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EVALUATION OF VARIOUS EXOTIC GRASSES IN SEMI-ARID CONDITIONS OF PABBI HILLS, KHARIAN RANGE

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ABSTRACT

A field study was carried out to investigate the response of various warm season forage grass species under semi-arid conditions of hills, Kharian range during 2006. Sprouting response of Blue panic was the highest (91%), followed by Mott grass (77%) and Pangola grass (75%) in the first data record (April, 2006) while Blue panic grass also showed the highest sprouting percentage (81%) followed by Finger grass (63%) during the second data record (June, 2006). Fresh biomass production was highest in Blue panic followed by Finger grass during spring season. Dry matter yield was also higher in Blue panic than other grasses during spring 2006. In Monsoon season, more fresh biomass was produced by Finger grass followed by Vetiver grass and Pangola grass and more dry matter production by Finger grass followed by Vetiver grass. Buffel grass had the highest crude protein contents (9.24 %) along with highest total digestible nutrients (54.51%). Blue panic grass and Digitaria grass are recommended for semi-arid conditions of Kharian range.

Key words: Forage production, exotic grasses, semi-arid conditions, proximate composition, feeding value, microbes.

INTRODUCTION

Pakistan has a wealth of 145 million heads of livestock which contribute 11.20% to the GDP (Anonymous, 2008). Nutritional requirements of these animals are mainly fulfilled by fodder crops and agro-industrial wastes. However, rangelands also contribute significantly in providing forage to these livestock. Therefore, the sustainable use of rangelands is vital for providing forage to livestock and the development of national economy. Currently, overgrazing of rangelands, depletion of vegetation cover, shortage of forage and fodder resources and poor livelihood of pastoral communities are some of the major issues and problems for the food security in the country (Afzal *et al.*, 2007). Large herds of livestock graze freely in the rangelands due to which range productivity has decreased and most of these areas are infested with unpalatable plants. In many countries, improved ecotypes of forage grasses have increased the range productivity for the native and naturalized grasslands (Walsmsley *et al*, 1978). It is of paramount importance that high yielding and palatable grass species should be established in their suitable eco-sites (Muhammad and Naqvi, 1987).

Forges when preserved at early stages of their development have relatively higher crude protein content, ether extract and ash contents but crude fiber, acid detergent, lignin, hemi-cellulose and cellulose increase with later harvesting resulting in decreased dry matter digestibility (Mirza *et al*, 1986). For cereal forages and grasses, it has been established that dough stage is the most appropriate stage to make a compromise between dry matter yield and forage quality (Qamar *et al*, 2000).

MATERIALS AND METHODS

The study was conducted at Pabbi hills which are part of Himalayan foothills. The hillocks are detached from each other by terraces and gullies formed by severe erosional dissection of anticline. The rocks consist of semi-consolidated, weekly cemented calcareous, coarse, friable sandstones, underlain by layers of clay, shale and sandstone (Afzal *et al*, 2007). Climatically, the area falls in the sub-tropical continental and sub-humid regions of northern Punjab. Therefore, the climate is of extreme type having higher summer temperatures, cold nights in winter, torrential and erratic rainfalls during the monsoon season. Summer from April to June is normally very hot and dry. The winter rains mostly occur in December and January. Frost occurs in December, January and sometimes it may occur in February. Windstorms are not common. Average wind velocity varies from 0.29 to 2.9 knots per hour (Anonymous, 2004). The soil is slightly alkaline with pH value of 7.7, soil organic matter is very low (0.53%) indicating that soil is very poor in fertility. The nitrogen status is also very low (0.04%) whereas the Phosphorous (5.44 ppm) and Potash (70.10ppm), status lies between medium fertile soils (Nizami *et al*, 2004).

