



1988

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DEPARTMENT OF AGRICULTURE
WESTERN AUSTRALIA

Evaluation of New Pasture Legume Species in Terms
of Summer Feeding Value and Effects on Wool Production

SUMMARY OF EXPERIMENTAL RESULTS - 1988

T. CASSON, KA. FISHER, Dr B. WARREN

TRIAL: 86KA71

LOCATION: Private Farm 'Monalta', owner T. Barritt
(12 km south-east of Katanning)

SITE DESCRIPTION:

Soil Type: 40% grey loamy sand over clay, pH (H₂O) 6.0-6.5
20% red loam pH (H₂O) 7.5-8.0
40% transitional pH (H₂O) 6.5

Paddock History: Continuous cropping from 1981 to 1985
Sown to pasture 1986 (for grazing trial)

Average Rainfall: 475 mm per annum

TRIAL DETAILS:

Treatments: (A) Regenerating pasture, sown in 1986
1. *Medicago polymorpha* var. *brevispina* cv Circle Valley
2. *Medicago polymorpha* var. *brevispina* cv Serena
3. *Medicago truncatula* cv Paraggio
4. *Trifolium subterraneum* cv Dalkeith

(B) Sown in 1987
5. *Medicago polymorpha* var. *brevispina* cv 4980
6. *Lolium rigidum* cv Wimmera spraytopped with 350 ml/ha of Roundup®

Design: Randomized complete block
3 replicates (0.91 ha plots)

Sowing Date: 1. 4980 - 13/5/87 direct drilled with 12-run combine
2. Wimmera ryegrass - 22/5/1987 direct drilled with 12-run combine

Sowing Rate: 4980 seed - 11 kg/ha inoculated and lime pelleted
Wimmera ryegrass seed - 10 kg/ha

Fertilizer: 40 kg/ha superphosphate drilled with seed in 1986. 150 kg/ha superphosphate on all plots, 45 kg/ha Urea on ryegrass plots in Winter 1988.

Herbicide: Sprayseed 200® 1/ha 22/5/1987 prior to sowing on Wimmera ryegrass plots only.

Fusilade 212® 450 ml/ha 17/7/1987 on legume plots only.

Roundup® 350 ml/ha 1/10/1987 on Wimmera ryegrass plots plus on replicate (one plot) of 4980 which had excessive contamination of ryegrass (topping treatment).

Fusilade® 2 l/ha 28/9/1988 ryegrass control in plots 9, 10, 12 (legume plots contaminated with ryegrass).

Gramoxone W® 1.0 l/ha 5/10/1988 on ryegrass plots.

Insecticide: Rogor® 90 ml/ha 20/5/1987, 85 ml/ha 12/6/1987, and 85 ml/ha 12/9/1988 on all legume plots.

CROPPING: Spear wheat direct drilled with 12-run combine at 50 kg/ha on 1/6/1989

Fertilizer: Top dressed with 50 kg/ha superphosphate 9/5/1989 on all plots.
Urea applied using combine at 3 rates per plot - 0, 20, 40 kg/ha, with 0.5 m buffers on 1/6/1989.

Herbicide: Sprayseed 200® 1.5 l/ha all plots 26/5/1989
Hoegrass® at 1.5 l/ha all plots 10/7/1989

PASTURE SAMPLES:

QUANTITY: Samples were taken throughout the year to measure the amount of pasture on offer, the plant density, dry matter and seed yield.

QUALITY: Samples were taken for analysis of Dry Matter Digestibility, Crude Protein, Crude Fibre (Acid Detergent Fibre and Lignin, Neutral Detergent Fibre), Ash and Alkane content, Estimated Metabolizable Energy, and Nitrogen content, at ~6 weekly intervals, commencing 3/9/1986.

ANIMAL DETAILS:

Stocking Date:

15/8/1986	Sheep were allocated to the plots.
13/8/1987	Sheep were removed from the plots in order to spell the pasture.
22/9/1987	Sheep were returned to all regenerating plots. and allocated to Wimmera ryegrass and 4980 plots sown in 1987.
3/2/1988	Sheep removed from all plots due to drought.
18/5/1988	Sheep were re-allocated to plots.
18/4/1989	All sheep were removed from the trial to permit cropping of the site.

