CHAPTER 2

DRY MATTER YIELD, SELECTION, CHEMICAL COMPOSITION, DIGESTIBILITY AND VOLUNTARY INTAKE OF PASTURES.

2.1 Experimental procedure.

2.1.1 Study objectives in brief.

This study was conducted in two phases

i) the first phase involved the measurement of the above indices on the primary growth of sainfoin and sheep's burnet and the subsequent regrowth (cut in such a way as to yield three areas of each pasture which were grazed at 6 weeks, 12 weeks and 15 weeks of age from midsummer to autumn, 1989).

ii) phase two, which involved the grazing of the second and third regrowths of sheep's burnet and sainfoin and regrowths of lucerne that had been planted a year earlier. The pastures had been cut in a similar way as to yield three areas of each which were grazed at 6 weeks, 8 weeks and 15 weeks of age during the winter of 1989 and after about 9 weeks of regrowth during the spring of 1989.

Dry matter yield, chemical composition and <u>in vitro</u> digestibility of organic material collected by oesophageally

fistulated animals were studied.

An in vivo vs. in vitro study was also undertaken. In vitro digestibility of organic matter values were then corrected to in vivo digestibility values on the basis of the relationships between in vitro and in vivo digestibility for each pasture. Voluntary intake of organic matter was then calculated from in vivo digestibility of organic matter and faecal output of organic matter by the experimental animals. In addition, selection of plant parts (leaf and stem material) was determined by measuring leaf to stem ratios prior to putting the animals on pasture and at the end of the trial periods.

The aim was to obtain an indication of the above indices of nutritive value of sainfoin and sheep's burnet and to compare them to lucerne.

2.1.2 Material

2.1.2.1 Dry matter yield and leaf to stem ratios.

Samples of each pasture were cut using four quadrats each measuring 0,5 m^2 and wool shears.

2.1.2.2 Animals : Preparation and cannulation.

Six Döhne Merino male sheep were fistulated in the oesophagus. The fistulae were similar to the type described by Chapman and Grovum (1984). It consisted essentially of a spatula of a section of a 65 mm diameter pipe made of perspex, a wooden plug, a bolt and a wing nut. These animals were used to obtain pasture samples for quality determination. The fistulae were cleaned regularly. In addition 15 Mutton Merino rams were used during each period as "fillers" for faeces collection and voluntary intake determinations. All animals were vaccinated against enterotoxaemia, regularly dosed to prevent infestation by internal parasites and had their hooves trimmed.

2.1.2.3 Pastures

The sainfoin and sheep's burnet had been established the previous autumn at the Hatfield Experimental Farm of the University of Pretoria. The size of the camps for each

pasture was 0,50ha. The farm is situated in a summer rainfall area at an altitude of 1370m above sea level and has an annual precipitation of 700 mm. The camps were irrigated fortnightly to the equivalent of 15mm rainfall as part of the general irrigation frequency of the small stock section where the trials were undertaken. A lucerne camp of approximately the same size had been established a year earlier and had been used continuously in previous trials. The camps were adjacent to each other. An infestation of ryegrass in the sainfoin and sheep's burnet during the first season of growth was controlled by hoeing and chemical treatment. All subsequent weed infestation was controlled by handweeding.

The camps had been fertilized in the spring of 1988. An analysis of soils in the different camps prior to the autumn/winter of 1989 yielded the results in Table 2.1.

Table 2.1 Results of soil analysis on experimental plots.

Sample	pH (H_2O)	R* ohm	Bray II P mg/kg	Ammonium acetate extractable				Texture
				Ca	Mg	K	Na	
Sainfoin plot	6,51	1300	30	610	203	32	27	ClLm**
S. burnet plot	6,84	1800	45	663	243	48	24	ClLm**
Lucerne plot	6,51	1700	54	633	173	173	16	ClLm**

* Resistance

**ClLm - Clay loam

Subsequently LAN and KCl were applied to the sheep's burnet camp at a rate of 300 kg/ha and KCl at the same rate to the sainfoin camp.

2.1.2.4 Treatments

The experimental animals were allowed to graze the test forages only. Water was provided during the trials. A salt mix (an equal mixture of dicalcium phosphate and common salt) was also provided on an ad lib basis during the winter trials. Intake of the salt lick was not measured.

The treatments during the trials were:

i) Treatment 1 (T1) - Sainfoin
ii) Treatment 2 (T2) - Sheep's burnet
iii) Treatment 3 (T3) - Lucerne

There were five "fillers" (rams) per treatment and two oesophageally fistulated sheep per treatment during each of the eight periods (P1 - P8) [Section 2.1.1] of the study. The "fillers" were adapted for one week and faeces subsequently collected for four days. The sheep with oesophageal fistulae were used to collect pasture material at the beginning of the adaptation period, the beginning of the collection period and at the end of collection. They were allowed to adapt to the pasture for at least three days before collection.

2.1.3 Experimental routine.

Animals were weighed after an overnight fast prior to and at the end of each trial period. The animals were put to pasture at 06h00 and returned to the barn at 18h00 (except the last period in Phase II when animals remained on the pastures for the duration of the trial). The "fillers" were equipped with harnesses and nylon canvas bags for faeces collection. They had access to water at all times.

2.1.4 Parameters.

The following parameters were studied:

2.1.4.1 Plant yield and selection of plant parts.

a) Dry matter yield (t/ha)
b) Leaf:stem ratios prior to adaptation and end of collection periods.

2.1.4.2 Chemical composition of samples collected from oesophageal fistulae and clipped samples[1].

a) Organic matter content (OM).
b) Ash content.

[1] - Clipped samples were used for the determination of mineral contents due to salivary contamination of material from oesophageal fistulae.

c) Crude protein content (CP) of dry matter.

d) Acid detergent fibre content (ADF) of dry matter.

e) Neutral detergent fibre content (NDF) of dry matter.

f) Acid detergent lignin content (ADL) of dry matter.

g) Cellulose content of dry matter (calculated).

h) Hemicellulose content of dry matter (calculated).

i) Acid detergent insoluble nitrogen content (ADIN) of dry matter.

j) Calcium (Ca), Phosphorus (P) and Magnesium (Mg) contents of dry matter.

k) In vitro digestibility of organic matter (IVDOM).

l) In vivo digestibility of organic matter (calculated from IVDOM values using the relationships between IVDOM and in vivo DOM yielded by the in vitro vs. in vivo study (Section 2.1.1)).

m) Voluntary intake of organic matter (OMI).

2.1.5 Methods

2.1.5.1 Trial period

The animals were adapted for one week followed by a collection period of four days. The animals had been put on pasture before the beginning of the trials. Thus the length of each trial period was eleven days.

2.1.5.2 Trial implementation

2.1.5.2.1 Body mass

The mean masses of the experimental animals (Section 2.1.3)were used to determine the metabolic live mass ($LW^{0,75}$) for use in intake calculations.

2.1.5.2.2 Collection of pasture samples.

2.1.5.2.2.1 DM Yield and leaf to stem ratios.

The quadrats employed were placed on the plots using stratified random sampling. The areas with the quadrats were then clipped 5 cm from the ground using an ordinary wool shear. The fresh mass of each sample was weighed after dead material had been removed and subsamples were oven-dried in aluminium foil containers at 100°C for 24 hours and re-weighed. Dry matter content was calculated as follows (AOAC, 1984):

$$\% \text{ Dry matter} = \frac{\text{Dry mass (g)}}{\text{sub sample mass (g)}} \times 100$$

Dry matter yield were obtained by multiplying the mean fresh mass by the mean dry matter percentage. Subsamples were also taken for each pasture and a known mass separated into leaf and stem. The proportions of leaf and stem were noted and expressed as a ratio. This was repeated at the end of the

trial in an area inside and outside the exclusion cages to obtain an indication of the selection of plant parts (leaf and stem) by the experimental animals. Samples of the cut material were also taken and dried at 60°C to be used in determining Ca, P and Mg levels.

