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PLACE OF OVERSOWN LUCERNE IN DRY HILL COUNTRY FARMING SYSTEMS

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Abstract

Four years data from a steepland site near Omarama, North Otago (500 mm rainfall), shows that on average oversown lucerne produced 5.3 t/ha/annum, with 3.3 t/ha of this being produced between mid August and late November. The translation of this small-plot yield to expected production under normal grazing is discussed. In deriving the expected production, corrections are made for the long term production from nearby dryland lucerne stands, the effects of varying terrain within hill blocks and the effects of grazing management on utilisation.

Recent research results and farmer practice both indicate that extensive areas of lucerne can be managed with simple systems that do not necessitate more intensive subdivision than for pasture. The expected production under grazing is used in a linear programme model of a semi-arid zone farm system, which includes a wide range of options. Examples investigated with the model included 'warm' and 'cold' properties, varying levels of development and allowing some irrigation. The likely costs of establishing lucerne are some 70% greater than for a clover-based pasture. However the model shows that the pattern and quantity of grazing provided by lucerne on low-sunny country makes it a profitable part of a development programme that balances year-round feed supplies, particularly on colder properties.

Keywords: *Medicago sativa,* rangeland, semi-arid, oversowing, grazing management, profitability, model.

INTRODUCTION

In the semi-arid zone of North and Central Otago there are some 4-500,000 ha of steepland soils with naturally high pH, base saturation and fertility, which are well suited to the introduction of lucerne *(Medicago sativa)* (Douglas 1970). These soils are situated mainly on low-altitude sunny faces which are too drought prone to sustain perennial clover-based pasture. In a recent review on the establishment of lucerne from oversowing, Musgrave (1982a) noted that although establishment rates are low and variable, and there is much scope for improvement, adequate establishment could be obtained with reasonable reliability in wetter parts of the semi-arid zone and the sub-humid zone. It was also noted that in the event of poor establishment it is possible to thicken up stands, by spelling to allow reseeding.

There is a degree of uncertainty within the farming community as how best to manage extensive areas of grazed lucerne and how to translate yields from small plots under cutting, into the returns which might be expected to accrue to the farming operation as a whole, from an investment in oversown lucerne. This paper uses the authors small plot data and recently published work on grazing management to assess the likely lucerne production and utilisation. The estimated production is then used as an input in a computer model to assess the place of over-sown lucerne in a whole farm development programme.

Table 1: DETAILS OF YIELDS OF LUCERNE FROM SMALL PLOTS AND. THE PREDICTED LONG TERM YIELDS (t/ha)

	to 30 November	Annual Total
1973174	1.72	4.94
1974/75	2.87	6.27
1975/76	4.04	4.78
1978179	4.63	N.A.
Mean	3.32	5.33
Long Term Mean	3.45	4.68

N.A. = Not Available

EXPECTED LUCERNE YIELDS

Small Plots

In Table 1 the yields over four seasons from small plots on a low altitude (480 m) sunny face near Omarama are shown. A high proportion of the annual yield is grown between mid-August and the end of November.

Long Term Mean

When the production from this site was compared with data from dryland lucerne stands in the area in the same years (Douglas & Kinder 1973, Scott & Maunsell 1981, Musgrave unpubl.) production to the end of November was below a nine year average and production over the whole season above average. Thus the 4 year mean value has been adjusted relative to the dryland lucerne yield in the same years, to give an expected long term mean (Table 1). Production on the sunny faces to the end of November was about 10% below production on the flats, while whole season production was about 20% less. This was a reflection of the earlier drying out which occurred on sunny faces.

Effect of Terrain

To correct the small plot yields for the variation which exists within hill blocks, two blocks at Tara Hills were taken as an example. Rock outcrops accounted for about 5% of the surface area, shady slopes for 8-21% and mid altitude areas for 7-10% (Edge 1979). Small plot yields were calculated on surface area, and the steep slopes on these blocks increased the effective surface area by some 4-6% over the map area.

