INNSPUB

International Journal of Agronomy and Agricultural Research (IJAAR)
ISSN: 2223-7054 (Print) 2225-3610 (Online)
http://www.innspub.net
Vol. 10, No. 3, p. 48-54, 2017

RESEARCH PAPER OPEN ACCESS

Optimum sowing date, seed rate and age of cutting of some rainy season sown forage crops for hay production in the Gezira

Sara A. Babiker*, Mohammed A. M. Khair, Shadia A. Salih

Forage and Pasture Research Program, Agricultural Research Corporation (ARC), Wad Medani, Sudan

Article published on March 31, 2017

Key words: Sowing date, Seed rate, Cutting age, Forage crops, Hay production

Abstract

The study involved four separate experiments *viz*, two for each of clitoria and phillipesara in 2005, 2006 and 2007 and two for each of Abu Sabeen and lubia in 2005, 2006 and 2008 at Gezira Research Station Farm (GRSF) of the Agricultural Research Corporation (ARC), Wad Medani, Sudan. The experimental design for each crop was a split-split plot design where sowing date was allotted for the main plot, seed rate for the sub plot and cutting age for the sub-sub-plot with four replications. At harvest, the parameters measured were plant count/m^2, plant height (cm), leaf/stem ratio, fresh and dry forage yield (t/ha). The results revealed that, the forage yield of clitoria was not affected by the seed rates. In contrast, phillipesara, Abu Sabeen and lubia showed very limited inter-seasonal responses to the change in the seed rate. Delaying harvesting from 45 days after sowing (DAS) to 75, resulted in a significant increase in the forage yields for the four crops. While the forage yield of phillipesara was not affected by sowing date, that of clitoria was higher when August 30 sown and those of lubia and Abu Sabeen were higher when August 15 sown.

* **Corresponding Author:** Sara A. Babiker ✉ saraae2004@yahoo.com

Introduction

Seasonality in forage production all over the world stands as a rule of thumb mainly due to the seasonality of rainfall. Despite that however, year-round provision of adequate quantities of high quality forages is paradoxically indispensible for sustainable animal production. This latter is usually being fulfilled in the developed countries by the conservation of the seasonally produced forage as silage in wet countries or as hay in hot sunny countries (Metcalfe and Nelson 1987).

Sudan is not an exception as its rainy season; the most conducive period for forage production is confined only to the period from May to October. In contrast to the developed countries, appropriate forage conservation systems for year-round use are completely lacking in Sudan. Consequently, fluctuations in livestock production throughout the year are not unusual. The livestock population in Sudan is estimated at 103 million heads and the annual forage gap is estimated at 21 million tons (75% of that of old Sudan) (Khair, 2011). Most of this forage gap is in the concentrates (Khair, 2011). Chances to increase the production of the concentrates in Sudan however, are limited. That is because the annual production of sorghum grain, the back bone of the concentrates, in Sudan hardly exceeds 5 tons and the quantities of the seed cakes are little (Khair, 2011). Added to that, considerable quantities of molasses (which are originally not very big) are being utilized in biofuel production. To bridge that big forage gap in Sudan therefore, production of large quantities of high quality forages conserved as hays remains as the most possible option.

Undoubtedly, rainfed forage production stays as the most feasible way. That is because about 10 million feddans are annually left un-harvested due to terminal drought which results in grain crop failure. Even in the irrigated agriculture, sizable areas are annually cut off production due to water shortage during grain filling stage.

Hay making requires dry and sunny condition for rapid drying of forages. These conditions in Sudan are fulfilled during late October through the following June (Adam, 1996).

Winter (November-early February) however, is not conducive for the production of large quantities of forages. The period from late February through late June on the other hand is extremely dry and hot that the economics of forage irrigation seems highly questionable (Khair and Salih, 1994). The rainy season (July- early October) therefore, remains as the most conducive period for the production of large quantities of forage under rainfed areas and with minimum irrigation in irrigated areas (Taha and Khair 2014). For Hay making, harvesting of the rainy season sown forages has to be synchronized with late October to early November to avoid quality deterioration due to aging. Hence, the sowing dates need to be shifted to sometime in August.

