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Comparative Evaluation for Yield and Nutritive Value of Irrigated Grasses in Oman

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ABSTRACT

This research was conducted over two years (1991 and 1992) to evaluate the yield and nutritive value of Rhodes grass (*Chloris gayana*) variety Callide, which is the main irrigated grass in the Sultanate of Oman, versus four other irrigated grasses : Green panic (*Panicum maximum*) variety Trichloglume; Gatton panic (*Panicum maximum*); Signal grass (*Brachiaria leucumbers*) and Bambastic panic (*Panicum coloratum*). All five grasses were evaluated for yield and nutritive value using seven cuts/growing season. Dry matter (DM) yield differed significantly among grasses ($P<0.05$). Gatton panic had the highest yield, followed by Rhodes grass, Green panic, Bambasti panic and Signal grass. Cutting time had no significant effect ($P<0.05$) on DM yield of grasses, however there was a significant interaction ($P<0.01$) between cutting time and type of grass. Signal and Bambasti panic were found to be relatively more nutritive, with significantly ($P<0.005$) low crude fiber, high nitrogen free extract ($P<0.005$) and high organic matter digestibility ($P<0.005$) compared to the other grasses. Overall gross energy and protein yields per hectare were higher for Gatton panic, Rhodes grass and Green panic. Gatton panic seems to have a good potential as an irrigated grass to replace Rhodes grass in the Sultanate.

Key Words : Yield, Nutritive value, Irrigated grasses, Energy, Protein, Digestibility.

INTRODUCTION

The development of forage production systems in the Sultanate of Oman has been based on selection of suitable forage types and evaluation of their response to fertilizers under irrigation conditions, their tolerance to salinity and their ability to persist and develop successfully as perennial forages under the arid climatic conditions of the country.

Rhodes grass, currently the major irrigated grass in the Sultanate, is reported to be relatively tolerant to salinity and drought (ICAR, 1969). It is also reported to be responsive to fertilizer particularly nitrogen (Farnworth and Ruxton, 1974a); phosphate (Farnworth and Williams, 1977) and potash (Farnworth and Williams, 1978). Rhodes grass also proved to be a successful reclamation crop for saline soils in Saudi Arabia, with a DM-yield of 15 t/ha. (Farnworth and Williams, 1977).

Under the climatic conditions of the Sultanate of Oman, Rhodes grass showed a characteristic cyclic pattern of growth, with yield peaking in the summer around July and declining to a low in the winter during January and February. DM yields range from 20 to 53.5 t/ha (Stephens, 1993). This drop in yield tends to affect roughage supply to stall-fed ruminants in the country.

There is a continuous increase in the area cultivated by Rhodes grass in the Sultanate, however, because of drought, and the severe shortage in underground water. There is also a need for other irrigated grasses with higher water use efficiency (WUE), yields and nutritive value in comparison to Rhodes grass.

Research results in Saudi Arabia showed that Panic species gave good yield and frequent cutting with higher protein and lower crude fiber contents compared to Rhodes grass (Farnworth and Ruxton, 1973). It was also reported that Signal grass is tolerant to salinity and drought with good nutritive value (ICAR, 1969).

The main objective of this research was to evaluate yield and nutritive value of Signal and Panic grasses in comparison to Rhodes grass.

MATERIALS AND METHODS

The research was carried out at Rumais Livestock Research Station, Sultanate of Oman (Latitude 23° 41' N and Longitude 58° E). The soil is a sandy loam with a pH ranging 7.5-8.7. This wide range in soil pH was probably due to the variation in soil composition and amount of organic matter in the soil. The climate of the area is hot and humid with very low rainfall ranging 50-60 mm per annum. Average minimum and maximum temperatures range between 13.5 to 17.9°C in December (winter season) and 27.4 to 42.1°C in July (the hottest month of the year). Evapotranspiration rate (mm/day) varies between 3.6 (Dec. - Jan.) to 10.8 (June-July).

The grasses were sown on March 2, 1991. Each grass was replicated twice in two plots (2m x 1.5m). The grasses were broadcast at a seeding rate of 12.5 kg/h and covered by hand. Plots were surface irrigated twice a week with an annual quantity of water ranging 2500 - 2600 mm/ha. Fertilizers were broadcast by hand in seven equal doses. The first dose was given two weeks after sowing at a rate of 50 kg N/ka as urea (46% N) + 50 kg N/ka as a compound fertilizer (20-10-10), 25 kg P_2O_5 and 25 kg K_2)/ha. The same dose of the fertilizers was repeated after each cut until the 6th cut.