2.1.5.2.2.2 Extrusa from oesophageal fistulae.

Pasture samples were collected using the oesophageally fistulated sheep at the beginning of the adaptation period, the beginning of the collection period and the end of the collection period. The animals were starved overnight to prevent contamination of selected pasture material through regurgitation of fermentation products. Care was taken to ensure that no material was eaten on the way to the pastures from the barn. The cannulae were removed and the canvas bags tied around the necks of the animals during the collection process. Sufficient material was usually obtained after about 45 minutes of grazing. The cannulae were reinserted immediately after collection and the animals were allowed to graze with the "fillers" for the rest of the day.

The material collected from the cannulae was strained through a double layer of cheesecloth to eliminate saliva and then dried at 50° C for 48 hours. It was then milled to pass a one millimeter sieve of a Beaver mill and subsequently stored in glass or plastic bottles for analysis.

2.1.5.2.3 Faeces collection to determine intake.

All the rams (fillers) were equipped with harnesses and nylon canvas bags for faeces collection. The canvas bags were closed at 18h00 on the day prior to the collection of faeces. Faeces were collected twice daily during the last four days of the trial prior to taking the animals to pasture (06h00) and just before driving the animals to the barn (18h00) to reduce loss of faeces. The faeces were also collected at the same times when animals remained on pasture for the whole trial period.

2.2 Experimental design and statistical analysis of data.

There were four trial periods in each phase of the study as described in Section 2.1.1. All experimental animals, which had similar masses and ages, were allocated randomly to treatments in each trial period.

Experimental design

Phase of experiment	Period	Treatments		
		Treatment 1	Treatment 2	Treatment 3
I	P1	Sainfoin	Sheep's burnet	-
	P2	Sainfoin	Sheep's burnet	-
	P3	Sainfoin	Sheep's burnet	-
	P4	Sainfoin	Sheep's burnet	-
II	P5	Sainfoin	Sheep's burnet	Lucerne
	P6	Sainfoin	Sheep's burnet	Lucerne
	P7	Sainfoin	Sheep's burnet	Lucerne
	P8	Sainfoin	Sheep's burnet	Lucerne

The data yielded by the study were analyzed separately for each phase for treatment and period effects and their interaction, using a two-way analyis of variance procedure in the general linear models programme (Freud & Littell, 1981), and utilizing the least square means and a probability level of 5 %.

2.3 Sampling methods.

2.3.1 Pastures.

Clipped samples and extrusa collected from oesophageal fistulae were processed, milled and stored as described in Sections 2.1.5.2.2.1 and 2.1.5.2.2.2.

2.3.2 Faeces.

Ten percent of the daily faeces excretion was pooled over the collection period and stored frozen in plastic bags at -15°C. Pooled samples were subsequently thawed and a

subsample used for the determination of the dry matter content of the faeces. The rest was dried at 60°C in a forced draught oven before grinding to pass a one mm sieve of a Beaver mill and stored in glass and plastic bottles for analysis.

2.4 Analytical methods.

2.4.1 Dry matter content.

Pasture and faecal material were dried at 100°C for 24 hours in a forced draught oven in aluminium foil containers or porcelain crucibles. Where porcelain crucibles were used the samples were cooled in a desiccator containing silica gel and weighed. The aluminium containers used for the determination of dry matter content of cut pastures and wet faeces were weighed directly from the oven, with the scale reading always readjusted to zero before the next reading. The dry matter content (%) was calculated as recommended by the AOAC (AOAC, 1984).

2.4.2 Ash content.

Partially dried samples of pasture and faeces (60°C) were dried overnight at 100°C in porcelain crucibles, weighed and incinerated in a muffle furnace for four hours at 600°C, cooled in a desiccator and weighed.

The ash content of the material used for the determination of in vitro digestibility of organic matter was calculated as follows:

$$\% \text{ Ash} = \frac{\text{Ash mass (g)}}{\text{Sample mass (g)}} \times 100$$

The ash content of faeces was calculated on the basis of the dry matter as recommended in the South African Department of Agriculture Handbook of Laboratory Methods (1989):

$$\% \text{ Ash} = \frac{\text{Ash mass (g)}}{\text{Dried sample mass (g)}} \times 100$$

2.4.3 Organic matter content.

The organic matter (OM) content of pasture material for the in vitro digestibility of OM determinations was calculated as follows:

$$\% \text{ OM} = \frac{\text{Dry matter (g) - Ash mass (g)}}{\text{Sample mass (g)}} \times 100$$

The organic matter content of faeces was calculated as follows:

$$\% \text{ OM} = 100\% - \% \text{ Ash (dry matter basis)}$$

2.4.4 Crude protein content.

The nitrogen (N) content of pasture samples was determined by the macro kjedahl method (AOAC, 1984). A block digester was used for the digestion of the sample and a Tecator Kjeltec System Model 1002 for the distillation.

Percentage crude protein (CP) was calculated as follows:

$$\% \text{ CP} = \% \text{ N} \times 6{,}25$$

2.4.5 The acid detergent fibre.

The acid detergent fibre (ADF) contents of pasture and faeces samples were determined with a Tecator Fibertec System as outlined in the Application Note AN 03/78: A sample milled to pass a one millimeter sieve was weighed (1 g) in a filter crucible and placed in a Hot Extraction Unit of the Fibertec System. The extraction was carried out with 100 ml of acid detergent solution (ADS) (Van Soest, 1963) for one hour (after boiling commenced). This was followed by cold extraction with acetone on the Cold Extraction Unit of the system. The samples were dried at 100°C overnight and ashed at 550°C for three hours.

ADF was calculated as follows:

$$\% \text{ ADF} = \frac{W_1 \text{ (g)} - W_2 \text{ (g)}}{W_0 \text{ (g)}} \times 100$$

where W_1 = dry mass of sample after ADF extraction

W_2 = mass of ash

W_0 = sample mass

2.4.5.1 Nitrogen content of acid detergent fibre (ADIN).

Acid detergent fibre in a sample was extracted using the same procedures as in 2.4.5 except that the sample mass was higher (± 2 g) and 150 ml of ADS was used (to yield a sample large enough for nitrogen determination). The acetone extraction was also omitted and the sample dried at 60° C overnight. Nitrogen content of the residue was determined as in 2.4.4.

2.4.5.2 Lignin content of acid detergent fibre (ADL).

Acid detergent lignin was determined in the manner outlined in Application Note 04/78 of the Tecator Fibertec System. The samples were prepared with the ADF procedure as outlined in 2.4.5 but not ashed. A sequential extraction with 72% sulphuric acid was carried out for three hours. The sample remaining after filtration and washing with hot water was

dried overnight, weighed (W_1) and ashed in a muffle furnace at 550° C for three hours. The residue was then cooled in a desiccator and weighed (W_2).