Optimum seed rate for phillipesara (*Vigna trilobata*) and clitoria (*Clitoria ternatea*) (Ishag and Khair, 1975 unpublished) and Abu Sabeen (*Sorghum bicolor*cv) (Ishag, 1989) were determined. The phenomenon of selfthinning with time which is reported for alfalfa (*Medicago sativa*) (Khair, 1997) is also expected in all crops under prolonged growing period. If the sowing date as an example is advanced to August as suggested above, the growing period may be short enough for the crop to be affected by selfthinning. Hence, the optimum seed rate for the forage crops under such delayed sowing need to be determined. Likewise, the age of cutting for the forage is determinant for the quantity and the quality of forages (Khair, 1993). The objective of this study therefore, is to determine the optimum sowing date, seed rate and age of cutting of rainy season sown Abu Sabeen, phillipesara, clitoria and lubia for hay making.

Materials and methods

Experimental site

The optimum sowing date, seed rate and age of harvesting of rainy season sown clitoria, phillipesara, Abu 70 and lubia were studied for hay production at GRSF of the ARC, Wad Medani, Sudan (latitude 14° 24 N, longitude 33° 29 E and altitude 406.9 m above sea level). The soil of the experimental site was heavy alkaline (pH 8.0 – 8.6) with cracking clay (40 –65%) and less than 1% organic carbon and 0.03% total nitrogen and total phosphorus (406–700 ppm).

The study involved four separate experiments *viz*, two for clitoria and phillipesara in 2005, 2006 and 2007 and two for Abu Sabeen and lubia in 2005, 2006 and 2008.

Experimental design

The experimental design for each crop was split-split plot where sowing date, *viz* (15/8 and 30/8) was the main plot, seed rate, *viz*, [(10, 20, 30 kg/fed for Abu 70), (5, 7.5 and 10 kg/fed for each of clitoria and phillipesara) and (20, 25 and 30 kg/fed for lubia)] was the sub plot and cutting ages, *viz* 45, 60 and 75 (DAS) was the sub-sub-plot with four replications.

Cultural practices

Land was disc ploughed, disc harrowed, leveled then ridged (80 cm). The sowing methods of clitoria and lubia were in holes 15 cm apart, while the sowing methods of Abu 70 and phillipesara were drilling on the top of the ridges. Fertilizer (186 kg urea/ha for Abu Sabeen and 46 kg urea/ha for clitoria, phillipesara and lubia) was placed prior to seeding. Irrigation was applied every 10 to 14 days according to weather conditions. The experiments were kept weed-free by hand weeding.

Data collected

At harvest, phenological data was taken, a single cut was taken from each crop and the parameters measured were plant count in an area of 1 m^2, plant height (cm) as a mean of five randomly selected plants and leaf/stem ratio as an average of three plants on a dry matter basis. The crops were cut from the ground level in an area of 3.2 m^2, i.e. 0.8 * 4 m^2. The fresh matter yield was immediately weighed in the field and a subsample of 1 kg fresh matter was oven-dried at 85°C for 48 hours for dry matter determination.

Statistical analysis

A standard analysis of variance was performed for each experiment in each year using Genstat version 12. For each crop, homogeneity test for the dry forage yield was performed prior to the season based combined analysis.

Results

Even though many agronomic data were collected, the reported data in this report are confined to those of the dry forage yield.

Phenology

Irrespective of the sowing dates, lubia and phillipesara remained vegetative across the three cutting ages (Table 1). As for Abu Sabeen, it remained vegetative when cut at 45 DAS in both sowing dates. However, when cut at 60 DAS, the early sown crop was at booting stage and the lately sown one was starting heading. When cut at 75 DAS, Abu Sabeen attained the stage of 100% heading and 75% heading for August 15th and 30th, respectively.

Table 1. Phenological Stages of four forage crops at different cutting stages and sowing dates.

Cutting ages (DAS)	45	60	75
Sowing date		15/8	
Crop			
Clitoria	10% F	75% F	early pods
Phillipesara	Veg.	Veg.	Veg.
Lubia	Veg.	Veg.	Veg.
Abu 70	Veg.	Boot stage	Full heeding
		30/8	
Clitoria	10% F	10% pod	50% pod
Phillipesara	Veg.	Veg.	Veg.
Lubia	Veg.	Veg.	Veg.
Abu 70	Veg.	SH	75% H

F: Flowering, H: Heading, Veg: Vegetative, SH: Start heading.

