor en la época tardía que en el época inicial. El peso seco de los arbustos en el sitio protegido fue mayor que en el sitio abierto, mientras que para los pastos sucedió lo contrario. Los porcentajes de los arbustos tanto en época inicial como tardía fueron mayores a los de los pastos. La proteína cruda (PC) en los arbustos disminuyó debido a la madurez, de 22.4 % a 20.2% en la temporada inicial y de 22.6% a 17.1% en la temporada tardía en los sitios abiertos y protegidos respectivamente. Sin embargo, el contenido de PC de los pastos en los mismos periodos y sitio fue de 14.8% y 13.3% y 17.4% y 14.4%, el contenido de PC del pasto disminuyó y el contenido de cenizas incremento ($P<0.001$) con la madurez de las plantas. FDN en los arbustos estuvo de 53% a 45.3% y FDA tuvo una variación de 49% a 42.2% y de 46.1% a 45.3% para el caso de ADL de 19.2% a 15.7% y de 12.8% a 17.5% en el periodo inicial y final de la época en sitios abiertos y protegidos respectivamente. Los incrementos en el FDN, FDA y ADL durante la época inicial en el sitio abierto podrían deberse al pastoreo selectivo de los animales, mientras que el valor de ADL de 17.5% en la época tardía podría deberse a la madurez de la lignificación. Este estudio confirma que los animales prefieren arbustos a pastos como indicador del decremento de arbustos en un sitio abierto comparado con el sitio protegido.

Palabras clave: Arbustos; Pastos; Valor nutritivo; Madurez.

INTRODUCTION

Livestock production in Sudan depends mainly upon natural range which plays a vital role in national economy through provision of animal products for local consumption and foreign exchange. The total number of the livestock is estimated by 40, 48, 41 and 3 million of cattle, sheep, goats and camels respectively (AOAD 1990).This large numbers of the livestock belong mostly to the traditional pastoral production system and raised mainly on rangelands. The rangeland area in the Sudan is estimated by 96 million hectares. The majority of these lands were in the States which are hardly hit by desertification, especially those in the north, central and western Sudan. Natural rangelands provided about 75% of the feed available for the animal wealth in the country. The remainder 25% is provided by green forage and concentrates. Under this situation, most of the livestock are kept under extensive management system and are fed exclusively on rangeland resources. This practices facing considerable difficulties due to many interacting factors which adversely affect nomadic system such as seasonal fires, over- grazing and waves of drought and desertification, (Abdel Gadir 1994). Overgrazing lead to removal of the most palatable and high quality palatable plant species by grazing domestic and wildlife animals and finally range deterioration. Nutritive value of range plants varies from area to another, within season (early and late) and between seasons and periodic drought events. The potential of any feed to support animal production depends on the quality consumed by animal and the extent to which the feed meets energy, protein, minerals and vitamin requirement (Minson, 1990). For rehabilitation of deteriorated open rangelands in Sudan, use of enclosures as means of protection from grazing was practiced in Southern Darfur in nineteen eighties (Behnke, 1985). The enclosure system resulted in an increase in carrying capacity and suitable to be applied in depleted range ecosystems to ensure their sustainability (Ali, 1997). Livestock in the Butana area depends mainly upon rangeland grasses and forbs throughout the year. Enclosure management system was used for rehabilitation of deteriorated sites. However, very little work has been done to investigate the productivity and nutritive value of the range grasses and forbs throughout the rainy season (Mahala *et al.*, 2009). Therefore, the objective of this study was to evaluate the dry weight yield and chemical composition of some range grasses and forbs in protected and open range during early and late rainy season at Butana area, Sudan.

MATERIALS AND METHODS

Study area: The study was conducted at Butana area, which refers to the region between the main Nile, Blue Nile and the river Atbar with the Khartoum, El Gadaref and Kassala railways as the southern boundary. It covers approximately 120,000 km2, lying between latitude 13˚ 50' and 17˚ 50' N and longitude 32˚ 40' and 36˚ 00' E. The climate is semi-arid with the highest temperatures being in April above 40˚ C and in October around 36˚C. January is the coolest month with the maximum temperature being 17˚C. The annual rainfall ranges between 75 mm to 600 mm. The soil a medium to fine textured light clay, sandy clay or silty clay which contains more than 40% expanding clay (Hunting Technical Services, 1966; Khalil, 1986). The native plant species include grasses (*Schoenefeldia gracilis*, *Sorghum Purpureo Sericeum* and *Sehima ischaemoids*, forbs (*Ipemea cardiosepala* (Hantut), *Ipomea Cordofana* and *Blepharis edulis)* and woody species (*Acacia tortilis*, *Acacia Seyal* and *Acacia mellifera*).

Vegetation sample Collection

The sampling of vegetation was carried out at ELhwata area in the early rainy season (August) and in the late rainy season (September), from protected (ungrazed) and open (grazed) sites. In each site, during the two periods, 20 vegetation samples were taken using 1 m^2 quadrate. The plants from each quadrate were separated to forbs and grasses, then were air dried, weighed, labeled and kept in cloth bags for chemical analysis.

