MEAT & LIVESTOCK AUSTRALIA

On farm

Temperate Pasture Sustainability Key Program

Project number DAN.074, DAV.092, DAS.032 & DAT.016
Final Report

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Grazing Management Sites

Collectively, the four projects (DAN.074, DAV.092, DAS.O32, DAT.016), addressed the two major goals of the Temperate Pasture Sustainability Key Program:-

Goal 1a that potentially responsive perennial grass based pastures can be cost effectively upgraded through grazing management to become a 'desirable' pasture for animal productivity and sustainability; and

Goal 1b that newly sown perennial grass based pastures can be cost effectively maintained through grazing management as a 'desirable' pasture for animal productivity and sustainability.

Twenty two grazing management sites were established throughout the High Rainfall Zone (HRZ) of south eastern Australia to provide the core of the program. Because of their important role in environmental sustainability and total pasture productivity, the emphasis in the experiments was on the perennial grasses. Paddocks were selected to represent:-

- Newly sown pastures
- Degraded or run down pastures
- Native pastures

TRIAL DESIGN AND CORE TREATMENTS

The open communal trial design was used. This design was selected for simplicity and economy, as a single mob of sheep graze across all plots - the individual plots being located within a small 3-10 ha paddock. Plots were permanently fenced on three sides, and either open to communal grazing, or closed off to prevent grazing, by fencing the 4th side.

There were a set of eight core treatments imposed at all sites. Additional or local treatments were added at most sites.

The measurement area was 10m by 15m in every plot, but with buffer zones around each plot to give a maximum plot size of 15m by 20m. The 8 core treatments were:-

Treat 1 Set stocked throughout the year at a level defined in consultation with the associated producer group.

This SR was not necessarily the 'district average'. Based on limited data, it was concluded that effects on the pasture were more likely if SR was higher than the district average. The local producer group were encouraged to stock slightly higher than they would otherwise be happy with, to ensure the pasture system was under some pressure.

Treats 2-5 These were the four seasonal closures, for Winter, Spring, Summer and Autumn. Each treatment was open to communal grazing for three seasons and closed for one.

At each site, there was flexibility in the starting time for the seasons (for example, spring did not always start on Sept 1), but each season was 13 weeks. Therefore, if spring started on Sept 15, then winter automatically started on June 15 etc.

Treat 6 Increased grazing pressure in spring and communally grazed for the other three seasons.

The pasture was kept short in spring, either by set stocking using extended plots, or by frequent "rotational" grazing. To some extent this treatment was locally defined, as the height or dry matter level below which the pasture was to be kept, was determined with the producer group. The preferred level of extra grazing pressure in spring was influenced by the species present, both desirable and undesirable

Treat 7 Spring closure, with fodder conservation.

This treatment was closed to grazing at the start of spring, the same as treatment 3. The plots were then cut to approx. 5 cm as a simulated hay cut. The time of cutting was determined locally, to coincide with anthesis of the main grass species - ie, the normal time or stage for hay cutting. The forage was simply be removed from the plots, without any other effort to simulate hay making. The plots remained closed to grazing for the full spring season, irrespective of the timing of the hay cut.

Treat 8 Mob stocking (or rotational grazing) during autumn and winter, with open communal grazing during spring and summer.

As with treatment 6, the rules for this treatment were determined locally, depending on the species present and the desired changes in the pasture. Grazing (with a high stocking rate) was programmed to occur when a certain pasture height or dry matter level was reached, and continued until the animals had eaten the pasture down to the predetermined lower level. The upper and lower levels were set far enough apart so that in a 'normal' year, three or four grazings were imposed between the autumn break and the start of spring.

Local treatments were determined with the producer group and added to the core set. However, the number of local treatments was restricted to four or less.

Replication

In order to break the link between year of start, and the treatment effects, only two of the four reps had the treatments imposed in the first year. The remaining two reps were communally grazed, and had the treatments imposed for the first time, in the second year. Instead of four reps, the result was two reps by two times of start.

SITE DESCRIPTIONS AND CONTACT DETAILS

Site	Description	Contact Details
Glen Innes	Site 1 - "Lilburn" - Partially degraded Phalaris/Fescue pasture Site 2 - "Dundee" - A newly sown Cocksfoot/Fescue pasture	John Ayres Ph 067 301 900 Fx 067 301 999 Em ayresj@agric.nsw.gov.au
Tamworth	Site 1 - Degraded Phalaris/ Sub clover Site 2 - Native pastures based on wiregrass/redgrass Sites 3 and 4 - Newly sown Phalaris/ Sub clover pasture, one site grazed with cattle, the other with sheep	Greg Lodge Ph 067 631 176 Fx 067 631 222 Em lodgeg@agric.nsw.gov.au
Orange	Site 1 - ARVC, a mature Phalaris/WC pasture carried forward from DAN.28 Site 2 - "Newbridge", a degraded cocksfoot pasture, also from DAN.28 Site 3 - "Cargo", a native pasture based on *Microlaena* Site 4 - "Four Mile Creek", a newly sown Cocksfoot based pasture	David Kemp Ph 063 913 800 Fx 063 913 899 Em kempd@agric.nsw.gov.au
Canberra	Site 1 - "Hall", a native pasture based on *Danthonia* and *Microlaena*	Denys Garden Ph 06 246 5548 Fx 06 246 5255 Em denysg@pi.csiro.au
Wagga Wagga	Site 1 - "Cootamundra", a degraded Phalaris/ Sub Clover pasture Site 2 - "Cootamundra", a newly sown Phalaris/ Sub/ White Clover pasture	Jim Virgona Ph 069 381 999 Fx 069 381 809 Em virgonj@agric.nsw.gov.au
Rutherglen	Site 1 - "Springhurst", a newly sown Phalaris/ Cocksfoot pasture	Angela Avery Ph 060 304 500 Fx 060 304 600 Em averya@rri.agvic.gov.au
Hamilton	Sites 1 and 2 - "Delany's", a degraded perennial ryegrass pasture, one site grazed by sheep and the other with cattle Site 3 - "Cavendish", a newly sown Phalaris/ Perennial Rye/ Sub Clover pasture Site 4 - "Balmoral", a degraded Phalaris/ Sub Clover pasture	John Graham Ph 0355 730 900 Fx 0355 711 523 Em grahamj@hammy.agvic.gov.au

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Site	Description	Contact Details
Victor Harbor	Site 1 - "Delamere", a newly sown Perennial Rye/ Cocksfoot/ Sub pasture	Tim Prance Ph 0885 555 366 Fx 0885 555 377 Em prance.tim@pisa.gov.au
Scottsdale	Site 1 - "Ross", a degraded Perennial Ryegrass pasture	Robin Thompson Ph 0303 522 588
	Site 2 - "Parattah", a newly sown Phalaris/ P Rye/ Cocksfoot pasture	Fx 0303 523 204 In Falklands till 1999
Kings Meadow	Site 1 - "York Park", a native pasture site, never fertilised and dominated by *Themeda* and *Danthonia* Spp. Site funded by National Landcare	Doug Friend Ph 0303 365 294 Fx 0303 449 814

Summaries of the outcomes from each site follow, in the same order as in the above table.

TPSKP: Northern Tablelands Sites - "LILBURN" Phalaris /Fescue site
Carol Harris and John Ayres, Agricultural Research and Advisory Station, Glen Innes

Background Highlights

Climate: Rainfall conditions in the establishment year (1991) and follow up year were favourable. However, low rainfall conditions prevailed at the onset of the experiment (autumn 1993) and this was followed by severe and protracted autumn/winter/spring drought in 1994 and 1995. The study period encompassed a two year drought regarded as the most severe drought event experienced this century.
Stocking Rate: The experiment commenced with a stocking rate of 10 wethers/ha and allowances for spring increase. This stocking rate was too high and was reduced to 7.5 wethers/ha. During the drought in 1994, stocking rate was further reduced in consultation with the producer group. Good rain in summer 1994 and summer 1995 allowed an increase in stocking rate; the current stocking rate is 5 wethers/ha. Since spring 1993, the spring increase in stocking rate was not employed.
Animal Weight & Condition Score: Despite the drought, animal weight was maintained between 50 - 60 kg. The average weight at the end of the trial was 62kg and condition score was 3.0. Animals were maintained through the drought with supplementary feeding to prevent extreme overgrazing.
Pasture Mass: Given the drought conditions, the communal area and the control treatment were always closely grazed; pasture mass ranged between ca. 500-1800 kg DM/ha. Green biomass was low in winter (ca.10%) and high in summer (>75%).

Herbage Mass & Growth Rate Results

Herbage mass data from the exclosures closely corresponded to estimates obtained from botanal transects on the plot; values ranged from 400-1800 kg DM/ha. Pasture growth in winter was typically less than 10kg DM/ha/day and sharply negative in 1994 reflecting an intensely cold winter. Pasture growth was very low in summer 1994 (<10 kg DM/ha/day) and summer 1995 (ca.20 kg DM/ha/day) reflecting the poor growth performance of Australian phalaris during hot summers.

Botanal Results

1. Under *continuous grazing*, phalaris was dominant in cool season (aut/win/sp) performance, Danthonia was dominant in summer, but fescue (and volunteer cocksfoot) declined to trace levels.
2. Phalaris was maintained by *continuous grazing* but *year-round controlled grazing* promoted increase in phalaris presence.
3. No treatment averted the decline of fescue.

Basal Area & Frequency Results

A feature of this site during the drought was the high percentage of bare ground in all treatments; in spring 1994 there was approximately 50% bare ground. Above average rainfall in spring 1995 and summer 1996 caused an increase in basal area and seedling recruitment of phalaris and danthonia such that bare ground is currently about 3-5%. The increase in basal area of phalaris was significantly greater in the *spring rest* and the *year-round controlled grazing* treatments. The increase in basal area of danthonia in the *year-round controlled grazing* treatment was also significant.

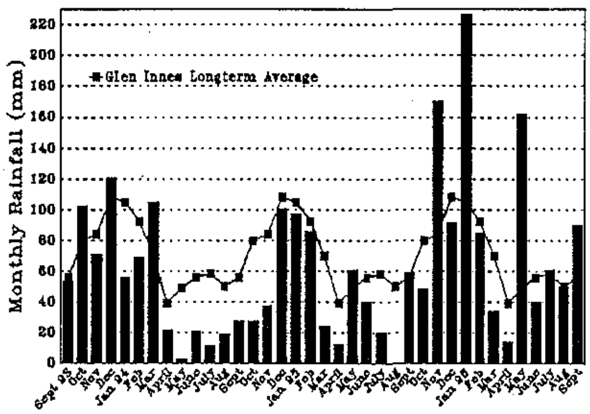
Seedling Recruitment Results

During 1994 there were very small numbers (1-2 seedlings/m^2) of phalaris seedlings, presumably due to lack of moisture. However, in 1995 after late summer rain there were moderate numbers of phalaris seedlings particularly in *spring rest* and *controlled grazing spring/summer* treatments (40 and 49 seedlings/m^2). The survival rate of these seedlings was high despite a particularly dry period in August 1995. Recruitment of danthonia at this site has been profuse, especially in 1995, with seedling counts ranging from 2790/m^2 to 6941/m^2 in the *continuous grazing* and *spring rest* treatments respectively; seedling survival of danthonia was high. Seedling counts for phalaris in 1996 were similar to 1995 with *controlled grazing spring/summer* and *year-round controlled grazing* being the best treatments; seedling survival was high. Danthonia recruitment was once again high in 1996. Conditions in autumn 1996 were favourable for white clover seedling recruitment particularly in the *controlled grazing for legumes* treatment (100 seedlings/m^2).

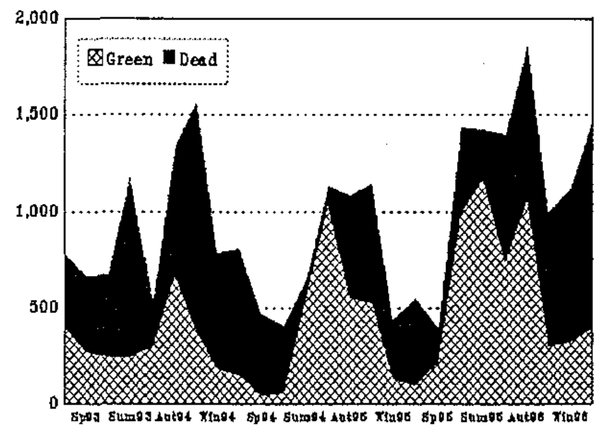
Conclusions

A balanced phalaris/danthonia sward was maintained by *continuous grazing* and phalaris presence was increased by *year-round controlled grazing*. These results confirm i) the drought tolerance of phalaris, and ii) the suitability of continuous grazing for cv. Australian. Potential benefits were conferred on phalaris performance by treatments that reduced defoliation in spring and summer; *spring rest* and *year-round controlled grazing* increased basal cover, while *spring rest, controlled grazing spring/summer* and *year-round controlled grazing* also increased seedling recruitment. These results are consistent with the literature which shows that strategic grazing in spring and summer to protect vegetative buds enhances summer survival of phalaris and increases autumn performance.

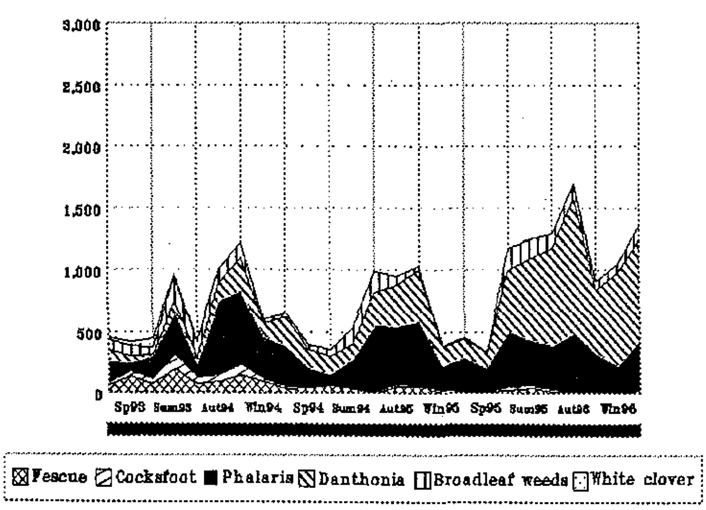
Monthly Rainfall: Sept 93 - Sept 96



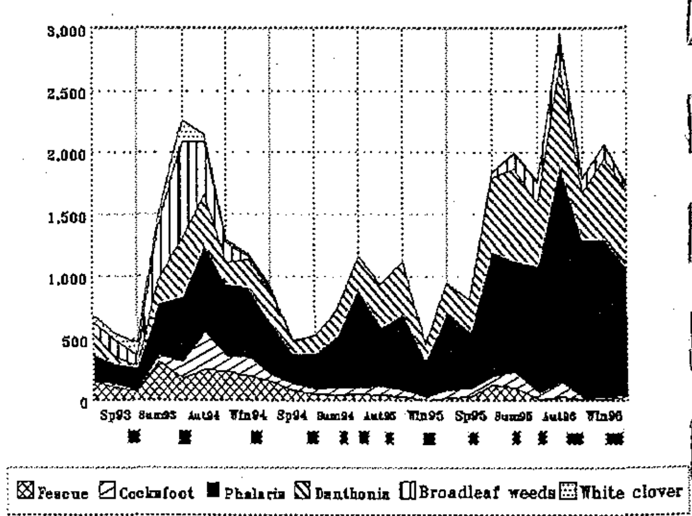
Herbage Mass - Continuous grazing treatment



BOTANAL: CONTINUOUS GRAZING



BOTANAL: YEAR-ROUND CONTROLLED GRAZING



TPSKP: Northern Tablelands Sites - "DUNDEE" Cocksfoot/Fescue site

Carol Harris and John Ayres, Agricultural Research & Advisory Station, Glen Innes

Background Highlights

Climate: Rainfall conditions in the establishment year (1991) and follow-up year were favourable. However, low rainfall conditions prevailed at the outset of the experiment (autumn 1993) and this was followed by severe and protracted autumn/winter/spring drought in 1994 and 1995. The study period encompassed a two year drought that is regarded as the most severe drought event experienced this century.

Stocking Rate: The experiment commenced with a stocking rate of 7.5 wethers/ha and allowances for spring increase. During the drought, the stocking rate was progressively reduced to 1.4 wethers/ha in consultation with the producer group. Good rain in summer 1994/1995 allowed stocking rate to be restored to the original stocking rate of 7.5 wethers/ha. The spring increase has not been employed since the first spring.

Animal Weight & Condition Score: At the commencement of the trial, mean sheep weight was 29.2 kg and condition was poor (1.5). The animals quickly gained weight and improved in condition. Over the drought, weight fluctuated between 50 - 60 kg. At the end of the trial sheep weight was 60 kg and condition score was 3.0.

Pasture Mass: Pasture mass in the communal and control areas has ranged between 750 - 4000 kg DM/ha. Pasture was at a minimum in late spring 1994 (250 kg DM/ha) and at a maximum in late autumn 1996 (ca. 4000 kg DM/ha). Green biomass was low in winter (<10%) and high in summer (ca. 75%).

Herbage Mass & Growth Rate Results

Herbage Mass data from the paired cages is consistent with the Pasture Mass data from Botanal. Pasture growth rate on the Northern Tablelands is typically <10 kg DM/ha/day over winter and about 40 kg DM/ha/day during active growth from October through May - this pattern of seasonal growth was recorded at Dundee. Negative growth rates were recorded in autumn/winter and spring of 1994 due to low soil moisture. Very high growth rates (ca. 80 kg DM/ha/day) were recorded in spring and summer in the first year in association with above average rainfall conditions.

Botanal Results

1. At the outset of the experiment and two years following establishment, the sward was dominated by sown species fescue and cocksfoot; white clover was a minor but significant component.
2. Under *continuous grazing*, one year of drought caused rapid demise of cocksfoot, fescue and white clover to trace levels and progressive invasion by crab grass, parramatta grass and broadleaf weeds.
3. Cocksfoot was retained at low levels in a number of treatments which involved resting over spring and summer, particularly *year-round controlled grazing*.
4. No treatment averted total demise of fescue
5. With the return to favourable conditions in summer and autumn 1996, a recovery of cocksfoot and white clover has been triggered. There has been a dramatic germination of white clover that was enhanced by the *summer rest* and *autumn rest* treatments. Cocksfoot has shown a trend to increase in basal area from *summer rest*, and seedling recruitment generally of cocksfoot is evident.

Basal Area & Frequency Results

Basal area of cocksfoot and fescue declined in all treatments through the drought and there was no significant difference between treatments. The autumn 1996 and spring 1996 basal area data for cocksfoot indicates a trend to recovery of cocksfoot especially in the *summer rest* and *year-round controlled grazing* treatments. Basal area of parramatta grass has increased in all treatments. Basal area of crab grass increased during the drought in 1994, but has declined in the last 12 months.

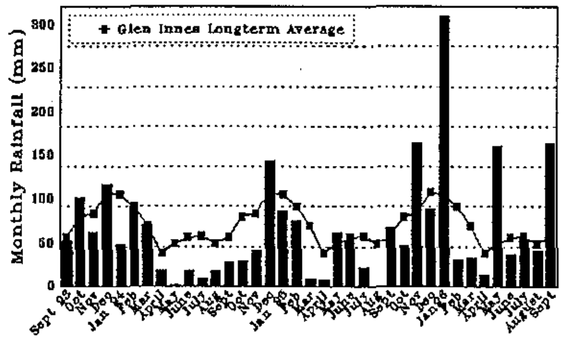
Seedling Recruitment Results

There was little or no recruitment of cocksfoot, fescue or white clover seedlings in 1994. However, in 1995, recruitment of white clover was quite high in the *spring rest* treatment (*continuous grazing*: 6 plants/m^2, *spring rest* : 225 plants/m^2). Survival rate of these seedlings was low due to a dry winter/spring. Recruitment of cocksfoot and fescue was higher than previous years but still low. The good rain and mild conditions of late summer and autumn of 1996 have been favourable for recruitment of cocksfoot, fescue and white clover.

