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S E. Flecker
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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 - 1987

Research Officers:  S.E. Flecker
                   C.W. Thorn
                   J.B. Rowe

Technical Officer:  T. Casson
INTRODUCTION

Pasture legumes improve the feeding value of summer pastures in a mediterranean-type environment by maintaining the protein intake of grazing animals over the dry summer period, much of which comes from the ingestion of legume burr (A.D. Wilson and N.L. Hindley, 1968). Some of the most important species of pasture legumes to have been released commercially are *Trifolium subterraneum* (sub.clover), *Medicago truncatula* (barrel medic) and *Medicago polymorpha* (burr medic) (D.B. Purser, G.B. Taylor and W.J. Collins, 1987). What little information is available on the feeding value of these species suggests that barrel medic pod (H. Brownlee, 1973) and dry sub.clover pasture (D.B. Purser, unpublished data, as quoted in D.B. Purser et al., 1987) do not supply sufficient nutrients to permit the maintenance of body weight. Field observations however, have shown that sheep grazing burr medic pastures over summer are more productive than sheep grazing sub.clover or grass pastures.

There is a wide range in pod structure and chemical composition between and within the different species of pasture legumes and this is likely to affect their feeding value. It is particularly relevant to consider the pod's content of seed because it is the seed that provides the main source of nutrients, especially lipids and proteins (G.D. Denney, J.P. Hogan and J.R. Lindsay, 1979). Preliminary research at Katanning (Western Australia) has shown that the pod:seed ratio of barrel medic is only approximately 35% whereas the pod:seed ratio of the burr medicos Circle Valley and Serena is approximately 50%. This finding suggests that the quality of burr medic pod is likely to be superior to the quality of barrel medic pod.

In July 1986, the Australian Wool Research Trust Fund allocated funds for a three year project entitled "Evaluation of New Pasture Legume Species in Terms of Summer Feeding Value and Effects on Wool Production." A grazing trial was subsequently established at Broomehill, a medium to high rainfall region (> 400 mm) of Western Australia. The expectation of this trial is that the feeding value of burr medic pastures in a mediterranean type of environment will be greater than the feeding value of sub.clover and barrel medic pasture, particularly over the dry summer/autumn period.
TRIAL: 86KA71
LOCATION: A. Fethers (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
Growing season - May to October 1987 ~ 211 mm/annum which was ~ 60% of the average

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: Randomised complete block
3 replicates (0.91 ha plots)

Sowing Date: 1. 4980 - 13/5/1987 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

Herbicide: Sprayseed 200® 2 L/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 one replicate (one plot) of 4980 which had excessive contamination of ryegrass (topping treatment).

Insecticide: Rogor® 90 mL/ha 20/5/1987 on regenerating legume plots only. 85 mL/ha 12/6/1987 on all legume plots.
PASTURE SAMPLES:

(A) QUANTITY
Pasture Density: 15/4/1987 and 20/7/1987
Dry Matter Yield: 29/9/1987
Seed Yield: 6/1/1988

(B) QUALITY: Samples were taken for analysis of Dry Matter Digestibility, Crude Protein, Crude Fibre, Ash and Alkane content at ~ 6 weekly intervals, commencing 3/9/1986.

ANIMAL DETAILS:

Stocking Date: (A) Regenerating plots
Sheep were allocated to plots on the 15/8/1986. 13/8/1987 - sheep were removed from the plots in order to spell the pasture.

(B) Regenerating plots plus 1987 sown plots
22/9/1987 - sheep were returned to all regenerating plots.

22/9/1987 - sheep were allocated to Wimmera ryegrass and 4980 plots that were sown in 1987.

Stocking Rate: 15/8/1986 to 11/1/1986 - 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)

3/2/1988 - sheep removed from all plots; insufficient feed to carry stock and to allow for adequate pasture regeneration in 1988.

Selection Criteria: Selection was for uniform fleece type and body weight.


Shearing: 20/8/1987

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 eight weekly intervals commencing 22/9/1987 to 3/2/1988 by clipping a 100 cm² mid-side patch.

Faecal Sampling: For whole seed content; concurrent with woolgrowth measurements

Rumen Fluid Sampling: For NH₃ level, VFA content, and pH; concurrent with woolgrowth measurements.