Stocking Rate:

15/8/1986 to 11/1/1988 -
6.6 sheep/ha (6 sheep on 0.91 ha plots)

11/1/1988 to 3/2/1988 - 4.4 sheep/ha
(stocking rate reduced due to feed limitations)

18/5/1988 to 18/4/1989 - 5.5 sheep/ha

Selection Criteria:

Selection was for uniform fleece type and body weight.

Drenching:

Panacur® 15 ml/head 11/2/1987, 21/9/1987, 11/1/1988.
Ivomec® 17.5 ml/head 24/1/1989.
Glanvac-6® 18/4/1989.

Shearing:

20/8/1987, 18/8/1988.

Liveweight: Measured at three weekly intervals from
15/8/1986 to 13/8/1987.

Measured at four weekly intervals from
22/9/1987 to 3/2/1988.

Measured at six weekly interval from
19/5/1988 to 18/4/1989.

INTRODUCTION

As outlined by S. Flecker in the 1987 summary for this trial, the expected result of the research is that the feeding value of burr medic pastures will be greater than the feeding value of sub. clover and barrel medic pasture, particularly over the dry summer/autumn period.

Pods play an important part in maintaining the protein intake of sheep over summer (Wilson and Hindley, 1968). Brownlee and Denney (1985) found that during summer, when more palatable pasture components become scarce, seed pod ingestion increases to 70%. Work by Cocks (1988) showed that ewes grazing mature medic pods gained weight as long as pod availability exceeded 10 kg/ha, while that by Brownlee (1973) and Purser (1987) suggested that barrel medic pod and dry sub. clover pasture do not supply sufficient nutrients to permit the maintenance of body weight.

Pod structure is important when considering summer nutritive value (Denney, G.D., Hogan J.P. and Lindsay J.R., 1979). The pod:seed ratio for the burr medics Circle Valley and Serena is 50% compared to a ratio of about 30% for barrel medics and 37% for sub. clovers (Wilson and Hindley). Seed number per pod, seed size and chemical composition also differs between legumes. All of these factors are likely to affect the digestibility (and therefore the nutritive value) of the pods and so determine the level of sheep production.

RESULTS

PLANT PRODUCTION

Table 1: Pasture quantity (prior to senescence) and seed yield data (mean of three reps)

VARIETY	PASTURE QUANTITY (DM t/ha)			SEED YIELD (kg/ha)		
	1986	1987	1988	1987	1988	1989
Circle Valley	6.57	1.30	4.02	888	398	569
Serena	5.88	1.33	4.94	925	436	431
Paraggio	4.11	2.05	5.36	489	310	301
Dalkeith	4.28	2.13	6.91	392	325	638
4980		2.03	4.84	381	426	
Ryegrass	1.96	1.75	3.15			
S.E.M.	0.400	0.234	0.488	56.50	12.59	103.6
LSD = 5%	0.880	0.509	1.503	138.25	201.50	293.0

PATURE QUANTITY AND SEED YIELD:

Circle Valley and Serena were the highest yielding pastures in 1986 in terms of both pasture quantity and seed produced (Table 1). In the following year, drought conditions were experienced and these two pastures saw a dramatic decline in production with only 20% of the previous years dry matter and roughly 45% of the seed available. Although there was an improvement in dry matter production in 1988, seed yields for Serena remained at the same level and for Circle Valley only improved by 42% (still only 64% of first years production of 888 kg/ha).

Dalkeith and Paraggio appeared to tolerate drought conditions better than Serena and Circle Valley, dropping by only in 50% dry matter production and 79% (Dalkeith), 66% (Paraggio) in seed yield. In 1988 both these pastures were higher in quantity and seed yield. It was Dalkeith, however, which improved the most, going from 2.13 to 6.91 t/ha dry matter and from 325 to 638 kg/ha seed yield in 1988.