The grasses were cut seven times with the 1st cut on 19/5/91; 2nd on 16/7/91; 3rd on 26/8/91; 4th on 29/9/91; 5th on 1/12/91; 6th on 15/1/92 and 7th (last) cut on 7/3/92. In all cuts, height of cutting ranged between 5-10 cm. For each grass and in each cut, the two plots were harvested at the same time for estimation of dry matter yield (DM). Sub-samples of 1 kg were taken randomly from each plot and for each grass, dried at 105°C overnight, ground to pass a 1 mm sieve and stored for chemical (proximate) analysis. The proximate analysis was done according to the Official methods of analysis of the Association of Official Analytical Chemists (A.O.A.C, 1984). *In vitro* organic matter digestibility (%) was determined for each forage according to Tilley and Terry (1963). Nutritive value of the grasses were estimated for the seven different cuts.

Results of the DM-yield and nutritive value of the grasses in the seven different cuts were analyzed as pooled analysis of variance for measurements over time based on a randomized complete block design (RCB), similar to that for the standard split-plot design (5 grasses x 7 cutting times x 2 replications) with grasses as main plots and times cuttings as sub-plots according to Gomez and Gomez (1984).

RESULTS AND DISCUSSION

The DM-yields of the different grasses are presented in Table 1. The highest yield was obtained for Gatton panic and the lowest for Signal grass, though the differences among Gatton panic Rhodes grass and Green panic, were not statistically significant, however there were significant differences ($P<0.05$) for Gatton panic, Green panic and Rhodes grass over Signal grass.

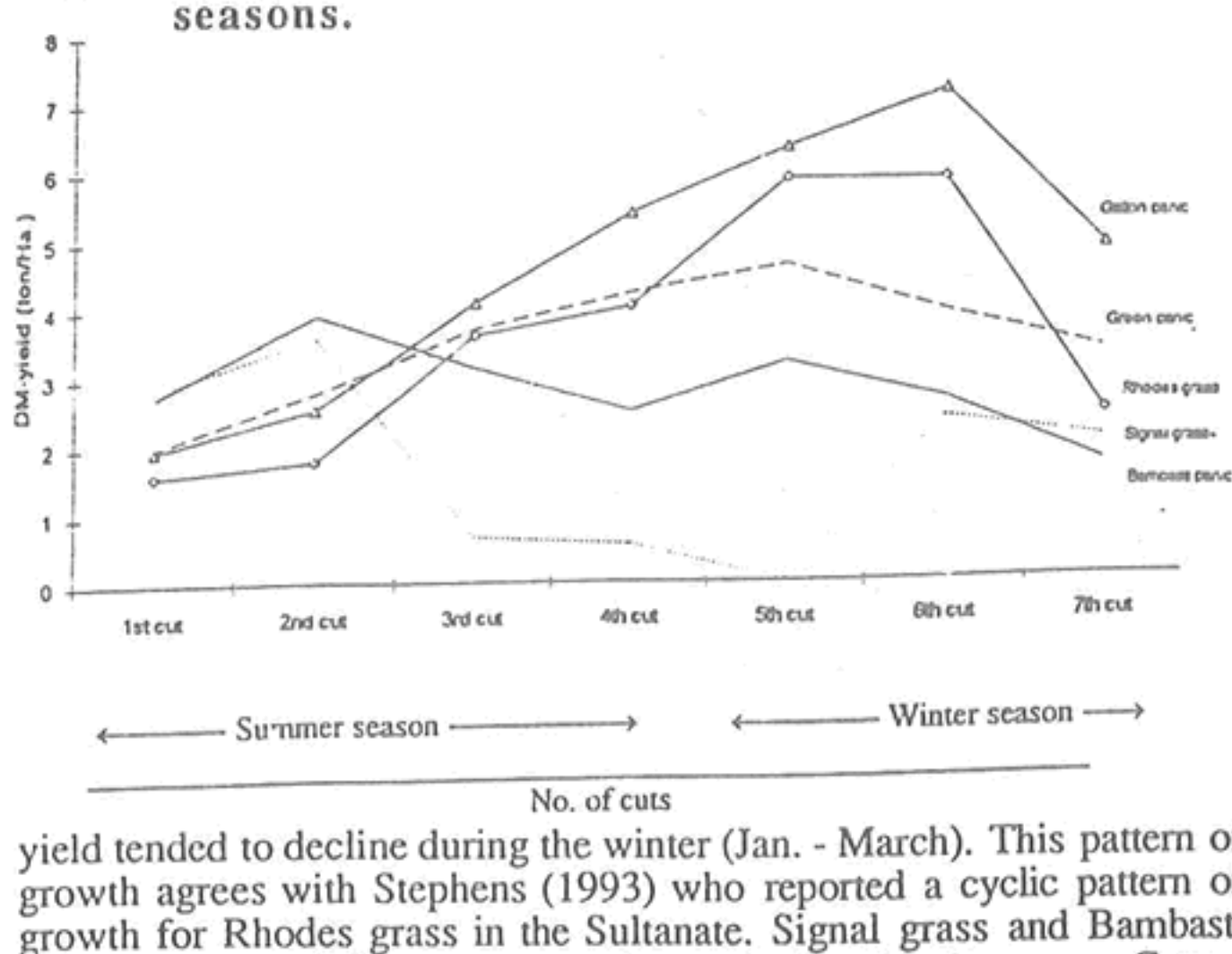
For all grasses, DM-yield was low during the 1st cut and increased gradually, peaking some where between the 5th and 6th cuts and then declining from the 6th cut for Gatton panic, and Rhodes grass and from the 5th cut for Green panic (Fig. 1). These three grasses had similar growth trend. They grew better between August-December and