Measurement of Feed Intake: - by insertion of slow release, indigestible Cr₂O₃ capsules:

1. Green feed - sheep were dosed in September 1986.

2. Dry feed - sheep were dosed in March 1987. Faecal collections were made to estimate daily faecal output. Pasture samples were taken over the month to correlate with the output of "indigestible" plant markers in the faeces, such as alkanes (a plant cuticular wax).
RESULTS AND COMMENTS:

Table 1. Plant density, dry matter and seed yield data of six different varieties of pasture (mean of 3 reps).

<table>
<thead>
<tr>
<th>Variety</th>
<th>Plant Density 15/4/87 (plants/m²)</th>
<th>Plant Density 20/7/87 (plants/m²)</th>
<th>Dry matter 29/9/87 (t/ha)</th>
<th>Seed Yield Dec 1986 (kg/ha)</th>
<th>Seed Yield Jan 1988 (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circle Valley</td>
<td>262</td>
<td>460</td>
<td>1.30</td>
<td>888</td>
<td>398</td>
</tr>
<tr>
<td>Serena</td>
<td>160</td>
<td>521</td>
<td>1.33</td>
<td>925</td>
<td>436</td>
</tr>
<tr>
<td>Dalkeith</td>
<td>809</td>
<td>512</td>
<td>2.05</td>
<td>489</td>
<td>310</td>
</tr>
<tr>
<td>Paraggio</td>
<td>482</td>
<td>388</td>
<td>2.13</td>
<td>392</td>
<td>325</td>
</tr>
<tr>
<td>4900</td>
<td>-</td>
<td>-</td>
<td>2.03</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>ST Ryegrass*</td>
<td>-</td>
<td>-</td>
<td>1.75</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

S.E.M. 103.40 37.51 0.25 56.50 12.59
LSD = 5% 252.80 91.79 0.56 138.25 201.50

* Spraytopped Wimmera Ryegrass

Plant Density

The plant density of the burr medic varieties Circle Valley and Serena in March was about one-third the plant density of Dalkeith (sub.clover) and about half the plant density of Paraggio (barrel medic) (Table 1). The low plant densities of the burr medics can be partially attributed to their characteristic high level of hardseededness (approximately 80%). Consequently only 20% of the burr medic seed which was set in 1986, compared with about 30-35% of the Paraggio seed and about 40% of the Dalkeith seed, could be expected to germinate in the following season.

In July a considerable decrease in the plant density of Dalkeith and Paraggio was evident whereas the plant density of Circle Valley and Serena increased (Table 1). A large proportion of Dalkeith and Paraggio seedlings would have wilted and died in the dry period (approximately three weeks) that followed the break of season in April. Many of the Circle Valley and Serena seedlings that germinated in response to the opening break would also have died. Burr medic seeds however, are known to germinate over a staggered period of time in any particular season. Consequently, burr medic seed would have germinated in response to subsequent rains that fell after the initial break of season thus accounting for the increase in the plant density of Circle Valley and Serena that was observed.

Dry Matter Production

Dalkeith and Paraggio produced approximately 0.8 t/ha more dry matter than the burr medics Circle Valley and Serena even though there was little difference in plant density between the four varieties of pasture in July (Table 1). This is probably because there was a higher proportion of older plants in the Dalkeith and Paraggio plant populations, which had germinated early in the season and had survived, than there was in the burr medic plant populations.
The older Dalkeith and Paraggio plants would have contained more dry matter than the younger burr medic plants that had germinated later in the season and which made up the majority of the Circle Valley and Serena plant populations at the time of sampling.

**Seed Yield**

The seed yield data for 1987/88 was not a true indication of the yield of seed from pasture which germinated in 1987 since it was made up of a combination of the seed that was set in 1986 and remained on the plots, seed contained in faecal pellets that were on the plots as well as seed that was set in 1987.

In 1987 Circle Valley and Serena yielded less than half as much seed as they did in 1986, Paraggio yielded about a third less seed and Dalkeith yielded approximately a fifth less seed (Table 1). Lower seed production can be attributed to the fact less plants germinated in the 1987 season and hence there were fewer plants to produce seed, and that lack of finishing rains would have inhibited the maturation process of seed.

There was no difference \( P < 0.05 \) in the yield of seed in 1987 between the different varieties of pasture being evaluated.

