Evaluation of dryland forage species for lowland Marlborough and 'Mid Canterbury

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Abstract

Grazing trials were established at Dashwood, Marlborough and at Winchmore Research Station, Mid Canterbury, to determine persistence, production patterns and changes in composition of various dryland pasture species. Plots were individually fenced and grazed to optimise individual species performance. At Dashwood (Dashwood shallow silt loam and stony loam, 600 mm rainfall), nine species were established: ryegrasses (Grasslands Supernui, Grasslands Nui, and a local ecotype), cocksfoot (Grasslands Wana), phalaris (Grasslands Maru), bromes (Grasslands Tiki and Grasslands Hakari), wheatgrass (Grasslands Luna), and a lucerne/phalaris mix (Grasslands Otaio Maru). All species were sown with white clover (Grasslands Tahora) and red clover (Grasslands Pawera). Interim results of the first 3 years show ryegrass species Supernui, Nui and the local ecotype established well in the first year but are gradually being surpassed by the slower establishing species such as Maru, Wana and Otaio lucerne. The Winchmore project (Lismore stony silt loam, 739 mm rainfall) included 11 species: lucerne (Grasslands Otaio), sheep's burnet, birdsfoot trefoil (Grasslands Goldie), red clover (Grasslands Colenso), browntop (Grasslands Muster), chicory (Grasslands Puna), wheatgrass (Grasslands Luna), ryegrass (Grasslands Pacific), smooth brome (Grasslands Tiki), upland brome (Grasslands Hakari) and grazing brome (Grasslands Gala). Over the first three years Otaio has remained as one of the best producers, but Colenso and Tiki, while producing well in the first year havedropped considerably by year three. Results demonstrate that there is potential for some species tested to enhance the production on the light east coast soils in the South Island but in the long-term persistence must be monitored.

Keywords: dryland, pasture species, pasture composition, pasture yield

Introduction

The major agriculture land use in Mid Canterbury and Marlborough is grazed pasture. Both Winchmore (Mid Canterbury) and the Dashwood (Marlborough) are considered dryland areas by New Zealand standards (Barker & Chu 1985) with low annual rainfall (Table 2) and soils of low water holding capacity. Farmers in these areas have to deal with large fluctuations in dry matter production (Rickard & Radcliffe 1976; Barrs *et al.* 1990) which generally result in large fluctuations in animal production, farm income and a consequential effect on the rest of the regions economy. Many farmers are unsure of new pasture species in terms of longevity, insect tolerance and seasonal productivity. Most tend to defer their use until proven in a framing system (Scales 1992). A range of pasture species identified to have potential for dryland production (Hume & Fraser 1985) were established at Winchmore and Dashwood to identify some of these values. The aim was to demonstrate production and persistency under grazing, and integrate this potential into dryland pastoral practices within both environments.

Methods and materials

Trial 1: Mid Canterbury

This trial is sited at the Winchmore Research Station. The Lismore stony silt loam soil was cultivated to produce a firm fine seedbed and the trial was drilled 28 October 1989. An Oyjord cone seeder (set at 15 cm row spacings), was used to ensure species were sown at the selected rate (Table 1). White clover (Grasslands Prop and Grasslands Tahora) and subterranean clover (Grasslands Mount Barker) were drilled with all grass species. 250 kg/ha of superphosphate and 2.5 t/ha lime had previously been applied in late September. Plot size was 14 x 12 m with 3 replicates and each plot was individually fenced. 250 kg/ha of superphosphate was applied each winter and in 1991 the trial received 110 kg/ha of potassium chloride.

Table 1 Species established and sowing rates (kg/ha) Winchmore and Dashwood sites.

Species	Common Name (cultivar)[1]	Sown rate Dashwood	Sown rate Winchmore
Lolium perenne	Ryegrass (Supernui)	25	
	Ryegrass (Nui)	25	
	Ryegrass (Pacific)		25
	Ryegrass (Local ecotype)	25	
Dactylis glomera ta	Cocksfoot (Wana)	10	
Bromus inermis	Smooth brome (Tiki)	13	13
8. stamineus	Grazing brome (Gala)		25
B. sitchenis	Upland brome (Hakari)	30	30
Agropyron trichophorum	Pubescent wheatgrass (Luna)	12	12
Phalaris aquatica	Canary grass (Maru)	8	
Agrostis capillaris	Browntop (Muster)		5
Medicago sativa	Lucerne (Otaio) coated seed	15	15
Lotus *corniculatus*	Birdsfoot trefoil (Goldie)		8
Trifolium repens	White clover (Tahora) (Prop)	3	
T. pratense	Red clover (Colenso)		12
	Red clover (Pawera)	2	
Sanguisorba minor	Sheep's burnet		15
Cichorium intybus	Chicory (Puna)		4

