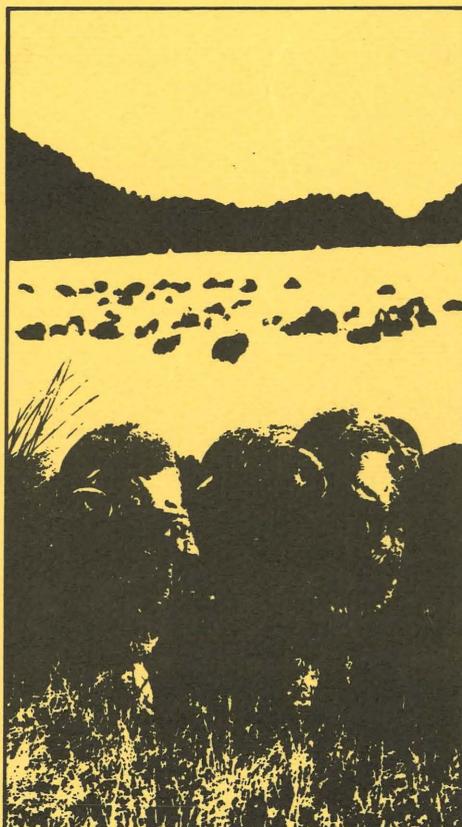
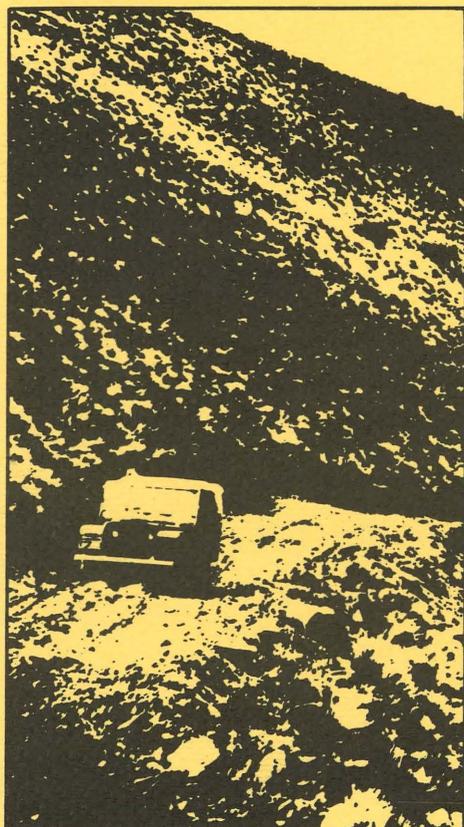


Proceedings of the

1985 HILL AND HIGH COUNTRY SEMINAR



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The Challenge of Goats

G. Batten*

The challenge of goats is for pastoral farmers to accept that goats are a vehicle for carrying them to economic survival, and for the agricultural establishment to accept that goats will take an increasingly prominent place in New Zealand's pastoral industry.

Such a challenge is not easy, given the historical role of goats in New Zealand — their association with early pioneering small holders, escapes and subsequent vegetation destruction, and latterly with alternative life stylers. However, the challenge is largely in the mind, and this paper offers farmers and the industry a thought pathway to decide how, rather than if, goats can be fitted in.

To lay the pathway, the paper answers the question "why go into goats?", although it may be more tempting to ask "why not go into goats?". The answers are more concerned with philosophy and background than practical goat farming as covered in other papers. Having answered the question why?, the what, when, where and how tend to fall into place.

Why go into goats?

There are some keys to successful commercial fibre and meat goat farming included at the end of the paper. However, a clear objective is needed at the beginning of any new enterprise.

Some reasons for going into goats are to diversify, to make more money, to better utilise resources, to control weeds, or to increase satisfaction from farming. The appropriate answer lies within the parameters of land and climate, labour and finance. These basic factors dictate the type of goats that should be farmed.

*MAF, Nelson

Translating the objective into practice requires a critical assessment of the framework of farming.

Framework of farming

(a) Land and climate

Land and climate are two of the main factors that determine production type and level.

It is not chance that goats, especially Angoras, are farmed in low rainfall areas of the world. At the same time, production of protein meat, fibre and milk requires good feeding. The drier New Zealand hill country is ideal for goats. This is not to say that goats cannot be farmed productively elsewhere, but overall profitability will be lower because of lower productive levels, and costs of higher losses.

Cashmere growth is influenced by hormones some of which are triggered by light, and logic suggests that southern New Zealand would be the best place to produce it.

Goats are susceptible to cold, wet windy weather. Shelter is an important management aspect, to cope with the shearing/kidding conflict during bad spring weather. At this stage of goat farm management, farms without natural shelter have problems.