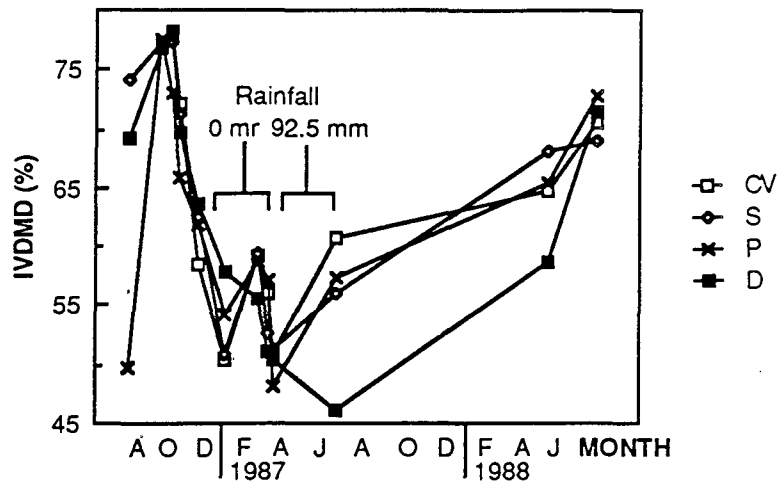


Fig 1: In vitro dry matter digestibility of pasture

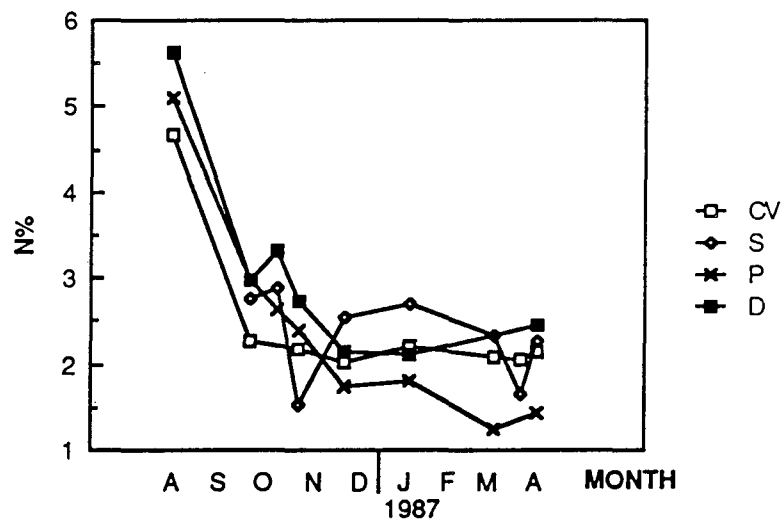


Fig 2: Nitrogen content of dry pasture

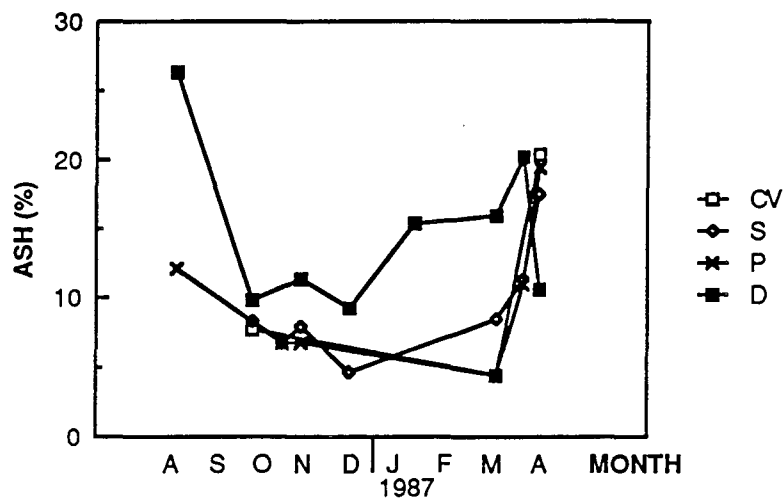


Fig 3: Ash content of dry pasture

The cultivar 4980, sown in 1987, had a similar production pattern to Circle Valley and Serena. Spray topped ryegrass produced considerably less dry matter than any of the other pasture species (less than 50%, $P < 0.05$), was only slightly depressed by the drought year (10% of 1986 production) and was again the lowest producer in 1988.

It should be noted that the pastures were no longer pure swards in 1988, with the total dry matter produced from 4980 plots consisting of up to 45% broadleaf weeds and grass (Table 2).