[1] All 'Grasslands' cultivar except Luna wheatgrass

Pasture measurement

The grazing time and the residual remaining after grazing was set for each species in order to maximise potential pasture production and persistence. Pasture yields were measured both pre- and post-grazing and yields expressed as the difference between the previous post-grazing cut and the present pre-grazing cut. The plot 'dry matter' reading was determined with a Gallagher pasture probe and then a 0.25 m^2 quadrat that gave a similar probe reading to the plot mean was located within the plot. This quadrat was cut to ground level with a shearing machine, and the herbage was washed, dried and weighed to determine dry matter. At each pre-grazing cut in 1990/9 1 and at one pre-grazing of the spring, summer and autumn in the next two years, levels of sown species, clover and weeds were identified by botanical dissection. Sufficient sheep to consume the herbage within 2-4 days were introduced to the plots immediately after each herbage sampling. The production year is from 1 July to 30 June.

Trial 2: Marlborough

The trial is located at Dashwood, in the lower Awatere Valley, on a dry subhygrous yellow-brown shallow silt (Northern site) and stony loam (Southern site) soil types. Typical pasture cover prior to trial establishment consisted of danthonia *(Notodanthonia* spp. syn. *Danthonia* spp.), striated *(Trifolium striatum)* and subterranean *(Trifolium subterraneum)* clovers. Mean annual rainfall is 591 mm (Lake Grassmere), and altitude is 90 m.

The total area was summer fallowed (1990191) after winter green feed. Following conventional cultivation, 2 t/ha lime (soil pH prior to sowing was 5.5), 125 kg superphosphate and phorate insecticide (Thimet 20G™: 5 kg/ha) to control grass grub *(Costelytru zealandica)* were applied and worked in. The trial was drilled (Table 1) into a find seedbed on 11 April 1991 using a cone seeder (same method as Winchmore). White clover (Grasslands Tahora) and red clover (Grasslands Pawera) were drilled with all grass species. Lucerne (Grasslands Otaio) was spring sown 25 September 1991. Each plot was 23 m x 22 m. Species were sown within a randomised block design, replicated four times. Two replicates were placed within each soil description. Each plot was individually fenced to allow independent sheep grazing. Maintenance fertiliser was applied each August at 100 kg/ha 28% sulphur super.

Pasture measurement and management

Dry matter production measurements were taken immediately before grazing, using hand clippers. Four 0.25 m^2 quadrat areas per plot were cut to 2-3 cm above ground level using a stratified randomisation selection method. Further samples were randomly collected from within individual plots before grazing for botanical dissections to identify total sown species, total clovers, weed and the dead component. Measurement year is from May to April (Figure 2). All plots were rotationally grazed with sufficient sheep to defoliate to the cutting height within 40-50 hours. For any plot grazed for a greater period, yield adjustments were made using calculated daily plot growth yields. The mean grazing intervals were 1991-92: 202, 129 days, 1992-93: 104,176, 88 days, and 1993-94: 73, 78, 85,75 and 133 days, Some plots were topped after grazing if and when required.

Results and discussion

Winchmore

Grass treatments

In the first two years production the sown grass component for all treatments was statistically similar to Pacific (Figure 1) but by the third year production from

Hakari and Tiki were significantly less. The clover yields from the Luna and Muster in the first year, and all except the grazing brome in the second year, were statistically higher than that from Pacific. However, in the final year 1992/93, clover yield in the Pacific treatment was significantly higher than all other grasses except Hakari.

Legume and forb treatments

Otaio (Figure 1) was one of the highest yielding species. Puna in the first year, and all except Goldie in the second, gave similar yields to Otaio. The Puna treatment in the first year, and sheep burnet in the third, produced significantly more clover than the Otaio treatment.

Rainfall in Mid Canterbury can vary widely from month to month (Table 2) but in general 1990191 was an average year, 1991/92 was dry in the summer and autumn and 1992/93 had higher than average rainfall. The prolonged dry period in 1991/92 had a levelling effect on yield (Figure 1) and as a result Otaio and Puna which yielded higher in the first year, were similar to the other species. Otaio recovered from the dry period better than the other species and responded to the higher rainfall in 1992193. The relatively poor production from grasses in the third year despite the better rainfall may be a result of grassgmb infestation which was evident through most plots. Otaio was the only species to maintain high yields over the three years of the trial. Goldie, Colenso, Hakari and Tiki all declined in yield by the third year, with Colenso having low plant numbers, thus substantiating results from east coast North Island (Smith *et al.* 1993). Luna, Muster and Gala maintained their yield relative to Pacific, and Luna and Muster had the best yield of clovers. Sheep's burnet and Puna gave medium to high yields and maintained plant numbers.

Figure 1 Annual yield (t DM/ha) of sown species and clover, Winchmore Research Station, Mid Canterbury.

