The utilisation of maize-crop residues for overwintering livestock 2. Strip and continuous grazing of maize-crop residues

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Over a three-year period (1989 to 1991), non-lactating, pregnant Sussex beef cows were subjected to either strip or continuous grazing of maize-crop residues over the winter feeding period. Stocking rate was based on providing each cow with 10 kg dry matter (DM) per day for 90 days, assuming 40% utilisation. Cows were blocked by age, live mass and body condition score (CS). Grazing was terminated by the need to start land preparation for the next season's maize planting. Grazing commenced on 26 July, 25 June and 25 June and ended on 2 October, 19 September and 17 September, providing 69, 87 and 85 grazing days in the respective seasons. After 57 grazing days, the mean live mass gain of cows in the strip-grazing treatment was 18.8 kg compared to 33.0 kg for the continuous grazing group. Body CS for both treatments was 2.9 after 57 grazing days. The similarity in animal performance between treatments indicates that the additional effort, labour and expense of having electric fencing required for strip grazing, is not warranted when grazing maize crop residues with pregnant beef cows.

Oor 'n periode van drie jaar (1989 tot 1991), is nie-lakterende, dragtige Sussex vleisbeeskoeie onderwerp aan strook- of aanhoudende beweiding van mielie-oesreste gedurende die wintervoerperiode. Veebelading het daarop berus dat elke koei voorsien is van 10 kg droë materiaal (DM) per dag vir 90 dae, met die aanname dat 40% van die reste gebruik word. Koeie is geblok volgens ouderdom, lewende massa en kondisietelling (KT). Beweiding is gestaak weens die nodigheid om lande voor te berei vir die volgende seisoen se mielie-aanplanting. Weiding het op 26 Julie, 25 Junie en 25 Junie begin en is gestaak op 2 Oktober, 19 September en 17 September, wat beteken dat daar 69, 87 en 85 weidae in die respektiewe seisoene was. Na 57 weidae, was die gemiddelde lewendemassatoename van die koeie in die strookbeweidingbehandeling 18.8 kg teenoor 33.0 kg vir die koeie in die aanhoudende-beweidinggroep. Die KT vir beide behandelings was 2.9 na 57 weidae. Die ooreenkoms in dierepresentasie tussen behandelings, dui daarop dat die bykomstige moeite, arbeid en onkoste verbonde aan elektriese heinings, nie geregverdig is by die beweiding van mielie-oesreste deur dragtige vleisbeeskoeie nie.

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Introduction

Previous research at Dundee (Part 1 — Crichton, Gertenbach & Henning 1998) demonstrated the potential of maize crop residues as a means of filling the winter feed gap in maize-producing areas of the dry, tall grassveld (Bioclimatic Group 8; Phillips, 1973) of KwaZulu-Natal. A problem encountered in that trial was the rapid decline in live mass and body condition score of cattle

toward the end of the grazing period. The decline in cow condition immediately prior to calving, followed by the breeding season in close succession, was a source of concern. A literature survey revealed no solution, apart from feeding conserved feeds, to the question of how to maintain the live mass gains achieved in cows grazing maize crop residues in the early part of the winter feeding period. A possible answer might be to strip graze the crop residues, thereby rationing out the available feed for a longer period of time.

The objective of this investigation was to find out whether the time and effort of erecting electric fences for strip grazing was warranted by an improvement of body condition and/or live mass compared to controls.

Procedure

Cultivation of the land

Over a three-year period (1989, 1990 and 1991), maize was established annually on 7 ha of land under dryland conditions. The soil type was classified as a Hutton, Doveton series (MacVicar *et al.*, 1977). Maize (HL2; a high lysine maize cultivar) was established at a seeding rate of 38 000 plants per ha. Following mechanical reaping, maize cobs remaining on the lands were picked up by hand, which is common practice in Northern KwaZulu-Natal.

Treatments

The 7 ha of land was divided into two equal halves of 3.5 ha each. The cows in each half were subjected to one of the following two treatments:

(i) strip grazing the crop residues, whereby an electric fence was moved across the land every second week. No back-fencing was used, and

(ii) continuous grazing of the crop residues.

The area where strip grazing was applied was alternated in consecutive years with the area where continuous grazing was applied.

Stocking rate was calculated by dividing the residue yield by 900 (it was assumed that each cow ingests 10 kg DM per day and that there would be 90 grazing days), with an expected 40% utilisation i.e. (dry matter yield (kg) / 900) × 0.40 cows/ha.

Prior to the start of the third year of the trial, the relevant maize lands were enlarged and contours added. The resulting areas of crop residues for the strip and continuous grazing treatments for the 1991 season were 3.6 and 4.7 ha, respectively.