**Table 2.** Chemical analysis of the cell and cell wall contents of samples of total-plant and plant parts of four pasture legume varieties sampled on 21/10/86.

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Sample type</th>
<th>Cell contents neutral detergent solubles (%)</th>
<th>Cell wall contents</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Cell contents</td>
<td>Hemi-cellulose (%)</td>
</tr>
<tr>
<td>Circle Valley</td>
<td>Total</td>
<td>69.5</td>
<td>9.9</td>
</tr>
<tr>
<td>Paraggio</td>
<td>Plant</td>
<td>63.1</td>
<td>13.8</td>
</tr>
<tr>
<td>Serena</td>
<td>Plant</td>
<td>68.0</td>
<td>10.1</td>
</tr>
<tr>
<td>Dalkeith</td>
<td>Plant</td>
<td>69.5</td>
<td>11.2</td>
</tr>
</tbody>
</table>

| Circle Valley | Leaf               | 72.8          | 10.1              | 13.7          | 3.4        |
| Paraggio     | Leaf               | 75.4          | 8.6               | 13.1          | 2.9        |
| Serena       | Leaf               | 77.9          | 8.2               | 9.9           | 3.9        |

| Circle Valley | Stem               | 63.7          | 6.9               | 25.6          | 3.8        |
| Paraggio     | Stem               | 62.4          | 8.9               | 24.2          | 4.5        |
| Serena       | Stem               | 57.4          | 9.2               | 28.7          | 5.7        |

| Circle Valley | Pod                | 63.7          | 14.9              | 17.3          | 4.0        |
| Paraggio     | Pod                | 43.4          | 27.9              | 23.2          | 5.6        |
| Serena       | Pod                | 57.3          | 18.0              | -             | -          |
Figure 1: Invitro Digestibility of samples of total-plant from four different varieties of pasture legumes.

Legend
- Circle Valley
- Serena
- Paraggio
- Dalkeith
Figure 2: Percentage of nitrogen in samples of total-plant from four different varieties of pasture legumes.

Legend
- Circle Valley
- Serena
- Paraggio
- Dalkeith

Time (month)
- August
- September
- October
- November
- December
- January
- February
- March
- April

Nitrogen (%)
Chemical Analysis of Cell and Cell Wall Contents

The cell contents represent the most digestible part of the plant cell whereas the cell wall contents represent the least digestible part of the plant cell. Consequently, the higher the Neutral Detergent Soluble (NDS) value of a sample the higher its expected digestibility. Within the varieties of medic the leaves contained more NDS than the stems and pods suggesting that the leaves are the most digestible of the plant components at the time of sampling (Table 2). The stems contained a greater proportion of cellulose to hemi-cellulose than the leaves or pods. Cellulose is less digestible than hemi-cellulose so it seems likely that the stem was less digestible than the leaf or pod during mid spring.

The NDS value of the stem of Serena was lower and the lignin value was higher than for the stem of either Circle Valley or Paraggio. This result was expected because Serena, being an early maturing variety, lignifies earlier than the later maturing Circle Valley and Paraggio varieties. Paraggio pods were more highly lignified than the pods of Circle Valley or Serena and are therefore expected to be less digestible. The low digestibility of the fibre fraction of the Paraggio pod would reduce its feeding value.

In-vitro Digestibility of Total Plant Samples

The in-vitro digestibility (IVD) of all four varieties of pasture was high in early-mid spring, decreased from mid spring to late summer then slightly increased or was maintained over autumn, except for Dalkeith which continued to decline into autumn (Fig. 1). The decrease in IVD that occurred in October corresponded with the onset of wilting and thus an increase in lignification and a decrease in digestibility.

By February most of the stem and leaf material would have dried off leaving highly fibrous, and therefore poorly digestible legume pod as the main source of feed available to grazing animals over the summer/autumn period. This accounts for the decline in IVD that was observed at this time.

The IVD of Dalkeith over summer was 3-7 percentage units higher than the IVD of the other varieties. The reason for this could be that the stem of Dalkeith, which made up the bulk of the Dalkeith pasture that was available over summer, is more digestable than the leaf whereas the leaf of the medic varieties is more digestible than the stem. The low digestibility of Paraggio over the summer period is due to the fact that the Paraggio pod is more fibrous than the other varieties and therefore less digestable.

