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Potentials of Guinea Grass (P*anicum maximum*) as Forage Crop in Livestock Production

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Abstract: *Panicum maximum* (guinea grass) is native to Africa but this grass was introduced to almost all tropical countries as a source of animal forage. It grows well on a wide variety of well drained soils of good fertility and it is suitable to stop soil erosion. It can survive quick moving fires which does not harm the underground roots and drought because of the deep, dense and fibrous root system. Guinea grass is a clump-forming perennial which grows best in warm frost free areas receiving more than 900 mm rainfall. Crude protein (CP) content of fresh guinea grass varied from 5.0 to 5.6% while guinea grass silage contains 5.0 to 5.5% CP. The digestibility (IVDOM) varied with the variety from 56.9% for Gatton to 87.7% for Vencidor. This paper reviews the potential of *P. maximum* as a forage for animal production in the tropics and Sub tropics.

Key words: *Panicum maximum*, forage, digestibility

Introduction

Panicum maximum (guinea grass) is a clump-forming perennial which grows best in warm frost-free areas. Guinea grass can withstood continuous heavy grazing with stocking rates of 2.5 cattle/ha for long periods under heavy annual rainfall and it performs better under rotational grazing. For the most nutritious grass it is best cut when it is 60-90 cm tall; but for higher yields it can be cut when it is up to 1.5 m tall. In order to maintain yields one third or one fourth of the plants should be replanted each year. Mixtures with legumes have been successfully established. (Humphreys and Patridge, 1995). Du Ponte *et al.* (1998) demonstrated that guinea grass can be successfully ensiled, maintaining nutritive quality and minimal spoilage under Hawaiian climatic conditions. They observed that the silage pH of all treatments dropped rapidly from day 0 (average pH : 5.67) to day 5 (average pH : 5.05) and continued to decline through day 30 (average PH : 4.69) of the ensiling process. They observed that the guinea grass can be successfully ensiled in Hawaii and silage production can be effectively integrated with pasture management in the dairy industry. Guinea grass plays more role in the habitat since its seeds provide food for birds such as Munias. This paper reviews the potentials of guinea grass as forage crop in livestock production.

Description: Guinea grass (*Panicum maximum*) is a tall vigorous perennial grass with stems up to 3.5 m tall that varies widely in growth habit. It grows in tropical and subtropical areas with more than 900 mm of rainfall on a wide range of soils. The deep, dense and fibrous root system allows guinea grass to survive quite long drought periods, but it performs best on well drained soils of good fertility in high rainfall regions. (Humphreys and Partridge, 1995). Guinea grass is tolerant of shade and fire, but not to water logging or severe drought. It produces high yields of palatable fodder and responds well to manuring, but rapidly declines in nutritive value with age. It dies if continually grazed close to the ground and needs rest late in the growing season. (FAO, 2003). *Panicum maximum* is indigenous to the subtropical areas of southern Africa where it occurs mainly in the sub habitat under trees (Pieterse *et al.,* 1997). Association with trees occurs because seedlings of *P. maximum* are better adapted to under tree *sub habitat* than those of *heteropogon contortus* and *hyparrhenia filipendula*, which usually occupy the same veld type as *P. maximum*. Bosch and Van Wyk, 1970 believed the association was more related to improved soil fertility in the sub habitat. The high N concentration, often found in the soil under leguminous trees, may be the most important factor determining the presence of *P. maximum* in the *sub habitat*. *P. maximum* is often considered as one of the best species for beef production in the republic of South Africa (Pieterse *et al.,* 1997).

Cultivars of guinea grass: *Panicum maximum* cv Gatton; is a variety of medium height grass originally from Zimbabwe (Humphreys and Patridge, 1995). It has darker green leaves and smooth stem nodes. It establishes more rapidly than the green panic with good first season yields and is easier to manage than the tall guinea grasses. O'Reilly (1975) described green panic (*panicum var trichglume*) cv Petrie as a native of Africa. It is also a tall, tufted, summer growing perennial. Green panic is lighter in appearance. Green panic or slender Guinea (*P. Maximum var trichoglume Eyles*) is a variety with fine stems up to 1.8 m high and short leaves. Mutale is a local cultivar of South Africa from the northern Transvaal. Another cultivar is Vencidor, which was bred for cold tolerance in South America.