Clitoria, seemed to be a day neutral crop. It was at the stage of 10% flowering when cut at 45 DAS for both sowing dates. When cut at 60 DAS, it was at 75% flowering stage for the early sowing and started pod setting in the late sowing (30th Aug.). When cut at 75 DAS however, the crop was at the stage of start podding and 50% podding when sown on August 15th and 30th, respectively.

Dry forage yield (t/ha)

Effect of seed rate

Table (2) shows the main effect of the seed rate on the dry forage yields of the four crops. In general, the forage yield of clitoria was not affected by the seed rates. In contrast however, phillipesara, Abu Sabeen and lubia showed very limited inter-seasonal responses to change in the seed rate.

For instance, the trend of the seed rate effect in phillipesara was not consistent among the three seasons. In 2007, there was no effect but in 2006, both yields of 5 and 7.5 kg/fed were significantly out yielded by that of 10 kg/fed. In 2005 however, the yield of 10 kg/fed was significantly different from that of 5 kg/fed, but both of these latter were not different from that of the 7.5 kg/fed. In the case of lubia, the effect of the seed rate was not significant in 2006 and 2008. In 2005 however, the yield of 20 kg/fed was significantly lower than that of 25 and 30 kg/fed.

Table 2. Effect of the seed rate on the dry forage yield of four forage crops sown during 2005, 2006, 2007 and 2008 at Gezira Research Station Farm.

Seed rate (kg/fed)	Seasons			
	2005	2006	2007/2008	Mean
	Phillipesara			
5	3.18	1.71	3.61	2.83
7.5	3.33	1.81	3.73	2.96
10	3.44	2.49	3.60	3.18
SE±	0.071	0.067	0.138	0.057
C.V.(%)	14.24	18.08	20.59	18.5
	Clitoria			
5	1.65	1.62	2.72	2.00
7.5	1.78	1.66	2.73	2.06
10	1.74	1.79	2.82	2.12
SE±	0.051	0.070	0.096	0.043
C.V.(%)	17.07	15.89	17.84	17.8
	Lubia			
20	2.11	1.69	2.28	2.03
25	2.39	1.73	2.25	2.13
30	2.36	1.63	2.39	2.13
SE±	0.074	0.082	0.124	0.055
C.V.(%)	15.91	16.97	17.72	17
	Abu Sabeen			
10	3.35	2.96	3.79	3.37
20	3.98	3.39	3.74	3.70
30	3.78	3.37	4.52	3.89
SE±	0.179	0.171	0.225	0.112
C.V.(%)	22.58	19.40	22.29	21.7

In the case of Abu Sabeen, the effect of seed rate was significant in 2005 and 2008. While the highest yield in 2008 was exclusively associated with the highest seed rate (30 kg/fed), in 2005, the yield of the second seed rate (20 kg/fed) was significantly higher than that of the 10 kg/fed, but was comparable to that of the 30 kg/fed.

The combined analysis showed that, no significant differences was found among the seed rates for both clitoria and lubia. In contrast, significant differences were found among seed rates for Abu Sabeen and phillipesara. The highest dry forage yield was obtained by the seed rate of 10 kg/fed for phillipesara (3.18 t/ha). For Abu Sabeen however, the highest yield was obtained by the seed rate 30 kg/fed (3.89 t/ha), but no significant differences was found between the seed rate of 20 and 30 kg/fed.

Effect of cutting age

Table (3) shows the main effect of the cutting age (DAS) on the forage yields of phillipesara, clitoria, lubia and Abu Sabeen. The common trend in the four crops is that delaying harvesting from 45 (DAS) through 75 (DAS), resulted in a significant progressive increase in the forage yields. The highest dry forage yield of phillipesara was 5.5 t/ha in 2007 and 4.6 t/ha in 2005. Likewise, those of clitoria were 2.5 t/ha in 2005 and 4.2 t/ha in 2007. The highest for lubia was 3 t/ha in 2005 and 3.6 t/ha in 2008. Those of Abu Sabeen were 6.1 and 6.5 t/ha in 2005 and 2008, respectively. The results of the combined analysis revealed that, highly significant differences were found among the cutting ages for the four forage crops and the highest dry forage yields were achieved when they were cut at 75 (DAS).

Table 3. Effect of cutting age (DAS) on the dry forage yield of four forage crops sown during 2005, 2006, 2007 and 2008 at Gezira Research Station Farm.