Predators are a major problem in many other countries. Normally New Zealand farmers are able to run livestock unattended with little fear of theft, but valuable, portable goats have recently become a commodity that thieves find hard to resist.

It is a popular belief that goat farms are on rough land growing scrub. This myth relates to the goats's historical place in New Zealand agriculture. Goats do not need

roughage, so they do not need scrub, and the high value of their products justifies use of the best land not the worst, even though gorse produces four times as much dry matter as pasture on hill country.

(b) Labour

The second main factor is people.

New Zealand pastoral farmers have some unique pastoral farming skills and knowledge reflecting experience, training and education built up over a century. However, they do not have the same skills in goat farming. There are similarities between goat, sheep and cattle management, but there are major differences too that become increasingly important as goat stocking rates and/or expectations increase.

There is a dearth of good information to help train farmers, and overseas guidance is not relevant as it is based in either very intensive or very extensive management systems. This problem is compounded by differences between breeds of goats. For example Angoras are biologically different from Cashmere goats.

It is difficult for a New Zealand farmer to develop the necessary skills and knowledge especially when advisory and research backup is limited. Erstwhile goat farmers can make positive progress in developing skills and knowledge by consciously developing their own experiences and sharing them with others. Proximity to other farms with similar goat enterprises could be important for mutual support to fill knowledge gaps.

Labour output is also related to rewards. For farmers who accept low income levels whilst waiting for capital gains, and seek other rewards in the meantime, goats are certainly rewarding to work with as they respond well to humans.

There are also rewards in being able to indulge in lateral thinking about this new industry. Shearing goats standing up, growing fodder trees that goats can utilise better, spread grazing to capitalise on the goats natural rotational instinct, putting coats on goats, herding them on high country, a vertically integrated goat to gown

industry structure are all examples of exciting and rewarding thinking.

Also exciting are the opportunities provided by new technology and the challenge in adapting this to goats. Embryo transfer and AI are already being quickly adopted on a relatively large scale, unhindered by traditional sheep breeding attitudes.

(c) Financial investment and financial return

The final factor is money. Facilities for farming goats require investment, and fencing is especially important. However the major investment is likely to be the animals themselves. This focuses attention of the very high current price levels, and current interest levels tighten the focus. The production risks of a new enterprise may not be acceptable to a borrower or a lender of substantial capital.

The very high current value of goats creates a situation foreign to many farmers, who are unable to accept the responsibility of risk.

Net income expectation is the other financial parameter. How much is needed to cover costs, especially for interest? When is the income to flow? What is the situation past the farm gate for processing and marketing the products?

Within the parameters of land and climate, labour and finance the objective can be established, and the farmer can decide 'why farm goats?'

Objectives

(a) Diversification

Diversification means to change or modify, but not necessarily to produce more profit. The same income from different sources may be acceptable.

Goats can be diversified because they produce mohair, cashmere, cashgora and meat. These are different from sheep and cattle products, sold to different segments of the market in different countries. They certainly are sold at different prices.

(b) Increased returns

The components of returns are income and expenditure. Income comes from product

volume and price, and goat products sell at high prices. Cashmere at \$170 per kg, mohair at \$30, goat meat at \$4 are top level FOB prices showing that buyers appreciate their value. Kilograms of mohair or grams of cashmere influence income per goat, and so farmer's income.

At present the majority of goat farmers make most money from stock sold at prices that have both productive and speculative elements. Each element needs to be quantified to assess its relation to the objective of increased returns.

(c) Satisfaction

Personal satisfaction is important to farmers, and goats may (or may not) give it. A stockman may value handling soft and silky mohair; a pasture man may rejoice in seeing thistles disappear. Conversely good cashmere-bearing goats do not necessarily look "good" animals, even if they are more rewarding to work with than sheep.

(d) Weed control

Positive weed reduction and maximum goat income are not compatible, although reduced weed control costs can sometimes more than balance the equation, and skilled management can help to match these conflicting objectives. Weed control can be a bonus from farming goats for other reasons, but weed eradication especially of scrub weeds requires a specific management programme with specific goats for a specific goal that is aimed at reducing costs.

Planning

Having defined a clear objective within the parameters of production, land and climate, labour and finance, the next step is to translate this preparatory thinking into plans for farming goats in the chosen enterprise.

(a) Weed control

Weed control with goats is an enterprise in its own right, because of the substantial and increasing costs of chemical and mechanical control. Even though an Agricultural Economics Research Unit study shows that goat weed control is in itself profitable by reducing those costs, farmers

have been reluctant to take up the method. The prospect of making even a small amount of money from fibre has been the necessary stimulus for increasing numbers of farmers to accept the complementary role of goats in control or eradication of weeds.