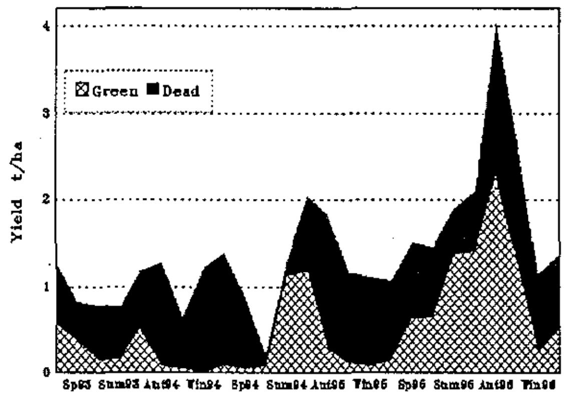
Conclusions

The only sown species to survive vegetatively through severe drought was cocksfoot, and then only at low levels when provided with a rest over spring and summer. The best treatment for cocksfoot was *year-round controlled grazing*. This is consistent with expectations suggested by the literature - carbohydrate reserves essential for recovery are maintained by reduced summer defoliation. Following favourable summer/autumn conditions in 1996, there has been a recovery of cocksfoot and white clover. Basal area expansion of cocksfoot has occurred, and germination of cocksfoot and white clover is evident.

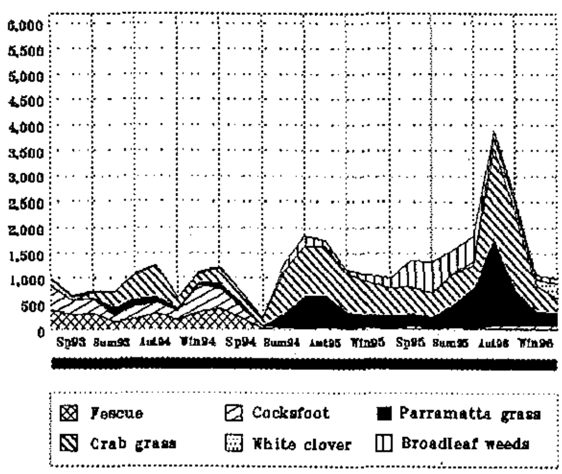
Monthly Rainfall: Sept 93 - Sept 96



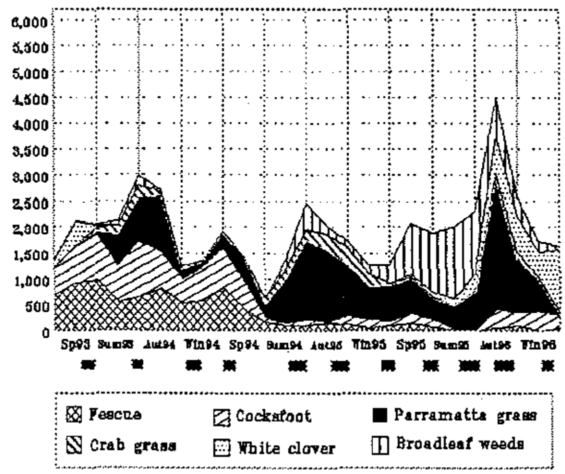
Herbage Mass - Continuous grazing treatment



BOTANAL: CONTINUOUS GRAZING



BOTANAL: YEAR-ROUND CONTROLLED GRAZING



Tamworth degraded phalaris pasture grazed by sheep

Summary: At the start of these studies in 1993 the average phalaris density of this 14 year-old Sirosa phalaris-Seaton Park subterranean clover pasture was 9 plants per m^2. This density was maintained in the extended spring and autumn closures, but declined to less than 1 plant per m^2 in continuously grazed plots. These differences were reflected in the pasture composition of phalaris in both its dry matter contribution and percent frequency in the pasture. Clearly, from this study the seasonal resting of pasture in both spring and autumn would be a simple and effective strategy that graziers could use to maintain phalaris in their sown pastures.

Seasonal conditions and stocking rate

The experimental site was severely droughted (Fig. 1b) from autumn 1994 to autumn 1996, with rainfall being below average in most months. Initially, the experimental area was grazed at 20 sheep per hectare in spring 1993 (Fig. 1c), but this was reduced to 6 sheep per hectare in autumn 1994. With dry conditions stocking rates were further reduced to 2 sheep per hectare in late-winter 1994, increasing after rain in spring 1995 to 7.4 sheep per hectare. The high proportion of dead herbage in the control plots (Fig. 1a) reflected the harsh seasonal conditions, with green herbage of mainly annual grasses and legumes increasing with rainfall in summer 1995 and autumn-winter 1996.

Percent composition, dry matter yield and frequency

Phalaris composition (percent dry weight) and dry matter yield (Fig. 2) was highest over time in the spring-autumn closures. In the controls, phalaris composition declined from 60 to 2%, while in the spring-autumn closure it declined from 60 to 40 %.

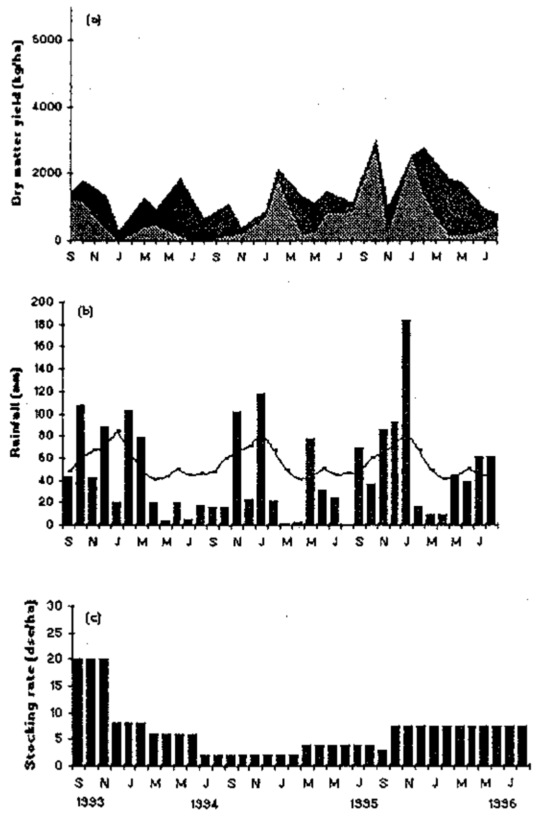


Figure 1. *(a) dry matter yield (kg/ha) in the control plots for green (light shade) and dead (dark shade) herbage, (b) actual and average monthly rainfall, and, (c) the monthly stocking rate (head/ha) from 1993 to 1996.*

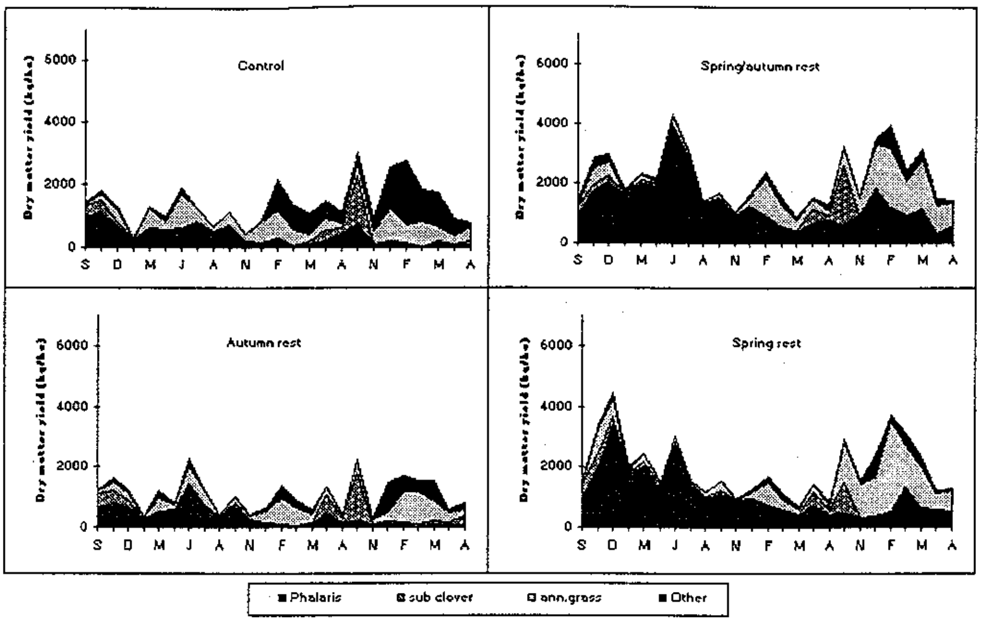


Figure 2.. *Dry matter yield (kg/ha) of phalaris, subterranean clover, annual grass and other herbage in continuously grazed control plots and spring, autumn, and spring-autumn closures.*

At the end of these studies in winter 1996 phalaris contributed less than 2% of the total dry matter (13 kg/ha in a total of 800 kg/ha), compared with 38% in the spring autumn closures (540 kg/ha in a total of 1420 kg/ha). These differences were also reflected in the phalaris frequency and basal cover data (Fig. 3), with phalaris frequency at the end of the study being 5% in continuously grazed controls and 54% in the spring-autumn closures. Therefore at the end of these studies, phalaris was a major pasture component in the spring autumn closures, but only a minor component in the continuously grazed controls.

No phalaris seedlings successfully established in any treatment. Since there was no recruitment of new seedlings all of the differences recorded, reflect the effects of seasonal grazing strategies on either the plants present at the start of these studies or any new vegetative buds that may have developed.

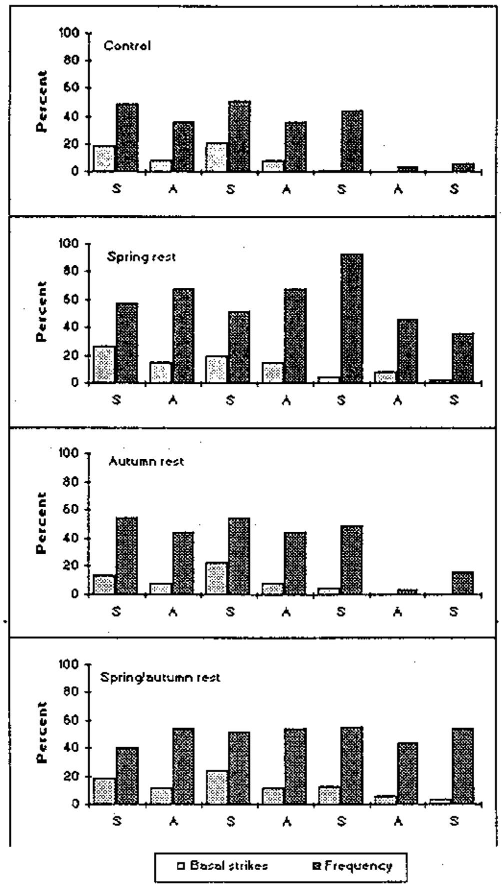


Figure 3. *Frequency and basal strikes of phalaris in control, spring, autumn, and spring-autumn closures.*

Tamworth degraded native pasture grazed by sheep

Summary: At the start of these studies in 1993 the native pasture was dominated by wiregrass (47%, dry-weight composition) and redgrass (29%). With dry conditions and a high stocking rate of 5 sheep per hectare, compared with the district average, wiregrass decreased to 34% of species composition and redgrass increased to 48%. In treatments designed to control wiregrass, its composition declined from 32 to 7% over 3 years. These results not only confirm the success of the wiregrass management startegy in reducing its level in pastures, but also show the resilience of these pastures under drought conditions.

Seasonal conditions and stocking rate

The experimental site was severely droughted (Fig. 1b) from autumn 1994 to autumn 1996, with rainfall being below average in most months. Initially, the experimental area was grazed at 5 sheep per hectare in spring 1993 (Fig. 1c). This stocking rate was maintained until autumn 1995 when it was decreased to 2.6 sheep per hectare. After rain in spring 1995 autumn 1996 stocking rates were increased to the initial level of 5 sheep per hectare. The high proportion of dead herbage in the control plots (Fig. 1a) reflected the harsh seasonal conditions, with green herbage of mainly annual grasses and legumes increasing with rainfall in winter and spring of most years.

Percent composition, dry matter yield and frequency

In the controls, wiregrass composition declined from 47 to 34%, while redgrass increased from 29 to 48%. In treatments designed to reduce the prescence of wiregrass, its dry-weight composition decreased from 32 to 7%. However, with heavy grazing and dry conditions the proportion of wiregrass declined in all treatments (Fig. 2).

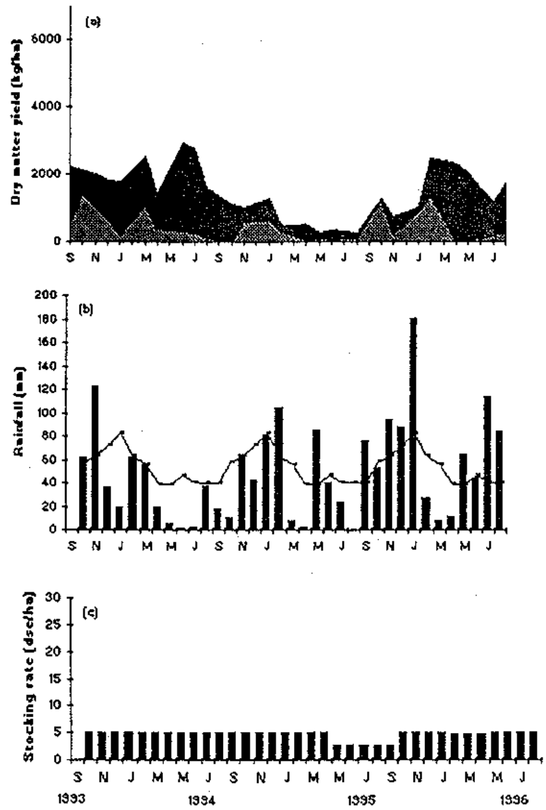


Figure 1. *(a) dry matter yield (kg/ha) in the control plots for green (light shade) and dead (dark shade) herbage, (b) actual and average monthly rainfall, and, (c) the monthly stocking rate (head/ha) from 1993 to 1996.*

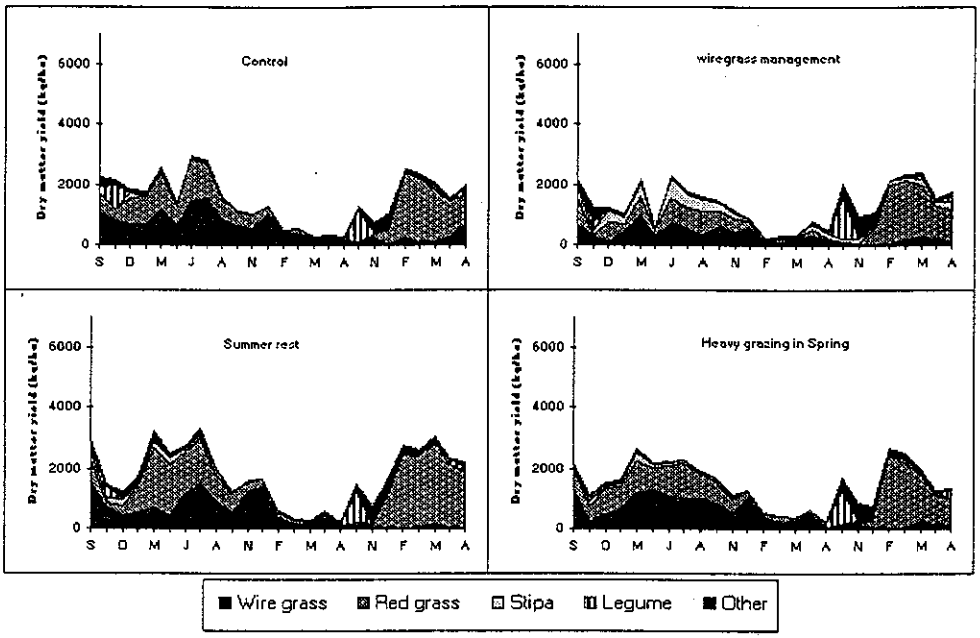


Figure 2. *Dry matter yield (kg/ha) of wiregrass, redgrass, stipa, annual legume and other herbage in continuously grazed control, wiregrass management, summer closure and heavily grazed in spring plots.*

These differences were also reflected in the frequency and basal cover data (Fig. 3), with the frequency wiregrass at the end of the study being 5% and redgrass 93%, in continuously grazed controls.

The outstanding result from these studies was the ability of the pasture to carry stock through the drought at a stocking rate higher than district average. This was attributed to (i) the high proportion of dead material at the start of the study that was able to act as a "standing hay crop in the paddock", and (ii) the ability of closely grazed redgrass plants to rapidly respond to summer rainfall and produce quantities of green leaf.

No seedling recruitment was recorded in these studies.

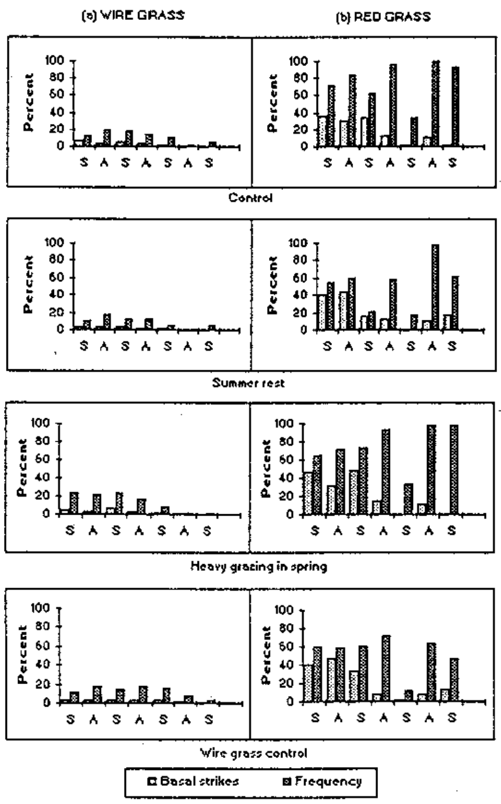


Figure 3. *Frequency and basal strikes of wiregrass and redgrass in contrasting treatments.*

Tamworth newly-sown phalaris site grazed by cattle

Summary: In this 3 year-old Sirosa phalaris-Seaton Park subterranean clover pasture, an extended spring-autumn closure increased phalaris dry weight composition by 21% and increased its frequency by 24%, compared with continuously grazed control plots. These results strongly indicate the benefit of seasonal resting of pasture in both spring and autumn compared with the other strategies examined. Seasonal rests at these times of the year, applied every 3-5 years, would be a simple and effective strategy that graziers could use to maintain the phalaris content of sown pastures in summer rainfall areas.

Seasonal conditions and stocking rate

The experimental site was severely droughted (Fig. 1b) from autumn 1994 to autumn 1996, with rainfall being below average in most months. Initially, the experimental area was grazed at 19 dry sheep equivalents (dses) per hectare in spring 1993 (Fig. 1c). Throughout the experimental period stocking rate fluctuated with feed availability, ranging from zero to 29 dses per hectare, with the average stocking rate being higher than in the sheep plots. The high proportion of dead herbage in the control plots (Fig. 1a) reflected the harsh seasonal conditions, with green herbage of mainly annual grasses and legumes increasing with rainfall in summer 1995 and autumn-winter 1996.