Nitrogen Content of Total Plant Samples

The percentage of nitrogen in a plant sample is an indication of its protein content (N% x 6.25 = crude protein content). The level of nitrogen in all four varieties of pasture declined in spring, was maintained in summer, then tended to decline again in autumn, except for Dalkeith in which the nitrogen content increased over autumn (Fig. 2). The decrease in nitrogen levels that occurred in spring was the result of the translocation of nitrogen out of the stem and leaf and into the pod or, more specifically, into the seed. The decrease in nitrogen content that occurred with the onset of autumn was probably due to the loss of nitrogen by leaching which occurs in response to autumn rains.

Serena appears to have the highest nitrogen content over summer while Paraggio appears to have the lowest.
Figure 3: Liveweight of sheep which were grazing four different varieties of pasture for the 1986/87 season and six different varieties of pasture for the 1987/88 season (mean of 3 reps.)
Liveweight

Throughout the spring of 1986, when both the quality and quantity of the available feed was non-limiting, there was no difference (P < 0.05) in liveweight between sheep grazing all four varieties of pasture (Fig. 3). From the beginning of summer the sheep that were grazing Circle Valley maintained the heaviest liveweight. This suggests the feeding value of Circle Valley over summer was greater than the feeding value of the other legumes. The low liveweight of sheep grazing Dalkeith over summer could be attributed to the fact that dry Dalkeith pasture had a lower content of either energy and/or protein than the other varieties since the quantity of feed was not limiting until April 1987. Sheep grazing Serena were the only sheep to lose weight with the onset of summer. This may be because Serena, being an early maturing variety, is more lignified and therefore less digestible at the beginning of summer than the other varieties of pasture legumes (Table 2).

The liveweight of all treatment groups decreased in late March in response to the reduction in pasture quality and quantity that occurs in autumn. During the autumn and winter period the liveweight of sheep grazing Circle Valley and Paraggio remained higher (P < 0.05) than the liveweight of sheep grazing Dalkeith and Serena. This suggests that the availability and/or the feeding value of Paraggio and Circle Valley was higher over this period than it was for Dalkeith and Serena.

When reallocated to the plots in September 1987, the sheep grazing the legume varieties all gained weight at a faster rate than the sheep grazing spraytopped ryegrass. Feed quantity however, soon became a limiting factor and all sheep had to be removed from the plots by early February 1988.

Table 3(a). Estimated growth of clean wool (kg/hd for each period of growth) for sheep grazing four different varieties of pasture legumes as derived from mid-side patch samples.

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Circle Valley</th>
<th>Serena</th>
<th>Paraggio</th>
<th>Dalkeith</th>
</tr>
</thead>
<tbody>
<tr>
<td>Period of wool growth</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15/8/86-2/12/86</td>
<td>2.09</td>
<td>2.11</td>
<td>1.87</td>
<td>1.93</td>
</tr>
<tr>
<td>2/12/86-5/03/87</td>
<td>1.36</td>
<td>1.12</td>
<td>1.24</td>
<td>1.05</td>
</tr>
<tr>
<td>5/03/87-26/5/87</td>
<td>0.79</td>
<td>0.71</td>
<td>0.79</td>
<td>0.53</td>
</tr>
<tr>
<td>26/5/87-13/8/87</td>
<td>0.56</td>
<td>0.51</td>
<td>0.56</td>
<td>0.38</td>
</tr>
<tr>
<td>TOTAL</td>
<td>4.80</td>
<td>4.45</td>
<td>4.46</td>
<td>3.89</td>
</tr>
</tbody>
</table>
Table 3(b). The weight of greasy fleece (mean of 3 reps (± S.D.)) and Yield (%) for twelve months growth of wool of sheep grazing four different varieties of pasture legumes.

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Greasy fleece weight (kg/ha)</th>
<th>Yield (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circle Valley</td>
<td>5.73 a (± 0.60)</td>
<td>75.17 a</td>
</tr>
<tr>
<td>Serena</td>
<td>5.52 a (± 0.73)</td>
<td>73.43 a</td>
</tr>
<tr>
<td>Paraggio</td>
<td>5.73 a (± 0.65)</td>
<td>72.20 a</td>
</tr>
<tr>
<td>Dalkeith</td>
<td>4.96 b (± 0.67)</td>
<td>73.57 a</td>
</tr>
</tbody>
</table>

N.B. Values in columns with the same subscript are not significantly different (P < 0.05).