% ADL was calculated as:

$$\% \text{ ADL} = \frac{W_1 - W_2}{W_0 \text{ (sample mass)}} \times 100$$

2.4.6 Neutral detergent fibre (NDF) content of dry matter.

Neutral detergent fibre contents of pasture and faeces were determined using the same apparatus in 2.4.5 except that Neutral Detergent Solution (NDS) was used (Van Soest & Wine, 1967).

% NDF was calculated as:

$$\% \text{ NDF} = \frac{W_1 \text{ (g)} - W_2 \text{ (g)}}{W_0 \text{ (g)}} \times 100$$

where W_1 = dry mass of sample after NDS extraction

W_2 = mass of ash

W_3 = sample mass

2.4.7 Cellulose.

Cellulose was calculated as:

$$\% \text{ Cellulose} = \text{ADF\%} - \text{ADL\%}$$

2.4.8 Hemicellulose.

Hemicellulose was calculated as:

% Hemicellulose = NDF% - ADF%

2.4.9 Calcium, Magnesium and Phosphorus.

The contents of these minerals were determined on clipped samples due to salivary contamination of samples collected from oesophageal fistulae. A sample milled to pass a one millimeter sieve of a Beaver mill (1 g) was digested in a block digester at 230°C using the wet digestion technique (Manual, Perkin Elmer Atomic Absorption Spectrophotometer pp AY 11). Calcium and magnesium were then determined on a Perkin Elmer 2380 Atomic Absorption Spectrophotometer. Calcium was determined at a wavelength of 422,7 nm and a slit setting of 0,7 nm using a hollow cathode tube.

Magnesium was determined at a wavelength of 285,2 nm and a slit setting of 0,7 nm using a similar lamp. An air-acetylene flame was employed in both the determinations of calcium and magnesium.

Phosphorus was determined on a Technicon Autoanalyser and the concentration determined from a calibration curve.

2.4.10 In vitro digestibility of OM (IVDOM).

In vitro digestibility of OM was determined by the method of Tilley and Terry (1963), as modified by Engels and Van der Merwe (1967). A 0,2 g sample (dried at 50°C and milled to pass a one mm sieve of a Beaver mill) was incubated in a test tube with rumen fluid, urea solution and artificial saliva for 48 hours at 39°C. The samples were shaken three times a day at regular intervals. Hydrochloric acid (1:4) was then used to lower the pH to about 2,0; 3 ml pepsin solution (8g/1000ml) added and incubated for another 48 hours. The contents of the test tubes were then filtered through Gooch crucibles using a vacuum pump and dried for 24 hours at 100°C. The residues were weighed and ashed at 550°C in a muffle furnace for three hours, cooled in a desiccator and weighed. Panicum maximum with an IVDOM of 70 - 75% was used as a standard. This was the standard used in the laboratory and was always kept in a refrigerator. The digestibility of organic matter was calculated as follows:

$$D = 100 - \frac{\text{Undigested residue (g)}}{\text{sample mass (g)}} \times 100$$

where D = digestibility of OM in vitro (IVDOM%)

- The sample mass of the incubated sample is expressed in terms of the OM content.
- Undigested residue is expressed in terms of the OM content.

As a result of the in vivo vs. in vitro DOM study (Table 2.14) the IVDOM figures were converted into in vivo DOM

values as follows:

(i) Lucerne and sheep's burnet:

% *in vivo* DOM = 0,746 IVDOM + 18,16[a]

(ii) Sainfoin:

% *in vivo* DOM = % IVDOM x 1,17[b]

The voluntary intake of OM was calculated from the *in vivo* DOM of the respective pastures and the organic matter content of the faeces (Langlands, 1975).

$$OMI = FO \times 100/(100 - DIG)$$

where OMI = organic matter intake (g/day)

FO = faecal output (g OM/day)

DIG = digestibility of the forage (%)

2.5 Results.

The results were divided into treatment effects and time period (P1 - P8) effects. The results for treatment effects are summarized with the standard error of means whilst period effects show the standard deviations and coefficients of variation of the parameters measured. The standard

[a] - Relationship (unpublished) between *in vivo* DOM and IVDOM obtained in this laboratory from work done on several planted pastures

[b] - the ratio of *in vivo* DOM to *in vitro* DOM obtained in the study (Table 2.14).

deviations, standard errors of means and coefficients of variation were calculated using the method of Snedecor (Snedecor, 1956). Unless otherwise stated values with at least one common letter on the same horizontal line do not differ significantly.

2.5.1 Dry matter yield and leaf:stem ratios[1].

Tables 2.2a and 2.2b show the dry matter yields (t/ha) and leaf:stem ratios of the pastures for phases I and II respectively. There were no significant differences between the yields of sainfoin and sheep's burnet in Phase I (first regrowths). However in Phase II (subsequent regrowths) the yields of sheep' burnet were significantly higher than sainfoin and the yields of both were significantly higher than those of lucerne. There were significant differences in leaf:stem ratios of the three pastures in both phases.

Table 2.2a. Dry matter yield (t/ha) and leaf:stem ratios of pastures. Means of three regrowth periods. Phase I.

Parameter	Treatment		
	Sainfoin	Sheeps' burnet	SE_m
DM yield (t/ha)	$5,1^{a}$	$6,0^{a}$	0,45
Leaf:stem ratio	$1,6^{b}$	$1,1^{a}$	0,25

[1] - No yield and leaf:stem ratios are given for the primary growth (P1) because of extensive weed infestation and shattering of material during cutting and sorting.

Table 2.2b. Dry matter yield (t/ha) and leaf:stem ratios of pastures. Means of three second regrowths[2] and one third regrowth period.

Parameter	Treatment			
	Sainfoin	Sheeps' burnet	Lucerne	SE_m
DM yield (t/ha)	$3,3^{b}$	$3,9^{c}$	$2,8^{a}$	0,32
Leaf:stem ratio	$3,3^{c}$	$0,9^{a}$	$1,6^{b}$	0,62

Tables 2.3a to 2.5 indicate the yields and leaf:stem ratios of the three pastures during the different periods of the study.

The results for sainfoin (Tables 2.3a and 2.3b) show that, the 12 week regrowth in Phase I (Table 2.3a) had a significantly higher yield whilst the 15 week regrowth had a significantly higher leaf:stem ratio. In Phase II (Table 2.3b) the 15 week autumn regrowth had a significantly higher yield. The spring regrowth (P8) had a significantly lower leaf:stem ratio compared to the 6 week and 8 week autumn/winter regrowths.

[2] - Sainfoin and sheeps' burnet only. Lucerne has been cut several times previously.

Table 2.3a. The influence of period on the DM yield and leaf:stem ratios of sainfoin. Phase I.

Parameters	Trial period and chronological age of pastures.		
	P2 (21/2/89-2/3/89) 6 weeks	P3 (4/4/89-14/4/89) 12 weeks	P4 (25/4/89-5/5/89) 15 weeks
DM yield (t/ha)	4,2[a]	6,7[b]	4,4[a]
S.D.	0,24	1,58	0,84
Leaf:stem ratio	1,4[a]	1,3[a]	2,0[b]
S.D.	0,29	0,38	0,61

Table 2.3b. The influence of period on the DM yield and leaf:stem ratios of sainfoin. Phase II.