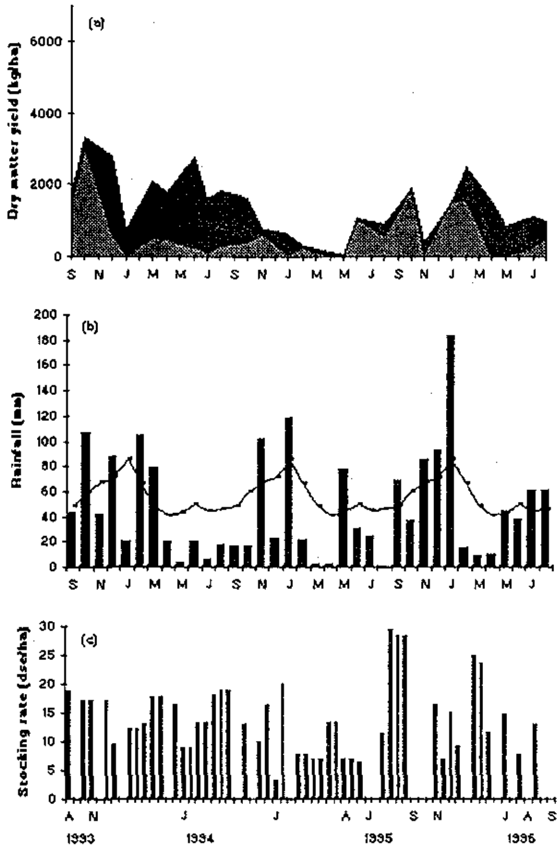


Figure 1. *(a) dry matter yield (kg/ha) in the control plots for green (light shade) and dead (dark shade) herbage, (b) actual and average monthly rainfall, and, (c) the monthly stocking rate (dses/ha) from 1993 to 1996.*

Percent composition, dry matter yield and frequency

Phalaris composition (percent dry weight) and dry matter yield (Fig. 2) was generally highest over time in the spring-autumn closures. In the controls, phalaris composition was maintained at around 15%, while in the spring-autumn closure it increased from 12 to 33 %.

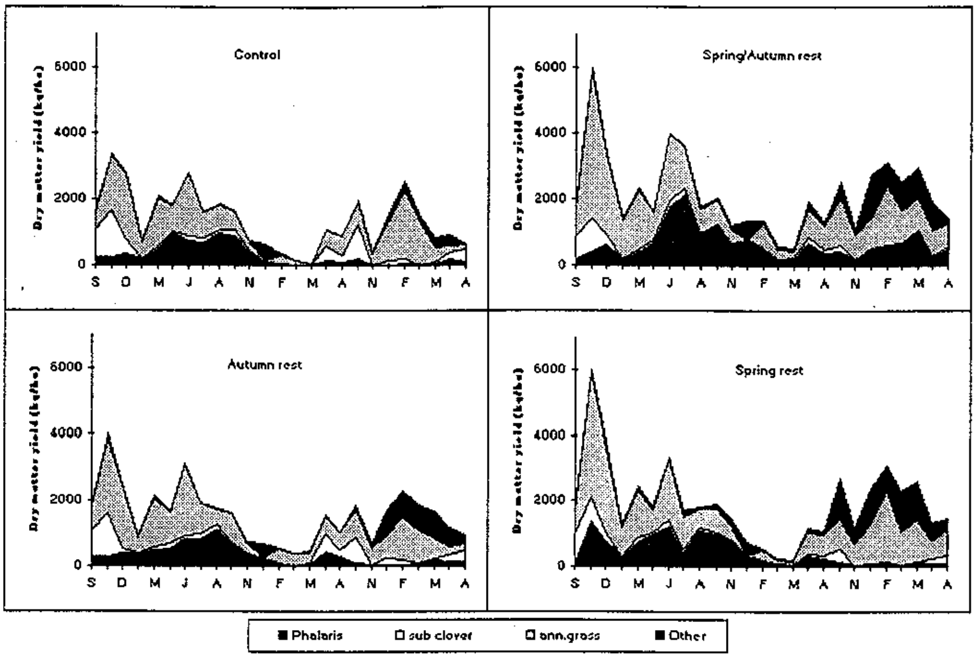


Figure 2. . *Dry matter yield (kg/ha) of phalaris, subterranean clover, annual grass and other herbage in continuously grazed control plots and spring, autumn, and spring-autumn closures.*

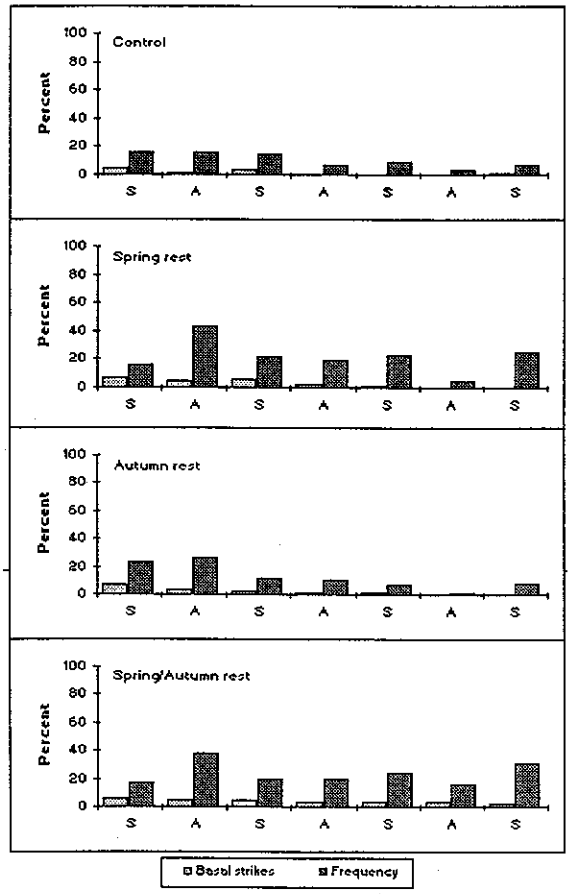


Figure 3. *Frequency and basal strikes of phalaris in control, spring, autumn, and spring-autumn closures.*

Statistical analyses of the linear trends of the effects of grazing treatments over time, showed that compared with the control the only treatment to significantly increase phalaris composition (on a dry-weight basis) was the spring-autumn closure (T-value=3.08). These differences were also markedly reflected in the phalaris frequency and basal cover data (Fig. 3), with phalaris frequency at the end of the study being 7% in continuously grazed controls and 31% in the spring-autumn closures. Therefore at the end of these studies, phalaris was a major pasture component in the spring-autumn closures, but only a relatively minor component in the continuously grazed controls.

No phalaris seedlings successfully established in any treatment. Since there was no recruitment of new seedlings, all of the differences recorded reflect the effects of seasonal grazing strategies on the either the plants present at the start of these studies or any new vegetative buds that may have developed.

Tamworth newly sown phalaris pasture grazed by sheep

Summary: In 1993, at the start of these studies average frequency of phalaris in this 3year-old Sirosa phalaris-Seaton Park subterranean clover pasture was 22%. After 3 years of grazing its frequency in the extended spring-autumn closures was 58%, compared with 21% in the continuously grazed plots. These differences were also reflected in pasture composition as measured by the dry matter yield contribution of phalaris. From this study the seasonal resting of pasture in both spring and autumn was shown to be a simple and effective strategy that graziers could use to maintain phalaris in sown pastures.

Seasonal conditions and stocking rate

The experimental site was severely droughted (Fig. 1b) from autumn 1994 to autumn 1996, with rainfall being below average in most months. Initially, the experimental area was grazed at 25 sheep per hectare in spring 1993 (Fig. 1c), but this was reduced to 8 sheep per hectare in autumn 1994. With dry conditions stocking rates were further reduced to 2 sheep per hectare in winter 1994, increasing after rain in summer 1996 to 7.1 sheep per hectare. The high proportion of dead herbage in the control plots (Fig. 1a) reflected the harsh seasonal conditions, with green herbage of mainly annual grasses and legumes increasing with rainfall in summer 1995 and autumn-winter 1996.

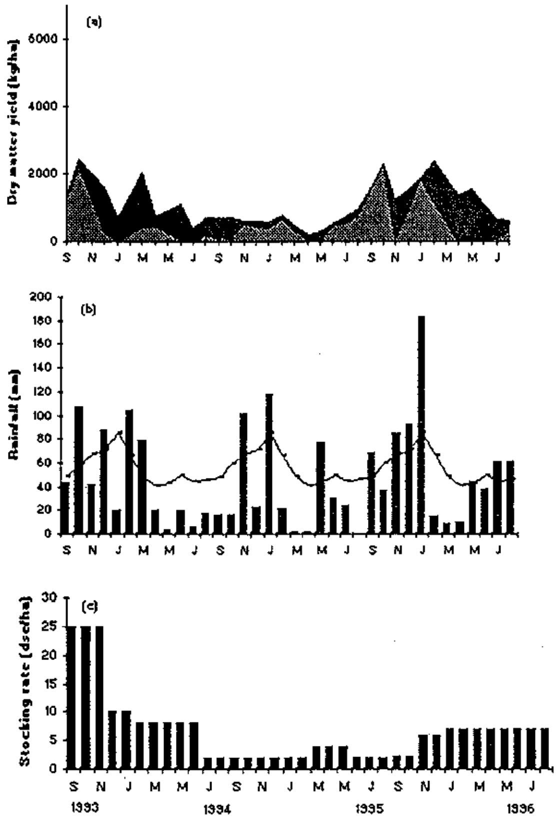


Figure 1. *(a) dry matter yield (kg/ha) in the control plots for green (light shade) and dead (dark shade) herbage, (b) actual and average monthly rainfall, and, (c) the monthly stocking rate (head/ha) from 1993 to 1996.*

Percent composition, dry matter yield and frequency

In the controls, phalaris plant frequency was maintained at about 20%, while in the spring-autumn closure it increased to 58%. Phalaris composition (percent dry weight) and dry matter yield (Fig. 2) was highest over time in the spring-autumn closures.

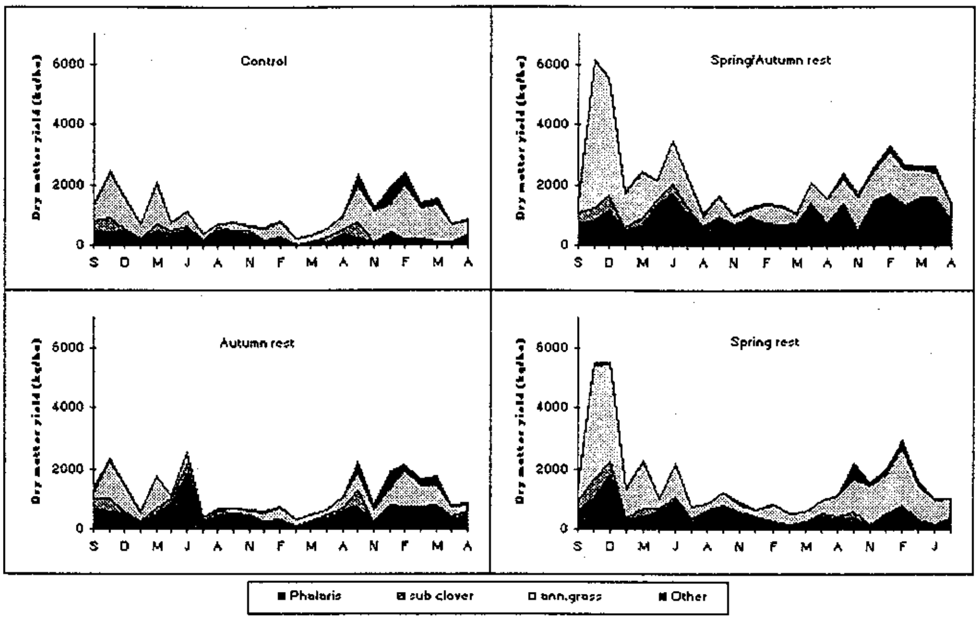


Figure 2. *Dry matter yield (kg/ha) of phalaris, subterranean clover, annual grass and other herbage in continuously grazed control plots and spring, autumn, and spring-autumn closures.*

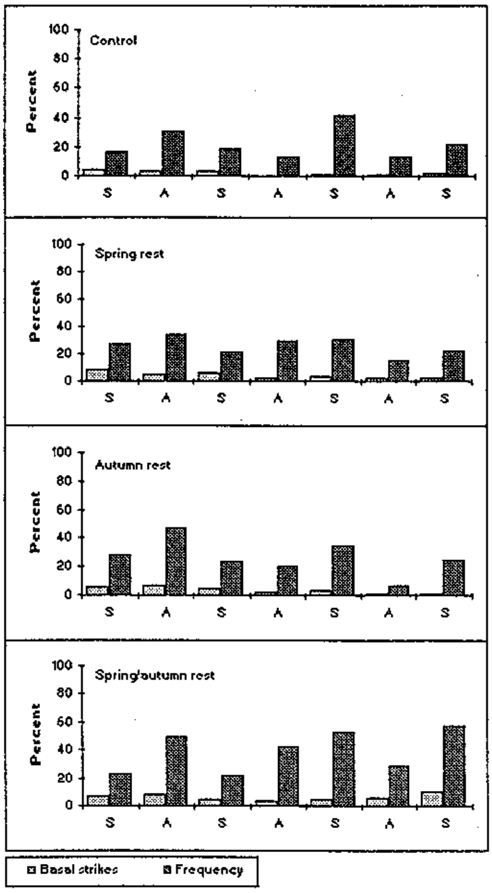


Figure 3. *Frequency and basal strikes of phalaris in control, spring, autumn, and spring-autumn closures.*

Statistical analyses of the linear trends of the effects of grazing treatments over time, showed that compared with the control the only treatment to significantly increase phalaris composition (on a dry-weight basis) was the spring-autumn closure (T-value=3.94). These differences were also reflected in the phalaris frequency and basal cover data (Fig. 3), with phalaris frequency at the end of the study being 21% in continuously grazed controls and 58% in the spring-autumn closures. Therefore at the end of these studies, phalaris was a major pasture component in the spring-autumn closures, compared with the continuously grazed controls.

No phalaris seedlings successfully established in any treatment. Since there was no recruitment of new seedlings all of the differences recorded, reflect the effects of seasonal grazing strategies on the either the plants present at the start of these studies or any new vegetative buds that may have developed.

ORANGE (ARVC) - well established phalaris based pasture

The major feature at this very favourable site has been the ability to limit phalaris dominance by increasing grazing pressure in spring (*Spring short*). This has allowed legumes the opportunity to represent up to 30% of the pasture at times in this treatment. However during the three years of TPSKP, the trends in all treatments have been similar and Phalaris has been maintained at similar levels across treatments. Both white and sub clovers have been retained in all treatments at less than 10%. Summer rest has favoured annual grass (*Bromus* spp), whereas herbicide has allowed increased forbs (broadleaf weeds) at the expense of the annual grass.

This site was established in 1989 on a highly productive soil. Total Feed on Offer (FOO) declined during the past three years from around 5t/ha overall to 1.5t/ha. Peak FOO was during 1992 through 1993. The droughts of 1991 and 1996 resulted in a similar reduction in total FOO.

Phalaris

Phalaris has increased during the past seven years on a composition basis (%) across the site to 1993 where it has tended to level out at 60% in the early spring assessments, or 1t/ha on a FOO basis.

The continuously grazed plots have increased at a faster rate than other treatments, which may reflect an inability of sheep to *keep on top* of pasture mass during rapid spring growth. This was in contrast to the *Spring short* and *Herbicide* treatments where phalaris was restricted.

Legume

The drought periods favoured subclover over white clover. However because of the mix of annual and perennial clovers, legumes were maintained throughout the trial, albeit at low levels at times. The dry periods enabled subclover to represent up to 60% of the pasture in 1991.

Annual grass

The major species has been *Bromus* which has increased markedly in the *Summer rest. Winter rest* and *Herbicide* have limited development of annual grass.

A major feature of this site has been the increase in cocksfoot where pasture was rested over summer, which was further enhanced where recommended rates of fertiliser were applied. This clearly indicates that more than one pasture management strategy may be required to gain full advantage of increased management practices. The use of recommended fertiliser rates was also associated with an increase in soft brome in all treatments, an improvement when compared to the high levels of *Vulpia* in plots without fertiliser. Facilitating positive botanical change over time by allowing rests from grazing under enhanced fertility conditions was achieved.

This experiment was established in 1990 and it was incorporated into TPSKP in 1993.

Cocksfoot represented 6% of the pasture in 1990, *Vulpia* 26%, soft brome 2% and subclover 38%. The grazier was considering resowing with the aim of increasing the perennial grass component. Two fertiliser treatments (base and recommended rates) were combined factorially with *Control, Autumn, Winter & Summer rest* treatments and also an annual grass *Herbicide* treatment.

Mean FOO for the first three years (1990-1993) was 1000kg/ha which increased to approximately 2000kg/ha for the remaining three years. This increase in FOO was largely in response to a reduced stocking rate from 14dse/ha for 1990-1993 to 10dse/ha for 1993-1996.

Cocksfoot

The *Summer rest + recommended fertiliser* treatment resulted in a cocksfoot proportion by spring 1996 of 34% in comparison with 24% in the *control + recommended fertiliser*, 13% in *Summer rest + basal fertiliser* and 1% in the *control + basal fertiliser*. The *Herbicide* treatment was oversown with cocksfoot seed in 1993 with successful establishment of plants allowing cocksfoot to represent 28% of the pasture in these plots. The proportion of cocksfoot in the *Winter rest* plots was similar to the *control* whereas cocksfoot tended to be disadvantaged by the *Autumn rest.*

Vulpia & Brome

There has generally been a reduction over time of *Vulpia* and an increase in soft brome where fertiliser was applied at the recommended rate. Reduction in the portion of *Vulpia* was more evident in *Summer rest + recommended fertiliser*.

Subclover

Subclover proportions started at approximately 40% for all treatments and varied over time with seasonal conditions. By spring of 1996 there was a reduction in subclover in *summer rest* (both the *basal & recommended fertiliser*) treatments in comparison with the other treatments. *Recommended fertiliser* treatments were all lower in the proportion of subclover than where *basal fertiliser* was applied.

This emphases that a number of tactics (rests &/or fertiliser) may be necessary to induce a positive change in more than one species.

In this environment both *Danthonia & Microlaena* have increased as a proportion of the pasture at the expense of Vulpia where some grazing management strategies have been utilised. A number of treatments have shown differences at this site in comparison with the control. It is particularly notable that what is understood to be common commercial practice (continuous grazing) favours *Vulpia* in the Cargo environment. Rest at any time favoured *Microlaena.* Where seasons were higher in rainfall (1993) extra grazing pressure favoured sub clover.

Danthonia & Microlaena are the major native grasses of interest and *Vulpia* the invading grass weed. The site was initially understocked at 3.7 dse/ha but this was adjusted up to 6.2 after 2 months and to 7.3 dse/ha in December 1993. This stocking rate was maintained through the remainder of the TPSKP.

Total FOO was initially around 2500kg/ha which increased to a mean of 2700 kg/ha across all treatments in spring 1993. This FOO quantity was maintained for the first 18 months and fell over a six month period to 1500kg/ha for most of the last 12 months for both *year 1 & year 2 starts* .

Microlaena

Microlaena has increased as a proportion of the pasture from 25% in Spring 93 to 45% in Spring 96. This increase has tended to be either neutral or higher (particularly *TCG),* in all treatments in comparison with the control. Thus rest at any time has not disadvantaged *Microlaena,* nor has extra grazing pressure for brief periods.

Any observed differences were less pronounced in the *year 2 start* treatments than in the *year 1 start.* The *Spring rest* in 1996 (both *year 1 & 2 starts)* was particularly favourable to *Microlaena.*

Danthonia

Danthonia has also tended to increase across the site over time at a lower rate than *Microlaena* from a mean of 20% in 1993 to 25% in Spring 96. With the *year 1 starts* the treatments with increased fodder removal in spring (*Spring short, Fodder* and *Best bet*) favoured *Danthonia.* This response was not obvious with the *year 2 starts.* This suggests that in the better spring of 1993 where growth rates of the pasture were high, increased removal of foliage gave the *Danthonia* an advantage.

