The Effect of Harvesting Interval on Herbage Yield and Nutritive Value of Napier Grass and Hybrid *Pennisetums*

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ABSTRACT : A 6 (accession)×5 (cutting interval) factorial experiment was conducted over two years to investigate the effect of stage of growth on herbage production, nutritive value and water soluble carbohydrate (WSC) content of Napier grass and Napier grass ×Pearl millet hybrids (hybrid Pennisetum). The purpose of the experiment was to determine the optimum stage of growth to harvest the *Pennisetums* for ensilage. Two Napier accessions (SDPP 8 and SDPP 19) and four hybrid Pennisetum (SDPN 3, SDPN 29, SDPN 38 and Bana grass) were compared at five harvest intervals (*viz.* 2, 4, 6, 8, and 10 weeks). Basal fertilizers were similar in all treatment plots, although nitrogen (N) top-dressing fertilizer was varied proportionately, depending on the harvesting interval. The application was based on a standard rate of 60 kg N/ha every six weeks. Stage of growth had significant effects on forage yield, WSC content and nutritive value of the *Pennisetums*. Herbage yields increased in a progressively linear manner, with age. Nutritive value declined as the harvesting interval increased. In particular, crude protein content declined rapidly ($p<0.001$) from 204 g kg^{-1} DM at 2 weeks to 92 g kg^{-1} DM at 8 weeks of growth. *In vitro* dry matter digestibility decreased from 728 to 636 g kg^{-1} DM, whilst acid and neutral detergent fibre contents increased from 360 and 704 to 398 and 785 g kg^{-1} DM, respectively. Rapid changes in nutritive value occurred after 6 weeks of growth. The concentration of WSC increased in a quadratic manner, with peaks (136-182 g kg^{-1} DM) at about 6 weeks. However, the DM content of the forage was low (150-200 g DM kg^{-1}) at 6 weeks. Therefore, it was concluded that *Pennisetums* should be harvested between 6 and 7 weeks, to increase DM content and optimize herbage production without seriously affecting nutritive value and WSC content. Accessions SDPN 29 and SDPP 19 appeared to be most suited for ensilage. It was suggested that WSC content should be incorporated as a criterion in the agronomic evaluation and screening of Pennisetum varieties. ***(Asian-Aust. J. Anim. Sci. 2003. Vol 16, No. 7 : 996-1002)***

Key Words : Napier Grass, *Pennisetum Purpureum*, *Pennisetum Purpureum×P. Americanum*, Silage, Cutting Frequency, Water Soluble Carbohydrates

INTRODUCTION

Napier grass (*Pennisetum purpureum*) and Bana grass (*Pennisetum* purpureum×P. americanum) are used by farmers to make silage in the smallholder and commercial dairy farming sectors of Zimbabwe (Manyawu et al., 1996). However, the farmers do not have sufficient information on the cutting management of the *Pennisetums*. This information is required to optimize herbage yields, nutritive value and the concentration of water soluble carbohydrates (WSC) in *Pennisetums* at the time of ensiling. Lack of the knowledge has resulted in farmers making silages that are of poor feeding value.

High concentrations of WSC are necessary for optimum silage fermentation. However, little research has been done to determine changes that occur in the concentration of WSC in *Pennisetums* at different stages of growth. But, the effects of stage of growth on the herbage yield and nutritive value of the *Pennisetum* are widely documented (Woodard and Prine, 1991; Butt et al., 1993; Spitaleri et al., 1995).

In general, it is accepted that *Pennisetum* herbage yields increase and nutritive value declines with increasing maturity (Woodard and Prine, 1991; Spitaleri et al., 1995). However, a full season's growth of Napier grass would not be adequate to support livestock production, because it will have low nutritive value (Gomide et al., 1969; Johnson et al., 1973). Butt et al. (1993) demonstrated that a three-week re-growth is also inadequate because of low herbage yields. Woodard et al. (1991) reported that silage made from immature *Pennisetum* is undesirable due to high buffering capacity, poor conservation and the high concentrations of acetate that develops in the silage. Regrowth of six to nine weeks in Napier grass was found to be optimum for herbage production and nutritive value (Mwakha, 1972; Butt et al., 1993). Longer periods (8-16 weeks) have been suggested for Napier grass intended for silage making by (Mwakha, 1972; Wilkinson, 1983), while Mugerwa and Ogwang (1976) and Spitaleri et al. (1995) recommended 8-10 weeks for hybrid *Pennisetums*. Due to this large variation in the recommended cutting interval, an experiment was conducted to determine the optimum stage of growth to harvest Napier grass and hybrid *Pennisetums* for ensiling, in the highveld of Zimbabwe.

