DETERMINATION OF FORAGE QUALITY OF INDIGENOUS AND EXOTIC RHODES GRASS ACCESSIONS UNDER RAINFED CONDITIONS

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ABSTRACT:- Utilization of grasses as fodder and forage is the most important source of nutrition for cattle as it provides them with metabolizable energy, carbohydrates, proteins and other important minerals. As global warming is increasing, overall water scarcity is resulting in deterioration of natural resources, and it is need of the hour to find fodder crop resources which are more accustomed to change climatic conditions. Hence, different exotic and indigenous varieties of Rhodes grass were tested for quality and yield parameters. Three varieties were imported from Australia and Zimbabwe namely Sabre, Tolgar (Australian) and Katambora (Zimbabwean). Dry matter yield and crude protein content of these grass varieties were analysed at three growth stages namely vegetative, flow-ering and maturity. These grasses have shown significant differences in fresh and dry matter yield. Fresh matter yield ranged from 6.17 to 6.68t ha^{-1} at pre-flowering, 9.67 to 11.83 t ha^{-1} at full flowering and 22.83 to 27.80 t ha^{-1} at maturity. While dry matter yield ranged from 0.86 to 1.38 t ha^{-1} at pre-flowering, 1.73 to 2.78 t ha^{-1} at full flowering and 6.67 to 8.67 t ha^{-1} at maturity stage. It could be attributed to their genetic inheritance potential. Mean value of crude protein content (CP) in three grasses varied from > 12% to < 5% depending upon the different growth stages of the grasses. Sabre showed highest CP content than other two at flowering stage. The results also showed that protein contents were lowest at the maturity stage of all the experimented grasses. This study has shown that Katambora is the variety which can be adapted to Pakistani climate and can give better forage yield in rainfed conditions, and this variety is ideal for live weight gain.

Key Words: Chloris gayana; Accessions; Productivity; Biomass; Growth; Pakistan.

INTRODUCTION

Grasses belong to family Poaceae are used for various purposes. It has occupied 23% of the rangeland area worldwide and is of the utmost value to humans and animals for nutrition (Singh, 2008). These are considered highly nutritious as they are taken as fodder and are rich in protein and starch content which provides metabolizable energy to body (Mensah, 1990).

With increasing population, livestock industry is also expanding which in turn demands production of green forage on large scale (Marsalis et al., 2009). Currently, it is grown on 12.6% of the total cropped area of Pakistan that is insufficient for the existing cattle population. Expansion of the area under fodder crops is not

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possible due competition with cash crops. Land fragmentation affects fodder production and is a direct result of rapid population growth. Therefore, better yielding and palatable grass species should be provided in their desirable ecosites (Mohammad and Naqvi, 1987).

Nutritive value of forage refers to its chemical composition, digestibility and the nature of digestive-products (Amakiri et al., 2011). After adequate amount of forage intake, crude protein is the main factor of forage quality. Grasses harvested at early stages of their phonological development have comparatively higher crude protein content, fats and minerals, while fiber, lignin, hemicellulose and cellulose increase with delayed harvesting resulting in decrease in digestibility (Mirza et al., 2002). Higher dry matter yield and better nutritive quality of grass harvested at full flowering stage better in terms of both yield and forage quality (Qamar et al., 1999).

Chloris gayana is a species of grass known as Rhodes grass. It is a fine stemmed, leafy turf forming perennial grass growing 60-150 cm and spreading by stolons. It is native of South and East Africa and adapted to tropical and sub-tropical summer rainfall area with moderately long dry season (Bose and Balakarishnan, 2001; Murata et al., 1965). Rhodes grass is primarily used in pasture establishment like hay or ley crop, it can be used to stabilize disturbed sites hence controlling soil erosion and it is one of the salt resistant fodder grasses (Bogdan, 1969).

Regarding the importance of grasses especially Rhodes grass, this study would deal with determination of productivity and biomass of indigenous and exotic accessions under rainfed conditions at the National Agricultural Research Centre, Islamabad located in the Pothwar plateau of Pakistan. Three exotic accession of Rhodes grass were evaluated under field conditions at NARC to compare the yield of different accessions of Rhodes grass at various stages of growth and for analysing the nutritional value of the grass in terms of crude protein at different stages.

MATERIALS AND METHOD

Study Area

The study was conducted at the National Agricultural Research Centre (NARC), Islamabad, Pakistan. The metropolitan area of Islamabad-Rawalpindi lies between 72°45′ and 73°30′ E and 33°30′ and 33°50′ N . The average annual rainfall is 1100 mm. Most of the rainfall is received during monsoon season (July-September). Summers are hot with maximum temperatures up to 40° C and in winters minimum temperature is up to 0° C with occasional frost (PARC, 1986).

