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THE EVALUATION OF DRY SEASON NUTRITIVE VALUE OF DOMINANT AND IMPROVED GRASSES IN FALLOWS IN CHIVI DISTRICT, ZIMBABWE

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ABSTRACT: *Five dominant (Cynodon dactylon, Perotis patens, Digitaria eriantha, Brachiaria brizantha, Hypethelia dissoluta) and two improved grasses (Pennisetum purpureum and Cynodon nlemfluensis) were compared for their nutritive value in Chivi district in terms of crude protein(CP), ash, dry matter(DM), neutral detergent fibre (NDF) and acid detergent fibre (ADF). The proximate analysis procedure was used to assess CP, ash and DM while NDF and ADF were estimated using the Van Soest et al. procedure. Significant differences were observed in the nutritive value of improved and dominant grasses. Cynodon nlemfluensis (5.54% CP, 39.04% ADF and 59.11% NDF) and P. Purpureum (5.35% CP, 39.17% ADF and 56.80% NDF) had significantly higher CP values and lower ADF values in comparison with dominant grasses, C. dactylon (3.75% CP, 44.13%ADF and 66.00% NDF), D. eriantha (2.21% CP, 48.78% ADF and 69.04 % NDF), P patens (3.51% CP, 47.51% ADF and 70.31% NDF), B. brizantha (2.37% CP, 50.95% ADF and 67.00% NDF) and H. dissoluta (2.10% CP, 44.49% ADF and 67.24% NDF). In terms of CP content comparisons, improved grasses have the potential to increase the carrying capacity of the fallows. It was concluded that the improved species have high nutritive value compared to the dominant grasses therefore have the potential to improve forage quality in terms nutritive value in fallow fields in Chivi.*

Key words: *Dominant grasses; Improved grasses; Nutritive value*

ORIGINAL ARTICLE

INTRODUCTION

In communal areas in Zimbabwe cattle play an important role as they are a source of income, draught power and, and organic fertilizer. However, productivity per animal is very low, and the contribution of the livestock sector to communal livelihoods is much lower than the expected potential (Ngongoni et al., 2006). A major constraint to the livestock industry is the inadequacy of feed. Communal livestock production depends on natural pastures whose dry season quality is too low. The result is low growth rates, poor fertility and high mortality rates of livestock in communal areas (Ngongoni et al., 2007; Gwaze et al., 2009; Nqeno et al., 2011).

One way to achieve increased communal livestock production is through the introduction of high-quality forages. Such forages must be adapted to biotic and abiotic factors such as soil fertility, climatic conditions and resilience to continuous defoliation. The reinforcement of grass-legume species into indefinite fallows which, according to a study by Manzungu and Mtali (2011) form more than 50% of land which was under cultivation in the early eighties, in Chivi district, is one approach which have been successfully used in other countries (Mnene, 2006; Mganga, 2009), for improving quality of forage in communal areas.

Among the promising forage grass species promoted as suitable in the semiarid region of Zimbabwe in which Chivi district is located, *P. purpuruem* and *C. nlemfluensis* could play an important role in providing a significant amount of high quality forage to livestock (Jingura, 2000 and Mapiye et al., 2006). Bana grass (*P. purpuruem* variety schumm) is vigorous and highly productive forage, which can withstand long periods of drought (Mhere et al., 2002). Star grass (*C. nlemfluensis* variety robustus) is a spreading perennial with stout rapidly growing stolons. It is highly persistent and resilient. Although little or no growth takes place during the drought periods, the grass rapidly recovers with the onset of rains (Mapiye et al., 2006 and Taliaferro et al., 2004). However,