Other cultivars of *panicum* include riversdale, a more uniform shorter line that was selected to avoid contamination with unpalatable coarse guinea grass. Makueni is also a medium height variety, light green in colour. It has dense, whitish hairs on both surfaces of the leaf and on the stem nodes, while the green flowering heads have a purplish tinge. (Humphreys and Patridge, 1995). Other cultivars of *P. maximum* are specific to various countries.

Nutritional composition:

Table 1 shows that the *in vitro* digestibility (IVDOM) of the cultivars ranged from 56.9% for the first harvest of Gatton, to 87.7% for the first harvest of Vencidor. These values compare favorably with those of Minson (1972), who reported digestibility values for petrie ranging from 52% for mature regrowth to 61% for month old regrowth. The material from vencidor had the lowest mean ADF and NDF and the highest IVDOM values of the 4 cultivars (Table 1). Pieterse *et al*. (1997) observed that of the 4 cultivars in Table 1, Vencidor was the best performing cultivar. It was reported as the highest DM producer, had the best water use efficiency; a well balanced nutrient concentration and a high IVDOM and low NDF and ADF concentrations. It was reported to remain vegetative with little stem material.

Table 1: ADF, NDF and IVODM concentrations in 4 *Panicum maximum* cultivars grown on a black turf soil in pots with N application equivalent to 160 Kg/ha N

Cultivars	Harvest	ADF (%)	NDF (%)	IVDOM (%)
Gatton	1	32.5	61.2	56.9
	2	30.6	64.7	72.9
	3	32.6	60.5	77.9
Petrie	1	35.3	65.1	60.9
	2	33.1	64.2	74
	3	29	0.3	69.5
Mutale	1	34.8	65.1	62
	2	32.8	63.8	70.7
	3	28.4	65.2	73.8
Vencidor	1	29.3	64	87.7
	2	25	57.8	74.8

Source: Pieterse *et al.,* 1997. ADF = acid detergent fibre, NDF = nitrogen detergent fibre, IVDOM = *in vitro* digestibility of organic matter.

Table 2 indicates variation in the proximate composition of *P. maximum var trichoglume Eyles* based on stage of growth and location of pasture (FAO, 2003).

Table 4 shows that digestibility decreased with level of maturity an all seasons except winter in agreement with reports that a decrease in N content and an increase in NDF, ADF and ADL content is associated with a decrease in digestibility (Ford *et al.,* 1979; Cilliers and Van der Merwe, 1993).

Digestible organic matter intake (DOMI) decreased from young to mature pastures in summer and autumn (Table 3). Minson (1972) also reported a drop in voluntary DOMI with increasing regrowth period. The decrease in quality of the material selected correspond well with the decrease in intake. Van Soet (1965) and Cilliers and Van der Merwe (1993) reported similar results for animals grazing pastures of decreasing quality. Laredo and Minson (1973) and Minson (1982) reported a negative relationship between intake and the NDF, ADF and ADL content of grasses, however Minson (1972); Laredo and Minson, 1973 and Minson, 1982 noted a positive relationship between digestibility and intake. No statistical significant differences were observed in winter for DOMI. Tudsri *et al*. (2002) reported variation in production potential of the range of *P. maximum* cultivars tested in Japan. Peiris and Ibrahim (1995) stated that the organic matter digestibility of the young grass (69%) was significantly higher than the mature grass (62.5%) and straw (55.8%) diets fed to cattle. They reported that the organic matter intake (kg/100 Kg LW/day) of unchopped and chopped grass diets were 2.6 and 3.3 respectively and these values significantly higher ($p < 0.01$) than the young grass (2.3) and Straw (2.1) diets but the digestible matter intake (domi) of the mature grass diet offered in the young and mature grass offered in the young and mature grass offered in the long form was similar (1.6 Kg/100Kg LW/day).