Table 2: Pasture Composition (%), August 1988

VARIETY	COMPOSITION		
	Pasture	Grass	Weeds
Circle Valley	73	7	19
Serena	66	4	30
Paraggio	65	10	24
Dalkeith	65	3	32
4980	55	10	35
Ryegrass	72	13	14

PASTURE QUALITY

Many of the pasture samples collected for the trial were bulked, or only taken from one replicate for quality estimation making a statistical analysis of the results difficult. For this summary available results are presented in graph form only. Some results are still not available. Bulk results for dry matter digestibility (IVDMD) are shown in Fig 1. The digestibility of Dalkeith was comparatively low during winter and spring. In October 1986 and again in July 1987, dry matter digestibility for Dalkeith was significantly ($P > 0.05$) lower than for Circle Valley.

The increase in digestibility of total samples collected between February and April (Fig 1) was not due to the appearance of green feed. It may have been caused by consumption of pod by sheep, as pod is of lower in vitro digestibility than stem. Depletion of pod supply would have the effect of increasing the overall digestibility of the pasture on offer. The fact that there is not an equivalent peak for Dalkeith supports this idea. Dalkeith pods are mostly buried and inaccessible to sheep and sampler alike.

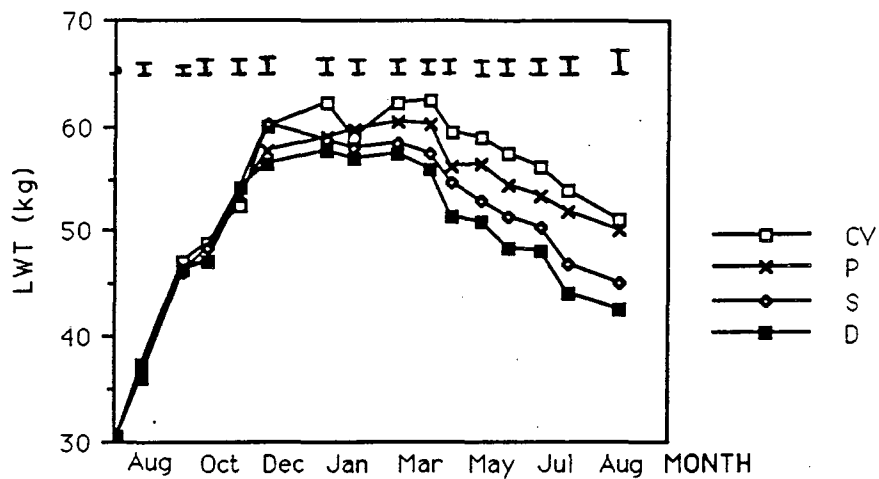


Fig 4: Sheep Liveweights 1986-87

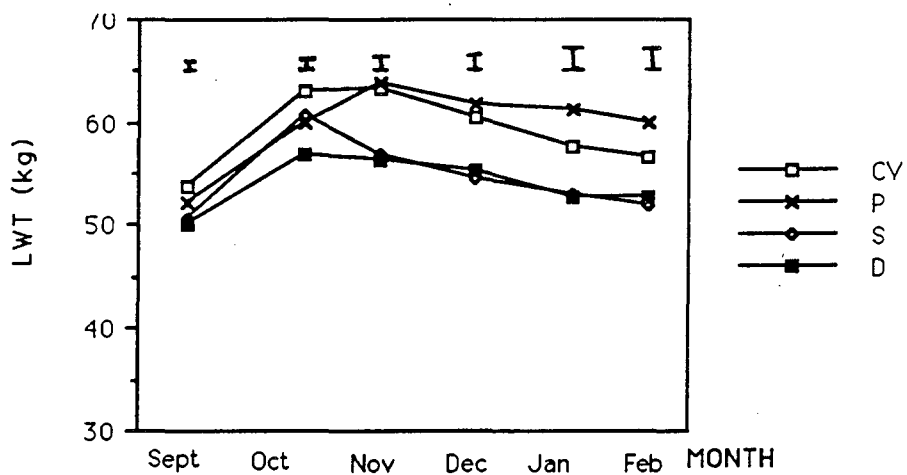


Fig 5: Sheep Liveweights 1987-88

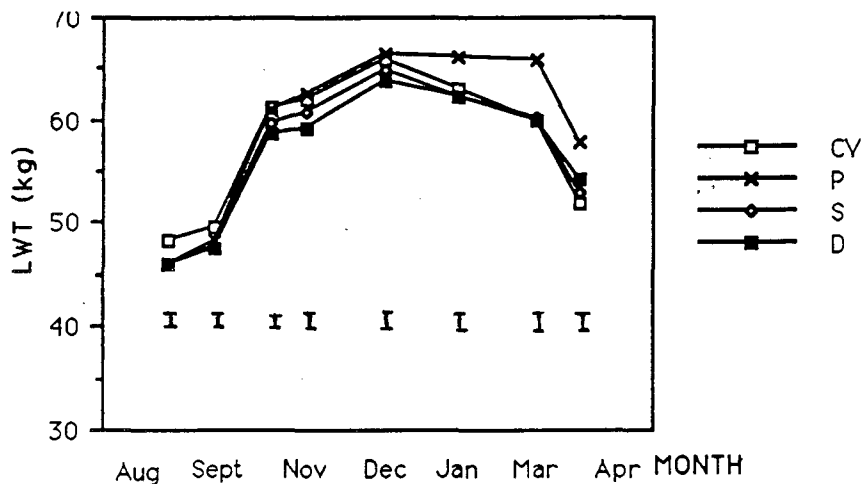


Fig 6: Sheep Liveweights 1988-89

SEASON	DATES	CV	S	P	D	R	4980
SPRING	15/8/86-2/12/86	2.107	2.128	1.89	1.943	1.787	-
	13/8/87-17/11/87	1.376	1.485	1.293	1.199	1.249	1.481
	18/8/88-13/12/88	1.706	1.661	1.54	1.576	1.523	1.572
SUMMER	2/12/86-14/4/87	1.819	1.528	1.712	1.357	-	-
	17/11/88-4/2/88	0.497	0.515	0.703	0.479	0.685	0.507
	13/12/88-18/4/89	0.789	0.795	0.959	0.823	0.828	0.803
WINTER	14/4/87-13/8/87	0.935	0.856	0.938	0.642	-	-

Table 3: Seasonal wool growth (kg)