Nine grasses (Blue panic, Green panic Buffel, Elephant, Mott, Pangola, Finger, Setaria and Vetiver) were tested in semi-arid conditions of Pabbi Hills during 2006. Tufts of these grasses were planted on 1st March

2006 with 50cm interspacing in 35x35m plots having 64 slips/tufts per plot. The experiment was designed in randomized complete block design factorial (RCBD). Data on sprouting was recorded on 1st April, 2006 (30 days after planting) and 2nd June, 2006 (94 days after planting) and calculated with the help of the following formula:

$$\text{Sprouting percentage} = \frac{\text{Sprouted slips/tufts}}{\text{Total slips/tufts}} \times 100$$

Data on fresh and dry matter production were collected from the same plots in spring 2006 (first week of April) and monsoon (last week of September) at 50% flowering stage. Three quadrats (1m x 1m) were laid down randomly and harvested for fresh and dry matter determinations. The green biomass was derived through the following formula:

$$\text{Green biomass (t ha}^{-1}) = \frac{\text{Fresh biomass weight}}{\text{Area in m2}} \times 10$$

Plant samples were air dried until the weight of dry matter became constant. Percent moisture contents were calculated with the help of following formula:

$$\% \text{ water} = \frac{(W_1 - W_2)}{W_1} \times 100$$

Where W_1 = fresh weight of forage (gm^{-2}) W_2 = air dried weight of forage (gm^{-2}):

The air dried plant samples were oven dried at 100°C for 24 hours for chemical analysis.

Chemical Analysis: Dry Matter (DM), Crude Protein (CP), Crude Fiber (CF), Ether Extract (EE) and ash of the samples were determined according to AOAC (1994). The dry matter was determined by drying the samples at 80°C till constant weight. Crude protein was estimated by micro kjeldhal method. Oven dried sample was digested with H_2SO_4 in the presence of catalyst mixture containing K_2SO_4 and $CuSO_4$. A known aliquate of the diluted sample was distilled in the presence of 10 ml of 2% boric acid solution and titrated against standard 0.1 N H_2SO_4. The percent of nitrogen was calculated for the estimation of CP. The ether extract in a sample was determined by extracting with diethyl ether at 60°C in soxhlet's apparatus. For crude fiber, sample was reflexed first with 1.25% H_2SO_4 and subsequently with 1.25% NaOH for 30 minutes each to dissolve acid and alkali soluble component present in it. The residue containing CF was dried to a constant weight and the dried residue was ignited in muffle furnace, loss of weight on ignition was calculated to express it as CF. For ash, sample was ignited in muffle furnace at 550°C to burn all the organic matter and leftover was weighed as ash. The nitrogen free extract (NFE) was calculated by subtracting the sum of CP, EE, CF and ash from sample weight on dry matter basis. Presence of total digestible nutrients (TDN) was determined with the help of following regression equation;

$$\%TDN = - 26.685 + 1.334(CF) + 6.598(EE) + 1.428 (NFE) + 0.967 (Pr) – 0.002 (CF) 2–0.670 (EE) 2– 0.024 (CF) (NFE)–0.055 (EE) (NFE)–0.146(EE) (Pr) + 0.039 (EE) 2 (Pr)$$

Nitrogen-Free Extract: Nitrogen-free extract was determined on dry matter basis as;

% NFE = 100 – (% crude protein + %crude fiber + % ether extract + % Ash)

The data were subjected to analysis of variance (ANOVA) and means were separated by using Least Significant Differences (LSD) (Steel *et al*., 1997).

RESULTS AND DISCUSSION

Grass Establishment: Data given in table-2 showed sprouting response of different grass species under study were recorded on 1st April, 2006. Sprouting percentage of Blue panic grass was the highest (91%) followed by Mott grass (77%) and Pangola grass (75%). Soon after most of the sprouting plants became dried due to lack of rains and rising temperature. However, good showers of rainfall were received during May 2006 due to which the penetrating buds started sprouting after good soil moisture condition. Hence, second observation was taken on 1st June 2006. In this observation sprouting percentage was again highest in Blue panic grass (81%), followed by Finger grass (63%) and Pangola grass (51%). The data suggested that both Blue panic and Finger grasses were comparatively more drought tolerant than the other grasses included in the study. Although the sprouting response in Vetiver grass was not very high (56%), it does not seem to be affected much due to the dry conditions in June (46%). Data showed that establishment and vigor of Blue panic grass, locally called 'Girm' is the best among all the nine grass species tested for the study.