Woolgrowth

Throughout the summer and autumn of 1986/87 sheep that were grazing Dalkeith had the lowest rate of woolgrowth while sheep that were grazing Circle Valley and Paraggio had the highest (Table 3(a)). The low level of wool production that was obtained from sheep grazing Dalkeith suggests that the feeding value of Dalkeith pasture over this period was less than that of the medic varieties. The high rate of woolgrowth of sheep grazing Paraggio suggests that the protein intake of these sheep was above maintenance. The seed of Paraggio is larger and about 10-15% 'softer' than the seed of the burr medic varieties. Consequently, it is likely that the protein in Paraggio seed was more digestible than the protein in the seed of the burr medic varieties.

Greasy wool production after 12 months growth did not differ significantly between sheep grazing the three medic cultivars (Table 3(b)). However, production from sheep grazing Dalkeith subterranean clover was significantly lower (P < 0.05). There were no significant differences in yield of wool.

Fibre Diameter

The fibre diameter of all treatment groups declined quite rapidly after late November (Fig. 4). This decline was a response to the reduction in pasture quality that occurs post-wilting and the reduction in pasture quantity that occurs in autumn. The rate of decline in fibre diameter was greater for sheep grazing Dalkeith than it was for sheep grazing the medic varieties. This suggests that the feeding value of Dalkeith pasture over the summer/autumn period is less than the feeding value of the medic varieties.
Figure 4: Fibre diameter of the wool produced by sheep which were grazing four different varieties of pasture legumes (mean of 3 reps).

Legend
- Circle Valley
- Serena
- Paraggio
- Dalkeith

Fibre diameter (microns/head/day)

Time (months from shearing)

1986 1987

Year
Figure 5: Concentration of ammonia (NH₃) in samples of rumen fluid taken from sheep which were grazing four different varieties of pasture legumes (mean of 3 reps).

Date of Sampling
Concentration of Rumen Ammonia

The concentration of rumen ammonia (NH₃) that is required for the maximal production of microbial protein is 5-10 mg/100 mL of rumen fluid (L.D. Satter and R.R. Roffler, 1977). From the results (Fig. 5) it appears that the concentration of rumen NH₃ was above optimum for sheep grazing all four varieties of pasture legumes at all times of sampling. That is, there was more NH₃ available to the animals than they could utilize. Consequently energy (ATP), which is used to remove excess NH₃ from the body in the form of urea, would have been lost from the system causing it to operate inefficiently.

It is probable that only a minimum amount of fermentable energy (carbohydrate) was available to the grazing animals over the summer/autumn period because pasture at this time is highly lignified and therefore of a low digestibility. The lower the intake of fermentable energy, the less microbial life that can be supported and the lower the conversion of NH₃ to microbial protein (a form that can be utilized by the host animal). It seems likely then that energy was limiting the efficient utilization of ingested protein from the legume pastures over this period.

The concentration of rumen NH₃ was greater (P < 0.05) in sheep grazing Paraggio in summer and early autumn than in sheep grazing the other varieties of pasture legumes. This may be because the 'in vivo' digestibility of Paraggio seed (a concentrated source of protein) was higher than the digestibility of the seed of the other varieties of legumes.

There was no correlation (P < 0.05) between the concentration of rumen NH₃ and production in terms of liveweight gain and woolgrowth.

Determination of Feed Intake in the Field

The use of capsules of slow-release chromicoxide (Cr₂O₃) was evaluated on green (September 1986) and dry (March 1987) feed. The results are not shown here, however, the technique appears to have promise.

The concurrent dosing with even chain C₂₈-C₃₂ n-alkanes (indigestible cuticular waxes on plants) enables both herbage intake and diet digestibility to be estimated in the same animal. Different plant species differ widely in their relative proportions of individual n-alkanes. Consequently it may be possible to establish the proportions of different plant species ingested by grazing animals from the pattern of n-alkanes found in the faeces relative to the pattern of n-alkanes found in the plant species in the diet (Mayes et al., 1986). Preliminary data suggests that the long chain C₃₃ alkanes are present in detectable quantities and have a low digestibility (5%) and therefore may be of some use in the determination of herbage intake in the field.
PEN FEEDING TRIAL 1

TITLE: Digestibility of new pasture legumes during the green feed phase.