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it is essential to evaluate the nutritive potential of recommended reinforcement forages as a means of providing high quality (nutritive value) dry season feed supply for smallholder livestock production systems before promoting them. This can be achieved through conducting a comparative evaluation of the nutritive value of dominant and improved/introduced grass species to check if the nutritive value of the grasses identified for reinforcement is superior to that of the grasses dominant in communal areas under local conditions. Previous studies have given more importance to introduced/improved species than dominant vegetation without characterizing the seasonal dynamics in the nutritive value of the forages in communal areas where no fertilizer application is done at reinforcement due to affordability. Mapiye et al. (2006) recommended selection of improved grass species that retain their nutritive value for the major part of the dry season to ensure sustainable livestock production in Zimbabwe communal areas. The objective of the study was to compare the nutritive value of dominant grass species with those of *Pennisetum purpureum* and *Cynodon nlemfluensis* cultivated under inherent soil fertility.

MATERIALS AND METHODS

Study Site

The study was conducted in Ward 28, in Chivi district, which is located in south central Zimbabwe. The district extends from 20° 14' S to 20° 24' S and lies between 30° 13' E and 30° 57' E. The area receives low and unreliable rainfall ranging from 450-600mm (Mapanda and Muvengahama, 2011; Nemarundwe and Kozanayi, 2003) and is generally characterized by poor crop productivity and food insecurity (Mtali and Manzungu, 2011). Major soils in Chivi were derived from coarse-grained granite and include the chromic luvisols, ferric luvisols and eutric regosols (Anderson and Ingram, 1993).

Samples preparation

An open environment (in situ) pot experiment was used to grow two improved grasses, *C nlemfluensis* and *P purpureum* at the onset of the rain season. The soil used in the pots experiment was from the fallows where dominant grasses grew and collected from a depth of 20cm. Each grass species was replicated 15 times (15 pots per grass species). The grass species were harvested (whole plant) at 5cm above ground at the onset of the dry season for nutritive analysis. On the other hand, samples of five dominant grass species (*Cynodon dactylon, Perotis patens, Digitaria eriantha, Brachiaria brizantha* and *Hyperthelia dissoluta*) growing in fallows in Chivi district were also collected at onset of the dry season. Fifteen samples per species (whole plant) were cut at 5cm above ground using shears. All the samples were packaged in khaki bags and stored in a shade until transported to the University of Zimbabwe Animal Science laboratory for analysis. All the samples were oven dried at 60^{o}C for 72 hours and ground in a Willey Mill to pass through 1mm sieve. The ground samples were kept in airtight containers before they were subjected to analysis for nutritive value.

Analytical procedures for chemical composition

The AOAC (1990) method was used for proximate analysis of the samples. Fibre analyses (Neutral detergent fibre (NDF) and acid detergent fibre (ADF)) were done according to the procedure developed by Van Soest et al., (1991).

Statistical Analysis

A one-way analysis of variance (ANOVA) was used to test the effect of grass species on nutritive quality, using PROC GLM of Statistical Analysis Systems (SAS, 2004) in a completely randomized design (CRD). Mean separation was by Predicted error differences were used as a mean separation technique at 5% alpha error level. The model was as follows:

$Y = \mu + A_i + E_{ij}$

Where:

Y is herbage quality (ADF; NDF; CP; ash; DM)

μ is overall mean

A_i is effect of plant species on nutritive quality (i = 1; 2; 3; 4; 5; 6; 7)

E_{ij} is residual error

RESULTS

Table 1 presents data on chemical composition of dominant and improved grass species in fallows in Chivi district. Dry matter (DM) content of the five dominant grass species (*Cynodon dactylon, Perotis patens, Digitaria eriantha, Brachiaria brizantha* and *Hyperthelia dissoluta*) evaluated were higher ($P<0.05$) than DM content of the improved *P. purpureum* and *C. nlemfluensis* species. The highest DM content of 94.92% was observed in *C. dactylon* followed by *Perotis patens, Digitaria eriantha,* and *Hyperthelia dissoluta* which had very similar DM levels ($P>0.05$). For the improved species DM levels was 90.27% and 90.18% for *P. purpureum* and *C nlemfluensis* respectively, and these were not significantly different ($P > 0.05$).