Maize crop residue yield and experimental animals

Before and after grazing, the yields of crop residues on the lands were determined in each treatment in similar fashion to the previous trial (Part 1 – Crichton, Gertenbach & Henning, 1998). The composition of the crop residues was determined concurrently with the pre- and post-grazing yield determinations in 1990, as described in Part 1.

Each year the trial was run the required number of cows were randomly selected from a Sussex herd comprising between 200 and 220 breeding females. Only cows confirmed pregnant by a veterinarian were selected. The mean live mass of the trial animals overall was 515.5 ± 5.1 kg. The cows were blocked by mass, age and condition score and randomly allocated to treatments within block.

Crop residue fraction selected by livestock

Concurrently with the composition determination in 1990, oesophageally fistulated steers were used at the commencement and termination of grazing to obtain fistula samples of grazing selected by the animals, according to the method described by Bredon & Short (1971).

Lick

Dundee lick (56.5% salt, 19.4% maize meal, 8.1% dicalcium phosphate, 16.0% urea) was supplied *ad lib.* Lick intake was monitored weekly for the 1989 season.

Mass and condition score

The cows were weighed and their body condition scores (CS) determined each week without prior fasting. CS was determined according to the method described by Van Niekerk & Louw (1990), a 5 point scale ranging from 1 (very lean) to 5 (very obese).

Statistical analysis

Final live mass of the cows was compared between treatments by analysis of variance and covariance.

Results

Grazing period

Grazing commenced on 26 July 1989, 25 June 1990 and 25 June 1991 and was terminated on 2 October 1989, 19 September 1990 and 17 September 1991 in the first, second and third seasons of the trial, respectively. The respective grazing periods were 69, 87 and 85 days.

In the second year of the trial, grazing of the residues was terminated because the average cow condition score had dropped below 2.5 (Part 1). However, in the first and third years of the trial, the necessity to start land preparation for the following season, forced cessation of grazing for those seasons.

Maize crop residue yield and cows per treatment

Based on the dry matter yields of crop residues for the three seasons (Table 1), 12 & 12, 11 & 9 and 12 & 13 pregnant Sussex cows were allocated to the strip grazing and continuous grazing treatments for the 1989, 1990 and 1991 seasons, respectively. In retrospect, stocking rate was erroneously calculated in the first year of the trial and a better rate would have been eight cows per treatment.

Table 1 Dry matter yields of the maize-crop residues at the commencement of grazing for 1989, 1990 and 1991

	Season		
Treatment	1989	1990	1991
Strip grazing (t/ha)	5.1	6.9	7.2
Continuous grazing (t/ha)	4.9	5.6	6.4

Live mass and condition score

The initial live mass and final live mass of the cows in the first year of the trial differed ($p \leq 0.05$) from the initial and final live mass in the second and third years of the trial (Table 2). The mean final live mass differed significantly ($p \leq 0.01$) between treatments when compared by analysis of covariance, with initial live mass as covariate.

Table 2 Initial live mass, final live mass and change in live mass in cows subjected to strip or continuous grazing of maize-crop residues *

		Treatment	
Season		Strip grazing	Continuous grazing
1989	Initial mass (kg)	472.3 ± 6.8	472.0 ± 6.8
	Final mass (kg)	503.8 ± 12.6	519.6 ± 12.6
	Change (kg)	+31.5	+47.6
1990	Initial mass (kg)	537.8 ± 12.3	536.9 ± 13.6
	Final mass (kg)	563.0 ± 10.2	583.6 ± 11.3
	Change (kg)	+25.2	+46.7
1991	Initial mass (kg)	539.4 ± 16.1	534.9 ± 15.4
	Final mass (kg)	539.5 ± 13.7	539.5 ± 13.1
	Change (kg)	+0.1	+4.6
Average	Initial mass (kg)	516.6 ± 7.1	514.6 ± 7.2
	Final mass (kg)*	535.4 ± 7.1[a]	547.6 ± 7.3[b]
	Change (kg)	+18.8	+33.0

* Final live mass and change in live mass were compared between treatments at 57 days.

[a,b] – Means in the same row with different superscripts differ significantly ($p < 0.05$), using analysis of covariance with initial live mass as covariate.

For both treatments, cow live mass increased for the first four weeks of grazing, then remained relatively constant, before declining between 6–8 weeks after the start of grazing. Live mass for the strip-grazing treatment remained below the mean live mass of cows in the continuous-grazing treatment for the duration of the grazing period (Figure 1).

After an initial period when cows gained condition, the CS of cows in both treatments declined for the remainder of the grazing period (Figure 2).