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MATERIALS AND METHODS

Site

The experiment was conducted at Grasslands Research Station, in Natural Region II of Zimbabwe. The site is representative of the Highveld region, where *Pennisetums* are widely grown. The soils at this location were largely granitic sandy loams.

Experimental design

Treatments (6 *Pennisetum* accessions, cut at 5 cutting intervals) were arranged as a complete factorial within a randomised block design, with four replications. The treatment plots measured 4.8 m×5.4 m in area. Inter- and intra-row spacings were 0.9 m and 0.3 m respectively. The outer-most row, on each side a plot, was treated as a guard row.

The six *Pennisetums* used in this experiment were high yielding accessions identified from a forage evaluation experiment (Manyawu, 1998). They consisted of two Napier grass accessions (SDPP 8 and SDPP19) and four hybrid *Pennisetums* (SDPN 3, SDPN 29, SDPN 38 and ICRISAT Bana grass). Three of the hybrid *Pennisetums* were accessions and the fourth (Bana grass) had cultivar status. Due to the presence of the latter cultivar, the terms "cultivar" and "accession" will be used interchangeably hereafter. The five harvesting (or cutting) intervals were 2, 4, 6, 8 and 10 weeks of regrowth. The effects of the cultivar, harvesting interval and their interactions were determined by measuring forage production, nutritive value and WSC content.

Establishment and fertiliser management

The *Pennisetums* were planted in December 1995 as rooted splits on a seedbed that had been prepared by ploughing and disc harrowing. Single superphosphate (18.5% P_2O_5) and agricultural lime were applied as basal fertilisers at the rates of 250 and 500 kg ha^{-1}, respectively. The same fertilisers, plus 100 kg ha^{-1} muriate of potash were applied at the beginning of Year 2 (1997) of the experiment. Nitrogen, as ammonium nitrate (34.5% N) fertiliser was applied at the rate of 60 kg N ha^{-1} during establishment in 1996 and as top-dressing fertiliser after the standardisation cut that marked the beginning of the data collection period in each year. At top-dressing, the N-fertiliser was applied in proportionate amounts at the beginning of each growth cycle (cutting interval). The proportions were based on an application rate of 60 kg N ha^{-1} every six weeks. Thus, experimental plots for 2, 4, 6, 8 and 10-week cutting intervals received 20, 40, 60, 80, 100 kg N ha^{-1}, respectively, at the beginning of each growth cycle.

Harvesting procedure and chemical analyses

The *Pennisetum* were harvested by cutting to a 10 cm stubble using hand sickles. Guard-rows were cut first. The height of the *Pennisetums* in each plot was then determined by measuring the three tallest tillers on each of four randomly selected plants (excluding four plants at the centre of the plot). The height was measured from the base of the tiller to the top-most ligule. Subsequently, the four *Pennisetums* at the centre of the plot were harvested and weighed and a 500 g forage sample was collected to determine DM, nutritive value and WSC contents. The remainder of the plot was harvested and weighed, to determine total herbage yields.

Dry matter content of the samples was determined in an oven at 80°C, for 48 h. The dried samples were ground through a 1.0 mm screen for the determination of crude protein (Kjeldhal-N×6.25), acid detergent fibre (ADF), neutral detergent fibre (NDF) contents (Van Soest et al., 1985) and *in vitro* dry matter digestibility (Tilley and Terry, 1963). Nutritive quality of the herbage was only determined during Year 2.

The water soluble carbohydrate content was determined on fresh herbage using the method of Allen (1989), modified to cater for the fresh nature of the samples. In the modified procedure, fresh forage was chopped into 1-2 cm pieces to obtain 50 g representative sub-samples for the analysis. Each sub-sample was then chopped in a blender, with 750 ml of distilled water. The blended sample was filtered though a double layer of cheese cloth into a 2.0 l beaker. The residue was then washed with 500 ml of distilled water. Fifty millilitres of the filtrate was again filtered through a 41 and 42 Whatman paper. Three millilitres of this filtrate was placed into a 50 ml volumetric flask and diluted to mark using distilled water. From the volumetric flask, 2 ml of filtrate was transferred to a 10 ml stoppered glass boiling tube, where it was mixed with 1.0 ml of anthrone reagent. The steps followed thereafter were similar to those described by Allen (1989).