"Goats are more effective weed controllers when forced into nutritionally stressful situations". Weed control can be a bonus from farming goats for other reasons, but weed eradication can be an objective in its own right, not to be confused with making money.

It should be noted, though, that production does not appear to be significantly influenced by nutrition. Growing on wethers that produce 40% more than does, is an attractive bonus from farming cashmere-producing wethers for weed eradication.

(b) Meat production

Meat is a byproduct and will continue to have this role for some years. Although New Zealand exported goat meat for many years, in recent times at higher prices than lamb, the demand for breeding goats, fibre production and weed control currently limits the numbers available for slaughter. The goat meat trade has traditionally suffered from lack of volume over which to spread overheads, or create marketable parcels. This disadvantage will continue, and limit the price that exporters can pay to farmers for their slaughter stock.

Whilst three times as much sheep meat as goat meat is eaten in the world, a greater number of people eat goat meat than sheep meat. This market is not only in poor countries, and it is not going to go away quickly. We have time to develop markets for our goat meat and should not lose that opportunity, but meat production as an enterprise should not be a priority at the moment.

(c) Fibre production

Fibre production is likely to be a major activity for hill country goat farming, and the farmer needs a clear breeding objective for fibre. Angora goats produce mohair. Most feral goats produce Cashmere in

varying quantities. Crossbreeding between these two types of goat produces crossbred fibre, most of which is Cashgora. Goat meat is not breed specific and the market place does not differentiate.

The Angora breed in this country is being established by either crossbreeding base stock and their progeny with purebred Angora bucks, or by purebred embryos being transferred to base recipient does.

Mohair has standards for quality based on colour, fineness, lack of kemp and weight of fleece. The crossbred animals produce a fibre intermediate between mohair and the fibre on the base goats. Some of this fibre is fine enough to be sold as cashmere at high prices. Some is sold as cashgora (i.e. 19-22 microns) for which a market is being established.

Cashmere grows on some goats and many ferals in New Zealand have this fine downy undercoat. Cashmere quality standards also relate to colour, fineness and fleece weight. There has been publicity given to a breeding policy for increasing cashmere weight and changing fibre colour to white by using bucks with some Angora blood, and warnings of the possible problems created if the fibre coarsens out of the cashmere fineness range.

In establishing a fibre production policy farmers should remember their overall objectives and the framework in which they were made as these will likely have most effect on the type of fibre produced. The main point is that there is currently a market at good prices for Mohair, Cashgora or Cashmere if these are the fibres being produced on the path towards the eventual fibre objective.

Economics

Diversification requires diversion of resources and is feasible only when there are early returns, high returns and a reasonable level of debt servicing — probably a maximum of 25%. In many cases the potential advantages of diversification are lost by erosion through hidden costs.

Increased returns are relative, and the problem in discussing alternative enter-

prises is establishing a basis for comparison. Making economic comparison with other enterprises is difficult. Calculations require definition of a goat productivity now, or from markedly improved stock in future generations. Usually omitted from economic comparisons are labour and especially basic pasture feeding costs, and often also interest costs. But these can be particularly relevant to goat farming with its different capital structure and feeding and management regimes.

Goats producing these high priced products are expensive, and interest on capital is the major expense factor. Other farming costs should not be significantly different to sheep and cattle farming costs.

When stock sales are more important than product sales, weaning percentage is particularly relevant to stock sale income.

Keys to success

Putting planning into practice needs commitment to success. The keys to success lie in having goats suitable to the farming conditions, the necessary husbandry and management skills and the financial aspects.

Future success will depend on further developing skills and knowledge to maximise production from these animals.

We have learned sufficient lessons about the need for market led production to not have to emphasise the importance of establishing markets first. The goat industry is fortunate in having established profitable markets waiting for its produce.

Marketing is critical, especially for new enterprises, and producers need to know about the product after it leaves the farm gate. Cashgora is a good example where speculation is influencing prices for a product that has not been marketed in a finished form. Cashmere is produced mainly in China, Afghanistan and Iran and supply is not satisfying demand. Several processors are paying apparently firm prices for specific qualities. Mohair production is similarly limited to South Africa, USA and Turkey where supply is not satisfying current demand and prices for New Zealand mohair have continued to edge upwards.

Goat meat is eaten by many people who for some years have been paying higher prices than for lamb. Many countries produce goats, many goats are traded live, and many are slaughtered for religious rather than nutritional reasons. There is a marked lack of market information about goat products, and producers need to stimulate more market research and development as well as keeping up to date with what is available. They must understand and measure the risks and returns for each product and market.

Finally, success will depend on the operation of a sound industry structure. Experience with new industries in recent years has emphasised the significance of an overall industry structure into which the production sector can be slotted. Kiwifruit is a good example showing the importance of organised product flow, quality, promotion, packaging and payment. Some other products have not been so successful, and the goat milk industry would be a lot further ahead now if it had established a viable framework seven years ago.