Parameters	Trial period and chronological age of pastures.			
	P5 (8/6/89-18/6/89) 15 weeks	P6 (18/6/89-28/6/89) 8 weeks	P7 (28/6/89-8/7/89) 6 weeks	P8 (7/11/89-18/11/89) 8-9 weeks
DM yield (t/ha)	4,7[b]	2,9[a]	2,4[a]	3,2[a]
S.D.	1,37	0,24	0,22	0,6
Leaf:stem ratio	3,2[a]	3,4[b]	3,5[b]	3,0[a]
S.D.	0,03	0,36	0,18	0,37

The results for sheeps' burnet indicate a significantly higher yield for the 12 week regrowth in Phase I whilst there were no significant differences in leaf:stem ratio between periods (Table 2.4a). In Phase II (Table 2.4b), the 15 week regrowth had a significantly higher yield compared to the other regrowths. However there were no significant differences in yield between the 8 week autumn/winter regrowth and 8-9 week spring regrowth. The spring regrowth had a significantly lower leaf:stem ratio.

Table 2.4a. The influence of period on DM yield and leaf:stem ratios of sheep's burnet. Phase I.

Parameters	Trial period and chronological age of pastures.		
	P2 (21/2/89-2/3/89) 6 weeks	P3 (4/4/89-14/4/89) 12 weeks	P4 (25/4/89-5/5/89) 15 weeks
DM yield (t/ha)	5,2[a]	7,1[b]	5,6[ab]
S.D.	1,20	1,88	0,59
Leaf:stem ratio	1,0[a]	1,0[a]	1,4[a]
S.D.	0,08	0,21	0,08

Table 2.4b. The influence of period on DM yield and leaf:stem ratios of sheeps' burnet. Phase II.

Parameters	Trial period and chronological age of pastures.			
	P5(8/6/89-18/6/89) 15 weeks	P6(18/6/89-28/6/89) 8 weeks	P7(28/6/89-8/7/89) 6 weeks	P8(7/11/89-18/11/89) 8-9 weeks
DM yield (t/ha	5,1[c]	4,1[b]	2,8[a]	3,8[b]
S.D.	1,10	0,80	0,48	1,36
Leaf:stem ratio	1,0[b]	1,0[b]	1,0[b]	0,4[a]
S.D.	0,18	0,08	0,36	0,26

Table 2.5 shows the results obtained for different cuts of lucerne. There were no significant differences in yield between cuts. The 15 week regrowth had a significantly lower leaf:stem ratio compared to the others whereas the 6 week regrowth had a significantly higher leaf:stem ratio. There were no significant differences in leaf:stem ratios between the 8 week winter and 8-9 week spring regrowths of lucerne.

Table 2.5. The influence of period on DM yield and leaf:stem ratio of lucerne. Phase II only.

Parameters	Trial period and chronological age of pastures.			
	P5(8/6/89 -18/6/89) 15 weeks	P6(18/6/89 - 28/6/89) 8 weeks	P7(28/6/89 -8/7/89) 6 weeks	P8(7/11/89-18/11/89) 8-9 weeks
DM yield (t/ha)	2,7[a]	2,5[a]	2,9[a]	3,1[a]
S.D.	0,46	0,26	0,12	0,24
Leaf:stem ratio	0,7[a]	1,4[b]	3,0[c]	1,3[b]
S.D.	0,18	0,28	0,36	0,18

Tables 2.6 to 2.9 provide an indication of the selection of plant parts by sheep grazing on the three pastures.

Table 2.6. Selection of plant parts by sheep. Leaf:stem ratios before grazing and at the end of grazing.

Phase of study	Treatment	Leaf:stem ratio		SE_m
		Before grazing	End of grazing	
I	Sainfoin	1,6[b]	1,2[a]	0,20
	Sheeps' burnet	1,1[a]	1,0[a]	0,05
II	Sainfoin	3,3[b]	2,9[a]	0,20
	Sheeps' burnet	0,9[a]	0,7[a]	0,10
	Lucerne	1,6[b]	1,0[a]	0,30

There were significant changes in leaf:stem ratios (before grazing and at the end of grazing) for sainfoin and lucerne (Table 2.6) but the change in leaf:stem ratio was not significant in the case of sheeps' burnet.

Table 2.7. Selection of plant parts by sheep during different stages of growth of sainfoin.

Phase of study	Trial Period	Chronological age of pastures	Leaf:stem ratio	
			Before grazing	End of grazing
I	P2 (21/2/89-2/3/89)	6 weeks	$1,4^{a}$	$1,0^{a}$
	P3 (4/4/89-14/4/89)	12 weeks	$1,3^{a}$	$1,3^{a}$
	P4(25/4/89-5/5/89)	15 weeks	$2,0^{b}$	$1,3^{a}$
II	P5 (8/6/89-18/6/89)	15 weeks	$3,2^{b}$	$2,5^{a}$
	P6 (17/6/89-27/6/89)	8 weeks	$3,4^{a}$	$3,2^{a}$
	P7 (25/6/89-5/7/89)	6 weeks	$3,5^{a}$	$3,5^{a}$
	P8 (7/11/89-18/11/89)	8-9 weeks	$3,0^{b}$	$2,5^{a}$

There were significant changes in leaf:stem ratio of sainfoin for the 15 week regrowth in both phases and 8 - 9 week regrowth in spring. There were no significant changes in leaf:stem ratios for the 6 week and 12 week regrowths in Phase I and 6 and 8 week regrowths in Phase II (Table 2.7).

Table 2.8. Selection of plant parts by sheep during different stages of growth of sheeps' burnet.

Phase of study	Trial Period	Chronological age of pastures	Leaf:stem ratio	
			Before grazing	End of grazing
I	P2 (21/2/89-2/3/89)	6 weeks	$1,0^{a}$	$1,1^{a}$
	P3 (4/4/89-14/4/89)	12 weeks	$1,0^{a}$	$0,9^{a}$
	P4(25/4/89-5/5/89)	15 weeks	$1,4^{a}$	$1,1^{a}$
II	P5 (8/6/89-18/6/89)	15 weeks	$1,0^{a}$	$0,9^{a}$
	P6 (17/6/89-28/6/89)	8 weeks	$1,0^{a}$	$0,9^{a}$
	P7 (28/6/89-8/7/89)	6 weeks	$1,0^{a}$	$0,8^{a}$
	P8 (7/11/89-18/11/89)	8-9 weeks	$0,4^{a}$	$0,3^{a}$

There were no significant changes in leaf:stem ratios before and after grazing by sheep of sheeps' burnet in both phases (Table 2.8).

Table 2.9. Selection of plant parts by sheep during different stages of growth of lucerne.

Phase of study	Trial Period	Chronological age of pastures	Leaf:stem ratio	
			Before grazing	End of grazing
II	P5 (8/6/89-18/6/89)	15 weeks	$0,7^{a}$	$0,5^{a}$
	P6 (17/6/89-27/6/89)	8 weeks	$1,4^{a}$	$1,1^{a}$
	P7 (25/6/89-5/7/89)	6 weeks	$3,0^{b}$	$1,4^{a}$
	P8 (7/11/89-18/11/89)	8-9 weeks	$1,3^{a}$	$1,0^{a}$

There was a significant change in leaf:stem ratio only in the 6 week regrowth of lucerne.

2.5.2 Chemical components of pastures.

Pooled samples were used for the Ca, P, Mg as well as ADL determinations. These values were therefore not suited for an analysis of variance procedure and therefore only means and standard errors of the means are shown in the tables.