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Ash values of *Cynodon dactylon* (7.39%), *Perotis patens* (8.27%), *Digitaria eriantha* (7.94%), and *Brachiaria brizantha* (7.07%) and the improved *C. nlemfluensis* (8.60%), were similar (P>0.05) but below ash content of *P purpureum* (P<0.05) which was 10.27%. The lowest ash values were observed in *Hyperthelia dissoluta* (4.40%)

There were no significant (P>0.05) differences in CP content of *C. nlemfluensis* (5.54%) and *P purpureum* (5.35%) which was significantly higher (P<0.05) than CP content observed in *Cynodon dactylon, Perotis patens, Digitaria eriantha, Brachiaria brizantha* and *Hyperthelia dissoluta* which were 3.75%, 3.51%, 2.21%, 2.37% and 2.10% respectively. Among the dominant grasses species the crude protein values of *H. dissoluta* and *D. eriantha* were similar (P>0.05) but lower (P<0.05) than those of *B brizantha*, *C. dactylon* and *P. patens*.

Chemical analysis for acid detergent fibre (ADF) indicated that *C. nlemfluensis* and *P. purpuruem* had similar (P> 0.05) ADF levels of 39.04% and 39.17% respectively. The ADF values were significantly lower (P < 0.05) than those of the dominant grass species. Among the dominant grass species, the highest ADF value was observed in *B.brizantha* (50.95%) and was significantly different (P< 0.05) to values observed in *D. eriantha* (48.78%) and *P. patens* (47.51%). *Cynodon dactylon* (44.13%) and *Hyperthelia dissoluta* (44.49%) had the lowest ADF values among the dominant grass species.

There were significant differences in neutral detergent fibre (NDF) between *C. nlemfluensis* and *P. purpuruem* (P<0.05), however, NDF values for the two grasses were significantly lower (P<0.05) than those of *P. patens, B. brizantha, H. dissoluta, C. dactylon* and *D. eriantha.*

Table 1 - Mean dry matter (DM), ash crude protein (CP), neutral detergent fibre (NDF) and acid detergent fibre (ADF) of native and improved forage species in fallows in Chivi district

Fallow age	DM	Ash	CP	ADF	NDF
B. brizantha	92.92^{c}	7.07^{b}	2.37^{c}	50.95^{a}	67.91^{b}
C. dactylon	94.92^{a}	7.39^{b}	3.75^{b}	44.13^{c}	66.00^{b}
D. eriantha	93.20^{b}	7.94^{b}	2.21^{d}	48.78^{b}	69.04^{ab}
H. dissoluta	93.20^{b}	4.40^{c}	2.10^{d}	44.49^{a}	67.24^{b}
P. patens	93.41^{b}	8.27^{b}	3.51^{b}	47.51^{b}	70.31^{a}
C nlemfluensis	90.27^{d}	8.60^{b}	5.54^{a}	39.04^{d}	59.11^{c}
P. purpureum	90.18^{d}	10.27^{a}	5.35^{a}	39.17^{d}	56.80^{d}
± SEM	0.51	0.32	0.10	0.64	0.57

^{abcd} Within column values with different superscripts differs significantly (P<0.05)

DISCUSSION

Crude protein content of the *C. dactylon, D. eriantha, P. patens, B. brizantha and H. dissoluta* and the introduced *P. purpureum* and *C. nlemfluensis* grass species ranged from 2.10% to 5.54%, a range within values observed by Mtali (2011) for the dominant species (1.76 % to 6.14%). Jingura (2000) recorded CP values of 8 % for *P. purpureum* in a trial conducted in Gokwe South, which is slightly above the value observed in the current study. Mapiye et al. (2006a) noted that early part of the dry season (May or June) nutritive value of improved grasses in Zimbabwe range from 1% to 5%. In the current study, improved *P. purpureum* and *C. nlemfluensis* species had the highest CP content of 5.54% and 5.35% respectively, compared to dominant grasses, which ranged between 2.10% to 3.75% therefore, the grasses have the potential to improve the quality of grazing in Chivi fallow lands. However, the observed CP values of *P. purpureum* and *C. nlemfluensis* were low and not comparable to some values reported in literature. Gwayumba et al. (2002) and Islam et al. (2003) reported higher CP value for *P. purpureum* (14%). The differences observed may be due mainly to influence of genotype and growth environment.