Statistical analyses

Data on herbage production and nutritive value were subjected to analysis of variance, using general linear models procedures (Proc GLM) of SAS (1996) statistical package (Statistical Analytical Institute Inc. Cary, North Carolina, USA). Data on WSC concentrations was analysed using GENSTAT 5 release 1.3 (1988). Least squares means are presented for relevant comparisons. Standard errors were calculated using the error mean square as an estimate of residual variance. Treatment means were contrasted using the least significant differences (Gomez and Gomez, 1984). GENSTAT was also used to perform linear, quadratic, exponential and logarithmic regression analyses to explain the changes in WSC concentration at different stages of growth. Results of Year 1 were analysed separately to those of Year 2.

Table 1. Herbage yields (kg DM ha^{-1}) of hybrid *Pennisetum* (SDPN) and Napier Grass (SDPP) harvested at different intervals

Cultivar	Cutting frequency (weeks) 2	4	6	8	10[a]	Cultivar mean	Treatment comparison: Treatment	Signif. level	S.E.D.
Year 1 (March-May)									
SDPN 3	90	270	890	860	2,760	970			
SDPN 29	190	520	1,610	1,450	2,170	1,180	Frequency	***	200
SDPN 38	140	440	1,040	1,780	3,580	1,400			
SDPP 8	130	590	1,240	1,960	1,100	1,000	Cultivar	**	220
SDPP 19	160	480	720	1,490	2,020	980			
Bana grass	110	350	750	550	520	460	Cutting Frequency x	**	480
Mean	140	440	1,040	1,350	2,020		Cultivar Interaction		
Year 2 (January-June)									
SDPN 3	460	1,080	1,900	2,790		1,560	Cutting		
SDPN 29	610	1,730	2,950	5,320		2,650	Frequency	***	290
SDPN 38	520	1,540	2,910	6,000		2,740			
SDPP 8	440	1,340	1,750	4,300		1,960	Cultivar	**	360
SDPP 19	620	1,710	3,050	6,140		2,880			
Bana grass	500	1,280	2,050	3,980		1,950	Cutting Frequency x	NS	720
Mean	530	1,450	2,440	4,750			Cultivar Interaction		

NS refers to non-significant differences ($p<0.05$). **, *** refer to significant differences at $p<0.01$ and $p<0.001$, respectively.
[a] No data in Year 2 because of accidental grazing.

Table 2. Plant height and total forage DM production estimates for six *Pennisetum* cultivars harvested at different stages of growth

Year	Period of data collection	Cutting frequency (weeks)	Total No. of harvesting cycles	Total forage DM yield (kg ha^{-1})	Average plant height[#] (cm)
1996	March-May	2	5	690	16
		4	2	880	12
		6	1	1,020	26
		8	1	1,340	23
		10	1	2,000	51
	Significance of differences			***	***
	S.E.D.			217	3
1997	January-March	2	4	2,110	30
		4	2	2,890	46
		6	1	2,430	60
		8	1	4,740	74
	Significance of differences			***	***
	S.E.D.			323	5

N.B. Comparison of yield data from 1996 should be restricted to cutting intervals that had an equal number of cycles (e.g. 6 weeks vs. 8weeks) or whose total period of data collection is similar (e.g. 2-week cutting intervals×5 intervals vs. one 10-week period).
[#] Plant heights were measured from the base of a plant to the top-most ligule.
*** Refers to significant differences ($p<0.001$)

RESULTS

Year 1 of the experiment was interrupted by a six-week dry spell that occurred between Weeks 2 and 8 of the sampling period. Small amounts (20 mm) of supplementary irrigation were provided to all experimental plots soon after the 6th and 8th week harvests, to prevent unnecessary mortality of the plants. Since Year 1 constituted part of the establishment phase of the *Pennisetums*, the supplementary irrigation also helped to ensure that plants harvested during data collection persisted into the following season. However,during Year 2, only three of the four blocks were used in the experiment because of poor persistence of the plants in the fourth experimental block. The experiment was expected to last three wet seasons, but, wide-spread destruction of plants by Eulipida mashona (White grub) at the end of Year 2 caused premature termination of the experiment.

Herbage yields at different stages of growth

The same treatment plots were used in Years 1 and 2. Herbage yields obtained in the experiment are shown in Table 1. Except for SDPN 3 and SDPN 29 during Year 1, herbage DM yields increased continuously with age in the cultivars.