Vulpia

The overall mean of *Vulpia* was 20%. All treatments tended to have a decrease in *Vulpia (*for both *year 1 & year 2 starts)* in comparison with the control, particularly the *Fodder* treatment.

Subclover

There was a relatively low level (5%) of legume across the trial. The *Fodder year 1* treatment initially resulted in a large increase in the proportion of legume in these plots but this was negated over time. *Spring short year 1* was advantageous to subclover. All treatments in the *year 1 starts* that have had an increased grazing pressure during the trial have tended to have an associated increase in the level of legume in comparison with the control.

ORANGE - FOUR MILE CREEK - newly sown cocksfoot

A feature of this site has been the ability of cocksfoot to survive where stocking rates have been appropriately adjusted and minimum FOO levels maintained. This has meant that pressure was inadequate to bring about major changes between treatments. A conservative stocking rate during the drought allowed livestock the opportunity to adequately feed on the small amount of green material without aggressively attacking plant bases, thus plant death was low. The general results support the concept of management within an 'envelope' where the lower boundary for forage on offer is 1 t DM/ha.

The site was sown 18 months prior to the start of TPSKP, cocksfoot was the dominant species in spring >93. There was also a high proportion (40%) of annual ryegrass in the form of dead, but standing material carried through from the previous season.

The site has been affected by the dry conditions and, to protect the pasture, the management committee reduced stocking rates from 10.1 dse / ha in Sept 93 to 5.3 in June 94 to 2.7 in March 95 with an increase to 4.9 in January 96. Consequently the total forage-on-offer (FOO) has been maintained above 1000kg/ha, mostly around 2000kg/ha. This has largely been dry material.

The *Spring rest* and *Fodder year 1 start* treatments built up a reservoir of FOO in the first spring which resulted in a generally higher FOO compared to the control (continuously grazed) during the experiment, but by spring 1996 FOO was similar in all treatments.

Cocksfoot

Despite the drought, cocksfoot has been retained with a mean across all treatments and all harvests of 80% of the pasture.

Spring/Autumn rest - year 2 start was the only treatment to result in a significant decrease in cocksfoot on a composition (%) basis. On a yield basis (kg/ha) Cocksfoot decreased in *Spring/Autumn rest* and *Fodder* in both *year 1 & 2 starts, Spring rest year 1*. From the *year 2 starts, Autumn, Winter, Mob Autumn / Winter* and *Time controlled grazing* (TCG) favoured cocksfoot compared to the control. These four treatments were no different to the control in the *year 1 starts*.

Phalaris

Phalaris was sown with the pasture mix but has occupied less then 5% of the pasture as a mean across all treatments and all harvests. Individually plants have generally been poorly developed which indicates a problem for phalaris in this paddock.

In comparison to the control, *Summer rest year 1 & 2 starts* has favoured phalaris, whereas *Spring rests* have been a disadvantage. *Fodder year 1 start* disadvantaged phalaris but the *Fodder year 2 start* favoured phalaris.

The build up of FOO in treatments with a *Spring rest year 1 start* has meant that several species represented in this pasture in these treatments have started from a higher plateau in terms of FOO than the control. This in turn has meant that both cocksfoot and phalaris have had Afurther to fall@, thus the rate of decline in FOO from spring 1993 to spring 1996 has been higher in these treatments than in the control. We need to be aware of this in interpreting the data.

Annual ryegrass

The proportion of annual ryegrass decreased over all plots from 1993 to 1996 as the overburden of dead standing material was dispersed. There were new germination's during TPSKP but these plants tended not to develop fully.

Subclover

Seedlings of subclover germinated but like the annual ryegrass seedlings tended not to develop well. All treatments from the *year 1 start* tended to have a decline in both proportion and yield in comparison to the control in subclover. In contrast the *year 2 start* treatments tended to have an increase in subclover compared to the control. This suggests that the more favourable seasons during the first 12 months allowed grass species to out-compete subclover where rests in any season were used. One factor which may have been of importance in the *year 1 starts* is shading.

Temperate Pastures Sustainability Key Program
Final Report on Canberra Grazing Management Site
October 1996

D.L. Garden, NSW Agriculture, PO Box 1600, Canberra, ACT 2601

The pasture at the Canberra site is typical of the better natural pastures on the Southern Tablelands of NSW. It is dominated by native grasses (eg *Danthonia* spp., *Microlaena stipoides, Elymus scaber*) but also contains naturalised grasses (eg *Vulpia* spp., *Bromus* spp.), some legumes (eg *Trifolium subterraneum, T. glomeratum*) and native and naturalised forbs. The area has been grazed by sheep and cattle for many years and, although it had received limited fertiliser over that time, it had never been cultivated and sown. The soil is acid (pH_{CaCl2} 4.2) and low in available phosphorus (Bray P 5.4ppm). Altitude of the site is 690m and annual rainfall 650mm.

Previous stocking was sheep and cattle at approximately 5 dse/ha. The base experimental stocking rate was 6 wethers/ha, increasing to 10 wethers/ha in spring. In addition to the eight core treatments, local treatments of high intensity-short duration grazing (HISD) at 200 and 500 wethers/ha, and oversown *Microlaena* seed were used.

Impact of season

Following an excellent spring in 1993, rainfall in 1994 was below average. Stocking rates were maintained as planned except for mid-spring 1994 to mid-summer 1995, when the base rate was reduced to 2/ha following a request by the property owner. The normal increase from 6 to 10/ha was not carried out in spring 1994, and the Spring High Stocking Rate treatment was not applied. Spring 1995 was an exceptional one and there was massive growth of clover (mainly naturalised clover) which persisted into early summer. Winter and early Spring 1996 were cold and wet.

Experimental Results

<u>Animal performance and pasture quality</u>
Apart from losses during dry periods, fleece-free weights of wethers have increased from 45 to 65 kg over the experiment Individual animals have reached weights of over 80kg with condition score 5. Crude protein of green pasture varied from 8 to 22% and digestibility from 50-78%. However, care is needed in interpretation of these data as all species are included in the sample. At each sampling we have kept estimates of the species mix of the quality samples and they do vary widely from sampling to sampling. Samples in spring 1995 contained significant amounts of clover.

<u>Botanical composition</u>
Data suggest that seasonal changes were mainly caused by changes in legume, annual grasses and weeds. However, the species most affected by treatment was Yorkshire fog, which increased in the Spring Rest treatment, particularly in the wet springs of 1995 and 1996. This shows the disadvantage of resting a pasture like this during a very good spring. The increase in Yorkshire fog dominated the other components at these times (ie *Danthonia* and Legume appear to have decreased). However, the effects on *Danthonia* appear to be marginal at best and *Microlaena* was not affected by any treatment. Thus, it appears that the perennial grasses are stable components, with the major variation occurring in annual species depending on season. In spring 1995, there was massive growth of naturalised legumes, which dominated the Botanal results.

However, the situation gradually reverted to normal as the legumes disappeared over summer/autumn.

Frequency and Basal area

Frequency was stable from year to year (*Danthonia*: 75-90%, *Microlaena* 15-40%, *Elymus* 10-20%) and there did not appear to be any treatment differences. Basal area of *Danthonia* showed little difference for the first 2 years, but appeared to be much higher in 1995. If this is the case, then these pastures may be more dynamic than previously believed. There have seen large numbers of *Danthonia* seedlings recruiting, with good survival until the next winter (Table 1). However, at this stage these plants are still small, and it is not known if they eventually become established plants of larger size. There was an apparent decrease in recruitment with the HISD treatment, but whether this is sufficient to have a long-term impact on botanical composition is unknown.

Table 1. Recruitment and survival of *Danthonia* seedlings in a grazed natural pasture on the Southern Tablelands of NSW

	Seedling Recruitment (no/sq m)	Survival to following Winter (%)
1993	170-180	70
1994	60-140	85
1995	200-800	N/A

Conclusions

Resting this type of pasture in spring is not beneficial as there is a build up of dry matter which persists for a long time. Also, in wet springs, lack of grazing allows Yorkshire fog to increase. Mowing for hay has the effect of reducing carryover of spring growth into summer and, once cut, sheep tend to keep the pasture short into the following season. The HISD treatment allowed a significant increase in utilisation of pasture by sheep, and these plots were always shorter and greener than the others. However, these treatments have been difficult to apply in relation to seasonal growth pattern and herbage mass targets, and whether this system can be incorporated easily into whole-farm management is unknown.

The natural pasture used in this experiment has been relatively stable and there have been little or no effects of treatments on the proportions of perennial grasses. However, there have been seasonal changes in annual/biennial species (annual grasses, legumes, weeds). There were differences between treatments in recruitment, which may produce changes in composition beyond the term of the experiment. This suggests there is value in studying the population dynamics of native pastures over a longer period to determine likely effects of changes in management.

Extension

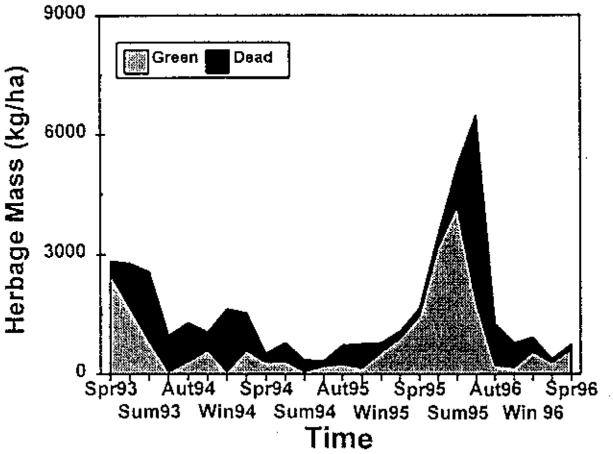
The site has been used for PROGRAZE activities and has been visted by producer and student groups. A field day organised by the Southern Tablelands Branch of NSW Grasslands Society will be held at the site in November 1996.

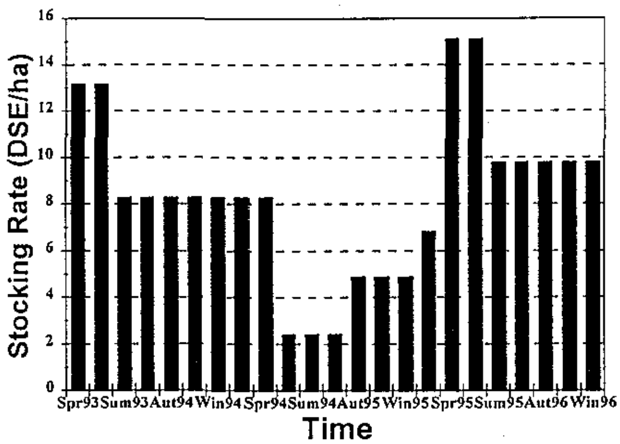
Final Report - Temperate Pasture Sustainability Key Program
Grazing Site at Cootamundra managed by NSW Agriculture from the Agricultural Research Institute by Dr Jim Virgona, Mrs Annabel Bowcher (Technical Officer) and Mr Albert Oates (Technical Assistant).

Degraded or "Old" Phalaris site

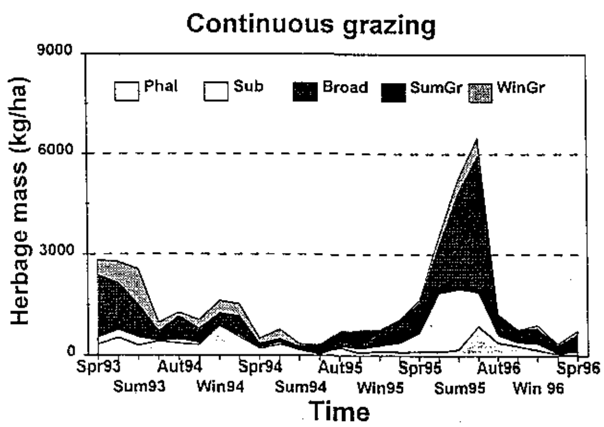
This site was dominated by annual species eg. Patterson's curse and silver grass from the outset with relatively low levels of phalaris (< 25%) and sub clover present (<8%). Availability of dry matter (green and dry) is shown in Figure 1. Together with the stocking rate data (Fig. 2), this clearly shows the large effect of the 1994 drought on standing biomass and livestock productivity. Each treatment was applied to two replicate in both years 1 and 2 of the experiment. However only the treatments applied in year 1 are considered here. Further analysis is taking place on the remaining data.

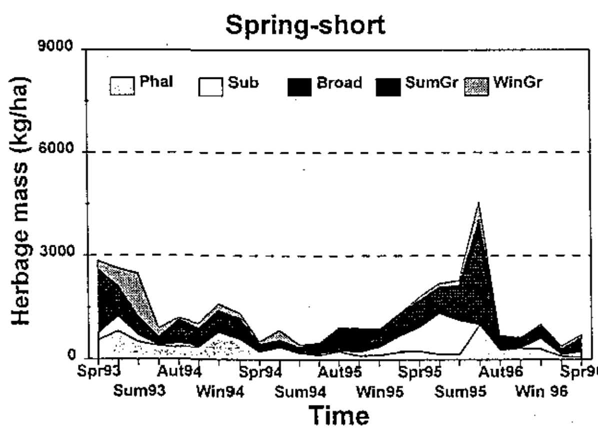
In addition to the core treatments three extra treatments were applied to examine the possibility of encouraging recruitment of phalaris in a declining stand. These were 1) herbicide + lock up for seed production and then after the break; 2) herbicide only 3) seed and post break lock-up only.

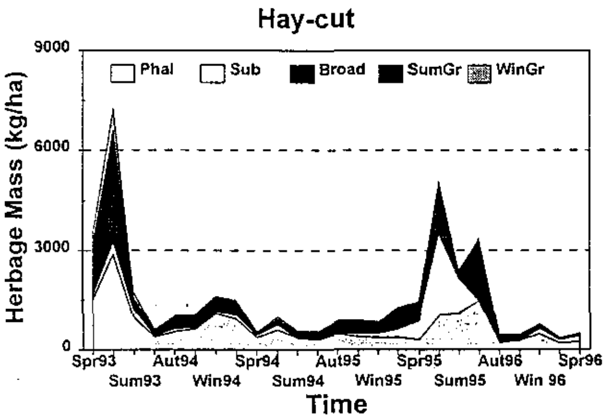


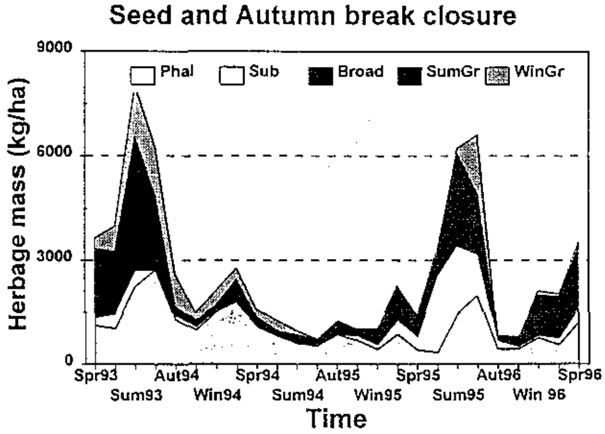


The treatments that will be compared here are the control (continuous grazing), spring-short (grazed to a low level over spring), hay-cut and the combined seed and post break lock-up (as above). Below the botanical composition of the feed on offer is presented for each of these treatments. The components shown are 'Phal' - phalaris, 'Sub', subterranean clover, 'Broad' broad leaf weeds, 'SumGr' C_4 annual and perennial grasses and 'WinGr' annual C_3 grasses.









The aim of this site was to examine grazing management strategies that would increase the contribution of phalaris, it appears that continuous grazing and the spring-short treatment actually decreased the role of phalaris. Surprisingly - given the physiological responses of phalaris to close defoliation in spring, the hay-cut treatment did not have as string an effect as the spring short treatment. The seed and autumn break lock up treatment did encourage phalaris but also the major weeds. In short none of these treatments or any of the others applied helped to boost the performance of phalaris. Nor did any of the treatments have a large effect of the production of sub clover. Only in 1995, after the drought) did sub clover production become substantial probably due to large hardseed breakdown.

A detailed study on the effects of the recruitment treatments showed why grazing strategies either with or without herbicide are unlikely to promote the recruitment of phalaris (Hill and Virgona 1995). The seed rain data for the major components are given for each of the recruitment (local) treatments and the control. While the lock-up treatments promoted seed production of phalaris there was still substantial seed production from annual grasses. In the following year there was little or no phalaris seedling found and certainly no recruitment. Ant theft was a likely cause.

Table 1. Seed numbers (m^{-2}) of major components within a phalaris-based pasture

	Phalaris (m^{-2})	Patterson's curse (m^{-2})	Silver grass (m^{-2})	Annual ryegrass (m^{-2})	Soft Brome (m^{-2})	Total Annual grasses (m^{-2})
Continuous grazing	9^{b}*	368^{b}	10439	1235^{b}	3188	14854
Herbicide + Spring-Summer lockup	4574^{a}	141^{b}	4103	6149^{a}	8252	18495
Herbicide	75^{b}	37^{b}	4169	1226^{b}	5262	10657
Spring-Summer lockup	2801^{a}	4131^{a}	12100	1037^{b}	7243	20381

*means followed by a common letter are not significantly different at p=0.05

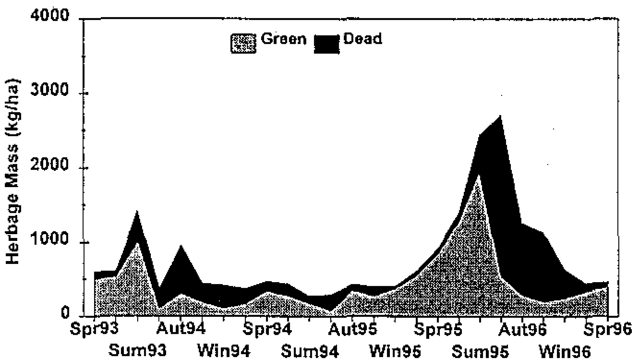
Conclusion.
The results from this site are largely negative. Grazing treatments, even when combined with herbicide, could not sustainably expand the contribution of phalaris or sub clover in this degraded stand. However, the lack of effect of spelling at some times in the year provides useful information when designing whole-farm grazing systems. There is still a good deal of analysis to be carried out especially on changes in botanical composition through time. Even so, graziers would be best advised to rip up such a pasture and start again!

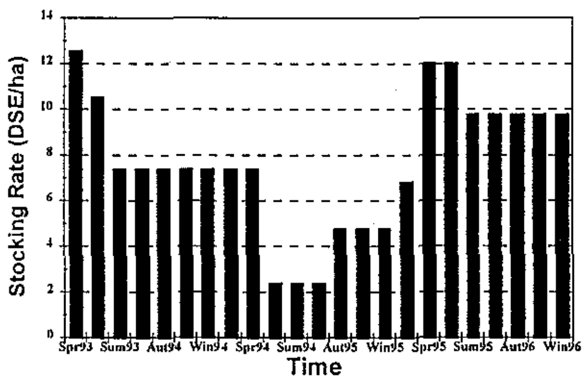
Final Report - Temperate Pasture Sustainability Key Program
Grazing Site at Cootamundra managed by NSW Agriculture from the Agricultural Research Institute by Dr Jim Virgona, Mrs Annabel Bowcher (Technical Officer) and Mr Albert Oates (Technical Assistant).

Recently sown or "New" phalaris site

This site was dominated by phalaris (50%) and white clover (25%) when the experiment commenced. In addition to the core treatments there was only one extra treatment applied at this site where the main aim was to investigate grazing management practices that would encourage the retention of phalaris in the pasture. This treatment was "rotational grazing" - a one paddock in 9 rotation was simulated with plots being grazed for 7 days in every 63. During Spring the increased stocking rate was also simulated by shortening the rest time.