Tables 2.10a and 2.10b show the mean chemical composition of the three pastures for Phases I and II respectively. There were significant differences between pastures with respect to CP, ADF, NDF and ADIN in both phases. In Phase I (Table 2.10a) there were also significant differences between sainfoin and sheeps' burnet with respect to OM, cellulose,

hemicellulose and ash contents. In Phase II, sainfoin and lucerne contained significantly higher OM and cellulose contents compared to sheeps' burnet (Table 2.10b) but the three pastures did not differ significantly with respect to hemicellulose content. Although no tests of significance were done on ADL, Ca, P and Mg contents, sainfoin had considerably higher ADL levels compared to the other two pastures. Sheeps' burnet had significantly higher ash contents in both phases. The results indicate a higher Ca content in lucerne and a higher Mg content in sheeps' burnet. The Ca:P ratio was highest (widest) in lucerne, followed by sheeps' burnet and sainfoin in that order.

Table 2.10 a. Chemical composition of forages (% of DM). Mean of the four periods in Phase I.

Parameter	Pasture		SE_m
	Sainfoin	Sheeps' burnet	
OM	$90,0^{b}$	$89,1^{a}$	0,45
CP	$23,1^{b}$	$18,1^{a}$	2,50
ADF	$41,1^{b}$	$21,6^{a}$	9,75
NDF	$51,5^{b}$	$36,0^{a}$	7,75
ADL	$14,8^{b}$	$5,6^{a}$	4,60
Cellulose	$26,7^{b}$	$16,0^{a}$	5,35
Hemicellulose	$10,4^{a}$	$14,3^{b}$	1,95
ADIN	$2,6^{b}$	$1,2^{a}$	0,70
Ash	$10,0^{a}$	$10,9^{b}$	0,45
Ca	1,00	0,90	0,05
P	0,29	0,25	0,02
Mg	0,57	0,70	0,07
Ca:P	3,45	3,60	

Table 2.10 b. Chemical composition of forages (% of DM). Means of the four periods in Phase II.

Parameter	Pasture			SE_m
	Sainfoin	Sheeps' burnet	Lucerne	
OM	$89,5^{b}$	$88,7^{a}$	$89,3^{b}$	0,24
CP	$23,4^{b}$	$17,2^{a}$	$26,1^{c}$	2,63
ADF	$39,1^{c}$	$21,3^{a}$	$25,3^{b}$	5,39
NDF	$48,0^{c}$	$31,3^{a}$	$35,5^{b}$	5,02
ADL	$18,1_{b}$	$6,1_{a}$	$4,8_{b}$	4,23
Cellulose	$21,0^{b}$	$15,2^{a}$	$20,7^{a}$	1,89
Hemicellulose	$8,9^{a}$	$10,0^{a}$	$10,2^{a}$	0,40
ADIN	$2,5^{b}$	$1,0^{a}$	$1,0^{a}$	0,50
Ash	$10,5^{a}$	$11,2^{b}$	$10,7^{a}$	0,21
Ca	0,84	0,99	1,43	0,18
P	0,41	0,39	0,33	0,02
Mg	0,45	0,97	0,49	0,17
Ca:P	2,05	2,54	4,33	

Tables 2.11a to 2.13 show the chemical composition of the pastures during the different trial periods and stages of growth.

Table 2.11 a. The influence of period on chemical components (% of DM) of sainfoin. Phase I.

Parameters	Trial period and chronological age of pastures.			
	P1 (26/12/88 -6/1/89) Sown previous spring	P2 (21/2/89 - 2/3/89) 6 weeks	P3 (4/4/89- 14/4/89) 12 weeks	P4 (25/4/89- 5/5/89) 15 weeks
OM	90,7^{b}	90,0^{b}	90,4^{b}	88,8^{a}
S.D.	0,14	1,21	1,32	1,29
CP	29,6^{b}	29,2^{b}	16,9^{a}	16,8^{a}
S.D.	0,85	1,79	0,69	3,12
ADF	34,7^{a}	45,4^{b}	41,1^{ab}	43,2^{b}
S.D.	2,62	7,04	7,19	6,73
NDF	50,9^{a}	53,5^{a}	51,1^{a}	50,6^{a}
S.D.	0,99	3,43	3,54	4,09
ADL	11,1	16,7	15,0	16,3
Cellulose	23,6^{a}	28,7^{a}	26,1^{a}	28,4^{a}
S.D.	2,97	7,04	7,19	5,35
Hemicellulose	16,2^{b}	8,0^{a}	10,0^{a}	7,5^{a}
S.D	3,61	3,91	4,52	3,10
ADIN	3,5^{c}	3,0^{b}	2,0^{a}	2,0^{a}
S.D.	0,78	0,48	0,38	0,48
Ash	9,3^{a}	10,0^{a}	9,6^{a}	11,3^{b}
S.D	0,14	1,21	0,40	1,29
Ca	0,80	0,62	1,36	1,23
P	0,27	0,43	0,27	0,19
Mg	0,31	0,48	0,55	0,93

Crude protein content was significantly higher in the primary growth compared to the regrowths in Phase I. There was a significant decrease in CP from the 6 week old pasture (P2) to the 12 week old pasture (P3). There were no significant differences however between the 12 week (P3) and 15 week (P4) old pastures.

In Phase I (Table 2.11a) there were no significant differences between the summer regrowths (P2, P3, P4) of

sainfoin with respect to ADF, NDF, cellulose and hemicellulose despite the different periods (age) of the pastures. However, there were significant differences in these parameters when the regrowths were compared with the primary growth (P1) which had significantly lower values for the fibre indices.

Table 2.11 b. The influence of period on the chemical components (% of DM) of sainfoin. Phase II.

Parameters	Trial period and chronological age of pastures.			
	P5 (8/6/89-18/6/89) 15 weeks	P6 (17/6/89-28/6/89) 8 weeks	P7 (25/6/89-8/7/89) 6 weeks	P8 (7/11/89-18/11/89) 8-9 weeks
OM	$90,0^{bc}$	$89,4^{b}$	$88,3^{a}$	$90,3^{c}$
S.D.	$0,47_{a}$	$0,83_{a}$	$0,90_{a}$	$0,56_{b}$
CP	$21,9^{a}$	$22,1^{a}$	$21,6^{a}$	$28,1^{b}$
S.D.	$3,36_{b}$	$0,75_{b}$	$2,35_{b}$	$1,55_{a}$
ADF	$41,4^{b}$	$41,0^{b}$	$41,9^{b}$	$32,3^{a}$
S.D.	$2,41_{b}$	$3,42_{b}$	$7,61_{b}$	$3,38_{a}$
NDF	$50,4^{b}$	$50,4^{b}$	$49,0^{b}$	$42,4^{a}$
S.D.	1,26	3,38	5,51	4,09
ADL	$22,4_{a}$	$18,1_{a}$	$18,7_{a}$	$13,2_{a}$
Cellulose	$19,0^{a}$	$22,9^{a}$	$23,1^{a}$	$19,1^{a}$
S.D.	$2,41_{a}$	$3,42_{a}$	$7,61_{a}$	$3,38_{a}$
Hemicellulose	$9,0^{a}$	$9,4^{a}$	$7,1^{a}$	$10,0^{a}$
S.D	$2,54_{c}$	$2,91_{a}$	$2,30_{c}$	$1,37_{b}$
ADIN	$3,0^{c}$	$2,0^{a}$	$3,0^{c}$	$2,3^{b}$
S.D.	$0,28_{ab}$	$0,32_{b}$	$0,42_{c}$	$0,38_{a}$
Ash	$10,0^{ab}$	$10,7^{b}$	$11,7^{c}$	$9,7^{a}$
S.D	0,47	0,83	0,90	0,56
Ca	0,92	0,76	-	0,83
P	0,35	0,39	-	0,49
Mg	0,49	0,44	-	0,42

A similar trend is noticed in Phase II (Table 2.11b) where there were no significant differences in the fibre indices for the late autumn (P5) and winter (P6 & P7) regrowths despite chronological age but significantly lower values

were obtained in the spring regrowth (P8).