In Year 1, the plots were harvested at the end of the wet season, between March and May when most of the hybrid *Pennisetums* had started to develop flowers. Consequently, SDPN 3, SDPN 29 and SDPN 38 became stemmy and higher yielding than the rest of the *Pennisetum*. Therefore,

Table 3. Water soluble carbohydrate (WSC) content of Napier grass (SDPP) and hybrid Pennisetum (SDPN) varieties at different stages of growth

Treatment	Treatment level	Water soluble carbohydrate content (g kg^{-1} DM)	
		Year 1	Year 2
Cutting frequency (weeks)	2	83	86
	4	160	115
	6	182	136
	8	91	128
	10	133	
Significance of differences		***	***
S.E.D.		9	11
Cultivar	SDPN 3	142	106
	SDPN 29	149	142
	SDPN 38	121	108
	SDPP 8	129	126
	SDPP 19	125	112
	Bana grass	110	105
Significance of differences		*	NS
S.E.D.		11	14

NS refers to non-significant differences ($p>0.05$).
*, *** Refer to significant differences at $p<0.05$ and $p<0.001$, respectively.

significant ($p<0.01$) cutting time×cultivar interactions were observed for herbage yield during Year 1. During Year 2, data collection was done between January and March. However, 'Week 10' were lost because the experiment was grazed by stray livestock.

Generally, total DM production was highest at longer cutting intervals (Table 2). Repeated cutting at short intervals resulted in low herbage yields compared with longer uninterrupted periods of growth. Although changes in plant height were erratic in Year 1 because of the drought, in Year 2 plant height increased linearly ($r^2=0.994$) with age.

Changes in the water soluble carbohydrate content

The WSC contents of *Pennisetums* at different stages of growth are shown in Table 3. In both years of the experiment, the concentrations of WSC tended to increase from 2 to 6 weeks of regrowth, and declined thereafter. However, during Year 1 the concentration of WSC increased sharply between the 8th and 10th week, from 91 g kg^{-1} DM to 133 g kg^{-1} DM after a week 6-8 nadir. The increase followed 132 mm of rainfall that were received soon after the 8th week and it coincided with renewed growth in young and old tillers. Apparently, the resurgence in tiller growth distorted the quadratic nature of change in the concentration of WSC that had been observed during the initial 8 weeks of re-growth. Maximum WSC concentrations occurred at about six weeks of growth. The decline in WSC concentration after the six-week peak was greater in moisture stressed plants of Year 1.

Nutritive value of *Pennisetum* forage at different stages of growth

Although the *Pennisetum* accessions differed greatly in nutritional value, nutritional composition was mostly influenced by stage of growth (Table 4). Nutritive quality of the *Pennisetum* forage declined from two to eight weeks of grwoth. At each interval CP content and IVDMD declined significantly ($p<0.05$) and NDF increased ($p<0.05$). Acid detergent fibre content only increased significantly ($p<0.05$) between six and eight weeks. Thus, nutritive value and WSC content were optimum around 6 weeks of growth.

There was no accession that was altogether high in nutritive value, WSC content and forage yield. For example, SDPN 3 had the highest levels of CP and lowest concentrations of ADF and NDF. However, its IVDMD values were inexplicably low throughout all age groups. It also had a low herbage yield. On the contrary SDPP 19 was

Table 4. The effect of cutting frequency on the nutritive value of different varieties of *Pennisetum* fodder crops during Year 2

Treatment	Treatment level	Nutritive constituents (g kg^{-1} DM)				
		Dry matter	Crude protein	Digestible dry matter	Acid detergent fibre	Neutral detergent fibre
Cutting frequency (wks)	2	143	204	728	360	704
	4	166	143	705	364	735
	6	149	126	694	375	759
	8	185	92	636	398	785
Significance of differences		*	***	***	***	***
S.E.D.		13.2	4.7	8.7	13.2	15.1
Cultivar	SDPN 3	157	160	673	357	713
	SDPN 29	160	134	688	382	754
	SDPN 38	159	139	681	386	759
	SDPP 8	149	142	716	365	757
	SDPP 19	174	135	685	379	756
	Bana grass	164	137	698	377	736
Significance of differences		NS	***	**	**	***
S.E.D.		16.1	11.3	21.1	16.2	18.6

There were no significant ($p<0.05$) interactions between stage of growth and Pennisetum accessions. NS refers to non-significant differences ($p>0.05$).
*, **, *** Refer to significant differences at $p<0.05$, $p<0.01$ and $p<0.001$, respectively.

high yielding and it had high DM contents and IVDMD. However, it had a mediocre nutritive value in terms of CP, WSC and NDF contents.