Lick intake

For the 1989 season, the average daily intake of lick in the strip-grazing group was 177 g/animal/day and that in the continuous-grazing group was 279 g/animal/day.The recommended intake of this lick is 500 g/cow/day.

Utilisation

For the 1990 season, the post-grazing residue yield was 3.15 and 3.44 t residues per ha for the strip- and continuous-grazing treatments respectively. When comparing the percentage residues utilised

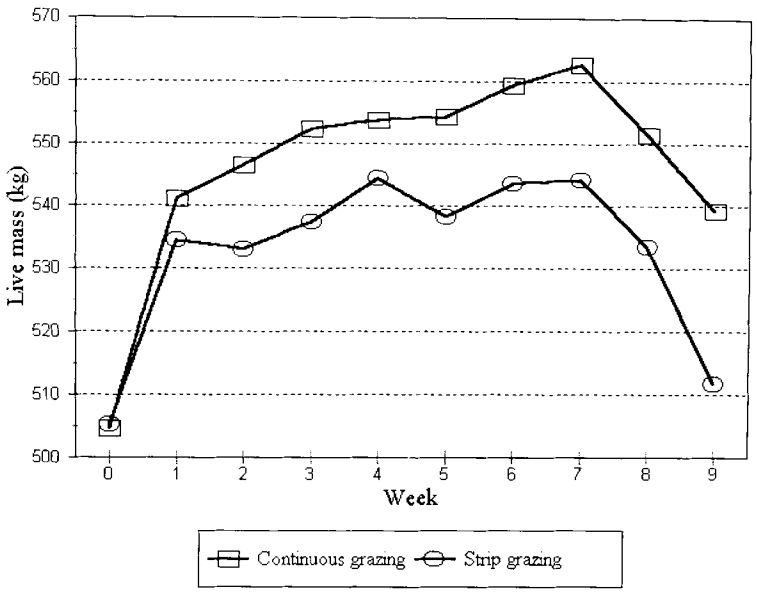

Figure 1 Live mass changes (average over three years) in cows subjected to continuous or strip grazing of maize-crops residues over nine weeks.

Table 3 Initial condition score (CS), final condition score and change in condition score in cows subjected to strip or continuous grazing of maize-crop residues *

		Treatment	
Season		Strip grazing	Continuous grazing
1989	Initial CS	3.0	3.1
	Final CS	3.0	3.2
	Change	0	+0.1
1990	Initial CS	3.0	2.9
	Final CS	2.6	2.6
	Change	–0.4	–0.3
1991	Initial CS	3.2	3.2
	Final CS	3.0	2.9
	Change	–0.2	–0.3
Average	Initial CS	3.1	3.1
	Final CS	2.9	2.9
	Change	–0.2	–0.2

* Final condition score and change in condition score were compared between treatments at 57 days.

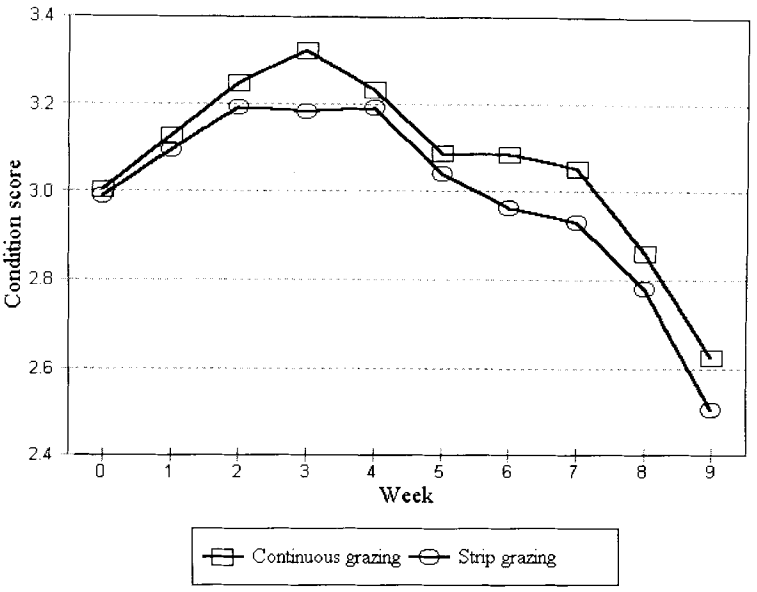

Figure 2 Body condition score changes (average over three years) in cows subjected to continuous or strip grazing of maize-crops residues over nine weeks.