Table 2.12a. The influence of period on the chemical components (% of DM) of sheeps' burnet. Phase I.

Parameters	Trial period and chronological age of pastures.			
	P1 (26/12/88 -6/1/89) Sown previous spring	P2 (21/2/89 - 2/3/89) 6 weeks	P3 (4/4/89- 14/4/89) 12 weeks	P4 (25/4/89- 5/5/89) 15 weeks
OM	89,1^{a}	89,1^{a}	89,6^{a}	88,7^{a}
S.D.	0,35$_{b}$	0,60$_{b}$	0,39$_{a}$	1,08$_{a}$
CP	20,5^{b}	23,6^{b}	14,2^{a}	14,0^{a}
S.D.	1,98$_{a}$	2,49$_{a}$	1,91$_{a}$	1,12$_{a}$
ADF	24,0^{a}	20,8^{a}	21,1^{a}	20,3^{a}
S.D.	1,27$_{ab}$	3,55$_{b}$	4,30$_{ab}$	2,80$_{a}$
NDF	37,9^{ab}	38,7^{b}	35,0^{ab}	32,3^{a}
S.D.	0,78	5,56	3,81	0,98
ADL	4,8^{a}	4,5^{a}	7,2^{a}	5,9^{a}
Cellulose	19,3^{a}	16,3^{a}	13,8^{a}	14,4^{a}
S.D.	1,63$_{ab}$	3,55$_{b}$	4,30$_{a}$	2,80$_{a}$
Hemicellulose	13,9^{ab}	17,9^{b}	13,6^{a}	12,0^{a}
S.D.	2,05	3,10	2,32	2,65
ADIN	1,0^{a}	2,0^{b}	1,0^{a}	1,0^{a}
S.D.	0,42$_{a}$	0,58$_{a}$	0,38$_{a}$	0,26$_{a}$
Ash	11,0^{a}	10,9^{a}	10,4^{a}	11,3^{a}
S.D	0,35	0,60	0,39	1,08
Ca	0,82	0,70	0,97	1,10
P	0,22	0,31	0,25	0,22
Mg	0,74	0,55	0,78	0,74

Whereas there was no significant difference between the primary growth and the 6 week regrowth of sheeps' burnet as far as CP was concerned (Table 2.12a, Phase I), there was a significant decrease in CP in the 12 week and 15 week regrowth - a similar trend as in sainfoin. The ADF contents were similar for all growth stages. The same trend

occurred for cellulose and ash. There was a significant difference in hemicellulose and NDF contents between the primary growth and the 6 week regrowth. Calcium tended to increase with age whilst P showed the opposite trend.

Table 2.12b. The influence of period on chemical components (% of DM) of sheeps' burnet. Phase II.

Parameters	Trial period and chronological age of pastures.			
	P5 (8/6/89-18/6/89) 15 weeks	P6 (17/6/89-27/6/89) 8 weeks	P7 (25/6/89-5/7/89) 6 weeks	P8 (7/11/89-18/11/89) 8-9 weeks
OM	88,6^{a}	88,6^{a}	88,8^{a}	89,0^{a}
S.D.	0,91	0,24	0,50	0,64
CP	16,4^{a}	14,7^{a}	14,8^{a}	22,9^{b}
S.D.	0,61	0,75	2,17	4,32
ADF	22,2^{a}	20,3^{a}	19,8^{a}	23,0^{a}
S.D.	0,58	3,85	2,36	1,09
NDF	31,0^{a}	29,5^{a}	27,3^{a}	37,4^{b}
S.D.	1,34	1,34	3,24	1,72
ADL	6,7	7,3	5,9	4,5
Cellulose	15,5^{ab}	13,0^{a}	13,9^{ab}	18,5^{b}
S.D.	0,58	3,85	2,31	1,09
Hemicellulose	8,8^{a}	9,2^{a}	7,6^{a}	14,4^{b}
S.D.	1,92	4,48	0,93	2,01
ADIN	1,0^{a}	1,0^{a}	1,0^{a}	0,8^{a}
S.D.	0,34	0,42	0,26	0,37
Ash	11,4^{a}	11,1^{a}	11,7^{a}	11,0^{a}
S.D	0,91	0,29	0,50	0,64
Ca	1,02	1,11	-	0,83
P	0,36	0,33	-	0,49
Mg	1,10	1,11	-	0,70

There were no significant differences between the late autumn (P5) and winter (P6 & P7) regrowths with respect to CP (Table 2.12b, Phase II). However, they differed significantly from the spring regrowth. Acid detergent fibre remained similar for all growth stages as in Phase I. The same trend was noticed with hemicellulose except with the spring regrowth. Neutral detergent fibre was similar for the winter regrowths but these differed significantly with the spring regrowth. Ash content followed the same trend as in Phase I.

Table 2.13. The influence of period on chemical components (% of DM) of lucerne. Phase II only.

Parameters	Trial period and chronological age of pastures.			
	P5 (8/6/89-18/6/89) 15 weeks	P6 (17/6/89-27/6/89) 8 weeks	P7 (25/6/89-5/7/89) 6 weeks	P8 (7/11/89-18/11/89) 8-9 weeks
OM	87,9^{a}	90,3^{b}	89,1^{c}	90,1^{b}
S.D.	0,64$_{a}$	0,50$_{bc}$	0,45$_{b}$	4,25$_{c}$
CP	17,9^{a}	29,2^{bc}	26,4^{b}	30,7^{c}
S.D.	0,28$_{b}$	1,45$_{a}$	2,01$_{a}$	3,03$_{a}$
ADF	36,0^{b}	19,9^{a}	21,5^{a}	24,0^{a}
S.D.	0,57$_{b}$	2,78$_{a}$	4,16$_{ac}$	3,07$_{c}$
NDF	50,8^{b}	27,2^{a}	30,3^{ac}	33,8^{c}
S.D.	0,78	3,86	2,86	3,79
ADL	6,2	4,7	4,3	4,0
Cellulose	29,8^{b}	15,2^{a}	18,1^{a}	19,5^{a}
S.D.	0,57$_{b}$	2,54$_{a}$	4,84$_{a}$	3,33$_{a}$
Hemicellulose	14,8^{b}	7,3^{a}	8,8^{a}	9,8^{a}
S.D.	0,21$_{a}$	1,44$_{a}$	5,33$_{a}$	1,76$_{a}$
ADIN	1,0^{a}	1,0^{a}	1,0^{a}	1,0^{a}
S.D.	0,07$_{c}$	0,28$_{a}$	0,36$_{b}$	0,26$_{a}$
Ash	12,2^{c}	9,7^{a}	11,0^{b}	9,9^{a}
S.D	0,64	0,50	0,45	0,76
Ca	1,47	1,44	-	1,37
P	0,28	0,43	-	0,30
Mg	0,54	0,45	-	0,49

There were significant differences between the 15 week regrowth (P5) and 6 and 8 weeks winter regrowths of lucerne (P6 & P7) with respect to CP (Table 2.13). There were also significant differences in CP content between the spring regrowth and the winter regrowths except the 8 week regrowth. There were significantly higher ADF and NDF contents in the 15 week regrowth compared with the shorter regrowth periods. The same trend occurred for cellulose and hemicellulose. High Ca levels occurred in lucerne of all growth stages.