Cutting age	Seasons			
	2005	2006	2007/2008	Mean
	Phillipesara			
45	1.67	1.00	1.54	1.41
60	3.72	2.12	3.89	3.24
75	4.56	2.90	5.50	4.32
SE±	0.096	0.074	0.153	0.065
C.V.(%)	14.24	18.08	20.59	18.5
	Clitoria			
45	0.61	0.73	1.13	0.82
60	2.02	1.91	2.93	2.28
75	2.54	2.44	4.21	3.06
SE±	0.060	0.055	0.100	0.043
C.V.(%)	17.07	15.89	17.84	17.8
	Lubia			
45	1.32	1.27	1.05	1.21
60	2.53	1.50	2.29	2.11
75	3.01	2.29	3.58	2.96
SE±	0.074	0.058	0.084	0.042
C.V.(%)	15.91	16.97	17.72	17

Cutting age	Seasons			
	2005	2006	2007/2008	Mean
	Abu Sabeen			
45	1.58	2.35	1.54	1.82
60	3.44	3.68	4.03	3.72
75	6.09	3.70	6.48	5.42
SE±	0.171	0.128	0.183	0.093
C.V.(%)	22.58	19.40	22.29	21.7

Effect of sowing date

Table (4) shows the main effect of the sowing date on the dry forage yields of phillipesara, clitoria, lubia and Abu Sabeen. Lubia and Abu Sabeen sown on Aug. 15th resulted in higher dry forage yields than sowing on Aug. 30th. For clitoria however, sowing on Aug. 30th resulted in higher dry forage yields. In contrast, the dry forage yield of phillipesara was not significantly affected by sowing date in the three seasons. In full agreement with the seasonal analysis, the combined analysis showed that, significant differences were found between the sowing dates for clitoria, lubia and Abu Sabeen. The highest dry forage yield was obtained from the August 15th sowing for the lubia and Abu Sabeen (2.25 and 4.39 t/ha, respectively), while the August 30th sowing was the best for the clitoria (2.22 t/ha).

Table 4. Effect of sowing date on the dry forage yields of four forage crops sown during 2005, 2006, 2007 and 2008 at Gezira Research Station Farm.

Sowing date	Seasons			
	2005	2006	2007	Mean
	Phillipesara			
15 August	3.41	2.16	3.55	3.04
30 August	3.23	1.85	3.74	2.94
SE±	0.081	0.153	0.180	0.083
C.V.(%)	14.24	18.08	20.59	18.5
	Clitoria			
15 August	1.67	1.50	2.51	1.89
30 August	1.78	1.88	3.00	2.22
SE±	0.042	0.019	0.066	0.027
C.V.(%)	17.07	15.89	17.84	17.8
	Lubia			
15 August	2.49	1.90	2.34	2.25
30 August	2.08	1.47	2.27	1.94
SE±	0.117	0.027	0.105	0.053
C.V.(%)	15.91	16.97	17.72	17
	Abu Sabeen			
15 August	4.59	3.71	4.88	4.39
30 August	2.82	2.77	3.15	2.92
SE±	0.117	0.155	0.204	0.094
C.V.(%)	22.58	19.40	22.29	21.7

Interaction effect

The interaction effect of sowing date x seed rate, cutting age x seed rate and sowing date x seed rate x cutting ages on dry forage yield of four forage crops was not significant (Data not shown). On the contrary, the interaction effect of sowing date x cutting age was significant (Table 5).

Table 5. Sowing date and cutting age (DAS) interaction effect on the dry forage yields of four forage crops sown during 2005, 2006, 2007 and 2008 at Gezira Research Station Farm.

Cutting age	45		60		75		SE±
Sowing date	15 Aug.	30 Aug.	15 Aug.	30 Aug.	15 Aug.	30 Aug.	
	2005						
Phillipesara	1.50	1.84	4.10	3.32	4.63	4.50	0.136
Clitoria	0.47	0.75	2.21	1.83	2.33	2.75	0.085
Lubia	1.34	1.29	2.88	2.19	3.26	2.76	0.105
Abu Sabeen	1.25	1.90	4.50	2.38	8.01	4.17	0.241
	2006						
Phillipesara	1.17	0.83	2.23	2.01	3.07	2.72	0.105
Clitoria	0.53	0.94	1.75	2.07	2.23	2.65	0.078
Lubia	1.71	0.83	1.67	1.32	2.33	2.26	0.083
Abu Sabeen	2.56	2.14	4.67	2.69	3.90	3.50	0.182
	2007/2008						
Phillipesara	1.05	2.03	4.21	3.57	5.38	5.63	0.217
Clitoria	0.67	1.58	2.94	2.91	3.91	4.51	0.142
Lubia	1.08	1.02	2.12	2.46	3.82	3.34	0.118
Abu Sabeen	1.96	1.13	4.23	3.83	8.45	4.51	0.259