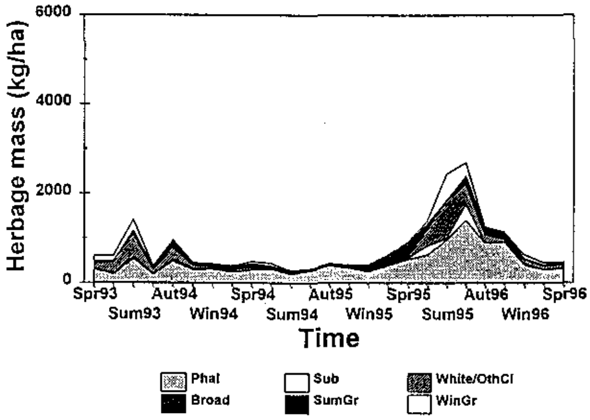
The pasture was sown in 1992 into a paddock with a long cropping history. Despite desirable botanical composition overall production was low as shown by both the level of standing feed and the stocking rate (below) over the first year. Indeed an the pasture was extremely nitrogen responsive (Virgona and Oates 1996) which indicated the low level of fertility on the site. A drought in 1994 caused large declines in pasture and livestock production. By 1995 the pasture was able to support and economically viable number of stock.



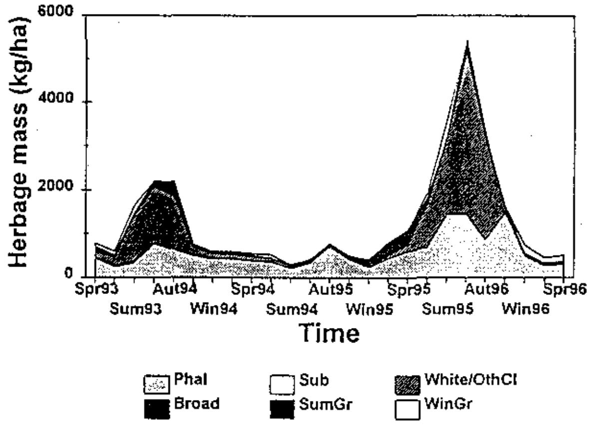


Across all treatments phalaris has always dominated the sward (see below : 'Phal' - phalaris, 'Sub' - sub clover, 'Broad' - broad leaf weeds, 'WinGr' - C_3 annual grasses, 'SumGr' - C_4 grasses, 'White/Oth clover' - white and other clovers). This was especially the case in 1995 when clover and non-sown species failed due to the drought. There was no treatment where phalaris disappeared from the sward. This may have been due to the timely reduction in stocking rate during the drought. As all treatments maintained a strong base of phalaris production the main interest has become what effects of grazing management there was on other species. The Summer rest and Autumn/Winter mob stocking treatments provide and interesting contrast. The mob stocking treatment ensured that phalaris strongly dominated throughout time and other species were excluded whereas the summer lock-up treatment allowed white clover to produce large amount of herbage in the relatively wet summers of 93/4 and 95/6. The rotational grazing treatment allowed a large bulk of phalaris to accumulate during the springs of 1993 and 1995 and maintained a higher level of phalaris during the drought (especially Spring) in 1994. Although sown, sub clover has generally been a minor component of the pasture and none of the grazing management treatments have substantially altered this.

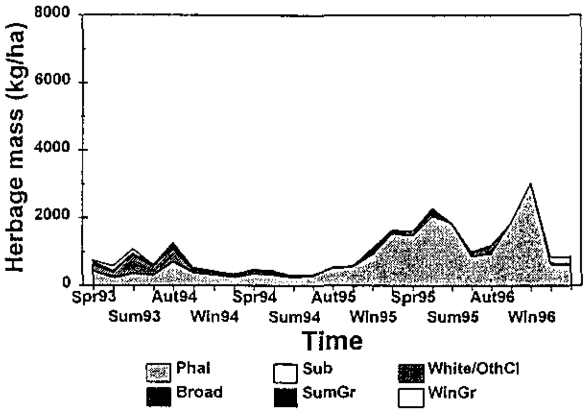
Continuous Grazing



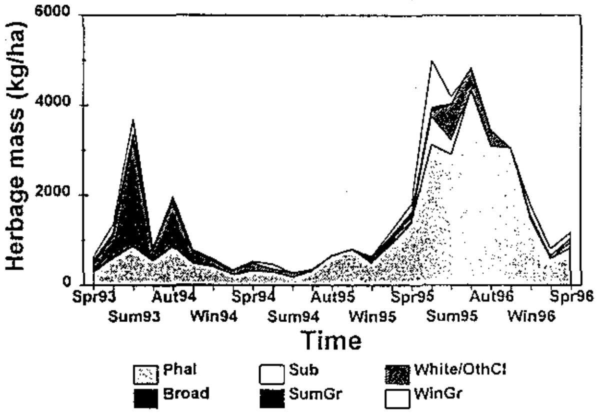
Summer rest



Autumn/Winter mob stocking



Rotational Grazing



Conclusion.

This site, although initially very infertile is in a state of transition. As fertility builds there may be some opportunity to manipulate botanical composition with grazing management. However, at this stage in the analysis it appears that no one treatment caused substantial decline in the phalaris content. Overgrazing, especially during the drought was avoided and, given that disappearance of phalaris may be episodic, this may explain why there was no treatment effect. The effect of the grazing regimes on other species was more marked, there is a clear indication that mob stocking over winter and autumn may be detrimental to clover growth under some conditions. Whereas a strategic summer rest in a wet summer may favour white clover in this environment.

Even though there are few strikingly obvious results to report, this in itself may prove interesting. The lack any change in the botanical composition of the pasture in response to seasonal rests may be important in designing whole-farm grazing management strategies. Further analysis of the data is being undertaken before anticipated publication in 1998.

Finally for both sites at Wagga valuable time was lost making measurements which were totally unnecessary. Endless moving of cages and taking pasture digestibility samples were the cause of much work and yet will probably never be analysed - mainly for methodological/scientific reasons. Much of this came about because of the rigid centralised control over the project and the "democratic" (lowest common denominator) nature of decision making. It is hoped that in future in like-projects may be designed to avoid these flaws.

Temperate Pasture Sustainability Key Program
Springhurst Grazing Management Site
Report As At 30 October 1996

Angela Avery and Greg Seymour
Institute for Integrated Agricultural Development

Introduction:
Springhurst is located in north east Victoria. The site was established on a newly sown cocksfoot phalaris pasture to address goal 1b; that a newly sown perennial grass based pasture can be cost-effectively maintained through grazing management as a desirable pasture for animal production. Prior to the establishment of the perennial pasture the paddock had a long cropping history and was strongly acid. A cocksfoot (Porto), phalaris (Sirosa), sub clover pasture was sown in 1992. The pasture composition at the commencement of the experiment was 33.5% phalaris and 40% cocksfoot.

Results:
Cocksfoot: The spring rest grazing treatment imposed over the period of the experiment did not maintain cocksfoot. Most of the autumn growth of cocksfoot appears to occur from sterile tillers. Buds at the base of fertile tillers are slow to produce leaf area and greater amounts of fertile tillers are likely to be formed under the spring rest treatment than under the continuously grazed treatment. As a consequence the spring rest treatment has a reduced capacity to produce leaf area in autumn. Summer rest and deferred grazing in autumn increased the yield of cocksfoot (table one). A lack of grazing in summer combined with the summer rainfall experienced throughout the experiment (even in the "drought" year) appears to have enabled plants to break dormancy and establish leaf area which has allowed cocksfoot to be competitive in autumn relative to companion species.

Table One: Grazing Treatment Effects On Cocksfoot
("t" values for absolute yield when treatments are compared to the control)

Grazing Treatment	"t" Values
Spring Rest	-3.15*
Summer Rest	1.17
Autumn Rest	0.10
Winter Rest	0.01
Increased Spring Grazing	0.14
Fodder Conservation	0.84
Mob Stocking	-0.87
Autumn Deferment	1.32
July Closure	-0.13

** p,0.05 +iv and -ve values indicate a significant upward and downward trend respectively*

Phalaris: All grazing management treatments imposed at Springhurst over the duration of the experiment maintained phalaris composition despite the pasture being subjected to several months of drought and high levels of utilisation. Compared to set stocking, the dry matter contribution of phalaris significantly increased in the winter rest and mob stocking treatments (table two).

Table Two: Grazing Treatment Effects On Phalaris

("t" values for absolute yield when treatments are compared to the control)

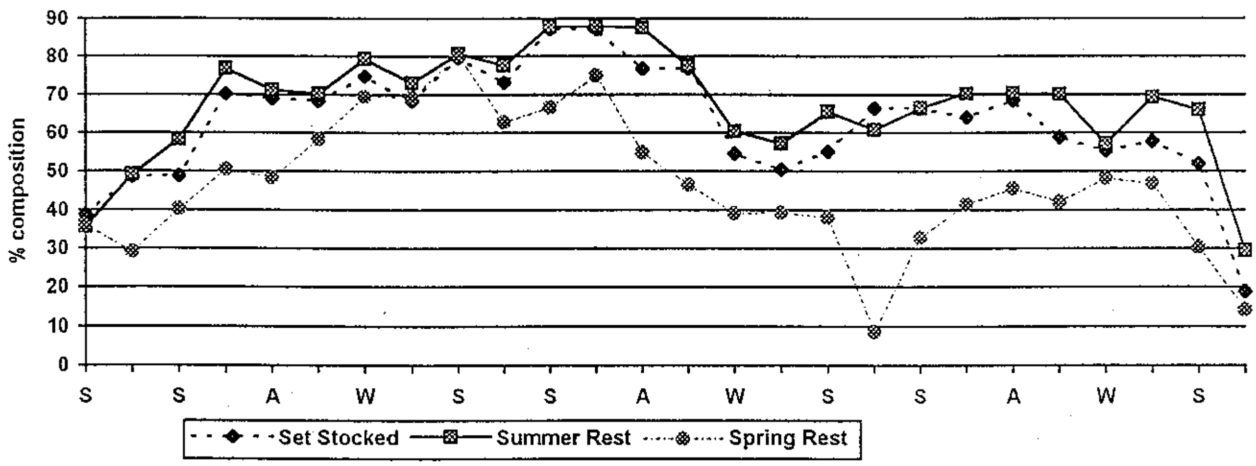
Grazing Treatment	"t" Values
Spring Rest	1.19
Summer Rest	0.36
Autumn Rest	1.53
Winter Rest	5.60*
Increased Spring Grazing	0.31*
Fodder Conservation	0.28
Mob Stocking	2.26
Autumn Deferment	0.11
July Closure	0.91

** p,0.05 +iv and -ve values indicate a significant upward and downward trend respectively*

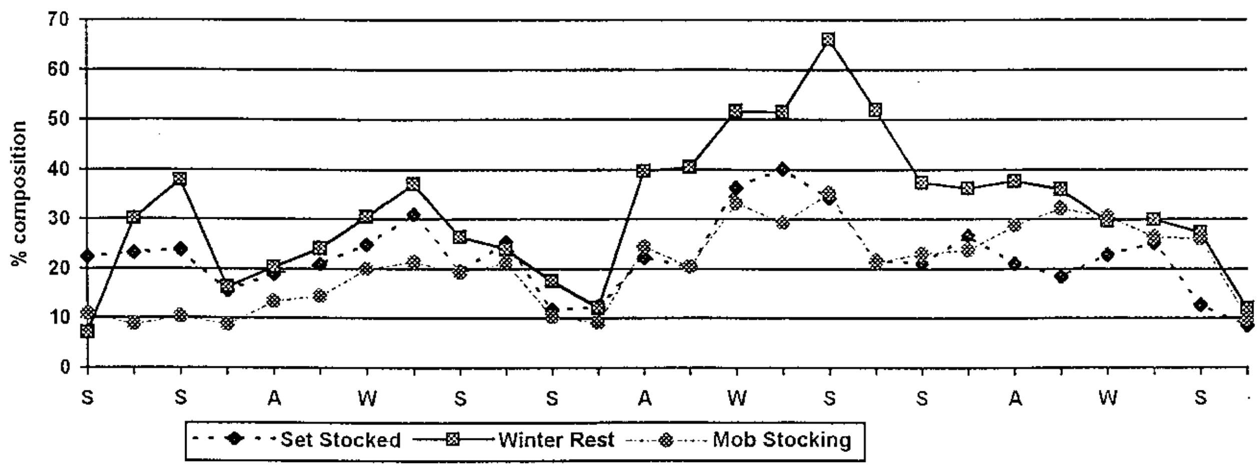
Annual Grasses: The composition of annual grasses (ryegrass, barley grass and silver grass) increased in all treatments except the fodder conservation treatment where there was a decline in annual grass composition ("t" score -1.06). There was a significant increase ("t" score 4.51) in annual grasses in the spring rest treatment.

Sub Clover: Until late winter 1996 sub clover has made a minor contribution to sward composition. There were no significant differences in sub clover composition between treatments. Those that showed a positive trend were however the spring rest, mob stocking and autumn deferment treatments.

Graph One: Grazing Treatment Effects On The Percentage Composition Of Cocksfoot



Graph Two: Grazing Treatment Effects On The Percentage Composition Of Phalaris



TPSKP Final Report (DAV 92) Hamilton Region 30.10.96 (to be read in conjunction with the technical report - Canberra Workshop 1996)

John Graham, Dion Borg and Jean Lamb.

The 4 sites involved in this region are situated at **Delany's** 13km south of Hamilton (2 sites, a sheep site and cattle site.), **Luhrs** 10km north of Cavendish, and **Watts**, 10km south of Balmoral.

Delany's

This site was chosen because it was considered a degraded perennial ryegrass (Vic.) sub clover (Mt Barker) pasture with a little over 20% ryegrass present in August 1993. The soil type is predominantly Hard Pedal Brown Duplex (Northcote classification), the top 9cm consisting of very fine sandy clay loam, with slight fine iron stone gravel, lower layers comprising a medium -heavy clay loam. Major roots extended to up to 20cm, with minor roots extending to 50cm depth.

The Ohlsen P Ranges from 5.65 to 6.25, and pH 4.53.

Figures 1 and 2 show the rainfall pattern and temperatures of this site.

The rainfall in 1994 and 1995 was 582.2mm and 700.6mm respectively, and rainfall to Oct 1996 was 641.4mm. The long term average for this site is 709mm. The average minimum monthly temperature ranged from 0.4°C in 1994 (a July minimum of -3.0°C) , to 0.9°C in 1995 (minimum of -3.6°C in October) and an average to October 1996 of 0.6°C (minimum of -3.8°C in June). The average maximum monthly temperature ranged from 27.2°C in 1994 to 25.7°C in 1995. The maximum temperatures occurring in Jan -Feb (38.4°C, 25.7°C and 40.5°C for 1994, 1995 and 1996 respectively.)

Figure 1

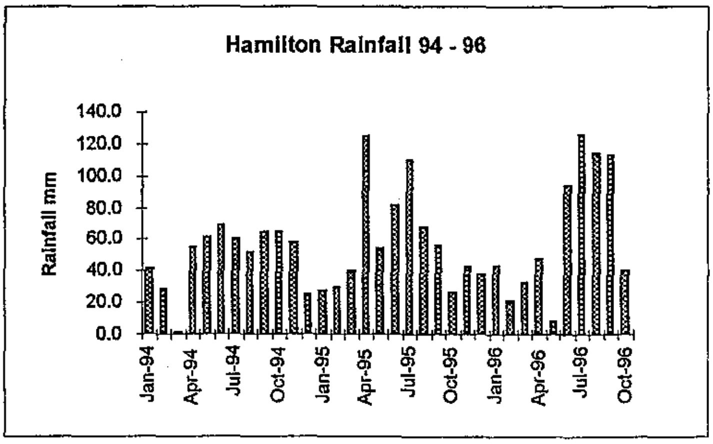
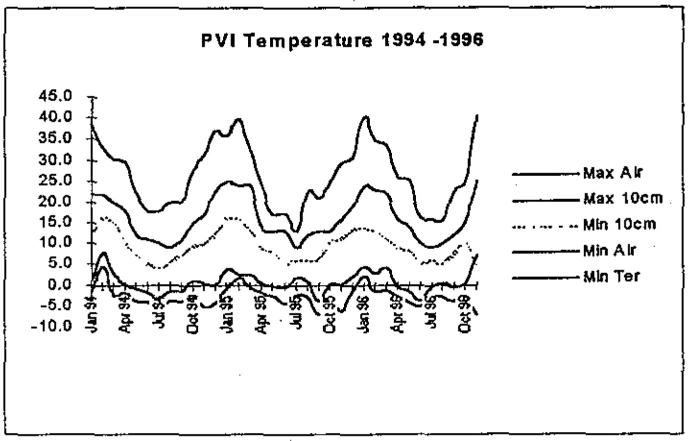


Figure 2



The Core treatments at all Hamilton region sites comprised of :-

1 Control Set stocked
2 Autumn spell
3 Winter spell
4 Spring spell
5 Summer spell
6 Extra grazing pressure in spring
7 Fodder conservation
8 Mob stock in autumn/winter

Site 1 Delany's - Sheep site
This site was stocked at 12 wethers/ha, and received 65kg single superphosphate per year. The stocking rate was increased by 70% in spring to simulate spring lambing.

The local treatment at this site comprised:-
9 Additional superphosphate (250kg single superphosphate per year)
10 Additional superphosphate (250kg single superphosphate per year) plus sod seeding of sub clover in 1994)
11 Spray top in spring (Gramoxone)

Of the core treatments the mob stock in autumn/winter - treatment 8 has increased the ryegrass content compared to the control, and the increased fertiliser treatments also significantly increased the ryegrass content. These treatment also significantly decreased the percentage of Onion grass. Spelling in spring significantly increased the Sweet Vernal (Anthoxanthum odoratum) content of the pasture a perennial grass weed.
Subclover content was significantly increased by treatment 6 - increased grazing pressure in spring.
The following figures show the basal counts (fig.3) (an indication of the number of plants per square metre) of ryegrass for the control and significant treatments, and the frequency of the occurrence of perennial ryegrass (Fig. 4),and onion grass (Fig 5).