Two years data from a shady face adjacent to the site represented in Table 1 suggested that lucerne production is only 60% of that on the sunny face. Four years data from lucerne at mid altitude (1070 m) (Musgrave 1977a) shows that lucerne production is 70% of that at low altitude until the end of November, and 50% on an annual basis. When the corrections for rock, aspect, altitude and slope are combined, for these examples production was likely to be from 90-93% of that from small plots. The lucerne growth input for the model was assumed to be 90% of the long term mean.

GRAZING MANAGEMENT

The concepts of grazing management for lucerne have evolved considerably from those advocated in the 1960's, when it was considered that lucerne was essentially a hay type plant and that grazing management should endeavour to mimic cutting (Iversen 1967). More recent reviews of grazing management have reaffirmed the disastrous effects of continuous grazing on lucerne survival and the critical need for adequate spelling between grazing (Leach 1978, Janson 1982). However there is a growing awareness that the length of the grazing period can be extended, with a consequent reduction in the number of paddocks required for a closed rotation. In a short term grazing experiment at Lincoln, O'Connor (1971) noted that, compared to a 14 paddock system, a 3 paddock system gave better lamb growth but poorer ewe growth, with an overall decrease in liveweight gain/ha of 8%. A second experiment showed that grazing duration had no effect on lucerne survival or subsequent yield, while the spelling period markedly effected both.

In a 4 year grazing study at Canberra, McKinney (1974) was able to show that with grazing durations up to 25 days in summer and 45 days in winter, lucerne yields and persistence were almost solely dependent on spelling periods and little affected by grazing duration. Animal output was influenced by both factors to some extent, but the dominant effects appeared to be loss of lucerne under continuous set stocking, and excessive stem development with long spelling times, both reducing animal output. The highest animal output was achieved with either 2 or 3 paddock systems. Both O'Connor (1971) and McKinney (1974) have demonstrated that, as in other pasture systems, what is the best management for the lucerne plant is not necessarily the best for animal output.

These studies have helped to develop the principles of lucerne grazing, but are often not directly applicable, since in most areas few farmers attempt to operate closed lucerne systems (Brosnan 1982, Mace 1982, Talbot 1982). A recent study of particular relevance to this problem looked at the survival of continuously grazed lucerne and the effects of 65 day spelling period during each season (Meyer & Kirchner 1982). Over 90% of the variation in lucerne survival was accounted for by the amount of dry matter accumulated during the spelling periods. Two 65 day spells within summer and autumn were sufficient to maintain high plant numbers (Fig. 1).

In grazing experiments with a continuous grazing treatment which were started in early spring, lucerne plant numbers were maintained for the initial 3-6 months (Smith 1970, Brownlee 1973, McKinney 1974, Southwood & Robards 1975). In all these situations animal liveweights were maintained at similar levels to rotational treatments until death of lucerne plants occurred. These results support the sort of system which is evolving in Central Otago, where some farmers set stock their lucerne until lamb marking and then move into a rotation, with grazing durations of around 2 weeks (Talbot 1982).

Recent research and farmer experience from low rainfall areas (450-700 mm) suggests that there are two alternative simple systems which could be used for oversown lucerne that would maintain animal production as long as spelling periods were adequate.

1. A three paddock rotational system, which uses up to a 25 day grazing duration.
2. Set stocked from just prior to lambing until marking and then periodically grazed with larger mobs, such as lambs after weaning etc..