Nutritional qualities of guinea grass: Pasture quality parameters decreased from the young to mature stages as a result of differences in plant composition between levels of maturity. The presence of an increased proportion of plant stems, typical of older plants, may restrict access to leafy parts and force animals to consume lower quality herbage (Reling *et al*., 2001). The quality of available bites is depressed when green leaf-material is scarce and largely dispersed among senescent material especially in the case of older pasture for which the NDF and ADL fractions increased with level of maturity (Table 4). The nitrogen content (CP) of pasture also decreased from the young to mature stages (Table 3 and 4). Reling *et al.* (2001) concluded that increased pasture maturity had a negative effect on the nutritional value of *P. maximum* cv gatton pasture, indicating that this forage would be best utilized at younger stages of development.

Environmental temperature was reported to influence the production of vegetative material in guinea grass. Tillering was observed to be delayed at low temperatures also plant size and leaf area in all cultivars were greater when temperature was increased. Above a temperature of 20 ^{o}C plant responses in terms of plant

Table 2: Nutrient composition of Green panic *(P. maximum var trichoglume Eyles*)

	As % of dry matter					
	DM	CP	CF	ASH	EE	NFE
Fresh, vegetative, 40cm, Tanzania	25.0	8.8	29.9	11.2	1.6	48.5
Fresh vegetative, 80cm, Tanzania	25.0	8.8	32.8	12.9	1.5	44.0
Fresh, early bloom, Tanzania	28.0	5.3	39.6	10.6	1.4	43.1
Fresh cut of intervals of 1 wk, Malaysia	22.0	20.5	24.1	11.4	0.9	43.1
Fresh cut of intervals of 2 wk, Malaysia	23.0	14.3	27.4	12.2	0.9	45.2
Fresh cut of intervals of 3 wk, Malaysia	23.0	12.6	28.7	13.0	0.9	44.8
Fresh cut at intervals of 4 weeks Malaysia	23.0	11.7	30.9	13.0	1.3	43.1
Fresh cut at intervals of 5 weeks, Malaysia	24.5	10.2	30.6	13.9	0.8	44.5
Fresh cut at intervals of 6 weeks, Malaysia	25.0	9.6	31.2	13.2	1.2	44.8
Fresh, mature, Nigeria	25.7	7.8	33.4	12.2	1.4	45.2
Hay, wet season, 8 weeks, 110cm, Thailand	86.9	7.7	39.0	10.9	1.6	40.8
Hay, wet season, 10 weeks, 170cm, Thailand	87.3	5.5	40.1	10.4	1.4	42.0
Hay, wet season, 12 weeks, 170cm, Thailand	86.5	5.5	40.1	10.4	1.4	42.6
Hay, dry season, 6 weeks, 65cm, Thailand	88.6	11.9	31.7	12.0	3.2	41.2
Hay, dry season, 8 weeks 70cm, Thailand	90.8	8.3	35.7	13.0	2.0	41.0
Hay, dry season, 10 weeks, 70cm, Thailand	89.7	6.6	35.5	13.2	1.8	42.9
Hay, dry season, 12 weeks, 95cm, Thailand	91.1	7.2	36.4	12.5	2.1	41.8
Silage, Tanzania	20.0	6.3	39.7	19.6	2.7	31.7

Source FAO, 2003. DM = dry matter, CP = crude protein, CF = crude fibre EE = ether extract, NFE = nitrogen free extract

Table 3: Digestibility (%) of green panic

	Digestibility (%)					
	Animal	CP	CF	EE	NFE	ME
Fresh, cut 40 cm	sheep	64.8	71.6	31.3	67.0	2.23
Fresh, 80cm	sheep	43.2	73.5	13.3	59.8	2.00
Early bloom	sheep	50.9	63.9	50.0	53.4	1.91
Mature	cattle	60.3	53.0	42.9	65.0	1.95
Hay, 6 weeks	sheep	62.0	58.0	61.0	57.0	1.93
Hay at 8 weeks	sheep	49.0	56.0	53.0	49.0	1.74
Hay at 10 weeks	sheep	36.0	58.0	47.0	54.0	1.80
Silage	sheep	34.9	82.4	40.7	51.7	1.95