There were no significant accession x stage of growth interactions in forage nutritive value.

DISCUSSION

In this experiment, stage of growth of *Pennisetums* had the greatest effect on herbage yield, WSC content and nutritive quality. The effects of stage of growth and variety are discussed separately in the following sections.

Effect of stage of growth on herbage yield and quality

The low herbage yields obtained in all accessions during Year 1 are typical in the first season of establishment (Manyawu et al., 1998). The following discussion will concentrate on Year 2 results because plants in this phase of the experiment were more mature and therefore likely to give more relevant results. The January to March period, which was chosen for data collection during Year 2 had high rainfall and it provided the highest forage dry matter yields under Zimbabwean conditions (Manyawu et al., 1998). It also coincides with the period when most smallholder dairy farmers harvest *Pennisetums* for silage.

Our observations in the current experiment that herbage yields increased and nutritive quality declined as the harvesting interval of forage increases, have also been reported by Vincente-Chandler (1959), Mugerwa and Ogwang (1976), Woodard and Prine (1991) and Spitaleri et al. (1995) working in tropical environments. Even during the drought of Year 1, herbage yields tended to increase with age, but the rate of growth was retarded by lack of moisture. The pattern of herbage accumulation in both years suggests that herbage yields will increase beyond 10 weeks. However, the rate of change in nutritive value was rapid (especially for CP) in the same time scale (Table 4). This suggests that the optimum harvesting period lies within eight weeks of growth, and since IVDMD, CP, and ADF contents declined markedly after six weeks, it is suggested that the *Pennisetums* be harvested at about six weeks of growth to optimize nutritive value.

Several scientists recommended that *Pennisetums* should be harvested between 6 and 10 weeks of regrowth, to optimize forage yield and nutritive value (Mwakha, 1972; Mugerwa and Ogwang, 1976; Woodard and Prine, 1991; Butt et al., 1993 and Spitaleri et al., 1995). In the Kenyan highlands, Odhiambo (1974) observed no significant changes in the nutritive value of Napier grass that was 7-12 weeks old (76-137 cm tall). He reported that the herbage yield of Napier grass increased up to 24 weeks of growth, although nutritive value started to decline between 12 and 17 weeks of growth. These large variations in the recommended period of regrowth may have emanated from differences in the conditions for growth in different environments and possibly, differences in the cultivars of *Pennisetum*. To cater for these differences in Zimbabwe, the recommended period of growth was extended to 7 weeks, to ensure sufficient herbage yields and DM contents for ensiling. Therefore, we recommend that *Pennisetums* should be harvested between 6 and 7 weeks of growth.

However, herbage intended for silage making should also be assessed for WSC content. The peak concentrations of WSC found in the current experiment (182 and 136 g kg^{-1} DM in Year 1 and 2, respectively) were higher than those generally reported. They equate to 38 g WSC kg^{-1} fresh weight (Fw) in Year 1 and 21 g WSC kg^{-1} Fw in Year 2. In cultivars such as SDPN 29 which had higher sugar contents, peak concentrations of WSC were 42 and 28 g kg^{-1} Fw during Year 1 and 2, respectively. Wilkinson (1983) stated that silage prepared from herbage with WSC concentrations below 20 g kg^{-1} Fw are at risk from secondary fermentation. He defined the "adequate" level of WSC concentration as 30 g kg^{-1} Fw, following a study of 213 silages made from temperate crops. On a dry matter basis, Catchpoole and Henzell (1971) reported that a silage crop should have 130-160 g WSC kg^{-1} to undergo a stable lactate-dominated fermentation. We, therefore, conclude that the peak concentrations of WSC achieved at 6 weeks in the current experiment can sustain a stable fermentation.

Wilkinson (1983) cited seven references from 1971 and 1979 which showed that Napier grass harvested in the tropical environment between 40 and 80 days of growth contained WSC concentrations of 10-20 g kg^{-1} Fw. He concluded that Napier grass harvested for ensilage without pre-wilting or treatment with additives was likely to be affected by secondary fermentation. In contrast, our results suggest that minimum treatment with additives or wilting will be necessary.