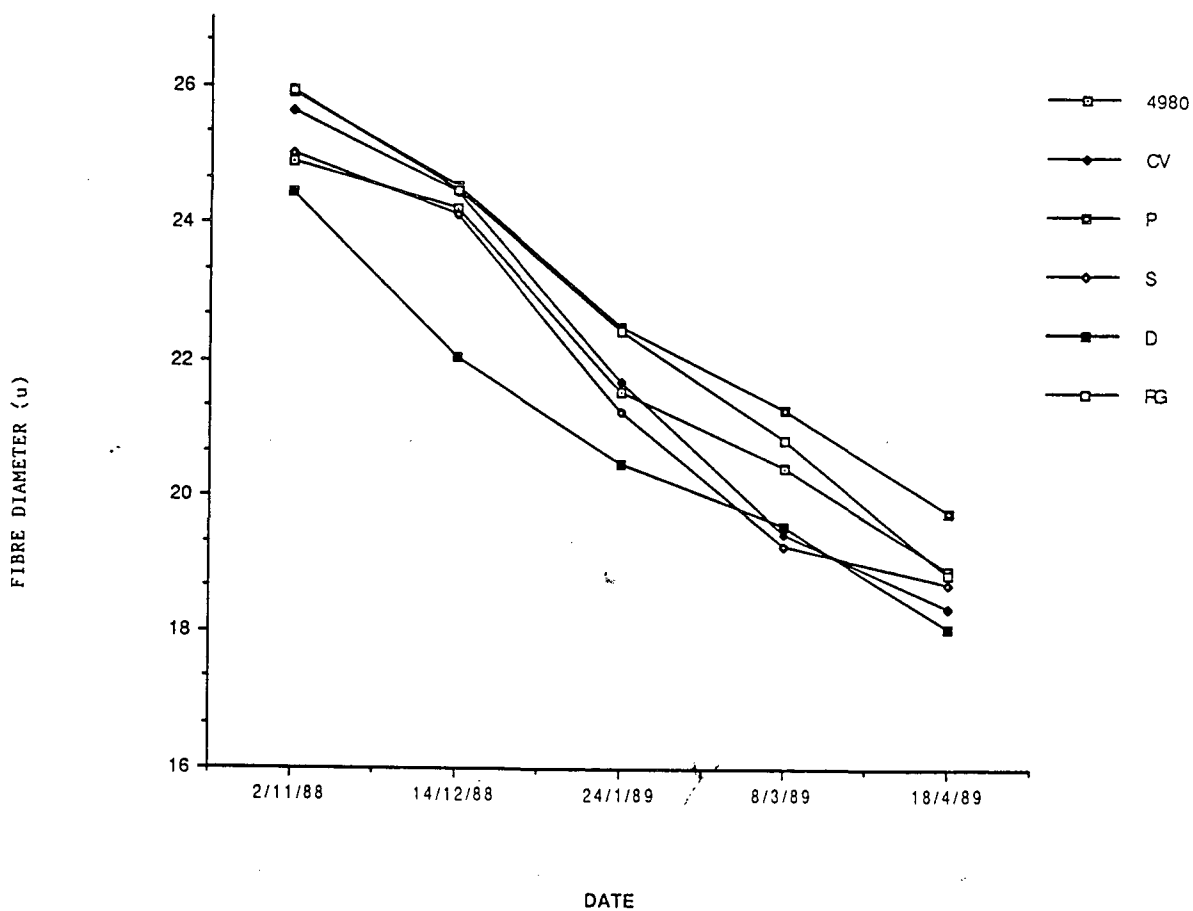


Fig 7: Fibre diameter 1988-1989

Nitrogen content of total pasture samples dropped from 4.5 - 5.5% in spring to below 3% during summer/autumn. Maintenance of nitrogen levels in the total samples over summer was due to the presence of pods. All of the legume pods contained between 3 - 4 % nitrogen compared to about 1.5% for stem material (Fig 2).

Dalkeith had the highest ash levels throughout 1986-87, only dropping in comparison to the other pastures in April. The great increase in percent ash for the medics during April was probably due to increased ingestion of sand along with burr. Medic burr was approximately 4% ash compared to 15 - 20% for the sub. clover pods (Fig 3).

ANIMAL PRODUCTION

LIVEWEIGHT

Sheep grazing Paraggio and Circle Valley had the highest liveweights throughout 1986-87 and into early 1988 (Fig 4 & 5). Those on Paraggio also had the highest liveweights during the drought conditions of 1988 and were significantly ($P<0.05$) heavier than sheep on Serena or Dalkeith. Then again in March 1989 they were the heaviest ($P<0.05$) at 65.9 kg.

The liveweight production graph for sheep grazing 4980 was mid way between that of Circle Valley and Serena. For Dalkeith the graph was similar to that for Serena. Ryegrass was consistently the poorest pasture for liveweight production except during December to February 1988, when sheep were of equivalent liveweight to those on Circle Valley.

WOOL GROWTH