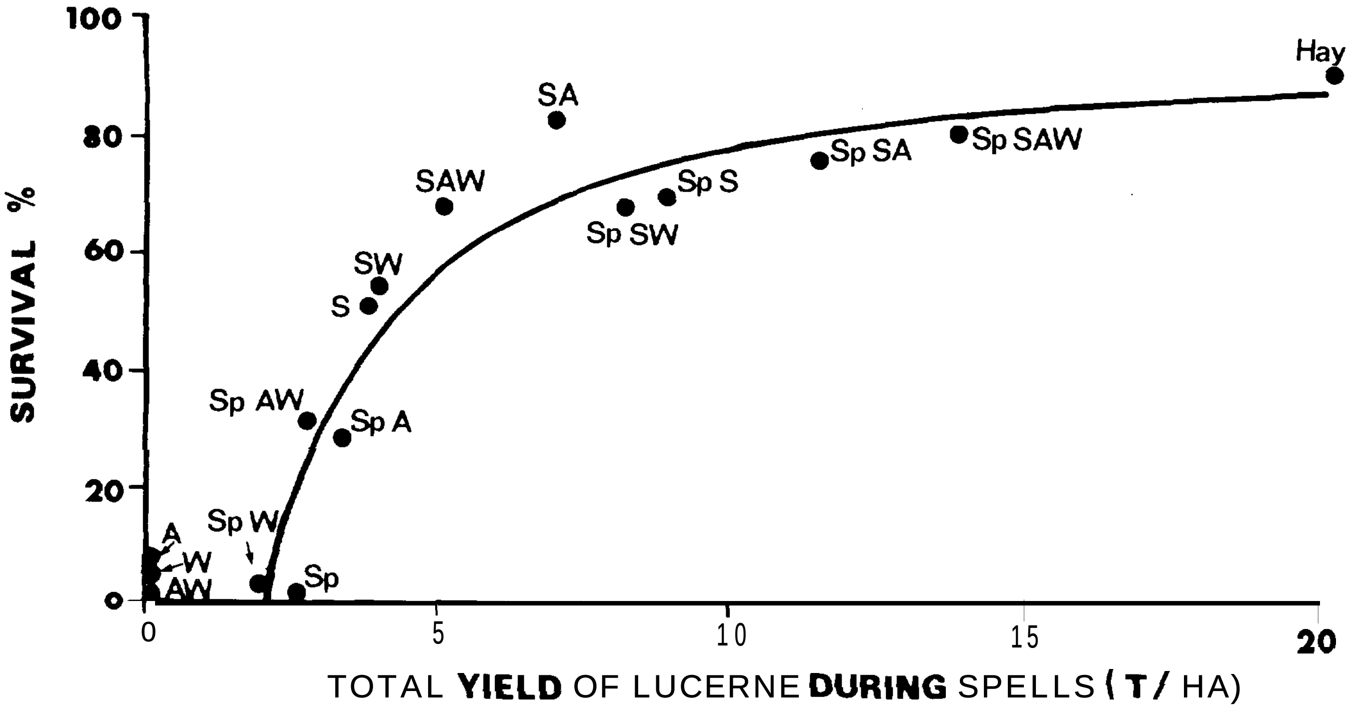

Fig. *1 The relationship between lucerne plant survival, under otherwise continuous grazing, and the yield of lucerne over two years from 65 day spells during the seasons indicated. (Sp, S, A, W = the four seasons, Hay = continuously mown for hay). After Meyers & Kirchner 1982.*

The first option requires closer subdivision than is normal for pasture, the second does not.

ECONOMICS WITHIN A FARM SYSTEM

A linear programme model has been developed to examine the profitability of a wide range of options for development of hill country in North and Central Otago (Musgrave 1982b). The model is essentially a form of feed budgeting, calculating the balance of pasture development and sheep enterprises which maximises return per unit area, depending on the nature of the property. The low-sunnv countrv can be develooed to a clover based pasture or lucerne. or remain as native 'pasture. The other classes of hill country do not have the lucerne option. Capital costs included in the calculations include earthworks for irrigation, pasture development, fencing and stock. Running costs include maintenance fertiliser, fence maintenance and interest on capital charged at 9%. There was no allowance made for fixed costs, such as land, building, labour, plant or tracking.

The assessed likely productivity of oversown lucerne from the previous sections was included in the model structure, assuming 75% utilisation of the lucerne (c.f. 79% — Thomson 1978). The costs used were on the same basis as for oversown clover pastures on low-sunny faces, with an allowance for 10 kg/ha Rere seed and for an additional 25% of seeding costs, on the conservative assumption that one in four blocks sown may need reseeding. On this basis establishing lucerne on low-sunny faces costs some 70% more than establishing a clover based pasture.