Biomass Production: Forage production of these grass species grown during March 2006 was determined twice during 2006-07. During spring 2006, Blue panic attained the highest green biomass (4.26 t ha^{-1}) than other eight grass species Second highest fresh weight was gained by Finger grass (2.85 t ha^{-1}), followed by Vetiver grass (1.5 t ha^{-1}) (Table 2). During the monsoon season, fresh biomass showed a general increase. Finger grass gained the highest fresh weight with 8.03 t ha^{-1} followed by Vetiver grass (7.59 t ha^{-1}), Pangola grass (7.40 t ha^{-1}) and Blue panic (6.24 t ha^{-1}).

Dry matter production during spring was the highest (1.09 t ha^{-1}) in Blue panic followed by Finger

grass (1.01 t ha^{-1}) (Table 2). Except Vetiver grass (0.53 t ha^{-1}), all the remaining grasses showed very low DM production. This was probably due to the reason that grasses were young, only one month old, and could not have established properly by that time. After about six months of their plantation, i.e. in September 2006, the grasses showed improvement in forage production. Finger grass produced the highest dry weight (3.01 t ha^{-1}) followed by Vetiver grass (2.88 t ha^{-1}), Blue panic grass (2.79 t ha^{-1}) and Pangola grass (1.47 t ha^{-1}) (Table 2).

Afzal and Ullah (2007) reported that *Digitaria* spp. (Finger and Pangola grasses) were established vegetatively dividing runners, hence, are not recommended for large scale plantation due to high cost of operation to grow these grasses through runner planting. However, they recommended growing these grasses in small pockets where good soil and comparatively ample moisture is available to increase DM productivity of the range area. Next higher DM yield was given by the Vetiver grass (Table-2). However, this grass has very low palatability but is frequently used in soil conservation practices. Keeping in view the good growth and sol binding properties it is recommended for soil conservation operations in the eroded areas.

Table 1. Basic characteristics of grass species under study at Pabbi Hills during 2006

S. No.	Common name	Botanical name	Source	Brief description
1	Blue panic grass	*Panicum antidotale*	Pakistan	Vigorous, profusely branches stem up to 2.5mhigh, long blue green leaves, stem soon becomes hard, can acquire bitter taste due to accumulation of oxalic acid.
2	Green panic grass	*Panicum maximum*	Tanzania	Tufted perennial up to 3.5m tall, very succulent and nutritious, suitable for mix seeding with legumes.
3	Buffel grass	*Cenchrus ciliaris*	Tanzania	Tufted tussock farming grass, stem up to 1.5m high, long strong root system, high protein and digestibility.
4	Elephant grass	*Pennesetum purpureum* Var. merkeri	Tanzania	Tall, erect, thick stem up to 4.5m high, planted like sugarcane, culms having three nodes are cut into pieces and buried in the soil up to two nodes with 3rd above the ground.
5	Mott grass	*Pennesetum benthium* Vr. Giant napier	Pakistan	Tall, erect, stem up to 6.5 m high, planted like sugarcane, culms having three nodes are cut into pieces and buried in the soil up to two nodes with 3rd above the ground.
6	Pangola grass	*Digitaria decumbens*	West Indies	Erect stem up to 1m tall, from open turf, pasture grass, stands tramping and grazing, nutritious but quality declines sharply with age.
7	Finger grass	*Digitaria swazilandensis*	Zimbabwe	Profusely branched stem up to 60cm tall, grow on poor soils, tolerates drought, low yielding, less palatable, good soil binder.
8	Setaria grass	*Setaria anceps*	Kenya	Tufted, perennial, stem up to 2m high, compressed lower parts leaves up to 40cm long glabrous, panicle dense cylindrical, nutritious and highly palatable.
9	Vetiver grass	*Vetiveria zizynoides*	Kenya	

Source: Muhammad (1989)

Response of Blue Panic grass was encouraging in terms of sprouting, fresh and dry matter production, however, being a tall and comparatively coarse grass, it does not have good palatability index as that of other tested grasses (Ullah *et al.*, 2006). Buffel grass did not give comparatively good response probably due to heavy soil of the experimental area whereas its satisfactory establishment and healthy growth have been well documented even in more adverse climatic conditions of hot sandy deserts of Pakistan. These findings are in agreement with Afzal and Ullah (2007). Buffel and Setaria grass species are recommended for further range reseeding trials in the semi-arid conditions of Pabbi Hills.