Figure 3

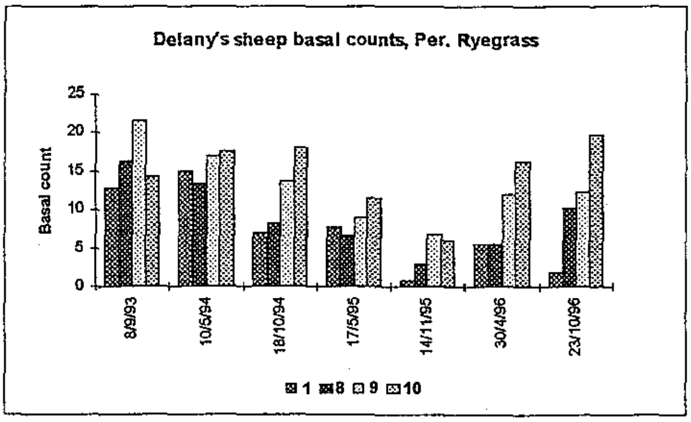


Figure 4

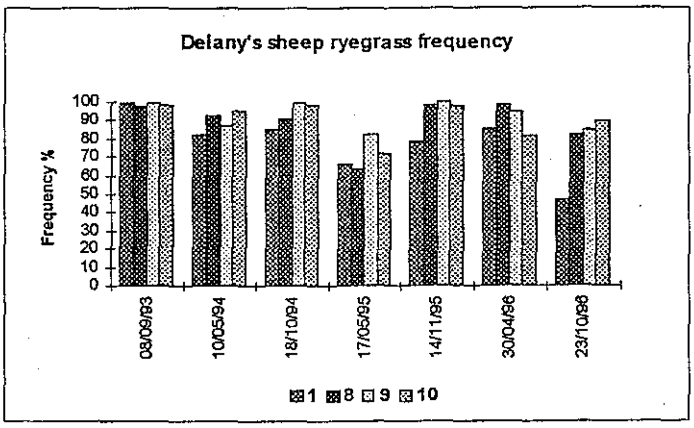


Figure 5

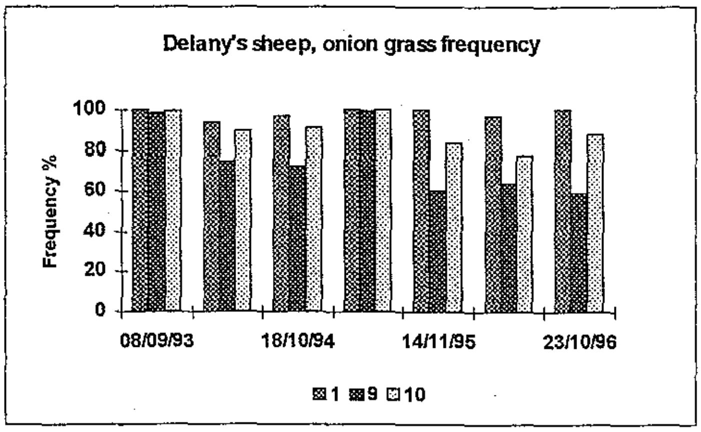
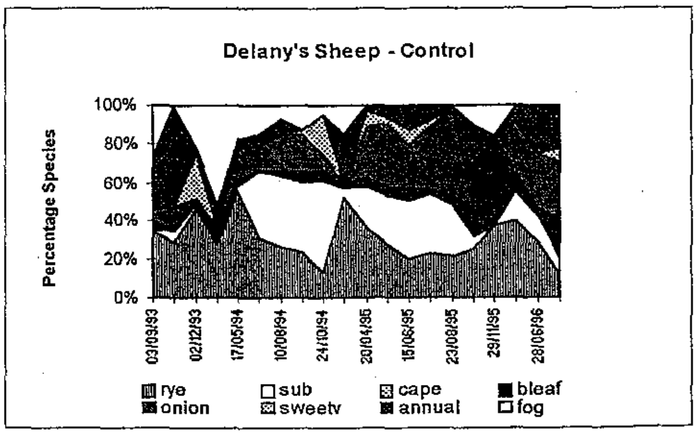


Figure 6



Figures 6, 7 and 8 show the significant effect of treatment on the percentage of ryegrass compared to the control.

Figure 7

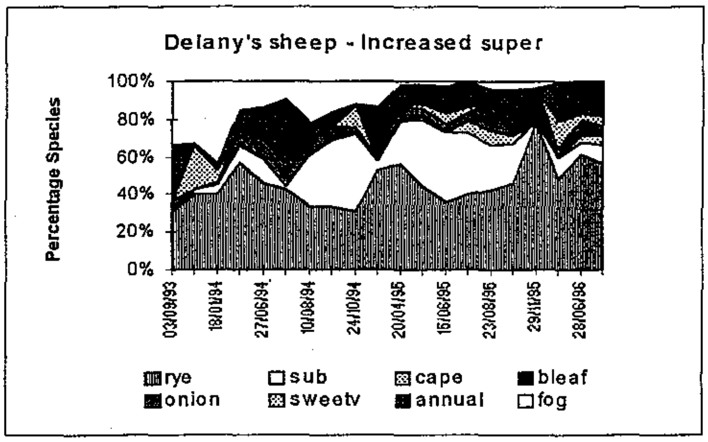
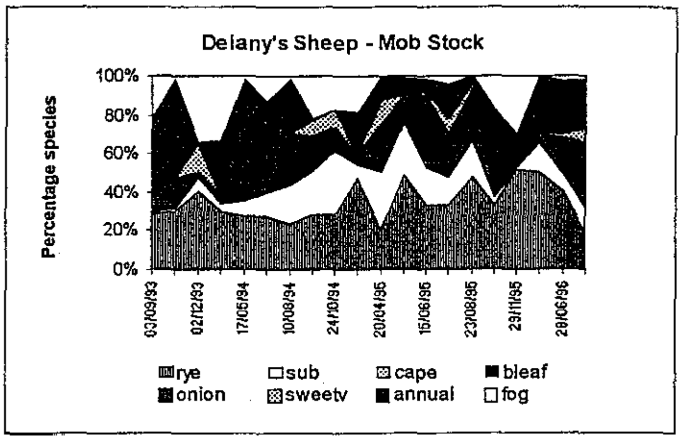


Figure 8



Cattle Site

Livestock used on this site were weaner steers, placed on the plots in January each year. They were stocked at 2.0 per hectare, with a spring increment of 70% as with the sheep. This site received a similar fertiliser application as the sheep site

The local treatments at this site comprised:_

9 - Sheep all year, cattle in autumn

10 - Sheep all year, cattle in winter.

11 - Sheep all year, cattle in spring.

12 - Sheep all year, cattle in summer .

As with the sheep site, the Mob stock treatment significantly increased the ryegrass content,

Figure 9

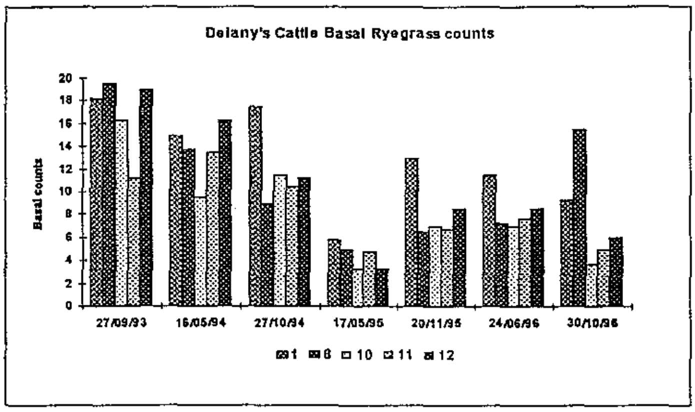


Figure 10

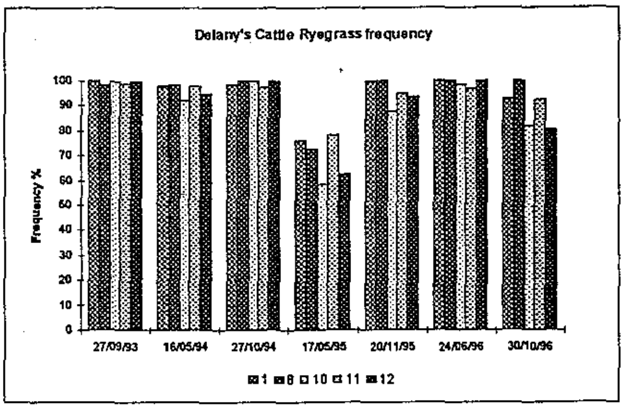


Figure 11

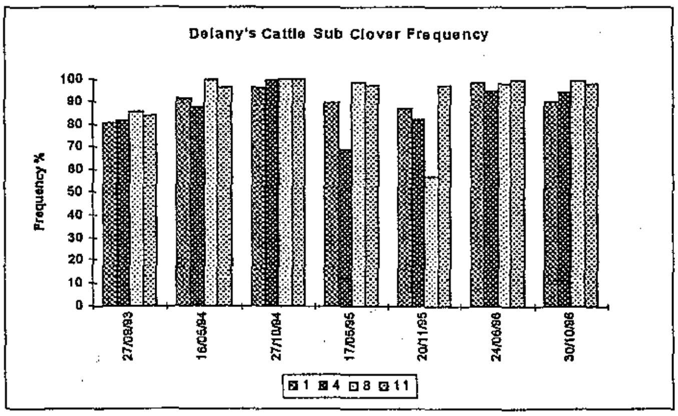
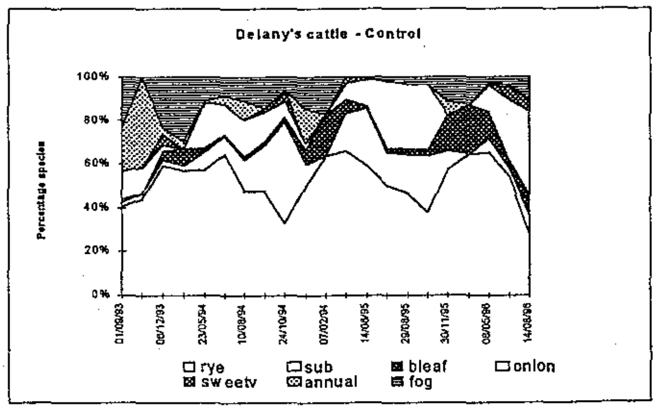


Figure 12



Autumn closure (treatment 2) decreased the percentage of subclover and ryegrass, and increased the percentage of annual grasses. Sheep then cattle in Winter, Spring and Summer decreased the percentage of ryegrass (treatments 10, 11 and 12). Treatment 11 increased the sub clover content. Figures 11, 12, 13 and 14 show the significant differences in composition due to treatment

Figure 13

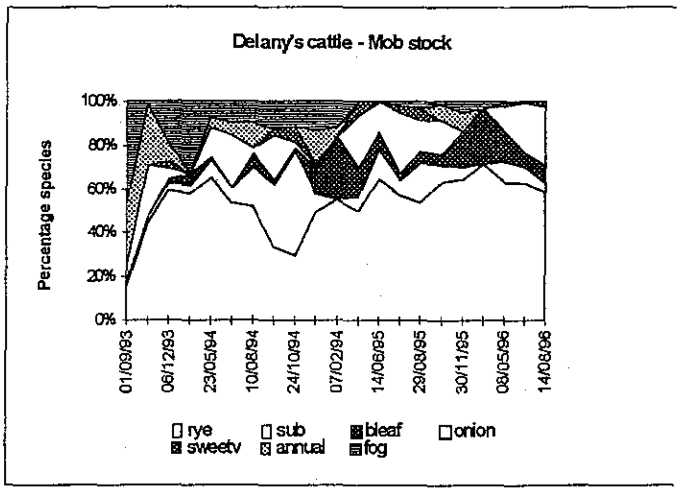
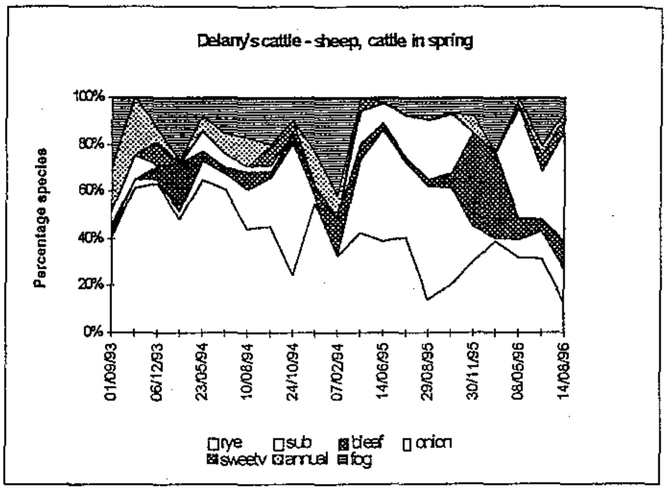


Figure 14



Site 3 Luhrs (Cavendish)

This site was chosen because it was newly sown pasture, sown in 1992 in alternate rows, to phalaris (Unita and Sirosa), perennial ryegrass (Vic.) and subterranean clover (Trikkala and Larisa). The soil type is predominantly a Non-cracking Plastic Clay (Northcote classification), the top 15cm consisting of light clay with slight fine to medium iron stone gravel, lower layers comprising a silty clay with a fine-medium ironstone gravel. Major roots extended to up to 15cm, with minor roots extending to 35cm depth.
The Ohlsen P at this site averaged 7.83, and pH averaged 4.37.

Figures 15 and 16 show the rainfall pattern and temperatures of this site.
The rainfall in 1994 and 1995 was 388mm and 550mm respectively, and rainfall to Oct 1996 was 550mm. The long term average for this site is 650mm. The average minimum monthly temperature ranged from 1.3°C in 1994 (a July minimum of -2.6°C) , to 1.5°C in 1995 (minimum of 2.6°C in October) and an average to October 1996 of 2.6°C (minimum of 0.9°C in June). The average maximum monthly temperature ranged from 26.4°C in 1994 to 23.1°C in 1995. The maximum temperatures occurring in January (38°C, 37.1°C and 39.1°C for 1994, 1995 and 1996 respectively).

Figure 15

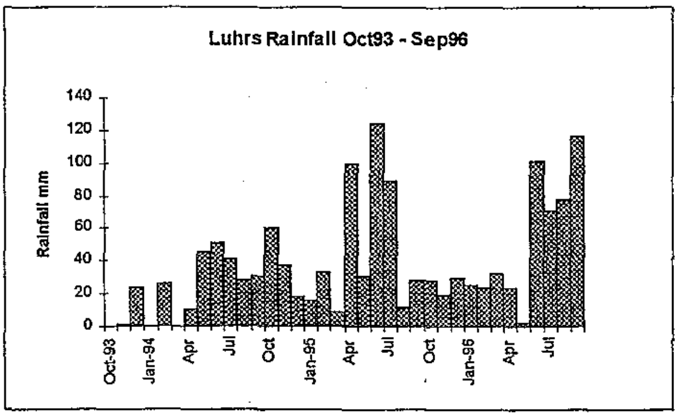
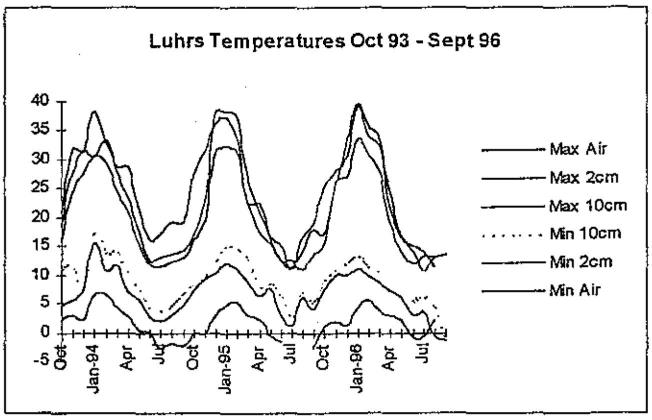


Figure 16



This site was stocked at 12 wethers/ha, and received 250kg single superphosphate per year. The stocking rate was increased by 70% in spring to simulate spring lambing.

The local treatments at this site comprised:-
9 Rotational grazing (6 weeks spell, 2 weeks grazing)
10 Hay, then spell to let phalaris set seed.
11 Close Nov to end of Dec, graze, then spell on Autumn break for 6 weeks.
12 Winter herbicide treatment - gramoxone and simazine
None of the core treatment significantly effected the percentage of phalaris, however the rotational grazing (treatment 9) significantly increased the percentage of both phalaris and ryegrass, and significantly decreased the percentage of annual grasses. Both Spring spelling (treatment 4) and hay making (treatment 7) significantly increased the percentage of ryegrass, but significantly decreased the subclover, and increased the annual grass content. Spelling the pasture between November 1 and the end of December, grazing and then spelling for 6 weeks after the autumn break (treatment 11) significantly increased the percentage of ryegrass, and decreased the annual grass content. Basal frequency counts are shown in figures 16, 17, 18 and 19.
Figures 20, 21 and 22 show the changes in

Figure 17

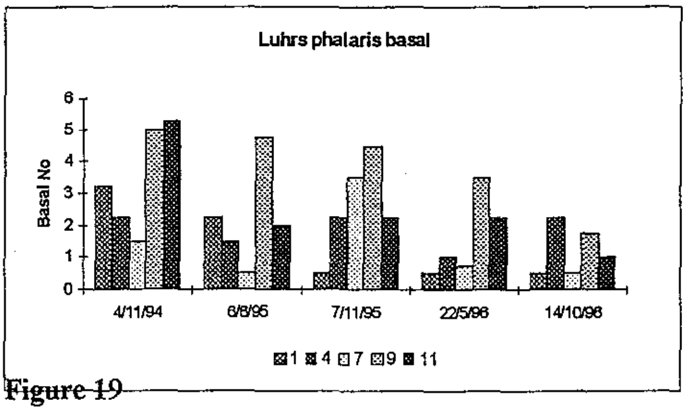


Figure 18

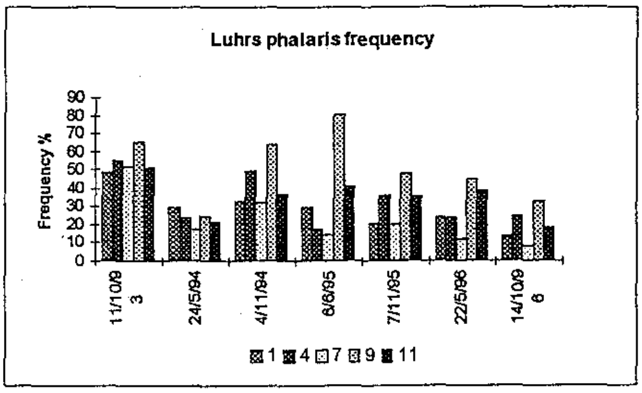


Figure 19

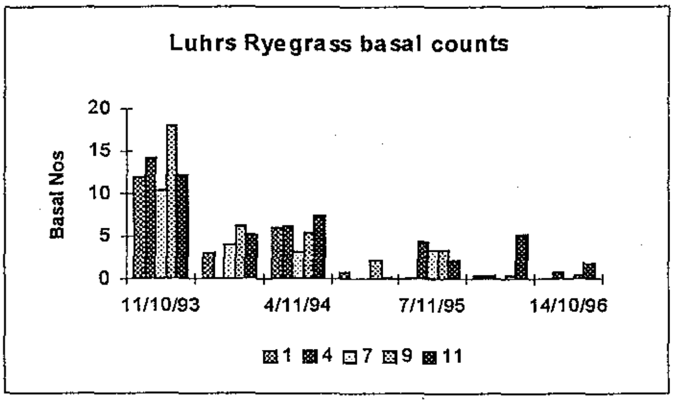
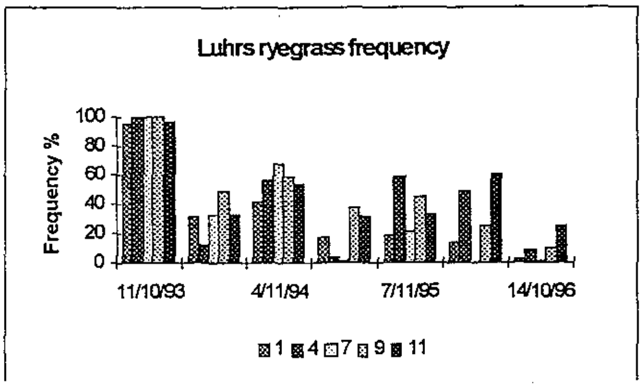


Figure 20



percentage of species present for the treatments that are significantly different than the control. The increase in phalaris and to a lesser extent ryegrass, due to rotational grazing can be seen in figure 21, compared to the control , and the benefit to ryegrass of the late spring, and early autumn spell can be seen in figure 22.