In Florida, Woodard et al. (1991) prepared well-fermented silage in laboratory silos using direct-cut forage from Napier grass that was eight weeks old and contained up to 83.7 g WSC kg^{-1} DM. In the same environment, Spitaleri et al. (1995) achieved WSC concentrations of 60 g kg^{-1} DM in seeded hexaploid hybrids of *Pennisetum* which were harvested at 6 and 12 weeks of age. In this experiment, the concentrations of WSC did not differ between 6 and 12 weeks of growth. In contrast, Tosi et al. (1983) reported higher values, up to 170 g WSC kg^{-1} DM in Napier grass that was eight weeks old. These differences in WSC concentration at similar stages of growth appear to result from varietal and environmental differences. However, they may also be due to differences caused by analytical procedures or even the diurnal time at harvesting.

Woodard et al. (1991) defined the optimum DM content for silage-making as 250-280 g DM kg^{-1}. Therefore, it may be necessary to pre-wilt *Pennisetum* herbage (Wilkinson, 1983) or add small amounts of cereals as moisture absorbents (Jones et al., 1990; Harrison et al., 1994) to increase the DM content of forage before silage making. high DM contents are necessary to avoid secondary fermentation.

Effects of cultivar on the ensilage potential of *Pennisetum* herbage

The current experiment demonstrated that there were differences of 37-39 g WSC kg DM^{-1} between cultivars. In a crop such as *Pennisetum*, that can have low WSC contents, differences of 38 g WSC kg DM^{-1} are large enough to influence the success or failure of fermentation. Therefore, the choice of Napier grass or hybrid *Pennisetum* cultivar will be important. Forage agronomists should use WSC content as one of the criteria in selecting appropriate cultivars of *Pennisetum*.

Although the actual concentrations of WSC obtained in the current experiment were generally high enough to sustain adequate fermentation, exceptionally high values such as those in SDPP 8 and SDPN 29 in Year 2 will ensure successful fermentation. The WSC contents of the two accessions exceed the 126-149 g kg^{-1} DM limits that were defined as adequate by Catchpoole and Henzell (1971). The occurrence of high levels of WSC content in some of the new and higher yielding accessions indicated a need for these to replace the old and widely used Bana grass. Forage production and WSC contents of Bana grass are inadequate for silage making.

The appearance of stems and stem elongation was associated with high values of WSC content because most hybrid *Pennisetums* were harvested during flower initiation in Year 1. Research by Manyawu (unpublished) indicated that developed stem fractions are a main diurnal storage organ for WSC in *Pennisetums*. Thus, the concentrations of WSC tended to be greater in flowering hybrids during Year 1. This observation can also explain the high levels of WSC concentration in varieties which rapidly developed stems and, therefore, inherently had a larger stem fraction (e.g. SDPN 29 or SDPP 8) than the leafier varieties such as SDPN 3 or Bana grass. However, the results should not be misconstrued to imply that stemmy varieties always have high WSC contents.

Accession SDPN 29 consistently had the highest levels of WSC and DM yields. However, it is a short-lived perennial that persists for about three years (Manyawu et al., 1998). In addition to having the lowest CP values, it was generally of mediocre nutritive value. Similar observations were made by Gupta and Mhere (1997) at Matopos Research Station. In spite of its limitations, SDPN 29 is recommended for cultivation as a silage crop in short-term leys. Among the Napier grass cultivars, SDPP 19 had satisfactory WSC contents, although its forage yields were low.

We found large differences in herbage production and nutritive value between cultivars in the current experiment as has been also reported by Mugerwa and Ogwang (1976) in tropical Africa, and Woodard et al. (1991) in tropical America. However, it should be noted that the comparisons made in the current experiment are relevant to short-term pastures. Longer-term experiments are required to assess differences between Napier grass and hybrid *Pennisetums* more accurately.

CONCLUSION

This experiment showed that to optimize forage production, nutritive value and WSC content, *Pennisetums* that used for silage making under Zimbabwean conditions should be harvested between six and seven weeks of age. Although the DM content of the forage may be low at this stage of growth, cost effective pre-ensilage treatment such as wilting and application of cereal flour should be used to increase forage DM content. Some of the new accessions of *Pennisetum* were better than the widely used Bana grass which is low yielding, and low in nutritive value and WSC content. In particular, SDPN 29 and SDPP 19 were most suitable, although the latter had low WSC contents. It is recommended that WSC content should be used as one of the criteria for evaluating forage *Pennisetums* varieties for silage making.

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