Factors such as differences in stage of growth, inherent soil fertility could have contributed to low CP values observed (Lukhele and van Ryssen, 2003). Influence in agronomic and genotype of forage species, difference in tolerance to soil quality characterising an area in which grasses grow also affect nutritive value of grasses. In this study, the CP content of both the dominant grasses and the improved grasses, which ranged between 2.10% to 5.54%, was lower than the levels recommended to meet the minimum requirements for growth (11.3%) and lactation 12.0% in ruminants (Agricultural Research Council, 1984).

Fibre fractions (ADF and NDF) are important as they describe those forage components that have low solubility in a specific solvent systems and are relatively less digestible than starch. ADF values of *C. dactylon, D. eriantha, P patens, B brizantha* and *H. dissoluta* were in similar range to result obtained by Mtali (2011). The ADF values of improved *P. purpureum* and *C. nlemfluensis* were similar to findings of Jingura (2000). Also the results obtained in the current study were within the range reported by Mapiye et al. (2006) who reported that fibre content of improved grasses range from 25%-30% in early growing season to around 50% in late growing season. The low values of ADF for *P. purpureum* (39.17%) and *C. nlemfluensis* (39.04%) compared to the dominant grass species (44.13% to 50.95%) indicates the superiority of the two improved grasses since detergent fibre fractions are negatively correlated to voluntary DM intake by cattle. The high ADF and NDF content noted in the dominant grasses reduce intake and digestibility of forages as illustrated by Van Soest (1995) who showed that ADF and NDF were negatively and significantly correlated to intake and digestibility of forages.

In terms of range improvement, the improved grasses have the potential to increase the current carrying capacity in fallows in Chivi district when compared to the assessed dominant grasses, as CP content in the

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improved grasses was double the level observed in most of the dominant grasses. This is especially so because cattle grazing *C. nlemfluensis* or *P. purpureum* require less quantities of forages per day to meet 7% and 12% for cattle maintenance and lactation requirements respectively compared to the dominant species studied.

CONCLUSION

The nutritive value (CP, ADF and NDF) of *P. purpureum* and *C. nlemfluensis* was significantly superior to that of the dominant grass species in Chivi district. It was thus concluded that *P. purpureum* and *C. nlemfluensis* have the potential to moderately improve the quality of grazing in fallows in Chivi district, which will increase the grazing capacity of fallows through decrease in quantity of forage, required to meet nutrient requirements for various physiological and production needs of cattle. Reinforcement of the fallows with P purpureum and C. nlefluensis is therefore recommended.

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REFERENCES

Agricultural Research Council (1984). The nutrient requirement of ruminant livestock. Supplement No-1. Commonwealth Agricultural Bureaux, Slough, UK.

Anderson JM, Ingram JSI (1993). Tropical soil biology and fertility. A handbook of methods. CAB International, Wallingford, UK.

AOAC (1990). Official methods of analysis. 15th ed. Association of Official Analytical Chemists, Washington, DC, USA.

Gwayumba W, Christensen DA, McKinnon JJ, Yu P (2002). Dry matter intake, digestibility and milk yield by Friesian cows fed two Napier grass varieties. Asian-Aust. J. Anim. Sci., 15(4): 516-521.

Gwaze RF, Chimonyo M, Dzama K (2009). Communal goat production in Southern Africa: a review Tropical Animal Health Production 41: 1157–1168.