Table 1. Cumulative DM-yield of irrigated grasses (t/ha. year) and mean DM-yield per cut (t/ha)

Parameters	DM-yield	SE*
Type of grass (cumulative yield)		0.9
Rhodes grass	25.0^{ab}	
Green panic	24.2^{ab}	
Gatton panic	31.2^{a}	
Bambasti panic	19.7^{bc}	
Signal grass	12.0^{c}	
Yield / cut (cutting time)		0.3 (NS)
1st.	2.9	
2nd.	3.6	
3rd.	3.6	
4th.	3.3	
5th.	2.7	
6th.	3.3	
7th.	2.9	

SE = Standard error of means .
^{a,b,c} Means followed by the same letter (s) for grasses are not significantly different ($P > 0.05$) according to LSD test.
LSD (0.01) = 4.9.
NS = No significant differences between cutting times ($P > 0.05$) .
Note that there was a significant interaction between type of grass and cutting times ($P < 0.01$) .

Fig. 1. DM-yield of the grasses in the different cuts and seasons.



yield tended to decline during the winter (Jan. - March). This pattern of growth agrees with Stephens (1993) who reported a cyclic pattern of growth for Rhodes grass in the Sultanate. Signal grass and Bambasti panic showed a different pattern of growth than Rhodes grass, Gatton panic, and Green panic. Signal and Bambasti panic peaked during the 2nd cut (July) and then DM-yield decreased to a minimum value by the 5th cut for Signal grass and by the 4th cut for Bambasti panic, respectively. They both peaked again during the winter season and tended to decrease by the 7th cut (Fig. 1).

The DM-yield reported for Rhodes grass in this study was in the range of yields quoted by Stephens (1993).

Signal grass and Bambasti panic tended to have significantly ($P<0.05$) lower crude fiber, higher nitrogen free extract (NFE) and higher, but not significantly different ($P<0.05$) crude protein contents compared to Rhodes grass and Green panic (Table 2). The latter were more or less similar in their nutritive value. Gatton panic was relatively better in nutritive value compared to both Rhodes grass and Green panic. Gatton panic had the highest crude protein content of all the grasses (10.7%). However, differences among all grasses for protein content was not significantly different ($P<0.05$).

In vitro organic matter digestibility (% IVOMD), total energy and protein yields of the grasses are shown in Table 3. Signal grass had the highest %IVOMD and the highest metabolizable energy (ME, MJ/kg

DM) content of all the grasses, followed by Gatton and Bambasti panic. However, even though Signal grass appeared to be the most nutritive grass, it yielded the least amounts of total energy and protein per hectare simply because of its low DM-yield. The highest total yields for both energy and protein were reported for Gatton panic, followed by Rhodes grass and Green panic.

Gatton panic yielded 28% more energy and 50% more protein than Rhodes grass, which is currently the major irrigated grass in the Sultanate, with no disease problems, suitable to mechanical harvesting and bale-making, and responsive to fertilization. It is capable of giving seven cuts/year with every cut at least equaling Rhodes grass and with a total DM-yield, 25% higher than Rhodes grass. The superiority of Gatton panic was more apparent when both DM-yield and nutritive value were considered together. The results obtained in this study demonstrated the potential of Gatton panic as an irrigated grass which may successfully replace Rhodes grass in the Sultanate of Oman.

