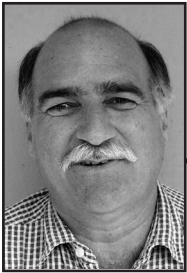


The effect of re-growth stage and cutting frequency on the chemical composition and fermentation characteristics of kikuyu pasture



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A trial was executed at the Outeniqua Experimental Farm to investigate the effect of re-growth stage and cutting frequency of kikuyu pasture on its chemical composition and fermentation characteristics. Four plots of 60 m² each were randomly selected in an existing kikuyu camp. Each plot was subdivided into six plots of 2 x 5 m, thus enabling a trial with six treatments and four replicates. Plots were first cut to ground level and soil samples were taken to determine the mineral status which was used as a guideline for fertilization. All fertilizer and irrigation applications were according to current recommendations.

The following treatments were evaluated: During a 42 days cycle, plots were cut after the following re-growth periods: 7 days (6 cuttings), 14 days (3 cuttings), 21 days (2 cuttings), 28 days (one cutting), 35 days (one cutting) or 42 days (one cutting). Cycles were repeated 35 days after the end of the previous cycle. Three cycles were completed between November 2005 and April 2006, but only results obtained from the first cycle will be reported in this presentation. Five weeks before the start of each cycle, the pasture was cut to a height of 50 mm. One week before cutting the first treatment, all the plots were again cut to a height of 50 mm and fertilized; this was then regarded as the starting date of the relevant cycle. The first treatment was therefore cut 7 days after the starting date. Other treatments were then cut as indicated above.

Three areas of approximately 0.1 m² each were hand-cut from each treatment per plot to a height of 50 mm and the material was collected, weighed and dried at 60° C. Samples were then milled through a 2 mm screen and stored at 4° C until analyzed. After taking the hand-cut samples, the rest of the plot was machine-cut to 50 mm and all the loose material raked out.

At the end of each cycle, the total area was cut to a height of 50

mm, fertilized immediately and again 28 days later, i.e. one week before the first cutting of a subsequent cycle. Fertilization was based on soil analyses results to maintain the following plant nutritional norms:

pH (KCL)	5.5
Phosphate	35 ppm
Potassium	100 ppm
Magnesium	>70 ppm
Calcium	>400 ppm
Copper	>1.0 ppm
Zinc	>1.0 ppm
Boron	> 1.0 ppm
Manganese	10-15 ppm

Nitrogen was applied at the start of each cycle and every 28 days thereafter at 55 kg N/ha. Irrigation was based on water tensiometer readings.

All samples were subjected to the following analyses:

Chemical: DM, crude protein (CP), crude fibre (CF), fat, ash, NFE, neutral detergent fibre (NDF), acid detergent fibre (ADF) and acid detergent lignin (ADL).

In vitro: 24 h NDF disappearance, 48 h IVOMD, gas production (ml gas/g OM) after incubation times of 0, 1, 2, 4, 8, 12, 24, 48, 72, and 96 h. Dry matter yield was also determined on each plot at the specified cutting times.

Only certain selected parameters will be discussed in this report

Table 1. The effect of treatment (between cutting frequencies) on the DM content and DM yield of kikuyu pasture.

Parameter	Parameter						SEm	P
	7d	14d	21d	28d	35d	42d		
DM content %	15.6 ^a	14.8 ^{ab}	13.9 ^b	13.5 ^{bc}	12.5 ^c	14.0 ^b	0.63	<0.01
Yield per cutting (ton/ha)	0.51	1.456	2.111	4.415	6.50	9.08	9	n/a
Yield per 42 day cycle (ton/ha)	3.08	4.369 ^{ab}	4.222 ^{ab}	6.517 ^{bc}	1	7	n/a	<0.01
	9 ^a				1 ^c	7 ^c	1	

Table 2: The effect of cutting number per treatment on the DM content and DM yield of kikuyu pasture.

Parameter	Re-growth period and cutting number						SEm	P
	7d, 1	7d, 2	7d, 3	7d, 4	7d, 5	7d, 6		
DM Content (%)	15.7 ^{ab}	13.5 ^a	14.8 ^a	17.7 ^b	17.2 ^b	14.7 ^a	0.70	<0.01
Yield per cutting (ton/ha)	0.579 ^a	0.101 ^b	0.421 ^a	0.506 ^a	0.789 ^a	0.693 ^a	0.82	<0.01
	14d, 1		14d, 2		14d, 3		SEm	P
DM Content (%)	14.3 ^a		15.8 ^b		14.3 ^a		0.37	<0.03
Yield per cutting (ton/ha)	1.272		1.738		1.359		0.15	0.128
	21d, 1			21d, 2			SEm	P
DM Content (%)	13.8			13.8			0.23	0.947
Yield per cutting (ton/ha)	2.536			1.686			0.18	<0.02

Data were analyzed as follows:

- i) Average values of the multiple cutting treatments (i.e. for each of the 7 days, 14 days and 21 days treatments) were used to compare with single cutting treatments (i.e. the 21 days, 28 days and 42 days treatments).
- ii) Data from each multiple cutting treatment were analyzed to determine the effect of multiple cuttings within a specific treatment.