Jingura RM (2000). Fodder production and use of farm-grown foods in the smallholder dairy sector: a participatory approach to designing feeding system in Gokwe South District, Zimbabwe. Phd Thesis, University of Zimbabwe. Harare, Zimbabwe.

Islam MR, Saha CK, Sarker NR, Jalil MA, Hasanuzzaman M (2003). Effect of variety on proportion of botanical fractions and nutritive value of different Napier grass (*Pennisetum purpureum*) and relationship between botanical fractions and nutritive value. Asian-Aust. J. Anim. Sci., 16(6): 837-842

Lukhele MS, Van Ryssen JBJ (2003). The chemical composition and nutritive value of the foliage of four sub tropical tree species in South Africa for ruminants. South African Journal of Animal Science, 33: 132 - 141.

Manzungu E, Mtali L (2011). Spatial and temporal distribution of fallow land and its utilisation in south east Zimbabwe. Research Application Summary. Second RUFORUM Biennial Meeting 20 - 24 September 2010, Entebbe, Uganda.

Mapanda F, Mavengahama S (2011). Assessment of selected soil nutrients and irrigation water quality in the dryland area of Chivi District, Zimbabwe. Scientific Research and Essays. 6: 14.

Mapiye C, Mupangwa JF, Mugabe PH, Chikumba N, Poshiwa X, Foti R (2006). A review of improved forage grasses in Zimbabwe. Tropical and Subtropical Agroecosystems 6: 125–131.

Mhere O, Maasdorp B, Titterton M (2002). Forage Production and Conservation Manual.: Growing and ensiling annual and perennial forage crops suited to marginal and semi-arid areas of Southern Africa. Ed. T. Smith. Livestock Production Programme. Natural Resources International.

Mganga KZ (2009). Impact of grass reseeding technology on rehabilitation of the degraded rangelands: A case study of Kibwezi District, Kenya. MSc Thesis, University of Nairobi, Nairobi, Kenya.

Mnene WN (2006). Strategies to increase success rates in natural pasture development through reseeding degraded rangelands of Kenya. PhD Thesis, University of Nairobi, Kenya.

Mtali L (2011). Spartial and temporal distribution and utilisation of fallow lands in Southern Zimbabwe. Msc Thesis. Department of Soil Science and Agricultural Engineering. University of Zimbabwe. Harare. Zimbabwe.

Nemarundwe N, Kozanayi W (2003) Institutional arrangements for water for water resource use: A case study from Southern Zimbabwe. Journal of Southern African Studies, 29: 193-206

Ngongoni NT, Mapiye C, Mwale M, Mupeta B (2007). Effect of supplementing a high-protein ram press sunflower cake concentrate on smallholder milk production in Zimbabwe. Trop. Anim. Health Prod. 39: 297–307.

Ngongoni NT, Mapiye C, Mwale M, Mupeta B (2006). Factors affecting milk production in the smallholder dairy sector of Zimbabwe. Livestock Research for Rural Development. 18: 72. Accessed on 18 July 2012. http://www.lrrd.org/lrrd18/5/ngon18072.htm.

Nqeno N, Chimonyo M, Mapiye C (2011). Farmers' perceptions of the causes of low reproductive performance in cows kept under low-input communal production systems in South Africa. Tropical Animal Health Production 43: 315–321.
Taliaferro CM, Rouquette (Jr) FM, Mislevy P (2004). Bermuda grass and star grass. p. 417-475. In L.E. Moser et al. (ed.) Warm-season (C4) grasses. ASA/CSSA/SSSA, Madison, WI.
Van Soest PJ (1995). Comparison of two different equations for predicting digestibility from cell contents, cell wall constituents and lignin content of ADF. Journal of Dairy Science, 48: 815.
Van Soest PJ, Robertson JB, Lewis BA (1991). Methods for dietary fiber, neutral detergent fiber and non-starch polysaccharides in relation to animal nutrition. Journal of Dairy Science 74: 3583-3597.

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