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Table 2. Nutrient composition of the different grasses (%DM-basis)

Parameters	Type of grass					
	Rhodes grass	Green panic	Gatton panic	Bambasti panic	Signal grass	SE·
Dry matter (DM)	19.8	19.3	18.6	22.0	20.8	0.8 NS
Organic matter (OM)[1]	87.4 [a]	87.4 [a]	86.5 [ac]	90.0 [b]	85.6 [c]	0.44 *
Crude protein (CP)	8.8	9.4	10.7	9.8	9.5	0.85 NS
Crude fiber (CF)[2]	34.0 [a]	35.0 [a]	32.3 [a]	29.6 [b]	28.5 [b]	1.0 **
Ether extract (EE)	1.8	1.7	1.9	2.0	1.8	0.14 NS
Ash[3]	12.6 [a]	12.6 [a]	13.5 [ac]	10.0 [b]	14.4 [c]	0.44 *
Nitrogen free extract (NFE)[4]	42.8 [a]	41.3 [a]	41.6 [a]	48.6 [b]	45.8 [c]	0.9 **

[a,b,c] Means followed by the same letter (s) in the same row are not significantly different (P > 0.05) according to LSD test.

[1] For OM there was a highly significant difference between grasses (P < 0.005). LSD (0.01) = 1.72.

[2] For CF there was a highly significant difference between grasses (P < 0.005). LSD (0.01) = 4.1.

[3] For ash there was a highly significant difference between grasses (P < 0.005). LSD (0.05) = 1.27.and LSD (0.01) = 1.72.

[4] For NFE there was a highly significant difference between grasses (P < 0.005). LSD (0.05) = 2.5 and LSD (0.01) = 3.4.

Table 3. *In vitro* organic matter digestibility (% IVOMD), total energy and protein yields of grasses

Parameters	Type of grass					
	Rhodes grass	Green panic	Gatton panic	Bambasti panic	Signal grass	SE
% IVOMD	58.0^{ab}	54.0^{a}	59.0^{ab}	58.0^{ab}	64.5^{b}	2.7
Energy content : Metabolizable energy* (ME): MJ/kg DM	8.8	8.2	9.0	9.0	9.8	
Energy yield ** ME (GJ / ha.)	220	198	281	177	118	
CP - yield ** (t / ha.)	2.2	2.3	3.3	1.9	1.1	

* ME values were calculated according to the equation given by Ministry of Agriculture , Fisheries and food. (1980):

$$ME = (0.152\ CP + 0.342\ EE + 0.128\ CF + 0.159\ NFE) \times \frac{D\text{- value}}{100 - TA}$$

where TA = % total ash and D - value = % IVOMD.

** Energy and protein yields were calculated from DM-yields (Table 1) and contents of CP and energy in the grasses (table 2 and 3). No statistical analysis was done for energy content , protein and energy yields because they were mean estimated values .

ab Means followed by different letter (s) in the same row were significantly different ($P < 0.005$) , according to LSD test .LSD (0.05) = 8.4 .

مجلة الإمارات للعلوم الزراعية (١٩٩٦) ٨ : ٩٣-١٠٢

مقارنة الإنتاج والقيمة الغذائية لبعض الحشائش المروية بسلطنة عمان

محجوب جعفر ، أخطر علي وخلفان مطر الشرجي
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ملخص :

تم مقارنة الانتاجية والقيمة الغذائية لحشيشة الرودس (العلف المروي الاساسي بالسلطنة) مع اربعة حشائش مروية جديدة هي : حشيشة قاتون بانيك ، حشيشة قرين بانيك ، حشيشة بامبستي وحشيشة سقنال. تم اجراء الدراسة بمنطقة الرميس - سلطنة عمان خلال موسمين زراعيين (٩٢/٩١). ولقد أعطت الاصناف قاتون بانيك ، حشيشة الردوس وقرين بانيك اعلى انتاجية بينما كان صنفي سقنال وبامبستي بانيك اجود في القيمة الغذائية مقارنة مع باقي الاصناف . بالرغم من القيمة الغذائية الجيدة لحشيشتي سقنال وبامبستي بانيك الا ان كمية الطاقة الكلية المنتجة والبروتين (القيمة الغذائية / للهكتار) الخام المنتج كانت اعلى لاصناف : قاتون بانيك ، حشيشة رودس وقرين بانيك. اوضحت النتائج الانتاجية والقيمة الغذائية الجيدة والتأقلم للظروف البيئية بالسلطنة لحشيشة قاتون بانيك وانه بالامكان زراعتها مستقبلا كعلف مروي بديلا لحشيشة رودس.

كلمات مفتاحية : الانتاج ، القيمة الغذائية ، الحشائش المروية ، الطاقة ، البروتين ، معامل الهضم .