Source FAO, 2003. ME = metabolizable energy

height, leaf number and area and plant dry weight tended to flatten out (Tudsri *et al.*, 2002). They suggested that Natsukaze cultivars of guinea grass is capable of producing acceptable dry matter yields of relatively high quality during the cool period provided that soil moisture is adequate for germination and growth. Hence, growing this cultivar as a special-purpose pasture on an appropriate proportion of the farm should help to reduce the feed shortage which normally occurs in Southern African countries‘ winter season. Since it also grows as well as other cultivars at higher temperatures, it could be used throughout the year.

Uses of *P. maximum* grass in animal production: Guinea grass is used as forage for beef production. It is used as a cultivated grass both for pasture and hay. Douglas *et al.* (1991) evaluated the effect of two different stocking rates (2 and 3 AU/ha) and levels of supplementation 0.5, 1.0 and 2.0 kg DM/100Kg LW/day) on the yield and nourishing value of guinea grass pastures during the dry and rainy months in a dry tropic region of Venezuela. They observed that 2 AU/ha stocking rate resulted in higher yield (kgDM/Ha-28 days 0 with 1921 kg at the beginning and 1691 kg at the end than the 3AU/ha stocking rate (1234 kg and 481 kg respectively). Also the residual DM left of over 50 cm height of the vegetation, by the animals in the 2 AU/ha stocking rate treatment, was superior in quality in terms of crude protein, *in vitro* organic matter digestibility (IVOMD) and TDN, was better for the grass to under the 2 AU/ha stocking rate.

Table 4: Chemical composition of oesophageal samples collected from sheep grazing *P. maximum cv gatton* pastures at different levels of maturity during summer, autumn or winter

	Young	medium	mature
Summer			
N%	2.9^{a} (0.1)	2.8^{a} (0.1)	2.0^{b} (0.2)
NDF%	46.2^{b}	52.1^{a} (0.8)	54.1^{a} (1.1)
ADF%	23.1^{c} (1.3)	24.7^{b} (0.3)	28.9^{a} (0.1)
ADL%	2.4^{c} (0.3)	3.4^{b} (0.3)	4.2^{a} (0.3)
IVOM%	76.9^{a} (0.8)	69.6^{b} (1.1)	64.3^{c} (1.1)
Autumn			
N%	2.0^{a} (0.1)	1.9^{b} (0.1)	1.8^{b} (0.1)
NDF%	51.9^{c} (0.4)	55.6^{b} (0.5)	59.5^{a} (0.5)
ADF%	28.8^{b} (0.2)	25.7^{c} (0.5)	30.8^{a} (0.5)
ADL%	3.3^{b} (0.2)	4.0^{a} (0.4)	4.1^{a} (0.1)
IVDOM	68.9^{a} (0.9)	65.4^{b} (1.1)	61.6^{c} (1.0)
Winter			
N%	1.8^{a} (0.1)	1.9^{a} (0.1)	1.5^{b} (0.1)
NDF%	52.5^{c} (0.5)	59.2^{b} (0.5)	63.8^{a} (0.6)
ADF%	27.1^{c} (0.9)	29.9^{b} (1.4)	35.7^{a} (1.1)
ADL%	4.0^{b} (0.1)	4.3^{b} (0.2)	5.6^{a} (0.1)
IVDOM%	62.5^{a} (1.1)	60.4^{a} (1.9)	55.4^{b} (1.2)

Source: Reiling *et al.* (2001). a,b,c Row means with common superscripts do not differ significantly (P>0.05).

Conclusion: *Panicum maximum* is often considered as one of the best species for beef production. There are vast differences between cultivars, in terms of potential production, quality of the herbage and reaction to N fertilization.

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