Proximate analysis

Samples from each treatment were mixed, ground in hummer mill to pass through a 1 mm screen, a 60 g sample was placed in plastic bags for chemical analysis. The samples were analyzed, for determination of crude protein, (CP), ether extract (Fat), and Ash (AOAC, 1980). Neutral detergent fiber (NDF), acid detergent fiber (ADF), and acid detergent lignin (ADL) were determined using procedures of Van Soest *et al.*. (1991).

Statistical analysis

Analysis of variance was used for data analysis (Steel and Torrie, 1986). Mean separation was done using the least significant difference (LSD) procedure.

RESULTS AND DISCUSSION

Forbs yield (g/m^2)

The effect of time of season and protection from grazing on forbs dry weight is shown in Table 1. Forbs dry weight in late season was significantly higher than in early season. Differences in weight

may be because plants in early season were small and with the progress of the season, plants increased in size resulting in increase in dry weight. In the protected area, dry weight of forbs was significantly higher than in the open area. This fact could be due to that plants in the open were grazed by animals leading to low yield, while plants in the enclosure were enhanced as a consequence of providing a better opportunity for establishment of those species. Similar results is reported by Amiri *et al*.(2008) and Angassa and Oba (2010). Forbs dry weight was significantly higher in protected area in late season compared to that in early season, whether protected or open (Table 2). This may be an indication of time of the season X grazing protection interaction for forbs dry weight.

Proportion of forbs to grasses

Table 1 show that the forbs to grass ratio was higher in late season, but it was not significantly different from that in early season. On the other hand, the ratio of forbs to grasses was significantly higher in the protected area than in the grazed area. This might be due to that forbs in the protected area remained intact, while in the open area they area preferably grazed or trampled by the grazing animals as reported by Bellows (2003). The data also showed that the forbs dominant in the area compared to grasses. Similar results were reported by Ahmed (1997) in a site close to the experimental site of this study where forbs are dominating such as *Ipomea cordofan* and *Indigofera arrecta*.

Table 1. Effect of season and grazing protection on forbs dry weight and forbs to grass ratio.

Treatments	Dry weight (gm/m^2)	Forbs to grass ratio
Period		
Early	11.7 [b]	71.4 [a]
Late	43.2 [a]	74.5 [a]
SE	3.4	4.1
Site		
Open	21.7 [b]	63.6 [b]
Protected	33.2 [a]	82.3 [a]
SE	1.3	3.5

Open= grazed Protected = ungrazed
SE= standard error

Grass dry weight (gm/m^2)

The effect of time of the season and protection from grazing on grass dry weight is presented in Table 3. Grasses dry weight in late season was significantly higher than in early season. This may be due to the fact that in early season plant growth was low, while in late season the growth was at its maximum. The dry weight of grass was higher in the open compared to that in the protected area, but the difference was not statistically significant. This might be due to that grasses were less preferred by grazing animals so their dry weight slightly increased in the open area even though the difference was not significant. On the other hand in the protected area, grasses may be subjected to high competition by the dominating forbs in the range so their dry weight was lower in the protected but not to a significant level.

Table 2. Season X gazing protection interaction for dry weight of forbs (gm/m^2).

Treatments	Early	Late
Open	11.1 [c]	32.4 [b]
Protected	12.3 [c]	54.0 [a]
SE	1.2	5.7

Open= grazed Protected = ungrazed
SE= standard error

Grass to forbs ratio

In Table 3, the grass component in the range was lower than that of forbs. The grass to forbs ratio early in the season was not significantly different from that late in the season. Grass to forbs ratio was higher in grazed area than in the protected area. This is due to that forbs are reduced by being removed by grazing animals as preferred compared to grasses. On the other hand in the protected area, grass proportion was reduced due to the presence of more forbs.

Grass to forbs ratio

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Chemical composition

Forbs. The CP in forbs decreased due to maturity from 22.4% to 20.2% in early rainy season and from 22.6% to 17.1% in late rainy season in open and protected site respectively Table (4). The results showed that CP were affected significantly ($P<0.001$) by period, location and interaction between them. This result is similar to that obtained by Dougall *et al.*

(1964). Due to accumulation of non nitrogenous material at late rainy season in pasture, CP content could be decreased mainly in forbs (Mc Donald *et al*., 2000).

Table 3. Effect of season and grazing protection on dry weight (gm/m^2) and grass to forb ratio.

Treatments	Dry weight (gm/m^2)	Grass to forb ratio
Period		
Early	6.3 ^{b}	28.6 ^{a}
Late	14.5 ^{a}	25.2 ^{a}
SE	1.2	3.4
Site		
Open	12.2 ^{a}	36.4 ^{a}
Protected	8.6 ^{a}	17.4 ^{b}
SE	1.3	3.2

Open=grazed, E= early period, SE=standard error, L=late period.