INTRODUCTION: A trial, in which greed feed that was harvested in October 1986, dried and fed to animals in pens, was designed to determine the 'in vivo' digestibility of the green feed phase of *M. polymorpha* cv. Circle Valley and Serena, *M. truncatula* cv. Paraggio and *T. subterraneum* cv. Dalkeith. These species are under evaluation in a paddock grazing trial at Katanning (WA).

TRIAL DETAILS

Treatments:

<table>
<thead>
<tr>
<th>Pasture (fed as rough-cut chaff)</th>
<th>Harvest Date</th>
<th>Feeding Rate</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Circle Valley burr medic</td>
<td>7/11/1986</td>
<td>650 g/hd/day</td>
<td>11 days</td>
</tr>
<tr>
<td>2. Serena burr medic</td>
<td>10/11/1986</td>
<td>650 g/hd/day</td>
<td>11 days</td>
</tr>
<tr>
<td>3. Paraggio barrel medic</td>
<td>14/11/1986</td>
<td>650 g/hd/day</td>
<td>11 days</td>
</tr>
<tr>
<td>4. Dalkeith subterranean clover</td>
<td>20/11/1986</td>
<td>650 g/hd/day</td>
<td>11 days</td>
</tr>
</tbody>
</table>

Sheep: 16 two-year-old merino wethers were used, weighing on average 44 kg. Each sheep was housed in an individual metabolism crate in which there was a continuous supply of water.

Design: There were four replicates of each treatment (one sheep = one replicate)

MEASUREMENTS:

Feed Analysis
(1) for 'in vitro' digestibility, crude protein, ash, crude fibre, digestible energy and dry matter.
(2) for 'in vivo' digestibility of dry matter and lignin.

Faecal Analysis Collections made daily for 6 days, weighed and analysed for dry matter, crude protein and lignin.

Urine Analysis Collection made daily for 6 days, bulked and analysed for crude protein.

-16-
RESULTS AND COMMENTS:

Table 1. 'In vivo' and 'In vitro' digestibility, digestible energy (DE) and protein content of four varieties of pasture legumes which were harvested green in October 1986, dried and fed to sheep in pens.

<table>
<thead>
<tr>
<th>Variety</th>
<th>'in vivo' digestibility (%)</th>
<th>'in vitro' digestibility (%)</th>
<th>Protein content (%)</th>
<th>Digestible energy (MJ/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circle Valley</td>
<td>76.1</td>
<td>78.9</td>
<td>18.8</td>
<td>15.0</td>
</tr>
<tr>
<td>Serena</td>
<td>74.6</td>
<td>71.8</td>
<td>18.3</td>
<td>14.7</td>
</tr>
<tr>
<td>Paraggio</td>
<td>74.2</td>
<td>72.4</td>
<td>18.2</td>
<td>14.6</td>
</tr>
<tr>
<td>Dalkeith</td>
<td>73.8</td>
<td>75.7</td>
<td>14.3</td>
<td>14.0</td>
</tr>
<tr>
<td>S.E.M.</td>
<td>0.76</td>
<td>0.78</td>
<td>1.73</td>
<td>1.75</td>
</tr>
</tbody>
</table>

DE = 0.1233 (crude protein) + 0.175 (dry matter digestibility) - 0.285

The 'in vivo' digestibility of Circle Valley was slightly higher (P<0.05) than the 'in vivo' digestibility of Paraggio and Dalkeith. This is reflected in the high levels of production observed for sheep grazing Circle Valley in the grazing trial (Table 1).

The protein content of Dalkeith was lower (P<0.05) than the protein content of the medic varieties. This is also reflected in the lower levels of production that was observed for sheep grazing Dalkeith in the grazing trial.
The effect of feeding varying proportions of roughage on the digestibility of Medicago polymorpha var. brevispina cv. Circle Valley pod.

Medics have the ability to produce high protein pods that are available as feed to grazing sheep over the dry summer and autumn period. The ingestion of pod in a grazing situation usually coincides with the ingestion of dry stem and leaf material, the quality and quantity of which varies over time. This trial attempted to determine the effect of feeding varying proportions of roughage (in the form of wheaten chaff) on the digestibility of Circle Valley medic pod. It was also used to determine if whole seed output could be used to estimate the intake of pod in the field.