This research study focuses on the Rhodes grass varieties imported from Australia and Zimbabwe. These three varieties namely, Sabre, Tolgar (Australian) and Katambora (Zimbabwean) sown for comparison of yield, productivity and quality in Islamabad environment.

Field Preparation and Sowing

For sowing, the land was prepared by disc plough followed by cultivator plough. The plot size was 5m x 10m. Sowing was done with the help of a hand pulled drill with rows placed 50 cm apart. The seed rate was kept at 5 kg ha^{-1}. Final seed

rate was adjusted considering the germination percentage. To minimise the chance of error; three replications of each treatment were sown. Days to flowering and days to maturity were recorded.

Data Collection

Plant height was recorded at pre-flowering, full flowering and maturity growth stages. Height of five plants was taken randomly and mean was calculated. Likewise, number of tillers of five plants were randomly counted and average number of tillers per plant was calculated. Fresh matter yield was collected by Adjustable Decimal Collapsible (ADC) quadrat (Khan, 1966). All plants within $1m^2$ were clipped at a stubble height of 15 cm and weighed to find out fresh matter. Samples were placed in an oven maintained at 80°C for 72 h to get dry matter yield.It was carried out by microKjeldahl method (AOAC, 1980).

RESULTS AND DISCUSSION

Herders of Pothwar face difficulty in getting suitable feed for their livestock throughout the year. Heavy grazing over huge areas of rangelands with almost double stocking rate exerted huge load on land resources, biodiversity and human population such as wildlife and livestock. The main reason being increase in human population as well as livestock population to meet growing human demand. This has led to deterioration of rangelands and ruthless cutting of trees and shrubs for household fuel utilization (Umrani et al., 1995). Resultantly, the more palatable species those earlier dominated the rangelands have been destroyed or thinned out and are now dominated by unpalatable low quality vegetation. Therefore, every year, insufficient feed during the dry time, collective with drought years, causes severe losses of livestock (Grainger, 1990; Alvi and Sharif, 1995).

Significant differences were observed among the different accessions ecotypes of the Rhodes grass. The dry matter yield of the species is generally dependent upon the genetic potential of the respective species interacting with the prevailing environmental conditions (Qamar and Arshad, 2002). The results revealed that the fresh and dry matter yield in grass varieties ranged from 6.17 to 6.68 t ha^{-1} for fresh weight at pre anthesis stage, 9.67 to 11.83 t ha^{-1} in full anthesis and 22.83 to 27.80 t ha^{-1}in harvesting stage while 0.86 to 1.38 t ha^{-1} dry matter yield in pre anthesis stage, 1.73 to 2.78t ha^{-1} in full anthesis and 6.67 to 8.67 t ha^{-1} in maturity harvesting stage (Table 1). This could be associated to their genetic heredity potential, environmental conditions and soil profile. These also play a vital role in determination of yield and its components. Dry matter yield increased as grasses grow from pre flowering stage to full flowering stage till maturity stage. The findings are in line with the study of Mirza et al. (2002) who showed highest dry matter yield at anthesis stage.

This high biomass may be the outcome of high shoot ratio of the grass. It is an agreed fact that leafy plants allow higher penetration of light and increased photosynthesis (Akmal and Janssens, 2004). Therefore, maximum growth rate of the plant results in increased dry mass production with rather efficient utilization of water and light

Table 1. Parameters taken at different growth stages of Rhodes grass varieties

Parameter	Vegetative	Flowering	Maturity
Fresh Weight (t ha^{-1})			
Sabre	6.17	11.83	22.83
Tolgar	6.33	09.67	27.80
Katambora	6.68	10.50	27.50
Dry weight (t ha^{-1})			
Sabre	1.24	2.78	6.67
Tolgar	1.38	1.85	8.00
Katambora	0.86	1.73	8.67
Height (cm)			
Sabre	60.69	126.00	139.0
Tolgar	70.27	096.33	156.0
Katambor	60.02	120.40	164.6
Crude protein content (%)			
Sabre	12.3633	10.260	4.823
Tolgar	12.3533	09.807	4.760
Katambora	12.4367	09.573	4.890

resources (Long et al., 2005). The higher shoot development of the species having all other factors e.g. soil, nutrients and unchanged growth conditions were advantageous to high biomass yield under the climatic conditions. Genetic differences play a significant role in plant biomass production giving edge to some cultivars over others due to their better resistance quality in unfavourable conditions (Jia et al., 2008; Shamsi et al., 2008).