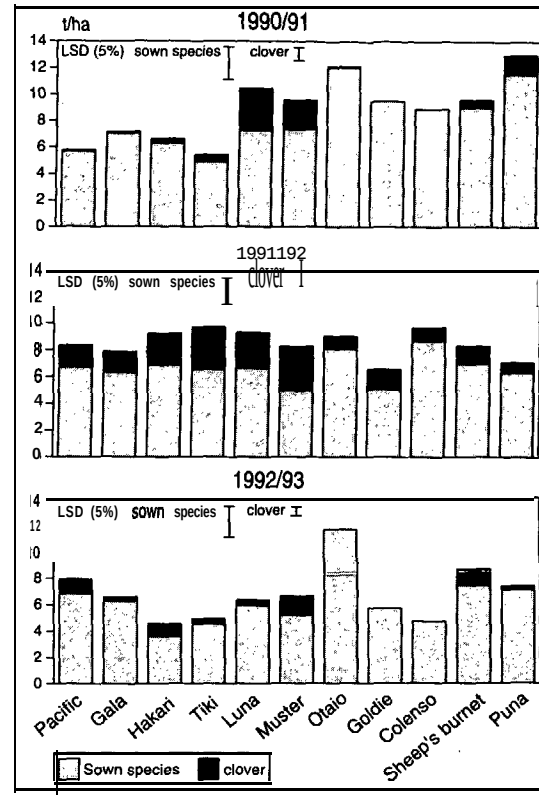


Table 2 Rainfall (mm) recorded at Winchmore Research Station, Mid-Canterbury 1990-93 and Dashwood, Marlborough 1991-94.

	Winchmore				Dashwood				
	90/91	91/92	92/93	Mean	91	91/92	92/93	93/94	Mean[1]
Jul	54.5	72.4	102.8	64.8		78.0	7.5	62.0	71.0
Aug	121.3	23.4	137.9	67.0		86.0	7.0	65.0	62.0
Sep	46.1	58.2	101.2	48.0		58.0	52.0	49.0	39.0
Oct	62.5	33.0	83.7	63.0		62.0	5.0	55.0	42.0
Nov	65.5	66.8	48.6	63.1		19.0	73.0	46.0	32.0
Dec	49.4	109.6	73.9	69.1		10.0	62.5	46.0	41.0
Jan	59.8	25.9	55.1	58.4	25.0	18.5	50.0	45.9	48.0
Feb	65.9	22.3	39.5	55.0	72.0	109.0	44.0	31.0	28.0
Mar	35.0	4.2	57.5	68.6	19.0	57.0	45.0	33.0	54.0
Apr	65.4	27.5	105.7	66.9	2.0	18.0	56.0	19.0	61.0
May	40.9	60.7	86.9	66.0	26.0	106.0	68.0		63.8
Jun	78.9	35.8	19.8	50.3	52.0	98.0	56.0		52.0
Total	745.2	559.8	912.6	738.0	196.0[2]	719.5	546.0	451.91	591.0

Winchmore mean 1950-93

[1] Lake Grassmere mean 1950-80

[2] Year to date

Dashwood

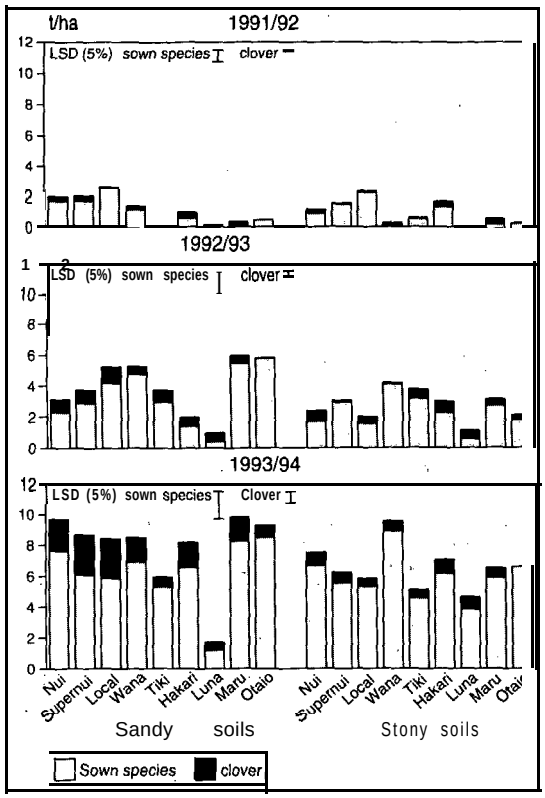
Establishment

Dry conditions prior to drilling made soil consolidation and therefore seed depth placement difficult. This may have contributed to reduced seedling establishment and vigour (Woodman *et al.* 1990), leaving seedlings sensitive to competition from volunteer species, and contributing to lower sown grass and clover content (Smith et al. 1993). Of the species sown, ryegrass was least affected. At this interim stage insect damage has not affected results.