Table 2: THE AREAS OF EACH LAND UNIT (ha) ASSUMED FOR THE EXAMPLES USED IN THE MODEL

Land Class	Brief description	'Warm'	'Cold'
1. High-fertility flats	Fan soils	50	50
2. Low-fertility flats	Stony alluvial	50	50
3. Low-sunny faces	Too dry for white clover	300	100
4. Low-shady faces	Equivalent altitude to 3.	100	300
5. Mid-sunny faces	White clover country up to snow tussock zone	300	100
6. Mid-shady faces	Equivalent altitude to 5.	100	300
7. High-altitude	Snow tussock zone	100	100

Two hypothetical 1000 ha properties have been used, which approximate two real units, a 'warm', predominantly north-facing property and a 'cold' southerly-facing property (Table 2). An initial run of the model was made to find the solution which gave the highest return (optimum) and then a series of runs were made with the amount of capital available for development restricted, to illustrate varying degrees of development (Table 3) bearing in mind that the unimproved state represents a capital sum of close to 20% of that required at the optimum. The 'safety factor' is the percentage that the cost of oversown lucerne

Table 3: THE EFFECT OF VARIOUS LEVELS OF CAPITAL DEVELOPMENT EXPENDITURE ON 'WARM' AND 'COLD' FARM UNITS

	% Optimum capital	Area in oversown Lucerne (ha)	'Safety factor' for over-sown lucerne	Area developed to oversown pasture (ha) Low-shady	Mid-sunny	Mid-shady	High-altitude	Stock units
Warm:								
	40	32	31	57	184	0	0	1305
	60	67	56	100	300	29	0	2416
	80	111	89	100	300	100	0	3320
	100 ($173,200)	300	157	100	300	100	100	4218
+ Irrigation	100 ($254,300)	300	112	100	300	100	100	5624
Cold:								
	40	24	98	70	100	0	0	957
	60	52	96	251	100	0	0	1876
	80	77	122	300	100	112	0	2774
	100 ($146,100)	100	658	300	100	300	0	3586
+ Irrigation	100 (222,500)	100	748	300	100	300	0	4768

could increase or production decrease before the models' solution would change, so is a measure of the margin for error. The return on development capital (after payment of interest) ranged from 19-32%.

The pattern of development, suggested by the model for the two properties has interesting implications for hill country development programmes. The 'easy' low-shady country has the highest average carrying capacity (Musgrave 1977b) and in practice tends to be developed first. However even at the lowest level of development it is economically desirable to develop substantial areas of mid-sunny country and some oversown lucerne to provide a balanced feed supply. The pattern of developing a balance of land units, giving the best results, was evident in all the examples tested.

The low-sunny country, mid-shady country and the high-altitude snow tussock country were the last areas to be completely developed by the model with all of the high-altitude country remaining native on the 'cold' property. The low-sunny country was progressively developed entirely to lucerne on both properties with high 'safety factorlevels. At 80% on the 'warm' property, 170 ha of low-sunny pastures, spelled from late summer to provide winter feed, came into the solution, but only with 3% 'safety factor'.

The effects of allowing small areas of irrigation into the solution were different for the two property types. The summer production of the lucerne was as important as the early spring production to balance feed supplies on the 'warm' property. On the 'cold' property, early spring feed was at a premium and the need for lucerne great, while midsummer feed demand was adequately catered for by the shady country and the irrigation and the high altitude country could not profitably be developed.

If it was desired to use lucerne in a closed paddock system, changing from 100 ha to 33 ha paddocks with a conventional fence would add approx. 17% to costs. In all of the examples used the increase could be absorbed without any change in the model solution.

CONCLUSIONS

The costs of establishing lucerne are some 70% greater than for a clover based pasture. However the model demonstrates that the pattern and quantity of grazing provided by lucerne on low sunny country makes it a profitable part of a development plan to balance year round feed supplies, particularly on colder properties.

Recent research results and farmer practice both indicate that extensive areas of oversown lucerne could be fitted into existing management systems without the need for additional subdivision.

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