Moisture Contents: Moisture contents of 60 to 69 percent in harvested biomass of different grasses were recorded in the study (Table-2). Meangal and Kirkby (1987) reported that old leaves of plant tissue might contain water contents from 75 to 85 percent of the fresh weight. This depicts that harvested material in addition to

green leaves also contained previous year's old growth that reduced moisture level in the plant tissue. The other reason for low water level could be the semi-arid conditions of the study site. Results indicated that percent moisture contents were higher during the monsoon season as compared to spring (Table-2). Succulence of forage species depends on the level of percent moisture. In this study, Mott grass had comparatively higher moisture contents in both seasons than other forage grasses (66% and 69%) in spring and monsoon, respectively. However, the difference in moisture contents of grasses is non-significant. Digestibility of forage is dependent on the moisture level of harvested plants. These results are also in line with Ullah *et al*. (2007).

Table 2. Sprouting percentage, Fresh and Dry Weight and Moisture Contents of grasses at Pabbi Hills during 2006. (average of three replications)

Name of Grass	Sprouting %age		Fresh Weight (t ha^{-1})		Dry Weight (t ha^{-1})		Moisture contents	
	1st April 2006	2nd June 2006	Spring 2006	Monsoon 2006	Spring 2006	Monsoon 2006	Spring 2006	Monsoon 2006
Blue panic	91^{a}	81^{a}	4.26^{a}	6.24^{ab}	1.09^{a}	2.79^{a}	66^{NS}	67^{NS}
Green panic	16^{gh}	16^{gh}	0.78^{g}	1.30^{ef}	0.26^{e}	0.45	65	65
Buffel	34^{e}	34^{d}	0.42^{hc}	2.89^{c}	0.16^{d}	0.94^{c}	61	67
Elephant	56^{d}	08^{ki}	0.11^{lm}	0.43^{ij}	0.04^{h}	0.17^{dh}	64	60
Mott	77^{ab}	16^{gh}	0.06^{mn}	0.06^{lm}	0.02^{mn}	0.06^{lm}	66	69
Pangola	75^{ab}	51^{c}	0.49^{h}	7.40^{a}	0.29^{e}	1.47^{b}	63	67
Finger	63^{c}	63^{c}	2.85^{b}	8.03^{a}	1.01^{a}	3.01^{a}	65	66
Setaria	62^{c}	34^{d}	0.44^{h}	2.95^{c}	0.16^{g}	0.99^{d}	63	67
Vetiver	56^{d}	46^{d}	1.50^{d}	7.59^{a}	0.53^{c}	2.88^{a}	65	66

Note: values followed by same letter(s) are statistically similar at P=0.05 level of significance.

Table 3. Proximate composition of grasses (% DM) at Pabbi Hills during 2006 (average of three replications, two cuttings)

Name of Grass	Dry matter	Crude Protein	Crude Fiber	Ash	Ether extract	Nitrogen-free extract	Total digestible nutrients
Blue panic	35.76	6.^{70bc}	43.65^{a}	7.48^{b}	4.22^{ab}	37.95^{bc}	52.07^{ab}
Green panic	35.08	5.48^{cd}	40.70^{a}	11.45^{b}	5.33^{a}	37.04^{c}	47.69^{bc}
Buffel	37.41	9.24^{a}	36.75^{a}	7.08^{b}	5.56^{a}	41.37^{ab}	54.51^{a}
Elephant	37.71	7.19^{b}	30.79^{a}	17.24^{a}	5.88^{a}	38.90^{b}	47.36^{c}
Mott	35.58	6.42^{bc}	32.50^{ab}	11.63^{ab}	3.02^{c}	48.23^{a}	53.82^{a}
Pangola	28.38	5.87^{cd}	37.18^{ab}	9.35^{b}	6.53^{a}	41.07^{ab}	48.98^{bc}
Finger	26.24	6.20^{bc}	38.83^{a}	11.67^{ab}	4.25^{ab}	39.05^{b}	50.41^{ab}
Setaria	42.39	7.19^{b}	38.18^{a}	12.33^{a}	3.00^{c}	39.30^{b}	52.76^{a}
Vetiver	25.57	4.03^{e}	43.09^{cd}	6.68^{cd}	4.84^{ab}	41.36^{ab}	50.22^{ab}
		LSD=2	LSD=7	LSD=6	LSD=2	LSD=5	LSD=3