Ryegrass

All ryegrasses established well and showed excellent vigour, particularly the local ecotype (Figure 2). During Year 1 (1991/92) ryegrasses generally out-produced all other species, and the clover content of Nui and Supemui was higher than that of the local ecotype. By Year 3 relative production from the local ecotype reduced and Nui appeared as the most productive ryegrass (Figure 2). Stock appeared reluctant to graze the ryegrasses, in particular the local ecotype, which is high in endophyte (Hoglund & White 1985).

Figure 2 Annual yield (t DM/ha) of sown species and clover, Dashwood, Malborough.



Cocksfoot

Wana was slow to establish on both 'soil types and initial yields were relatively low, but by Year 3 production had increased dramatically. The legume content increased over the three years, showing that despite general evidence of poor clover content within Wana pastures (Rumba11 1982), this grass can support a reasonable legume base. It was noted that Wana was the quickest species to respond after summer moisture stress. By Year 3 Wana appeared more acceptable to stock than the ryegrass species.

Bromes

Hakari and Tiki were slow to establish, with Hakari producing more in Year 1, especially on the stony loam where its production matched that of ryegrass. Initially Tiki had high levels of weeds (>30%) but by Year 3 its production was close to that of Hakari and did not differ significantly from other species (Figure 2) with the exception of wheatgrass on the silt loam (which was less) and Wana on the stony loam (which was greater). Both species appeared highly palatable to stock, with Hakari reaching seedhead a little earlier in the season.

Lucerne/phalaris

Initial establishment was poor, particularly for Maru (contributed only 8% to production). By Year 3 production had increased to match that of most other species, with luceme dominant in the mix.

Wheatgrass

Luna was very slow to establish but by Year 3 production had improved, particularly on the stony loam. Observations were that it carried well into the summer, but was slow to respond in the autumn. Luna appears highly palatable to stock.

Phalaris

Maru was slow to establish but by Year 3 was one of the best producers, especially on the silt loam. Seasonal production patterns of Maru in Marlborough appear similar to that reported elsewhere (Hume & Fraser 1985), with very good late winter/early spring growth but very little summer growth. Autumn growth was good, but less than that from Wana and the ryegrasses.

Conclusions

Generalisations are difficult as results are clearly site and soil specific. The productive capacity of various pastures changes over time. These interim results confirm that, once established, Otaio and Wana are reliable and productive pasture species. Gala grazing brome is appearing as the more suitable brome for coastal conditions. Although Maru was slow to establish its performance is improving with time. The rhizomatous nature of this grass and others such as Luna and Tiki brome make them ideally suited to the dry coastal conditions of Marlborough and Canterbury provided they are not smothered by competition during the first and second years of establishment. At the Winchmore site Puna, sheep's bumet and Muster are performing well at this stage. These pastures on both sites will be

re-visited in 3-4 years time to assess their longer-term persistence.

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REFERENCES

Barrs, J.A.; Radcliffe, J.E.; Rollo, M.D. 1990. Climatic change effects on seasonal patterns of pasture production in New Zealand. *Proceedings of the New Zealand Grassland Association 51: 43-46.*

Barker, D.J.; Chu, A.C.P. 1985. Strategies for dryland pasture management – a review. *Proceedings Agronomy Society of New* Zealand 15: 1 IS-120

Hoglund, J.H.; White; J.G.H. 1985. Environmental and agronomic constraints in dryland pasture and choice of species. *in Grassland Research and Practice Series No.3:* New Zealand Grassland Association 1985. ed. R.E. Burgess and J.L. Brock. 39-43.

Hume, D.E.; Fraser, T.J. 1985. Establishing and managing recent cultivars in arable dryland pastures. *in Grassland Research and Practice Series No.3:* New Zealand Grassland Association 1985. ed. R.E. Burgess and J.L. Brock. 45-49.

Rickard, D.S.; Radcliffe, J.E. 1976. Seasonal distribution of pasture production in New Zealand 12 Winchmore, Canterbury Plains, dryland and irrigated pastures. *New Zealand journal of experimental* agriculture 4: 329-335.

Rumball, W. 1982. Grasslands Wana cocksfoot *(Dactylis glomerata). New Zealand journal of experimental agriculture 10: 51-52.*

Scales, G.H. 1992 Dryland pasture species survey. Use of alternative pasture species by South Island east coast farmers (unpublished).

Smith, D.R.; Slay, M.W.A.; Gray, M.H.; Milne, G.D. 1993. On-farm establishment of drought-tolerant pastures on the east coast of the North Island. *Proceedings of the New Zealand Grassland Association 55: 33-38.*

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