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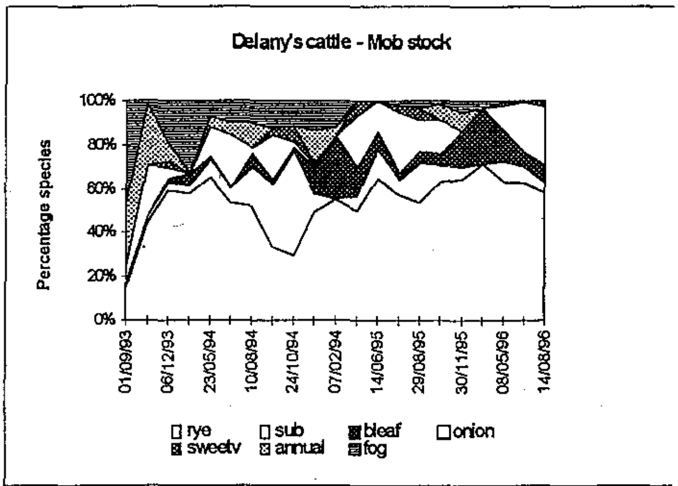
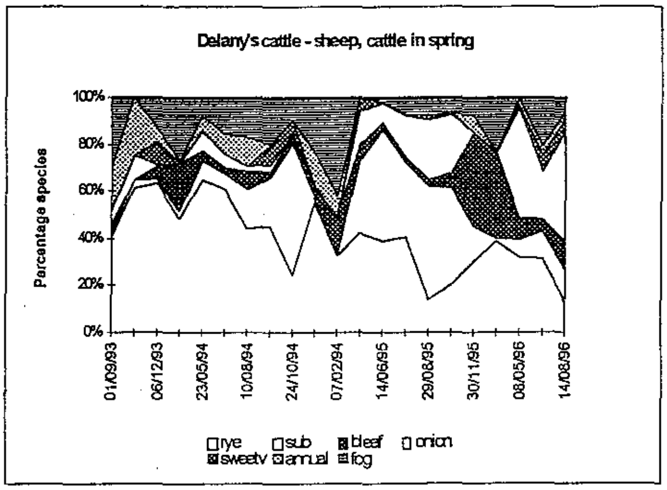


Figure 14



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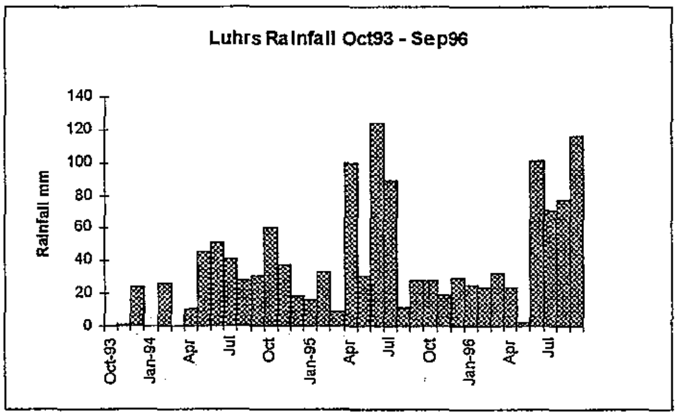
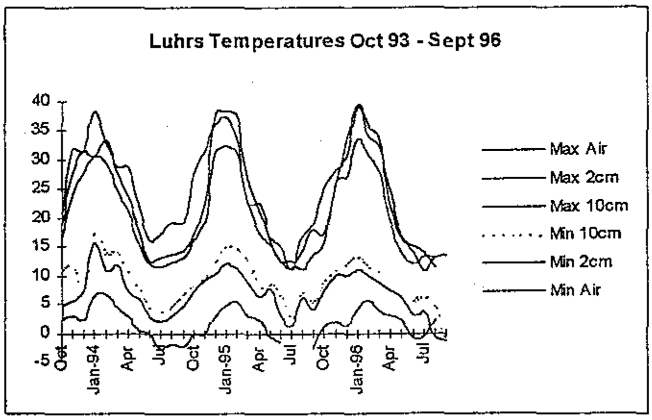


Figure 16



This site was stocked at 12 wethers/ha, and received 250kg single superphosphate per year. The stocking rate was increased by 70% in spring to simulate spring lambing.

The local treatments at this site comprised:-
9 Rotational grazing (6 weeks spell, 2 weeks grazing)
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11 Close Nov to end of Dec, graze, then spell on Autumn break for 6 weeks.
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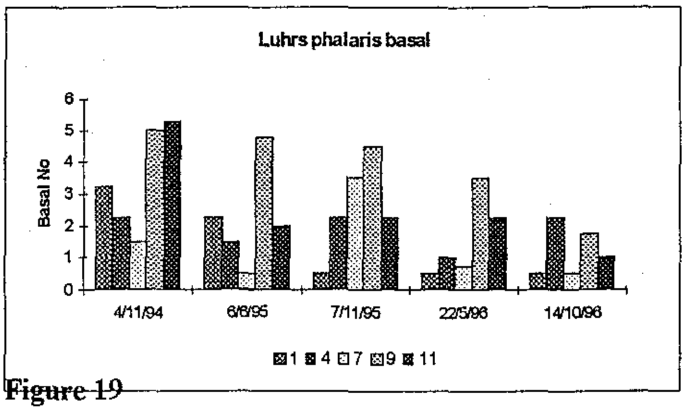

Figure 18

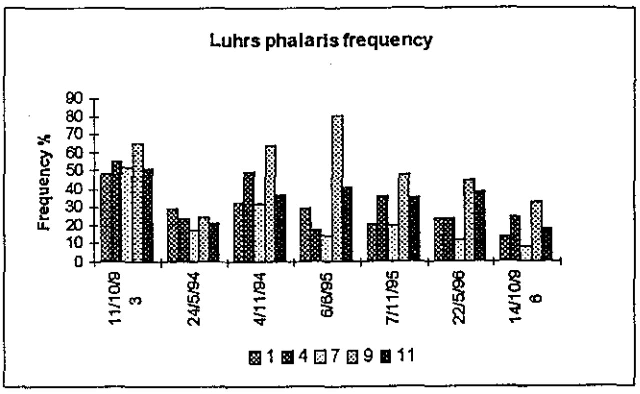

Figure 19

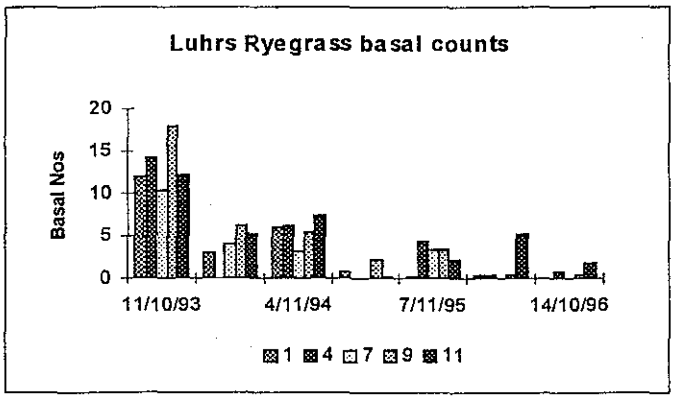

Figure 20

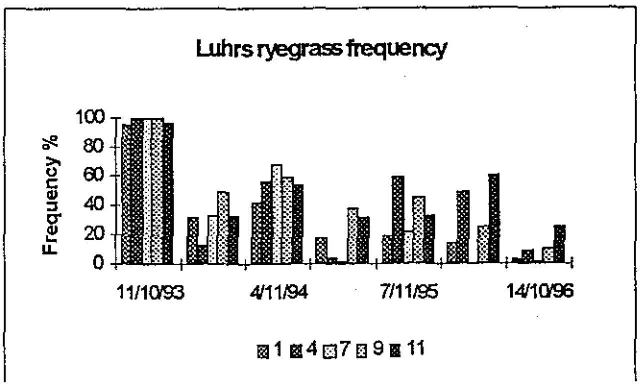

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Figure 21

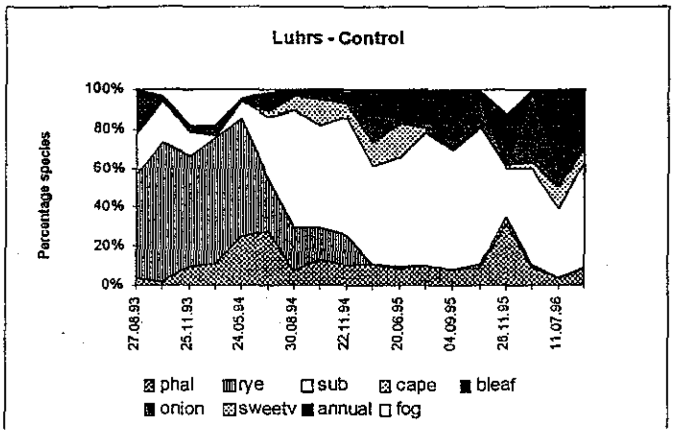


Figure 22

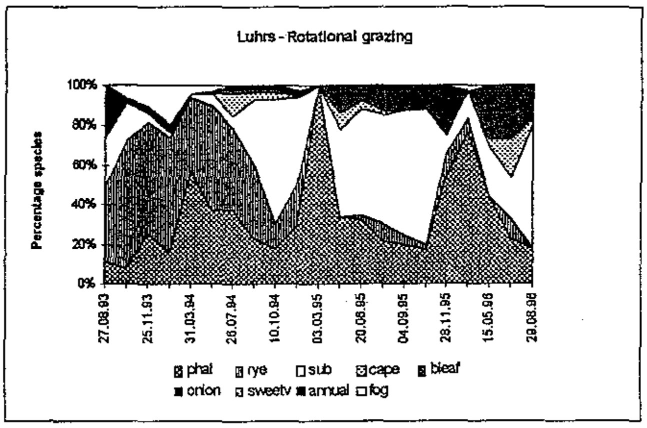
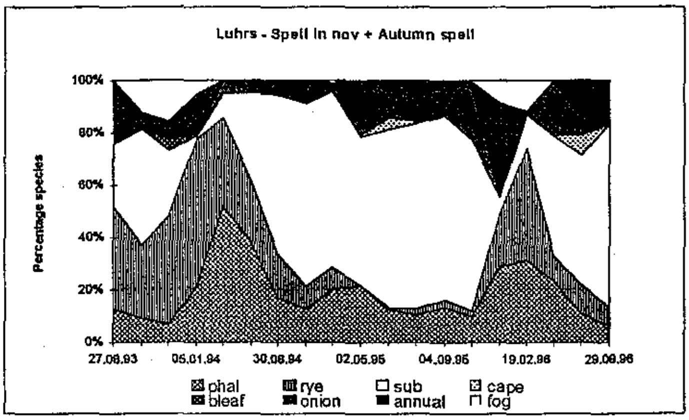


Figure 23



Site 4 Watts - Balmoral

This site was established on a degraded phalaris pasture, sown down in the early 70's to Australian phalaris and yarloop sub clover.

The soil type ranges from grey, yellow and brown Smooth-ped Earth. The top 10cm being fine sandy clay loam with moderate to fine iron stone gravel, changing to light medium clay with slight ironstone gravel at around 20cm.

Major roots extent to15cm, with minor roots extending up to 35cm in some cores.

The Ohlsen p is 5.7, and pH 4.4.

The rainfall (figure 23) in 1994 and 1995 was 412mm and 541mm respectively, and rainfall to Oct 1996 was 542mm. The long term average for this site is around 600mm. The average minimum monthly temperature was 1.7°C in 1994 and 1995 (a September minimum of -1.4 in 1994 and -2.6°C in 1995). The average maximum monthly temperature ranged from 26.7°C in 1994 to 24.2°C in 1995. The maximum temperatures occurring in January (38.8°C, 37.4°C and 39.8°C for 1994, 1995 and 1996 respectively). The temperatures are shown in figure 24.

This site was stocked at 12 wethers/ha (increasing by 70% in spring)and received 65 kg single superphosphate per year.

The local treatments comprised:-

9 Extra superphosphate (250kg single super) and spray topping

10 Extra superphosphate (250kg single super) and hay making and closing till the end of summer.

11 Spray topping in spring

12 An winter spray (gramoxone and simazine) to control annual grasses.

Figure 24

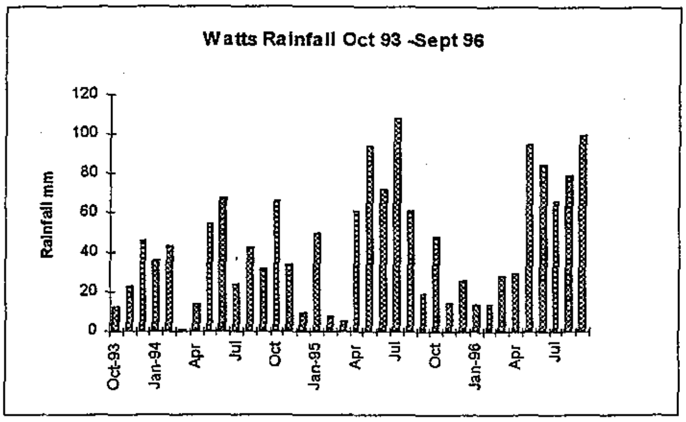
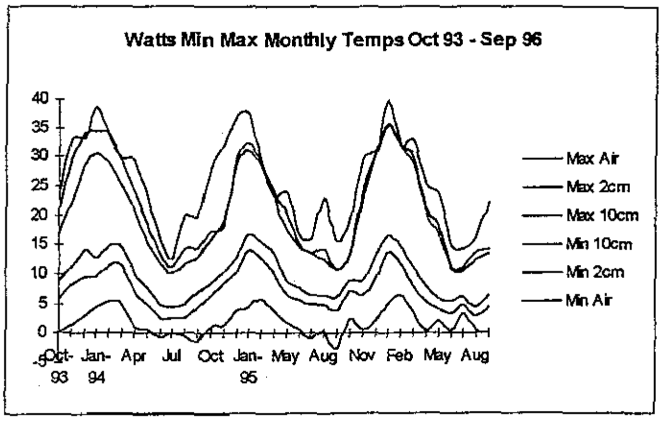


Figure 25



The only significant effect on change in botanical composition compared to the control treatment was due to treatment 8 - mob stock, which reduced the subclover content, treatment 9 spray top plus additional super, which increased the broad leaf weeds, and treatment 12, the winter spray, which increased the phalaris content of the pasture.

Figure 25

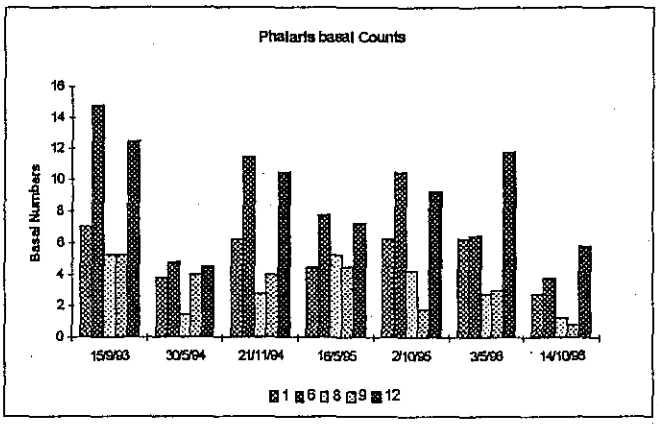


Figure 26

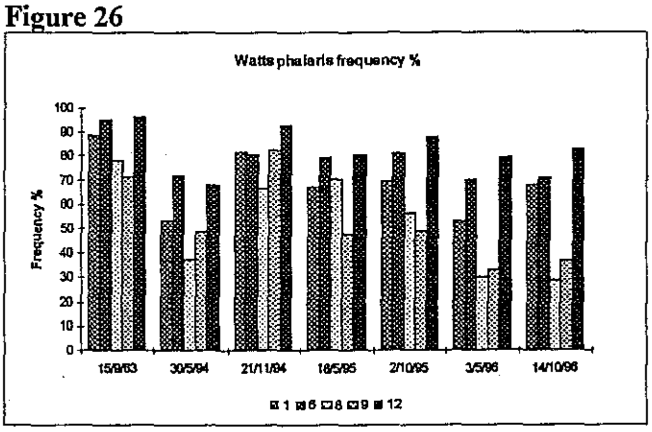


Figure 27

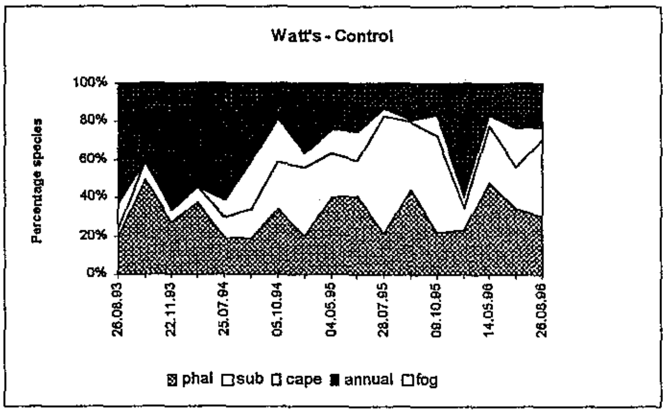
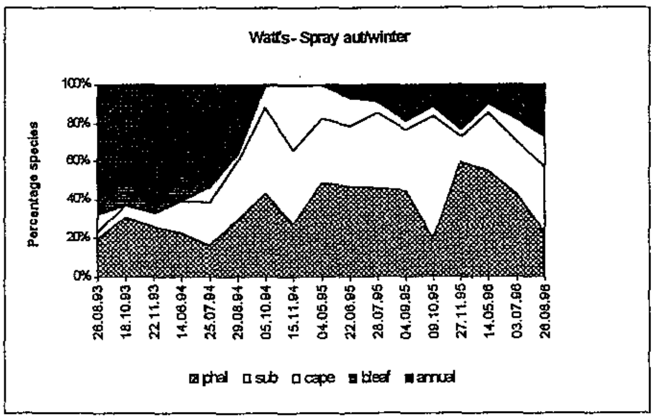


Figure 28



Figures 25 and 26 show the effect of treatment on basal counts and frequency of phalaris. The increase in the percentage of phalaris in the pasture due to treatment 12 is shown in figure 28, compared to the control (figure 27). The decrease in the percentage of annual grasses due to increased grazing pressure in spring can be seen in figure 29, whilst the effect of mob stocking on the subclover content can be seen in figure 30.

Figure 29

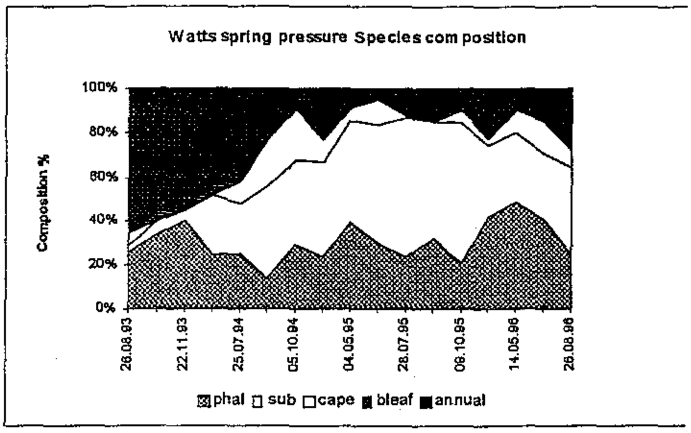
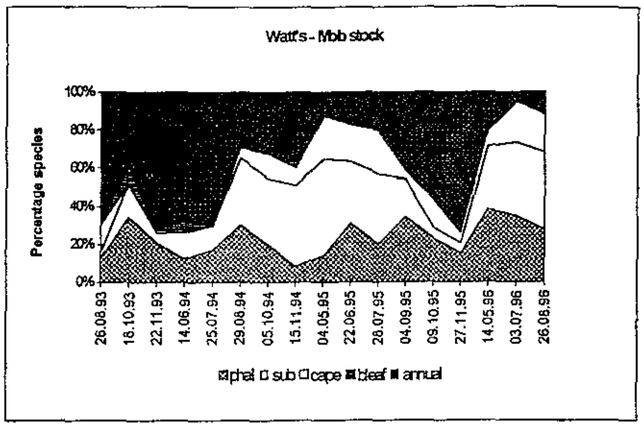


Figure 30



The botanical data collected at all sites was analysed by fitting a cubic smoothing spline using a mixed linear model Gilmore pers com; Veryla et al, in prep. From the fitted spline a t test was derived which was used to test wether changes in individual treatments were significantly ($p<0.05$) different from the control.