During Spring, wool growth from sheep grazing Circle Valley and Serena was above that for the other pastures and consistently higher (by ~10%) than Paraggio (Table 3). In the first year of the trial both Circle Valley and Paraggio produced the most wool from sheep over the dry summer months. During and after the drought conditions of 1988, however, it was the sheep on Paraggio that were the best producers (7.4 g/s/d). Sheep on ryegrass also maintained a relatively high level of wool production during this period at 6.29 g/s/d. Dalkeith sheep had the lowest wool growth rate of about 5 g/s/d in winter 1897.

There was good correlation between wool growth and liveweight change over summer.

$$\text{Wool growth} = 0.08(\text{LWTC}) + 13.7 \quad r^2 = 0.92.$$

There was also the expected correlation between wool growth and fibre diameter:

$$\text{Wool growth} = -19.8 + 1.32(\text{micron}) \quad r = 0.92$$

Fibre diameter (Fig 7) for Dalkeith sheep dropped very quickly from 24 to 21 microns after senescence of the pasture.

INTAKE MEASUREMENT

Two intake studies were conducted using slow release chromic oxide capsules. Measurements were made on green (September 1986) and dry (March 1987) feed. Results are presented in Tables 3 and 4.

On green feed, calculated intakes for the legumes were between 1.1 and 1.24 kg/sheep/day. This was in accordance with expected intakes, based on energy consumption, of 1.01 - 1.28 kg/sheep/day (MAFF Technical Bulletin 33). There were no significant differences between treatments in faecal output, dry matter intake or liveweight change. Paraggio had the highest feed conversion ratio.