Sowing date x cutting age effect

Table (5) shows the sowing date x cutting age interaction effect on the dry forage yields. In general, the effect of sowing date was extremely limited when the crop was cut at 45 DAS. Thereafter however, the effect of sowing date showed to be obvious.

Crop wise, however, sowing date x cutting age interaction effect on phillipesara was very limited and not worth of discussion. In clitoria however, the advancement of the cutting age seemed to clarify the effect of the sowing date but with general consensus that significantly high yield of the crop was associated with sowing on August 30 and harvesting at 75 DAS. In lubia, highest yields were associated with cutting the crop at 75 DAS and sowing on August 15. In Abu Sabeen, significantly highest yields were mostly associated with sowing on August 15 and harvesting the crop at 75 DAS. The results of the combined analysis reflected that,

the highest dry forage yield was obtained for lubia and Abu Sabeen when they were sown on August 15th and cut at the age of 75 DAS (3.14 and 6.79 t/ha, respectively) while for clitoria sowing on August 30th and cutting at the age of 75 DAS resulted in the highest yields (3.3 t/ha) (Table 6).

Table 6. Combined analysis of sowing date and cutting age (DAS) interaction effect on the dry forage yields of four forage crops sown during 2005, 2006, 2007 and 2008 at Gezira Research Station Farm.

Cutting age	45		60		75		
Sowing date	15 Aug.	30 Aug.	15 Aug.	30 Aug.	15 Aug.	30 Aug.	SE±
Phillipesara	1.24	1.57	3.51	2.97	4.36	4.28	0.112
Clitoria	0.56	1.09	2.30	2.27	2.82	3.30	0.057
Lubia	1.38	1.05	2.22	1.99	3.14	2.78	0.072
Abu Sabeen	1.92	1.72	4.47	2.97	6.79	4.06	0.143

Discussion

The four crops of this study are short day plants and hence, require long days for high biomass yields. If sown early enough (June-July) in the Gezira, they produce high biomass yields but their harvesting will be during the middle of the rainy season. The conditions of such a period i.e. the rainy season, is not conducive for hay making as this latter require sunny and hot condition. Such conditions prevail in the Gezira after October first. For that reason, the emphasis put on this study were how late these forage would be sown to attain acceptable yields immediately after the rain stops in the Gezira.

Time course population change due to selfthinning is very common among long standing crops such as alfalfa (Khair, 1997). If left unharvested for long periods, such selfthinning does not affect the yields due to the compensatory effect of tillering of the remainder of the crop (Khair, 1997). The growing season in this study was deliberately shortened by late sowing to avoid un due loss of quality by aging of the crops. Assuming such period is short enough for considerable selfthinning, increasing the seed rate did not in general increase the forage yields of most of the crops. Few exception were that 10 kg/fed had resulted in the highest yield of phillipesara in 2006 and the yield of 25 kg/fed was higher than that of 20 kg/fed in lubia in 2005.

Hence, the 20 kg/fed reported for Abu Sabeen (Ishag, 1989) and the 5 kg/fed reported for clitoria (Ishag and Khair, 1975 unpublished) were further consolidated in this study. Regarding phillipesara in 2005 and 2006, the yield of 5 kg/fed was surpassed by those of 10 kg/fed. In case of lubia however, only in 2005 yield of 20 kg/fed was significantly surpassed by that of 25 kg/fed.

As the four crops require longer days for high biomass yield, delaying sowing date to the second half of August was expected to remarkably reduce forage yields. This was not the case for the four crops as their yields closely resembled those of early sown ones (Khair, 1999). Within the studied sowing dates, the yields of lubia and Abu Sabeen in this study were clearly affected by delaying the sowing date from August 15th to August 30th. Those of clitoria were higher when sown on August 30th while those of phillipesara were not affected. The lack of differences among the yields of phillipesara among either sowing dates, justifies sowing the crop on August 30 to avoid rains of August which render the soil hardly unworkable.