A one-way ANOVA was used to analyze data for this report. Standard errors (mean) were determined and significance was declared at $P < 0.05$, unless otherwise indicated. Tukey's test was used to separate means. Data analysis was done with the aid of Statistica 7.0.

Results:

It appeared that up to 35 days, the dry matter content of kikuyu pasture decreased with increased re-growth periods. The DM content of the pasture increased again in the 42 days treatment. Although the differences between treatment means were statistically significant, they were small. However, it could have an impact on total DM yield per hectare over the long term.

Although the DM yields per cutting provide interesting information, there is no purpose in comparing the data between treatments because of the difference in re-growth time. However, when values are expressed as total DM yield over the 42 days cycle, it is interesting to note that the efficiency of DM production increased significantly as cutting frequency decreased. These results would suggest that too frequent grazing of a pasture could have a negative impact on pasture production. It must be added, though, that pasture yield estimations were based on very small sample sizes taken at the respective cutting frequencies and that extrapolations might not be very accurate.

The DM content of kikuyu samples from the 7 days re-growth treatment varied from cutting to cutting and no pattern could be discerned. The DM content of the second cutting was much lower than that of the others and could be related to environmental conditions. The DM yield per cutting did not differ too much, except for the second cutting that yielded the smallest amount of DM. Although this coincided with the lower DM content of this cutting, the DM content alone explains only a small part of the lower yield. Environmental conditions probably played a role.

The DM content of the second cutting of the 14 days re-growth material was higher than that of the other two cuttings. This might have had an effect on DM yield, but the difference in yield was not significant between the three cuttings.

Although the DM content of the two cuttings in the 21 days re-growth treatment remained constant, the second cutting yielded significantly less material than the first.

Results on the chemical composition of the pasture are presented in Tables 3 & 4. The average values of each multiple cutting treatment were calculated and compared with values from the single cutting treatments; these are presented in Table 3. The within-treatment results, where results between the different cuttings in a multiple cutting treatment were compared, are presented in Table 4.

The CP content decreased as the re-growth period increased from 7 to 42 days, while the crude fibre and NDF contents increased. The NFE content also increased, but the effect is not as apparent as with CP and fibre; only the 7 days and 42 days treatments differed in NFE content.

Within the 7 days re-growth treatment, CP decreased significantly from the first to the sixth cut, while the fibre fractions and NFE content increased. As in the 7 days re-growth treatment, the CP content of kikuyu in the 14 days re-growth treatment decreased from the first to the third cut, while crude fibre and NDF increased. The change in NFE content was not significant. In the 21 days re-growth treatment, the CP and NFE contents of the pasture did not change significantly from the first to the second cutting. The fibre fractions, however, increased significantly.

It is interesting to note that the chemical composition of kikuyu obtained from the last cut in each of the multiple cutting treatments was quite similar. The last cut of the three multiple cutting treatments (7, 14 and 21 days) coincided with the 42 days cutting treatment. In the multiple cutting treatments, however, the CP content of the last cutting was much higher and crude fibre and NDF much lower than those in the 42 days re-growth treatment (average CP = 20.8%, CF = 22.6% and NDF = 59.9% in the multiple cutting treatments vs CP = 13.8%, CF = 27.4% and NDF = 64.1% in the 42 days re-growth treatment).

Mean 24h NDF disappearance decreased with increased re-growth periods, but only when re-growth periods were longer than 28 days. This would suggest that the fibre became less digestible as plant material was removed less frequently than once a month. According to Table 1, the NDF content increased with increasing re-growth periods; this increase would probably be related to an increased ADF content. The differences between the 7, 14, 21 and 28 days treatments were not significant.

The 12h gas production values should give a fairly good idea of how fermentation rates compared between treatments. It can be seen that rates decreased as the re-growth period increased. The fact that the fermentation rate was so low in the 35 days treatment cannot be readily

Table 3. The effect of treatment (between cutting frequencies) on the chemical composition of kikuyu. Values are on a dry matter basis.

Nutrient	Cutting frequency (re-growth period)						SEm	P
	7d	14d	21d	28d	35d	42d		
Crude protein (%)	28.1 ^a	23.2 ^a	22.6 ^b	19.6 ^c	18.7 ^c	13.8 ^d	0.64	<0.01
Crude fibre (%)	19.0 ^a	20.5 ^a	20.5 ^a	23.5 ^b	25.5 ^c	27.4 ^d	0.45	<0.01
NFE (%)	38.7 ^a	41.0 ^{ab}	41.0 ^{ab}	41.9 ^{ab}	40.3 ^{ab}	43.1 ^b	0.98	<0.01
NDF (%)	53.4 ^a	56.8 ^b	58.2 ^b	60.3 ^c	59.8 ^c	64.1 ^d	0.62	<0.01

Table 4. The effect of cutting number per treatment on the chemical composition of kikuyu. Values are on a dry matter basis.