Table 4 The composition of maize-crop residues before and after grazing by pregnant beef cows subjected to strip or continuous grazing during 1990

		Maize crop residue component					
Treatment	Time sampled	Maize kernels (t/ha)	Stalks (t/ha)	Leaf (t/ha)	Cob (t/ha)	Grass (t/ha)	Total (t/ha)
Strip grazing	Pre-grazing	1.19	2.03	1.67	1.54	0.42	6.85
	Post-grazing	0.01	1.42	0.41	1.31	0	3.15
% Utilised		99.2	30.0	75.4	14.9	100	54.0
Continuous grazing	Pre-grazing	0.90	1.62	1.46	1.48	0.17	5.63
	Post-grazing	0.05	1.42	0.52	1.45	0	3.44
% Utilised		94.4	12.3	64.4	2.0	100	38.9

between treatments (Table 4), it appears that a larger proportion of the residues were utilised in the strip-grazing than in the continuous-grazing treatment. However, there was not a significant difference in the utilisation of the different fractions of the crop residues between treatments.

The oesophageally fistulated steers selected some grain and cob at the commencement of grazing, but ingested only leaf and stalk toward the end of the grazing period (Table 5).

Chemical analysis

The crude protein content of the different components of the crop residues varied from just over 11 g/kg (for cobs) to just below 80 g/kg (for maize grain, Table 6).

Table 5 Percentage of different fractions of maize-crop residues selected by oesophageally fistulated steers at the commencement and termination of grazing maize-crop residues with beef cows

		Residue component selected (%)		
Treatment	Time sampled	Leaf & stalk	Grain	Cob
Strip grazing	Pre-grazing	96.6	2.3	1.1
	Post-grazing	100	0	0
Continuous grazing	Pre-grazing	90.4	9.6	0
	Post-grazing	100	0	0

Table 6 Pre- and post-grazing crude protein content of the different components of maize-crop residues grazed by beef cows during 1990

		Maize crop residue component				
Treatment	Time sampled	Maize kernels (g/kg)	Stalks (g/kg)	Leaf (g/kg)	Cob (g/kg)	Grass (g/kg)
Strip grazing	Pre-grazing	73.0	71.1	36.6	13.2	62.0
	Post-grazing	77.5	56.6	36.4	21.4	–
Continuous grazing	Pre-grazing	73.0	57.8	18.9	11.1	62.0
	Post-grazing	58.8	52.5	22.9	14.4	–

Animal health

None of the cows developed health problems during the trial period. In the 1989 season, one of the cows in the strip-grazing group died owing to calving problems, shortly after 12 September. A 'filler' animal was not allocated to the group.

Discussion and Conclusion

The findings of this trial confirmed that maize-crop residues are effective in maintaining pregnant beef cows over the winter period. In the present trial, the need to start land preparation for the next season's maize planting prevented grazing continuing for more than an average of 79 days (19 days more than was achieved in the previous trial; Part 1). In the second year of the trial, if the loss in cow condition had not led to the decision to terminate grazing, the need to start land preparation would in any event have prevented further grazing of the lands. Overall, live mass and condition score changes were similar to those achieved in the previous trial at Dundee (Part 1).

The hope that strip grazing would lead to better animal performance for a longer period of time, was not realised. The additional effort associated with erecting electric fencing is therefore not warranted.

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References

BREDON, R.M. & SHORT, A.M., 1971. Oesophageal fistulation of cattle for pasture utilization studies, post-fistulation care and use of animals and sampling procedures. *Agroanimalia* 3, 141.

CRICHTON, J.S., GERTENBACH, W.D. & HENNING, P.W. VAN H., 1998. The utilisation of maize-crop residues for overwintering livestock. 1. Performance of pregnant beef cows as affected by stocking rate. S. Afr. J. Anim. Sci. 28(1), 000.

MACVICAR, C.M., DE VILLIERS, J.M., LOXTON, R.F., VERSTER, E., LAMPRECHTS, J.J.N., MERRYWEATHER, F.R., LE ROUX, J. & VON HARMSE, H.J., 1977. Grondklassifikasie. 'n Binomiese sisteem vir Suid-Afrika. 1 st. ed. Navorsinginstituut vir Grond en Besproeiing. Dept. Landbou-Tegniese Dienste, Pretoria.

PHILLIPS, J., 1973. The Agricultural and Related Development of the Tugela Basin and its Influent Surrounds — A Study in Subtropical Africa. Natal Town and Regional Planning Report Volume 19.

VAN NIEKERK, A. & LOUW, B.P., 1990. Condition scoring of beef cattle. Publication by the Department of Agricultural Development, Directorate Agricultural Information, Republic of South Africa.