Ash contents of forbs increased from 17.5 to 19.8% % in early period and from 18.3 to 18.8 to in late rainy season in open and protected site respectively Table (4). These findings were higher than 7.18% reported by Dougall *et al.* (1964) and very similar to 19.4 reported by Mahala *et al.* (2009).

Grasses. There were significant (P<0.001) variations in CP and Ash contents due to period, location and interaction between them (Table 6). Opposite to forbs CP in grasses increased due to maturity from 13.3% to 14.4% and from 14.8% to 17.4% in open and protected sites, respectively (Table 6). This observation was in consistent with Mc Donald *et al.* (2000).CP in grasses decreased due to grazing at both early and late rainy season.

Ash content in grasses decreased through the season from 30.4% to 22.8% and from 22.9% to 19.1% in open and protected sites, respectively (Table 6). These findings were higher than that reported by Mahala *et al.* (2010). It seems that grasses seem accumulated more ash than forbs. In general NDF, ADF and ADL were increased with maturity (Table 7). This result agreed with (Mahala *et al*., 2009) and (Hussain and Durrani 2009).

Table 4. The effect of season and range protection on CP%, Fat %and Ash% of forbs in Butana area(Elhawata).

Treatments	CP Period			FAT Period			ASH period		
Location	Early	Late	Means	Early	Late	Means	Early	Late	Means
Protected	22.4 ^{b}	20.2 ^{c}	21.3 ^{a}	1.3 ^{b}	0.2 ^{d}	0.7 ^{b}	17.5 ^{d}	19.8 ^{a}	18.6 ^{a}
Open	22.6 ^{a}	17.1 ^{d}	19.8 ^{b}	1.5 ^{a}	1.2 ^{c}	1.3 ^{a}	18.3 ^{c}	18.8 ^{b}	18.5 ^{b}
Mean	22.5 ^{a}	18.6 ^{b}		1.4 ^{a}	0.7 ^{b}		17.9 ^{b}	19.3 ^{a}	
SE		0.054			0.003			0.010	
Period (P)		***			***			***	
Location (L)		***			***			***	
P*L		***			***			***	

Open=grazed, E= early period, SE=standard error, L=late period, ** *= (P<0.001),
Protected = ungrazed aera, Lo=location, Pe =period, CP= crude protein

Table 6. Percentage of CP, Fat and Ash of grasses in grazed and ungrazed sites at early and late season in Butana (Elhawata).

Treatments	CP Time			FAT Time			ASH Time		
Location	Early	Late	Means	Early	Late	Means	Early	Late	Means
Protected	14.8 ^{b}	17.4 ^{a}	16.1^a	2.7 ^{b}	3.5 ^{a}	3.1 ^{a}	22.9 ^{b}	19.1 ^{d}	21.0 ^{b}
Open	13.3 ^{d}	14.4 ^{c}	13.8 ^{b}	0.8 ^{c}	0.3 ^{d}	0.5 ^{b}	30.4 ^{a}	22.8 ^{c}	26.6 ^{a}
Mean	14.1 ^{b}	16.0 ^{a}		1.7 ^{b}	1.9 ^{a}		26.7 ^{a}	20.9 ^{b}	
SE		0.054			0.003			0.010	
Pe		***			***			***	
Lo		***			***			***	
Pe*Lo		***			***			***	

Open=grazed, E= early period, SE=standard error, L=late period, ***= (P<0.001),
Protected= ungrazed area, Lo=location, Pe =period, CP= crude protein

Table 7. Chemical composition of grasses.

Treatments	NDF Time			ADF Time			ADL Time		
Location	Early	Late	Means	Early	Late	Means	Early	Late	Means
Protected	65.4 [a]	58.0 [c]	61.9 [a]	45.2 [d]	52.7 [b]	48.9 [b]	15.0 [b]	10.9 [c]	13.0 [a]
Open	51.7 [d]	61.0 [b]	56.6 [b]	51.1 [c]	54.2 [a]	52.7 [a]	9.6 [d]	15.3 [a]	12.5 [b]
Mean	58.5[b]	59.9[a]		48.1 [b]	53.5 [a]		12.3[b]	13.1[a]	
SE		0.03680			0.0322			0.0316	
Pe		***			***			***	
Lo		***			***			***	
Pe*Lo		***			***			***	

Open=grazed, E= early period, SE=standard error, L=late period, ***= (P<0.001),
Protected= ungrazed area, Lo=location, Pe =period, NDF= Neutral detergent fiber, ADF= acid detergent fiber, ADL= acid detergent lignin.

CONCLUSIONS

The study showed that the yield of forbs was higher than grasses in natural pasture in Butana. Forbs were higher in crude protein and lower in fibre.

Evaluation of pasture nutrients and yield can give valuable information that can improve the grazing management.

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