As a rule of thumb, the yield and quality of forages are inversely affected by the length of the growing period (Khair, 1999). Consequently however, harvesting the crops at 75 DAS even though increased the yields but the quality is expected to be lower than those of 60 DAS. The crude protein percentage of phillipesara, clitoria and lubia at the age of 70 days were 13.7, 14.5 and 13.9 % (Khair, 1999). Hence, the forage quality of the three legumes when harvested at 75 DAS seem to be highly acceptable to livestock (Pigden, 1969).

Irrespective of the sowing dates, the yields of the four crops when harvested at 45 DAS were very low. Similar low yields were reported for 4 to 6 weeks harvested barley (Salih *et al.*, 2006) phillipesara and clitoria (Khair, 1999) and Abu Sabeen (Eltalib, 2009). When harvested at 60 DAS, the yields of the four crops were not affected by sowing date as in 2006 and 2007/08. In 2005 however, the yield of the four crops were higher in Aug. 15th compared to the Aug. 30.

When harvested at 75 DAS however, the yields of phillipesara were sowing date independent, while those of clitoria were higher in August 30 sowing. In contrast however, the yield of lubia and Abu Sabeen at 75 DAS cutting were higher in August 15th sowing compared to the August 30.

Conclusions

The highest yield of phillipesara, lubia, clitoria and Abu Sabeen were associated with cutting at 75 DAS. Regarding the sowing date, the yields of phillipesara were sowing date independent, the yield of clitoria was highest when August 30th sown, while those of Abu Sabeen and lubia were highest when sown in August 15th. The optimum seed rate for the four crops was 10, 5, 20 and 20 kg/fed for phillipesara, clitoria, lubia and Abu Sabeen respectively.

References

Adam HS.1996. Agroclimatology, (in Arabic). University of Gezira, Sudan.

Eltalib MAM. 2009. Forage yield potential of the secondary crop of *Sorghum biocolor* L. Moench Cv. *Abu Sabeen* as influenced by some agronomic practices of the primary crop. PhD. Thesis, Sudan University of Science and technology.

Ishag HM, Khair MAM. 1975. (unpublished). Effect of seed rate and nitrogen fertilizer on the forage yield of clitoria and phillipesara.

Ishag HM. 1989. Pioneer 988. Aforage sorghum for irrigated Gezira. A report submitted to the variety release committee, ARC, Wad Medani, Sudan.

Khair MAM, Salih AA. 1994. Effect of watering interval on forages yield and quality of certain forages. Annual Report, Gezira Research Station, Wad Medani, Sudan.

Khair MAM. 1993. Forage yield potentials of three legumes under irrigation in the Sudan, Sudan Journal of animal production 6 pp 25-35.

Khair MAM. 1997. Effects of seed rates on the population and yields of alfalfa on heavy clays in Sudan. University of Khartoum Journal of Agricultural Science **5(2)**, 23-26.

Khair MAM. 1999. Principles of Forage Production. Training and Publication Administration. Wad Medani: Agricultural Research Corporation.

Khair MAM. 2011. Messages to Upgrade the Production and Consecution of Forages in Sudan. Training and Publication Administration. Wad Medani: Agricultural Research Corporation (in Arabic).

Metcalfe DS, Nelson GJ. 1987. The Botany of Grasses and Legumes. In Forages, The Science of Grassland Agriculture. Heath, M. E., Barnes, R. F. and Metcalfe, D. S. (Ed) IOWA State University press.

Pigden WJ. 1969. Laboratory analysis of herbage used to predict nutritive value. In Campebl J. B. (Ed). Experimental Methods for Evaluating Herbage. Ottawa Publication 1315. Canadian department of Agric..Queens printer pp 52-72.

Salih SA, Khair MAM, Gangi AS. 2006. Effect of seed rate and sowing date on growth, development, plant population and forage yield of barley in the Gezira, Sudan. University of Khartoum Journal of Agricultural Science **14(2).** p. 252-264.

Taha EY, Khair MAM. 2014. Effect of Irrigation Regimes on Water Productivity of some Rainy Season Forages in the Gezira, Sudan. University of Khartoum, Journal of Agricultural Science **22(1),** 166-178.