Nutrient	Re-growth period and cutting number						SEm	P
	7 d, 1	7 d, 2	7 d, 3	7 d, 4	7 d, 5	7 d, 6		
Crude protein (%)	33.2a	31.3ab	30.8ab	26.6bc	24.5c	22.1c	1.18	<0.01
Crude fibre (%)	17.2a	17.5a	17.2a	19.6b	20.3b	22.2c	0.37	<0.01
NFE (%)	33.9a	35.9ab	38.0ab	40.4bc	42.5c	41.4c	1.25	<0.01
NDF (%)	48.6a	50.3a	51.1a	55.3b	56.7bc	58.6c	0.60	<0.01
	14 d, 1		14 d, 2		14 d, 3		SEm	P
Crude protein (%)	27.0a		23.1ab		19.4b			
Crude fibre (%)	18.6a		20.3ab		22.6b		0.51	<0.01
NFE (%)	39.8		42.5		43.5		1.05	0.08
NDF (%)	53.4a		57.1b		59.8c		0.56	<0.01
	21 d, 1			21 d, 2			SEm	P
Crude protein (%)	23.7			20.9				
Crude fibre (%)	20.7			23.1			0.55	0.02
NFE (%)	40.8			41.3			2.08	0.87
NDF (%)	55.0			61.4			1.05	<0.01

explained, but it is possible that environmental conditions played a role. The 96 h values are an indication of the extent of fermentation, which was not significantly different between treatments, except for the 35 days treatment where the value was much lower.

Within-treatment effects are indicated in Table 6. Mean 24h NDF disappearance did not change much from cutting to cutting in any of the multiple cutting treatments and differences were not significant. However, 12h and 96h gas production increased significantly from the first to the last cutting in all three multiple cutting treatments. With the increase in NDF content observed from cutting to cutting (Table 2), and the fact that the NDF digestibility appears to remain constant between cuttings, it would appear that more fermentable material (g/g) become available from cutting to cutting.

Results from the current trial would suggest that multiple cutting of kikuyu pasture results in higher nutritive value, when looking at the

average values of each of the multiple cutting treatments. However, the chemical composition (especially CP% and NDF%) of the last cutting of each multiple cutting treatment did not differ that much from the 28 days and 35 days treatments.

The high CP content of younger material is not necessarily an advantage because a significant portion of the CP may be in the form nitrates and the high CP content of pastures usually contributes to abundant N-intake by pasture based cows. Frequent cutting appeared to have lowered total DM yield per hectare. It should therefore be kept in mind that pasture dry matter yields and effective fibre intake must be taken into account before deciding on an optimal grazing system.

Table 5. The effect of treatment (between cutting frequencies) on *in vitro* fermentation parameters of kikuyu.

Parameter	Cutting frequency (re-growth period)						SEm	P
	7 d	14 d	21 d	28 d	35 d	42 d		
24 h NDF disapp. (%)	70.0a	67.8a	65.6a	63.7a	53.7b	53.7b	1.86	<0.01
12 h gas prod. (ml/g OM)	77.3a	79.4a	65.3b	64.5b	39.3c	59.0b	3.13	<0.01
96 h gas prod. (ml/g OM)	292.5a	303.9a	291.1a	295.8a	261.9b	279.3ab	5.73	<0.01

Table 6. The effect of treatment (within cutting frequencies) on *in vitro* gas production of kikuyu.

Parameter	Re-growth period and cutting number						SEm	P
	7 d, 1	7 d, 2	7 d, 3	7 d, 4	7 d, 5	7 d, 6		
24 h NDF disapp. (%)	69.0	68.2	71.6	68.9	72.8	69.5	1.41	0.20
12 h gas prod. (ml/g OM)	28.8a	63.2b	76.0bc	92.8cd	106.6d	96.6d	4.32	<.01
96 h gas prod. (ml/g OM)	201.8a	268.4b	297.3c	312.7cd	342.1e	332.6de	5.87	<.01
	14 d, 1		14 d, 2		14 d, 3		SEm	P
24 h NDF disapp. (%)	65.6		71.3		66.6		3.72	0.53
12 h gas prod. (ml/g OM)	70.9a		84.8ab		90.3b		5.15	<.064
96 h gas prod. (ml/g OM)	271.2a		319.2b		321.4b		7.4	<.01
	21 d, 1			21 d, 2			SEm	P
24 h NDF disapp. (%)	64.6			66.6			3.72	0.53
12 h gas prod. (ml/g OM)	40.4a			90.2b			3.3	<.01
96 h gas prod. (ml/g OM)	261.3a			320.9b			8.22	<.01