SUMMARY

Perennial Ryegrass

At the degraded perennial ryegrass Hamilton sites (Delany's sheep and cattle) mob stocking (deferment at the autumn break to allow the pasture availability to accumulate to between 2000 and 2500kg/ha before grazing, and then rotational grazing until the end of winter) was the only core treatment beneficial to ryegrass. The spell at the autumn break obviously allowed the plant to build up energy reserves, and the rotational grazing also rested the plant allowing it to recover after grazing, giving it reserves to compete more strongly with it competitors. In the drier environment at the Luhrs site rotational grazing and the late spring spelling together with the autumn deferment significantly increased the perennial ryegrass content if the sward. As at the Hamilton site, rotation and autumn deferment would have allowed the ryegrass to gain energy reserves, and the late spring spell would have assisted the plant to survive the dry summer period.

Increased grazing pressure in spring significantly increased the sub clover content of the sward, as well as decreasing the annual and fog grass content of the sward, whilst at most sites, spelling for the duration of spring significantly decreased the subclover content.
The local treatment of additional superphosphate also significantly increased the perennial ryegrass content of the sward.
These results indicate that controlling excess spring growth together with some form of autumn deferment and rotation during the winter period with adequate superphosphate application will assist in improving the botanical composition of a degraded ryegrass pasture. Lax grazing pressure during spring will decrease the sub clover content increase the annual grass content and lead to pasture decline.

Phalaris

The significant increase in the percentage of phalaris due to rotational grazing (6 week spell and 2 week grazing) at the Luhrs site, indicated that phalaris will benefit from a period of spelling. Over the summer period during the spelling phase of the rotation cycle the phalaris remained green, whilst the continuously grazed plots remained dry, and there was increased water use in those plots rotationally grazed (Shroder pers comm). As with the perennial ryegrass plants, spelling the phalaris would have allowed it to increase energy reserves, increase rooting depth and thus make a larger contribution to the sward compared to continuous grazing.
The phalaris at the degraded Watts site benefited through controlling the annual grass component (Vulpia.spp.) of the sward through a late winter spraying.

MEAT RESEARCH CORPORATION TEMPERATE PASTURE SUSTAINABILITY KEY PROGRAM (TPSKP)

FINAL REPORT DAS 032

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Information presented in this report supplements report #1 (31/1/94), report #2 (30/10/94 and report #3 Launceston workshop (Dec 1995), except that any data presented will supersede data presented in previous reports.

SITE
Elevation 330m, Rainfall - area average 900 mm winter dominant (April - October) - trial site 1994 690mm, 1995 925mm.
Mean maximum air temperatures at the site ranged from 23°C in February down to 11°C in July, whilst mean minimums ranged from around 14°C in February down to 6°C in July.

Pasture was sown in September 1990. Mean composition for the trial duration has been 47% Victorian perennial ryegrass, 21% Porto cocksfoot, 18% sub clovers, 7% annual grasses, 5% slender thistles and 2% other species.

Feed on offer during trial (kg/ha total matter)

Control - maximums were 2170 kg/ha November 1993, 3120kg/ha December 1994 and 1520 kg/ha November 1995
- minimums 290 kg/ha March 1994, 810kg/ha May 1995 and 300 kg/ha April 1996

Spring closure reached 4510 kg/ha in 1993, 9900kg/ha in 1994 and 5070 kg/ha in 1995

High spring utilisation plots were grazed down to 1730 kg/ha November 1993, 110 kg/ha February 1994, 1400 kg/ha November 1994, 780 kg/ha February 1995, 1430 kg/ha November 1995 and 330 kg/ha April 1996.

SUMMARY
- **Perennial ryegrass** content of the site **decreased** during the trial - as measured by basal cover in the controls (set stocked), as well as in all other treatments. However the degree of the decrease in basal cover was **less** in the fodder conservation and autumn deferment/high spring utilisation treatments.
- These treatments also significantly **improved** perennial ryegrass composition relative to the control. Fodder conservation also **decreased** slender thistle composition whilst spring closure **increased** annual grass percentage.
- Pasture net growth rates were **suppressed** by closure in spring and **increased** by high spring utilisation, autumn deferment and winter closure.

CONCLUSIONS

We conclude that grazing management can be used to maintain the perennial ryegrass content of a newly sown pasture in a mild winter rainfall climate on a fertile soil at Delamere. Grazing management practises to consider would be those using a combination of fodder conservation, set stocking and autumn deferment/high spring utilisation. Spring closure would be a practise to be avoided as it would lead to an invasion of annual grasses.

A period of short deferment in late summer/early autumn may also be appropriate for maintaining perennial ryegrass composition - however this treatment will also increase slender thistle yields.

RESULTS

1. Composition - year one starts only

The following treatments significantly ($t > 2.0$ for spline analysis) changed the pasture composition relative to the control which was set stocked.

- Fodder conservation and a combination of autumn deferment and high spring utilisation **increased %** perennial ryegrass
- Late summer/short autumn closure **increased yield** of perennial ryegrass and yield of slender thistles
- Spring closure increased **both % and yield** of annual grasses and **decreased yield** of perennial ryegrass
- High spring utilisation on its own, and the late summer/short autumn closure **increased both % and yield** of slender thistles

None of the treatments had a significant effect on cocksfoot or sub clover composition

2. Basal cover % for perennial ryegrass - year one starts only

	6/9/93	9/9/96
Control	39	12
Spring close	35	14
Fodder conservation	28	19
Late summer/short autumn close	42	24
Autumn deferment/high spring utilisation	34	24

3. Net pasture growth rates - treatment means - both years

Control	25.6 kg/ha/day dry matter
Fodder conservation	20.2
Mob stocking	26.7
High spring utilisation	28.2
Autumn deferment/high spring utilisation	26.7
Winter closure	25.3

LSD (5%) 6.6 kg/ha/day

Note: Growth rates of other treatments ranged from 22.5 to 24.5 kg/ha/day

Final Site Report Summary - Ross

The Ross site is characterised by a 40 year old degraded perennial ryegrass based pasture typical of the midlands improved pasture area. The major companion species include barley grass (*Hordeum sp*), kentucky bluegrass (*Poa partensis*), *Bromus Spp*, sub clover, *Poa bulbosa* and spear thistles (*Cirsium vulgare*).

From the commencement of the trial in 1993 until January 1996, rainfall was generally below average except for the November to January period of each year. These late spring, early summer rains did little for pasture production, and may have been detrimental by inducing early germination of sub clover seed, the plants from which died over the ensuring summer.

The site was destocked for a 12 week period in 1994, and was not restocked until the pasture reached about 1,500 kg DM/ha. This was in contrast to the management of the surrounding farm, where supplementary feeding stopped and set stocking recommenced at the autumn rains. Consequently, in contrast to the trial area, the surrounding farm remained with a cover of less than 1,000 kg DM/ha until the following spring, and was thus unable to meet the animal production requirements over this time.

There was a general increase in the ryegrass component of the pasture across the whole site. Relative to the control, ryegrass increased more in the summer close and winter mob stock, but less in winter close, autumn close, no corbie control, spray topping and metharizium treatments. Explanations for all these observations are not apparent. Closing the site after the "drought" broke probably favoured ryegrass over the annuals, and allowed it to become re-established quickly, and thus exert increased competitiveness on the germinating annual grasses. Closing over summer possibly allowed ryegrass to increase tillering in response to rain received at this time. The observed increase in basal area supports this hypothesis. Failing to control corbie and cockchafers would be expected to have a negative effect on ryegrass, but populations of these insects were not high during the trial.

Barley grass declined in composition throughout the site, with its period of greatest decline coinciding with the time of least rainfall. Barley grass always flowered and produced seed, but during the "drought" plants and seed heads appeared smaller and contained few if any viable seeds by subjective assessment. The "drought" may have also meant that seedling barley grass plants were small and vulnerable to extinction by grazing and competition from the larger perennial ryegrass plants. Managements aimed at exploiting the vulnerability of annual grasses during, and after periods of low rainfall may be successful in reducing prevalence.

Sub clover has generally increased across the site taking up the gaps created by a lesser barley grass component.

Assessments suggest that thistles were increased by the summer close in most cases treatment. The transect measurements in most cases, do not reflect the overall plot situation with respect to this species, as it appears to be making a larger contribution than that measured. The botanal technique may not be the most suitable for monitoring large biomass, low density plants such as thistles.

Kentucky bluegrass increased in the flexible best bet and summer close plots. This may have been in response to not grazing after early summer rain. Irrespective of these observations, kentucky bluegrass only made a small contribution to dry matter production and probably would not be a preferred species. Autumn closure resulted in the largest increase in ryegrass basal area, presumably through the promotion of tillering. In contrast, the flexible best bet reduced basal area, probably by the presence of previous season residue shading the plant bases and discouraging tillering.

Control grazing in spring and summer close increased the basal area of kentucky bluegrass, where as mob stocking reduced it. Other treatments had slight positive and negative effects on it.

Frequency measurements of all species reflect the results of the composition data. Ryegrass seedling numbers were dramatically increased by summer closure and the flexible best bet treatments. These treatments resulted in emergence of 230 and 400 seedlings/m^2 respectively, compared to about 5/m^2 in the set stocked plots. This is probably because sheep tend to preferentially graze the immature ryegrass seed heads, and thus few produce seed. This is in contrast to the situation with barley grass, which tend to be avoided by the grazing animals once flowering commences. Barley grass responds to grazing by continuing to produce small flowers well into summer if moisture conditions allow. Despite the good ryegrass seedling emergence, survival to mature plants is low probably due to competition from larger more established plants. Seedling recruitment is therefore not the main mechanism of increasing ryegrass.

Limited continued observations of this site, will provide information on the longer term consequences for the barley grass and ryegrass populations.

Final Site Report Summary - Parattah

Rainfall at this site was below average for the last two years of the experiment. Despite this trend the summer of every year was characterised by above average rainfall. As a consequence feed on offer and pasture growth rate have fluctuated greatly with values typically being within the range of 500-2500 kg DM/ha and 0-50 kg DM/ha/day respectively. The stocking rate fluctuated in response to this rainfall pattern, but the site was never completely destocked.

When the experiment commenced the pasture was in its third year following sowing. The sown species included perennial ryegrass, cocksfoot, phalaris, white clover and sub clover. The main weed species present included fog grass (*Holcus lanatus*) and sweet vernal (*Anthoxanthum odoratum*) with traces of Vulpia and Agrostis species. Botanical composition has changed over the life of the experiment and is probably attributable to both climatic (rainfall) and management factors. It may be argued that rainfall is the major driving force and that management is acting within this constraint.

The contribution made by ryegrass has declined from both yield and composition perspectives throughout the site. The sensitivity to seasonal conditions is highlighted by ryegrass tending to increase at the last three harvests in response to good autumn-winter rains. Ryegrass composition declined relative to the control in the summer close, spring close and fodder conservation, flexible best bet and spring close treatments. These treatments combined with the summer rain improved the competitiveness of cocksfoot, resulting in depression of ryegrass. If this behaviour is typical of ryegrass in this environment should it be expected to be a major long term pasture species or be a "nurse crop" - "coloniser" whilst a long term species such as cocksfoot becomes established? Continued long term observations at this site should indicate the longer term fate of ryegrass and the population dynamics of the pasture.

Cocksfoot increased throughout the site with the summer close, spring close and fodder conservation and flexible best bet treatments fostering the largest increase. These managements probably pose the greatest threat to legume survival in cocksfoot dominant pastures. Treatments that meant the area was set stocked (control, red legged earth mite control, metharizium), lead to the least increase in cocksfoot and a greater proportion of legume. This may mean that set stocking is the best management to ensure cocksfoot does not completely dominate a pasture.

Fog grass was a major weed throughout the area when the experiment commenced but declined across the whole site during the observation period. The mob stocking and year round control grazing treatments maintained the highest levels of fog. A significant negative influence on fog survival may have been the dry times, during which available feed was low so the animals could be less selective in their grazing.

Phalaris, although a component of the seed mix, and initial composition failed to make any significant contribution to the botanical composition or productivity of the site. Plants survived but did not increase in abundance or size.

The dominant legume in this pasture is sub clover with rainfall appearing to be the major determinant of its abundance. During the first year and a half of observations legume rarely ranked with Botanal. Conversely during the last year when moisture was not limiting both sub and white clover regularly ranked. Control grazing in spring, and set stocking increased sub clover, whilst summer close, autumn close and fodder conservation depressed it. The likely mechanism to explain these observations is that minimising residue present on the plots in autumn created space thus allowing sub clover seedlings to germinate and survive with minimal competition.

The frequency and basal area measurements support the above botanical composition observations. Seedling recruitment does not appear to be the mechanism of botanical change. Irrespective of treatment ryegrass produced more (10-90/m^2) seedlings than cocksfoot (1-5/m^2). The flexible best bet treatment designed to maximise seed production and seedling recruitment was the most successful in this regard with both species. Seedling survival of both species was very low irrespective of treatment (1-5 plants/ m^2). Sub clover and the mature cocksfoot plants would be highly competitive for moisture with small, low vigour seedlings. It therefore appears that vegetative reproduction through increased tillering is a major means of increasing the perennial grass component of pastures.

This work is the first step in gaining an improved understanding of the population dynamics within this type of pasture. As with all research it poses a number of questions including, what happens if the various managements are stopped and set stocking resumed, and how does the species composition change over a longer period? Planned continued observations of this area may provide some of the answers to these questions.

Final Report on the "York Park" Grazing Management Site
Temperate Pasture Sustainability Key Program, September 1993 to September 1996

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The natural pasture on "York Park" is typical of natural pastures in Tasmania's Midlands. The pasture is dominated by native grasses, but also contains naturalised grasses as well as native and naturalised forbs (Table 1). The area has been grazed by sheep since settlement around 170 years ago. It has never been fertilised or sown to introduced species. The soil is very low in available phosphorus (Olsen P of 4). Mean annual rainfall is 590 mm.

Key Results of the Study

Carrying capacity, herbage mass, growth and quality

The pasture carried 2 DSE/ha for most of the period, during which rainfall was below average. Stocking rate was increased to 2.5 DSE/ha following a good autumn break in 1996. Sheep liveweights and condition declined each winter, but increased in the following spring, and there were no adverse effects on fleece weights.

Under set stocking, herbage mass was maintained at between 500 and 800 kgDM/ha. Dead herbage comprised between 25% and 85% of total herbage mass. The maximum herbage mass reached under a year-long spelling treatment was 2700 kgDM/ha.

Net pasture growth (NPG) from mid autumn to early spring was < 5 kgDM/ha/day. Pasture growth in the spring and summer was dependent on rainfall. The maximum NPG recorded was 17 kgDM/ha/day in spring 1993. Following summer rainfall, NPG was around 8 kgDM/ha/day. There were no treatment effects on NPG.

Digestibility and metabolisable energy of green herbage did not vary greatly through the year: digestible dry matter ranged from 60% to 70%, while metabolisable energy ranged from 8 to 10 MJ/kgDM. Crude protein content of green herbage, however, varied between *c.* 8% in the autumn and *c.* 16% in spring. A low protein content in *Themeda* in the autumn was the main cause of the low protein content of the pasture at this time of the year. *Themeda* was selected against by sheep in grazing at all times of the year, but especially in autumn and winter. *Poa labillardierei* was grazed very little at any time of the year. There were no treatment effects on forage quality.

Botanical composition

Themeda was the major component of the pasture (Table 1). However, the small native sedge, *Schoenus apogon*, had the highest basal cover (5.0%). Under set stocking the pasture showed seasonal fluctuations in botanical composition, but no substantial changes between years.

Treatments where significant changes occurred in botanical composition, involving one or more species, are shown in Table 1. The increased spring grazing treatment was effectively increased

Table 1. Initial composition (% HM: % total herbage mass; % BC : % basal area cover) of the pasture, and treatment effects based on significant T-values of fitted splines for % composition and/or yield data (+ve = increase; -ve = decrease)

Species	Initial composition		Treatments						
	% HM	% BC	Seasonal spell				Mob Stock		Incr. spring graze
			Spr.	Sum.	Aut.	Win.	Aut./Win.	Yr.-round	
*Themeda triandra**	41.7	3.5		+ve		-ve	+ve		-ve
Danthonia spp.*	27.2	3.3	+ve		+ve	+ve		+ve	+ve
*Microlaena stipoides**	7.6	0.2							
Anthoxanthum odoratum	6.1	0.7					-ve		-ve
Poa spp.*	-†	1.3							
Monocots	9.8	5.0							
Dicots	7.6	0.5		-ve		-ve			+ve

* Native grasses. † *P. labillardierei* excluded from herbage mass estimates.

grazing intensity year-round, as it continued to be grazed more closely following the initial increased spring grazing.

Phenology, seed and bud banks, and seedling recruitment

The growing period of *Themeda* was from September till April. It was killed by the first autumn frosts and then remained dormant through the winter. *Microlaena* also appeared to be winter dormant. By contrast, *Danthonia* continued growth through the winter. All three species made rapid growth in response to summer rainfall. Reproductive development began in November and continued until February, or later in the case of *Themeda*.

Seed banks of the native grasses were low relative to their bud banks (<10%), indicating their reliance on vegetative regrowth from established plants, rather than recruitment of new plants, for persistence in this pasture. *Danthonia* had the highest seed bank, ranging from 250/m^2 in 1994 to 170/m^2 in 1995 under set stocking (1996 data not yet available). All other native grasses had seed banks of less than 100/m^2. In contrast to the perennial native grasses, annual grasses, sedges and rushes, and several forb species had seed banks of >1000/m^2. Seed banks of the native grasses were increased two- to threefold by spelling over the reproductive period, provided seed production was not limited by seasonal conditions.

Few native grass seedlings were found in the pasture, and seedling recruitment was negligible (<1/m^2) in species other than *Danthonia*. There were no treatment effects on seedling emergence or recruitment. Averaged over all treatments observed, seedling emergence in *Danthonia* varied from 3.7 to 7.8/m^2 in the two years for which data are available (1994 and 1995), and percentage survival to April of the following year varied from 54% to 72%. Survival in all species was reduced by extended dry periods during summer.

Conclusion

The pasture was shown to be relatively stable under set stocking at moderate grazing intensities (2-2.5 DSE/ha). The pasture was characterised by low growth rates, and limited fluctuations in herbage mass through the year. Critical periods for animal production occurred in autumn, when forage quality was low, and in late winter, when the quantity of green forage was low.

The range of grasses present ensured year-round growth of the pasture, principally due to *Danthonia*, and also maximum response to summer rainfall, principally due to *Themeda*. *Microlaena* was most productive in the autumn, and provided valuable feed at this time. *Anthoxanthum*, although generally regarded as a weed in this pasture, also provided valuable winter and early spring feed.

Increasing the grazing intensity resulted in a decrease in *Themeda* and an increase in the proportion of *Danthonia* and forb species, particularly introduced flat weeds. Areas of natural pastures in Tasmania that are subject to high grazing intensities are commonly dominated by *Danthonia* and weedy forb species. *Themeda* was promoted by spelling in the summer, when its growth was most active, whereas *Danthonia* was promoted by spelling at other times of the year, but especially in the winter, when *Themeda* was dormant. The high content of *Themeda* in this pasture probably relates to the normal practice of spelling in the late spring/early summer period on this property.

Danthonia is undoutedly the most valuable grazing species in this pasture, and the results indicate that it could be increased by spelling at times of the year other than summer. Alternatively, some form of rotational grazing may be beneficial for *Danthonia*.

The low seed banks of the native grasses makes them vulnerable to local extinction in the event of loss of the established plants. So long as dense, vigorous stands of the native grasses are maintained, recruitment may not be important. However, where overgrazing, drought or other adverse impacts have reduced the cover or vigour of the native grasses, a long spring-summer spell is needed to provide for recruitment.