A level of intake on abundant green pasture of about 1000 g / day / sheep is close to the estimates of Hutchinson and Porter (1958) and Fels, Moir and Rossiter (1959)

Pasture quality was high, with all pastures having a dry matter digestibility of around 77 % and equivalent amounts of cell wall and contents. Quantity of feed was non limiting at around 6 t/ha for Circle Valley and Serena and just over 4 t/ha for Paraggio and Dalkeith.

	CV	S	P	D
Faeces (gDM/d)	263.5 ^a	300.5 ^a	320.0 ^a	314.3 ^a
DM Intake (gDM/d)	1102.0 ^a	1183.0 ^a	1240.0 ^a	1190.0 ^a
LW (g/d)	374.0 ^a	308.0 ^a	375.0 ^a	318.0 ^a
FCR	3.1	3.3	4.2	3.9

Table 3: Total dry faecal output, dry matter intake, liveweight change and feed conversion ratio for sheep grazing green feed.

	CV	S	P	D
Faeces (gDM/d)	887 ^a	951 ^a	878 ^a	546 ^b
DM Intake (gDM/d)	1872 ^a	2008 ^a	1885 ^a	1152 ^b
LW (g/d)	-62	-116	-106	-171

Table 4: Total dry faecal output, dry matter intake and liveweight change for sheep grazing dry pasture.

During the dry feed intake study, all sheep were losing weight and pasture quality was low at around 53% dry matter digestibility for all treatments. Estimated intakes were high for the medics at 1.87 - 2.01 kg/sheep/day and moderate for the sub. clover at 1.15 kg/sheep/day.

From the Faecal outputs above it was calculated that for sheep grazing Circle Valley, burr intake constituted 65% of the daily diet. This figure was derived using data from a pen feeding trial conducted by S. Flecker (unpublished data) in which pod characteristics were noted and it was determined that for Circle Valley 25.3% of ingested seed passed unharmed. Further work by S. Flecker indicated that there was 15.01 g/gDM of seed in the faeces of sheep grazing Circle Valley at the time of the intake study.

Seed and Burr intake were calculated as follows:

$$\begin{aligned}
 \text{Seed intake (g/d)} &= (F_o / 100) \times (\text{seed in faeces (g/gDM)} / 0.253) \\
 &= (887.3 / 100) \times (15.01 / 0.253) \\
 &= 526
 \end{aligned}$$

$$\begin{aligned}
 \text{Burr intake (kg/d)} &= 526 / \text{g seed} / \text{kg burr} \\
 &= 526 / 420 \\
 &= 1.227 \text{ kg} / \text{d}
 \end{aligned}$$

DISCUSSION

The feeding value of barrel medic pasture cannot, from these results, be said to be inferior to that of the burr medics. In fact Paraggio appears to provide a better nutrient supply over summer than Circle Valley and Serena. This may be due the fact that the seeds in Paraggio pods are larger than those of the burr medics and 10 -15 % 'softer'. A further pen feeding trial will be carried out this year to determine the digestibility of barrel medic burr. It may then be possible to calculate burr intake as for Circle Valley and so determine whether the summer feeding value of Paraggio is an attribute of burr ingestion or selection of other material (stem) by sheep.

Medic burr is grazed heavily towards the end of summer. Cocks (1988) observed an intake of 450 g seed / head / day as long as residual seed was greater than 10 kg. This gives credence to our result of 526 g seed / head / day. Seed yield results also indicate heavy grazing pressure on Circle Valley and Serena. It is interesting to note that the protected seed reserve of Dalkeith built up over the years under exactly the same grazing pressure. Wilson and Hindley (1968) found that daily ad lib intake of sub. clover pod in a pen feeding situation was about 600 g / sheep / day. Flecker and Casson (unpub. data) have observed the consumption of 1.5 kg Circle Valley burr/day by penned sheep.

Pod undoubtedly plays a major part in the nutrition of sheep grazing summer pasture. Wilson and Hindley (1968) proposed that the dry tops of sub. clover were at least as important as pods as a protein supplement for sheep. The similar production from sheep grazing Dalkeith and Serena may in part be due to this, but it seems more likely that the poor production from Serena is purely a function of early maturation.

A further intake study was been carried out in April 1989 to verify the results obtained on dry feed. The samples have been analysed and results should be available soon.

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