Note: proximate values followed by same letter(s) are statistically similar at P=0.05 level of significance

Chemical Analysis: Proximate composition of grasses under study on percent dry matter basis is shown in Table-3. Buffel grass had the highest crude protein (9.24%) along with the highest total digestible nutrients (54.51%) among all the grasses. Feeding value of forage is associated with two important factors, crude protein and total digestible nutrients (Afzal and Ullah, 2007). Bose and Balakrishnan (2001) reported that crude protein below 6-7 percent causes low milk, meat and wool production. Reproduction process of livestock may also be disturbed. Low level of crude protein may also depress the microbial activity in the rumen of the animals due to less availability of nitrogen.

Recommendations: Based on the results of the study, Finger grass (*Digitaria swazilandensis)* could be recommended for eroded soils of Pothwar Plateau with ample moisture due to its good soil binding property. Buffel grass (*Cenchrus ciliaris)* and Blue panic grass (*Panicum antidotale)* are recommended for this area on the basis of having higher biomass production and better

forage quality (crude protein and total digestible nutrients).

REFERENCES

AOAC (1994). Official Method of Analysis 12th edit. Association of Official Analytical Chemists (AOAC). Washington, DC. USA.

Anonymous (2004). Metrological Report. 2003-04. Metrological Wing, Agriculture Extension Department District Gujrat, Govt. of Punjab.

Anonymous, (2005). Economic Survey 2007-08. Government of Pakistan, Ministry of Food, Agriculture and Livestock (Economic Wing), Islamabad

Afzal, J. and M. A. Ullah (2007). Assessment of productive potential and utilization of rangelands and sown pastures in Pothowar Plateau. Annual Report 2006-07. National Agriculture Research Centre, Islamabad. 10pp.

Afzal, J. M. A. Ullah and M. Anwar (2007). Assessing carrying capacity of Pabbi Hills Kharian Range. The J. Anim. Pl. Sci. 17(1-2):27-29.

Bose, M. S. C. and V. Balakrishnan (2001). Forage production technologies. South Asian Publication Pvt. Ltd. New Delhi, India. 253pp.

Mengal, K. and E. A. Kirkby (1987). Principles of plant nutrition. 4th Edition. International Potash Institute, Bern Switzerland.

Mirza, S. N., N. Mohammad and I. A. Qamar (1986). Progress and achievements. Range Research Project Pothowar. Pakistan Agriculture Research Council, Islamabad. 37pp.

Muhammad, N. (1989). Range Management in Pakistan. ICIMOD Kathmandu, Nepal. Mohammad, N. and A.H. Naqvi. 1987. Dry matter yield of promising grasses in tropical arid rangelands of Sind, Pakistan. Trop. Agri. 61:70-71.

Nizami, M. M. I., M. Shafiq, A. Rashid and M. Aslam (2004). The soils and other agricultural development potentials in Pothowar. WRRI and LRRI, NARC Islamabad. 158pp.

Qamar, I. A., G. Akbar, and M. Asif (2000). Performance of summer grasses in arid rangelands of Dhabeji, Sind. Sci. Tech. and Dev. 19(1):45-47.

Steel, G.D, J.H. Torrie and D.A. Dickey (1997). Principles ad procedures of Statistical and Biometrical approach. 3rd ed. McGraw Hill Book Company, New York. 182pp.

Ullah, M.A., A. Razzaq and R. Saleem (2006). Performance of various forage grasses under spring and monsoon seasons at Pothowar Plateau. Int. J. Agri. & Bio. 8(3):398-401.

Ullah, M. A., J. Afzal and M. Anwar (2007). Determining range vegetation cover and composition of Pabbi Hills Kharian Range, district Gujrat. J. Appl. Sci. 7(16):2321-2326.

Walsmsley, D.V., A.L. Sergeant and M. M. Dooker. (1978). Effect of fertilizer on growth and composition of elephant grass (*Pennisetum purporeum*) in Tobago, West Indies. Tropical Agriculture (Trinidad). 55:329-334.