**Treatments:**

1. 100% Circle Valley pod
2. 66% Circle Valley pod plus 33% wheaten chaff
3. 33% Circle Valley pod plus 66% wheaten chaff
4. 100% wheaten chaff.

**Sheep:** 16 two-year-old merino wethers were used, weighing on average 45 kg. Each sheep was housed in an individual metabolism crate in which there was a continuous supply of water.

**Design:** There were four replicates of each treatment (one sheep = one replicate).

**MEASUREMENTS:**

**Pod Characteristics:** - Number seeds/pod, number of seeds/kg pod, weight of seed/kg pod, ratio seed:pod, % hardseededness.

**Feed Analysis:**

(1) 'in vitro' digestibility, crude protein, crude fibre, metabolizable energy and dry matter content of pod, seed, hull and chaff.

(2) 'in vivo' digestibility of dry matter and crude protein of treatment diets and of seed only.

**Faecal Analysis:** faeces collected daily, weighed, subsampled and analysed for dry matter, crude protein, crude fibre and content of whole seed.

**Urine Analysis:** Urine collected daily and volume measured, subsampled and analysed for crude protein.
RESULTS AND COMMENTS:

Table 1. Physical characteristics of Circle Valley pod and seed

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average number of seed/pod</td>
<td>4.3</td>
</tr>
<tr>
<td>Range of seeds/pod</td>
<td>3-6</td>
</tr>
<tr>
<td>Average number of seeds/kg burre</td>
<td>106375.68</td>
</tr>
<tr>
<td>Average weight of seed/kg burre (g)</td>
<td>420</td>
</tr>
<tr>
<td>Average ratio of seed:pod</td>
<td>42:58</td>
</tr>
<tr>
<td>Per cent hardseededness</td>
<td>95.75</td>
</tr>
<tr>
<td>Per cent seed viability</td>
<td>98.0</td>
</tr>
<tr>
<td>Average weight of 1000 seeds (g)</td>
<td>3.9</td>
</tr>
</tbody>
</table>

Table 2. 'In vitro' digestibility, content of crude protein and metabolizable energy (M.E.) of the whole pod, seed only and hull only of Circle Valley burre medic pod

<table>
<thead>
<tr>
<th>Pod Component</th>
<th>'in vitro' digestibility (%)</th>
<th>Crude protein (%)</th>
<th>Metabolizable energy (MJ/kg dry matter)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole pod</td>
<td>64.2</td>
<td>22.9</td>
<td>8.8</td>
</tr>
<tr>
<td>Seed only</td>
<td>87.4</td>
<td>40.3</td>
<td>13.1</td>
</tr>
<tr>
<td>Hull only</td>
<td>44.5</td>
<td>10.7</td>
<td>5.3</td>
</tr>
</tbody>
</table>

Table 3. 'In vivo' digestibility of four diets containing varying proportions of Circle Valley burre medic pod and wheaten chaff, and the 'in vivo' digestibility of the seed in each of those diets.

<table>
<thead>
<tr>
<th>Diet</th>
<th>'In vivo' digestibility (%)</th>
<th>'In vivo' digestibility of seed only (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100% pod</td>
<td>47.68</td>
<td>73.97</td>
</tr>
<tr>
<td>66% pod + 33% wheaten chaff</td>
<td>51.18</td>
<td>72.03</td>
</tr>
<tr>
<td>33% pod + 66% wheaten chaff</td>
<td>56.17</td>
<td>78.05</td>
</tr>
<tr>
<td>100% wheaten chaff</td>
<td>58.06</td>
<td>-</td>
</tr>
<tr>
<td>S.E.M.</td>
<td>1.54</td>
<td>3.39</td>
</tr>
<tr>
<td>LSD = 5%</td>
<td>3.77</td>
<td>8.29</td>
</tr>
</tbody>
</table>

Comments

The 33% pod diet was more digestible than the 66% and 100% pod diet (P < 0.05) (Table 3).
Feeding varying proportions of roughage to a diet of Circle Valley burr medic pod had no effect on the digestibility of the Circle Valley burr medic seed (P < 0.05). It seems likely that we will be able to use the output of whole seed as an indication of pod intake in the field because the proportion of whole seed recovered in the faeces is approximately the same irrespective of the level of roughage fed.

REFERENCES