2.5.3 Digestibility and voluntary intake of organic matter.

As stated in Section 2.4.10 an *in vivo* vs. *in vitro* study was carried out indoors in metabolism cages. The results of the study are shown in Table 2.14.

Table 2.14. Differences between *in vitro* and *in vivo* digestibilities as affected by pasture species.

	Digestibility of OM (%)		
Pasture	*In vitro*	*In vivo*	SE_m
Sainfoin	55.7	65.0	4.65
Sheeps' burnet	54.4	57.6	1.60
Lucerne	52.6	55.2	1.30

Lucerne and sheeps' burnet were deemed to fit in the prediction equation (Section 2.4.10):

$$\%\ \textit{in vivo}\ \text{DOM} = 0{,}746\%\ \text{IVDOM} + 18{,}16$$

In vivo digestibilities of organic matter for the two pastures for all the trial periods were then calculated from the in vitro digestibilities, using the equation. The calculated in vivo digestibilities of organic matter were used in all voluntary intake of organic matter determinations.

Based on the results of the digestibility study (Table 2.14), however, in vivo digestibilities of organic matter of sainfoin were estimated from the in vitro digestibilities by simple proportion, i.e.

$$\% \text{ in vivo DOM} = \% \text{ IVDOM} \times \frac{\text{in vivo DOM}}{\text{in vitro DOM}}$$

$$= \% \text{ IVDOM} \times \frac{65,0}{55,7}$$

$$= \% \text{ IVDOM} \times 1,17$$

The calculated in vivo digestibilities were then used for the voluntary intake of organic matter determinations.

Tables 2.15a and 2.15b show the differences between the pastures with respect to IVDOM and in vivo DOM. There were significant differences between the pastures in both IVDOM and in vivo DOM in both phases.

Table 2.15 a. IVDOM and in vivo DOM of pastures (Mean of the four periods in Phase I).

	Pasture		
Parameter	Sainfoin	Sheeps'burnet	SE_m
IVDOM (%)	$52,4^{a}$	$61,5^{b}$	4,55
In vivo DOM (%)	$61,1^{a}$	$64,0^{b}$	1,45

Table 2.15 b. IVDOM and in vivo DOM of pastures (Mean of the four periods in Phase II).

	Pasture			
Parameter	Sainfoin	Sheeps'burnet	Lucerne	SE_m
IVDOM (%)	$49,5^{a}$	$55,1^{b}$	$64,4^{c}$	4,35
In vivo DOM (%)	$57,7^{a}$	$59,2^{b}$	$66,2^{c}$	3,62

Table 2.16a portrays in vitro and in vivo digestibilities of OM of sainfoin for the different growth stages (trial periods) in Phase I. There were significant differences between the 6 week regrowth (P2) and 15 week regrowth (P4) in both parameters.

In phase II (Table 2.16b) there was a significant difference between the spring regrowth of sainfoin (P8) and the three preceding periods in both IVDOM and in vivo DOM. In addition there was a significantly lower in vivo DOM on the 6 week regrowth (P7) compared with the 8 week regrowth (P6).

Table 2.16 a. The influence of period on IVDOM and in vivo DOM of sainfoin. Phase I.

Parameters	Trial period and chronological age of pastures.			
	P1 (26/12/88 -6/1/89) Sown previous spring	P2 (21/2/89 - 2/3/89) 6 weeks	P3 (4/4/89- 14/4/89) 12 weeks	P4 (25/4/89- 5/5/89) 15 weeks
IVDOM (%)	$53,8^{ab}$	$49,6^{a}$	$52,2^{ab}$	$54,1^{b}$
S.D.	2,12	4,58	2,79	1,63
In vivo DOM(%)	$62,8^{ab}$	$57,8^{a}$	$60,8^{ab}$	$63,0^{b}$
S.D.	2,47	5,33	3,26	1,89

Table 2.16 b. The influence of period on IVDOM and in vivo DOM of sainfoin. Phase II.

Parameters	Trial period and chronological age of pastures.			
	P5 (8/6/89- 18/6/89) 15 weeks	P6 (17/6/89- 28/6/89) 8 weeks	P7 (28/6/89- 8/7/89) 6 weeks	P8 (7/11/89- 18/11/89) 8-9 weeks
IVDOM (%)	$48,9^{ab}$	$49,3^{b}$	$46,9^{a}$	$53,1^{c}$
S.D.	1,16	0,91	0,16	2,16
In vivo DOM(%)	$56,9^{ab}$	$57,5^{b}$	$54,7^{a}$	$61,9^{c}$
S.D.	1,11	1,05	0,16	2,54

Tables 2.17a and 2.17b show the in vitro and in vivo digestibilities of OM of sheeps' burnet for the different growth stages (trial periods) in Phases I and II respectively.

In Phase I, there were no significant differences in in vivo DOM. However, there was a significant difference in IVDOM between the 6 week (P2) and 12 week (P3) regrowths and also between the 6 week regrowth (P2) and primary growth (P1).

In Phase II, there were significant differences between the spring regrowth (P8) and the 15 week (P5) and 6 week (P7) regrowths in both parameters. There was also a significant difference between the 6 week regrowth and 8 week regrowth (P6) with respect to IVDOM.

Table 2.17 a. The influence of period on IVDOM and in vivo DOM of sheeps' burnet. Phase I.

Parameters	Trial period and chronological age of pastures.			
	P1 (26/12/88 -6/1/89) Sown previous autumn	P2 (21/2/89 - 2/3/89) 6 weeks	P3 (4/4/89- 14/4/89) 12 weeks	P4 (25/4/89- 5/5/89) 15 weeks
IVDOM (%)	$59,2^{a}$	$64,1^{b}$	$59,4^{a}$	$63,4^{ab}$
S.D.	0,14	4,24	5,09	3,19
In vivo DOM(%)	$62,3^{a}$	$66,0^{a}$	$62,5^{a}$	$65,5^{a}$
S.D.	0,14	3,15	3,80	2,37

Table 2.17 b. The influence of period on IVDOM and in vivo DOM of sheeps' burnet. Phase II.

Parameters	Trial period and chronological age of pastures.			
	P5 (8/6/89-18/6/89) 15 weeks	P6 (18/6/89-28/6/89) 8 weeks	P7 (28/6/89-8/7/89) 6 weeks	P8 (7/11/89-18/11/89) 8-9 weeks
IVDOM (%)	$53,9^{ab}$	$56,0^{bc}$	$53,0^{a}$	$57,3^{c}$
S.D.	1,73	1,88	2,05	2,61
In vivo DOM(%)	$58,4^{ab}$	$59,9^{c}$	$57,7^{a}$	$60,9^{c}$
S.D.	1,27	1,40	1,54	1,93

Table 2.18 shows the in vitro and in vivo digestibilities of OM of lucerne at different growth stages (trial periods) in Phase II. The spring regrowth of lucerne had a significantly higher IVDOM and in vivo DOM. There were no significant differences between the 8 week and 6 week regrowths. The 15 week regrowth had a significantly lower IVDOM and in vivo DOM than the other 6 and 8 week regrowths.