Livestock need better feed quality and quantity for meat and milk productivity by 70% while only 30% is dependent on genetic variability. The main nutritive value of forage quality depends upon total protein content and quantity of nutrients. In the feed of ruminants, total protein is very helpful to maintain the quality of their milk, meat and other products (Afzal et al., 2007). Due to less protein content in fodder (less than 5%) microbial activity in the rumen may decrease (Bose and Balakarishnan, 2001). The quality of fodder signifies the nutritive components level, palatability and digestion, and nutritional factors and milk production. Forages are the main diet components in feed of cattle and its different nutritive features support different yield levels.

Crude protein contents decreases as grasses advance towards maturity stage. In the present study, crude protein was best at the pre anthesis stage. As it grew to the full anthesis stage, total protein component decreased and it became the lowest at harvesting stage (Table1). The results are in accordance with the previous findings of Chin et al. (1974) and Yusoff (1994) who investigated that grasses at harvesting stage usually had good crude protein contents of above 12%. Milford and Minson (1966) studied that protein content of tropical grasses can also be increased through the application of nitrogen containing fertilizer. Without application of nitrogen fertilizer grasses accumulate less crude protein content. Chin et al. (1974) reported 23% protein contents at two weeks and 6.2% at seven weeks of maturity. These results were in line with the findings of Distel et al. (2005) who reported that crude protein in different grass species reduced with maturity.

With increasing clipping interval, decreasing total protein contents of grasses may be due to reduced shoot ratio (Chaparro and Sollenberger, 1997) or by a dilution effect due to increase dry weight with less common grass clipping (Crowder and Chheda, 1982). The present results are in accordance with Mero and Uden (1998)

and Fraser et al. (2001) who evidenced a reduction in protein content of cell wall in maturing grass varieties. Crowder and Chheda (1982) investigated that repeating grass cutting maximized plant growth and increased resources utilization, thus creating even greater demand for nitrogenous fertilizers. It was inferred that as plants reached maturity, these activities decreased, resulting in accumulation of low protein components in grasses.

Multiple comparisons among different varieties of Rhodes grass revealed that height of grass was positively correlated to dry matter yield, however, plant height was negatively correlated to crude protein content (Table 2). Similar results for Rhodes grass have also been recorded by Yisehak (2008).

Table 2. Multiple comparisons between varieties for different parameters

		Mean difference in varieties (I-J)		
(I) Varieties	(J) Varieties	Dry matter %age	Height	CP %age
Sabre	Tolgar	-0.4099	-50.6422	2.5033
	Katambor	-11.0070	-89.6178	7.5156
Tolgar	Sabre	0.4099	50.6422	-2.5033
	Katambor	-10.5971	-38.9756	5.0122
Katambora	Sabre	11.0070	89.6178	-7.5156
	Tolgar	10.5971	38.9756	-5.0122

Based on observed means.
The error term is Mean Square (Error) = 374.532.
** Significant at the 0.05 level.*

Forage production capacity of the depleted rangelands can be increased manifold if the areas are reseeded with high yielding ecotypes of these perennial grasses suited to these ecological zones, provided the livestock are grazed according to the carrying capacity of the pasture for sustainable use of this vast natural resource (Sharma and Verma, 1983).

This study most significantly has shown that Katambora is the variety which can be adapted to sub-tropical humid climatic conditions of Pothwar and can give better forage yield in rainfed conditions where annual precipitation is around 800 mm annually and it is ideal for live weight gain for livestock by providing it adequate protein content.

There is a need for ecological management of the degraded rangelands through restoration efforts with the introduction of native and exotic potential, nutritive high yielding grasses and scrub species. Rhodes grass is primarily used in pasture establishment like hay or ley crop, it can be used to stabilize disturbed sites hence controlling soil erosion. Looking at the current situation of rangeland productivity in Pakistan, it is need of the day that conditions should be improved to increase the forage productivity of the degraded rangelands. It is also important that better yielding and palatable grass species should be established in their desirable eco-sites. New better yielding and tolerant varieties can be produced by outcrossing local cultivars with exotic ones which will be better adapted to climatic conditions of Pakistan.

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AUTHORSHIP AND CONTRIBUTION DECLARATION

S. No	Author Name	Contribution to the paper
1.	Mr. Sohaib Arshad	Conceived idea, Methodology, Data collection, Data entry and analysis.
2.	Dr. Sarwat Naz Mirza	Technical input at every step.
3.	Dr. Imtiaz Ahmad Qamar	Technical input at every step.
4.	Mr. Maqbool Shahbaz	Supervised field work

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