Table 2.18. The influence of period on IVDOM and <u>in vivo</u> DOM of lucerne. Phase II only.

Parameters	Trial period and chronological age of pastures.			
	P5 (8/6/89-18/6/89) 15 weeks	P6 (18/6/89-28/6/89) 8 weeks	P7 (25/6/89-8/7/89) 6 weeks	P8 (7/11/89-18/11/89) 8-9 weeks
IVDOM (%)	$57,2^{a}$	$66,3^{b}$	$64,0^{b}$	$70,2^{c}$
S.D.	0,49	1,47	1,54	2,43
<u>In vivo</u> DOM(%)	$60,9^{a}$	$67,6^{b}$	$65,9^{b}$	$70,5^{c}$
S.D.	0,35	1,32	1,40	2,32

2.5.3.1 Voluntary intake of organic matter (OMI) of sheep on pastures.

Tables 2.19a and 2.19b portray the intake of organic matter by intact rams on the pastures in Phases I and II respectively.

There were no significant differences between sainfoin and sheeps' burnet with respect to both intake measures in both phases. However, sainfoin had a significantly higher intake per metabolic livemass than lucerne. There were no significant differences between sheeps' burnet and lucerne with respect to both intake parameters (Phase II).

Table 2.19 a. The intake of organic matter as influenced by pasture type (Mean of the four periods in Phase I).

	Pasture		
Parameter	Sainfoin	Sheeps'burnet	SE_m
OMI (g/day)	$995,4^a$	$1030,5^a$	17,55
OMI ($g/kgLW^{0,75}$/day)	$61,3^a$	$63,4^a$	1,05

Table 2.19 b. The intake of organic matter as influenced by pasture type (Mean of the four periods in Phase II).

	Pasture			
Parameter	Sainfoin	Sheeps'burnet	Lucerne	SE_m
OMI (g/day)	$1243,9^a$	$1201,3^a$	$1099,9^a$	42,7
OMI ($g/kgLW^{0,75}$/day)	$66,4^a$	$64,0^{ab}$	$57,8^b$	2,56

Tables 2.20a to 2.22 indicate the intake of organic matter by the rams during the different growth stages (trial periods) of the study. The rams were kept on the pastures for 12 hours/day from Period I (P1) to Period 7 (P7). During the trial in Period 8 (P8) however they remained on the pastures for 24 hours/day.

Tables 2.20a and 2.20b show the intake of OM by rams on sainfoin for the different periods of Phases I and II respectively.

Table 2.20 a. The influence of period on OMI of sheep grazing sainfoin. Phase I.

Parameters	Trial period and chronological age of pastures.			
	P1 (26/12/88 -6/1/89) Sown previous spring	P2 (21/2/89 - 2/3/89) 6 weeks	P3 (4/4/89- 14/4/89) 12 weeks	P4 (25/4/89- 5/5/89) 15 weeks
OMI (g/day)	1073,0[a]	936,5[a]	923,5[a]	1048,6[a]
C.V.(%)	11,6	6,6	7,6	17,9
OMI (g/kg $LW^{0,75}$/day)	68,7[a]	58,2[a]	56,2[a]	62,2[a]
C.V.(%)	9,8	7,3	9,3	16,7

Table 2.20 b. The influence of period on OMI of sheep grazing sainfoin. Phase II.

Parameters	Trial period and chronological age of pastures.			
	P5 (8/6/89- 18/6/89) 15 weeks	P6 (17/6/89- 28/6/89) 8 weeks	P7 (28/6/89- 8/7/89) 6 weeks	P8 (7/11/89- 18/11/89) 8-9 weeks
OMI (g/day)	943,4[a]	960,4[a]	970,0[a]	2101,9[b]
C.V.(%)	11,6	12,5	5,3	29,7
OMI (g/kg $LW^{0,75}$/day)	54,2[a]	53,6[a]	52,8[a]	105,9[b]
C.V. (%)	15,7	13,6	2,8	24,9

There were no significant differences between periods with respect to the two intake measures in Phase I (Table 2.20a). In Phase II (Table 2.20b) there were no significant differences with respect to both measures between the late autumn and winter trials (P5-P7). However there were

significantly higher intakes on the trial with the spring regrowth (P8: during which the animals remained on the pasture for the duration of the trial) than each of the preceding periods.

Tables 2.21a and 2.21b show the intake of OM by rams on sheeps' burnet for the different periods of Phases I and II respectively.

In Phase I there were no significant differences in OMI (g/day) of sheeps' burnet between all periods. However, there was a significantly higher OMI (g/kg $LW^{0,75}$/day) on the primary growth (P1) compared to the 12 week regrowth (P2). In Phase II there were no significant differences with respect to both parameters between the late autumn and winter regrowths (P5, P6, P7). The trial on the spring regrowth (P8) yielded significantly higher intakes compared to each of the preceding three periods as noticed in the case of sainfoin.

Table 2.21 a. The influence of period on OMI of sheep grazing sheeps' burnet. Phase I.

Parameters	Trial period and chronological age of pastures.			
	P1 (26/12/88 -6/1/89) Sown previous spring	P2 (21/2/89 - 2/3/89) 6 weeks	P3 (4/4/89- 14/4/89) 12 weeks	P4 (25/4/89- 5/5/89) 15 weeks
OMI (g/day)	1099,6[a]	996,9[a]	934,9[a]	1090,5[a]
C.V.(%)	13,2	8,6	12,9	16,1
OMI (g/kg $LW^{0,75}$/day)	69,9[a]	62,2[ab]	56,9[b]	64,7[ab]
C.V.(%)	10,9	9,5	13,9	15,4

Table 2.21 b. The influence of period on OMI of sheep grazing sheeps' burnet. Phase II.

Parameters	Trial period and chronological age of pastures.			
	P5 (8/6/89- 18/6/89) 15 weeks	P6 (18/6/89- 28/6/89) 8 weeks	P7 (28/6/89- 8/7/89) 6 weeks	P8 (7/11/89- 18/11/89) 8-9 weeks
OMI (g/day)	1018,3[a]	1046,9[a]	1123,3[a]	1616,8[b]
C.V.(%)	19,4	10,6	19,4	14,8
OMI (g/kg $LW^{0,75}$/day)	57,9[a]	58,1[a]	60,5[a]	79,6[b]
C.V. (%)	24,6	12,7	17,1	18,0

Table 2.22 shows the intake of OM by rams on lucerne in Phase II of the study. There were significantly higher intakes on the 15 week regrowth compared with the 6 week regrowth, with the 8 week regrowth in between.

There were significantly higher intakes on the trial with the spring regrowth (P8) than each of the preceding periods as in the case of sainfoin and sheeps' burnet.

Table 2.22. The influence of period on OMI of sheep grazing lucerne. Phase II only.

Parameters	Trial period and chronological age of pastures.			
	P5 (8/6/89-18/6/89) 15 weeks	P6 (18/6/89-28/6/89) 8 weeks	P7 (25/6/89-8/7/89) 6 weeks	P8 (7/11/89-18/11/89) 8-9 weeks
OMI (g/day)	$1090,0^{b}$	$827,7^{ab}$	$658,8^{a}$	$1823,0^{c}$
C.V. (%)	18,2	22,9	35,1	23,0
OMI(g/kg $LW^{0.75}$/day)	$60,5^{a}$	$47,3^{ab}$	$36,1^{a}$	$87,6^{c}$
C.V. (%)	10,5	16,2	28,2	23,7