The existing and future structures for goat fibre and meat are therefore important areas to consider.

The meat industry has exporters with little in-depth knowledge of markets, with

processors who may be exporters, producers whose slaughter goats are by-products of fibre production or weed reduction systems, and game meat processor/exporters who are undercutting farmed meat goats.

The Angora industry has a breed society structure with branches throughout the country and has provided substantial resources for farmer training and education. Many members have small flocks of high value. The Cashmere industry has a producer organisation which has co-operative breeding schemes in various forms as a framework for farmer training and education. Members are mainly commercial farmers with average flock size of over 300 goats. Both fibre producer groups belong to an interim goat fibre marketing committee that is endeavouring to co-ordinate a fibre marketing organisation from producer to raw fibre buyer. They are both working positively to improve the commercial bases for their industries.

In conclusion, the recommendation for going into goats is to follow a pathway of thinking about why goats should be on the farm, plan how to farm them productively and then ensure that the key factors are covered. This will create a stable and profitable goat industry that will maintain hill country viability in the years ahead.

Goat Management and Fibre Returns

B. R. D. Purchas*

Introduction

Surely the most maligned and misunderstood animal in New Zealand, the fibre-producing goat is now gaining rightful respectability. In the past, the prejudiced view of goats was of smelly, uncontrollable animals which jumped fences, ate anything, had footrot, charged on sight, and were pests which shouldn't be talked about.

My wife and I farm in partnership on flat land at Hawarden, where we run 1500 sheep. We have been farming goats as a family partnership since 1980. We started with ferals, and have since used angora bucks for crossbreeding in an upgrading programme. In 1982 we bought an entire flock of 80 first-cross animals, and this, together with our own first-cross animals, gave us a good number for selection.

We have farmed all grades, from feral to purebred angora, and I believe all types of fibre-producing goats have a place. We currently have 40 first-cross, 200 second-cross, five purebred does, 115 doe kids of various crosses, and some buck kids.

Why did we start? We liked the look of the animal, and we saw goats as a cheaper way of controlling our thistles, docks, mallow and hemlock. We achieved excellent control of these weeds, and are now farming our weeds as a renewable feed source providing ideal food for goats. We aim to farm, rather than eliminate, our weeds. The only weed we have which goats will not touch is barley grass. Even they find that too tough.

*Masons Flat, Hawarden

In 1980 there was no fibre marketing, and because of limited demand, surplus stock, wethers especially, were not easy to sell. Slaughter was their usual fate, which provided a reasonable return. However, this has changed. We now have an excellent pool system for fibre which has been operating twice a year. In 1986 we are moving to four pools a year. Surplus stock sales are buoyant, and wethers are now keenly sought after for weed control and fibre production. This season, no animals are available for slaughter.

I will devote most of this paper to goat management, and I will briefly discuss returns from fibre sales for the various grades of goats, as dollars are something in which we all have an interest.

Management

In my view there are three main components of successful goat management: fencing, grazing management, and personal contact.

Fencing

The first necessity is to ensure animal control by adequate fencing. Before taking delivery of our goats, we ran a mains wire around some paddocks. Goats will poke under a fence rather than jump it, so we placed the wire 30 cm out from our existing seven wire fences, and 30 cm above the ground. This controlled all but three animals. We made a mistake in not shooting those jumpers, but since sending them to the works the following year we have not had any goats jump. Graded-up animals are much quieter, and standard fences without

hot wires are adequate. Trees, however, must be protected.

Grazing management

Goats are browsers rather than grazers. They always move as a mob, and as they walk they nibble what tempts them. They usually do a circuit of the paddock in the morning, then rest and do the same again in the afternoon. Although they eat a percentage of grass other than clover, goats are non-competitive with sheep, preferring fibrous plants, seed heads, dry grass, weeds and woody plants including young trees. In a paddock with thistles for instance, goats first eat the flowers, then the leaves, and finally the stalks. We shift our goats to another paddock when they have removed the flowers, to do the same there, and once flowering has been controlled we then bring them back to strip the plants. However, goats will start eating weeds only when it suits them. They ignore young thistles, and wait until flowering before eating them with relish.

As goats do not get fat (about prime lamb condition is good body condition for a goat), there is no need to regulate feed intake to control body weight. Because they eat different feed, and don't become fat, we generally let the goats have the first unrestricted pick of paddocks. Also, production is at its best when feed intake is high.

Goats do not build up a natural resistance to internal parasites, but by giving them access to good goat feed ahead of sheep, we have encountered no worm problems.

Personal contact

I consider contact with the animal to be very important. We feed oaten hay, barley, straw or rough meadow hay as a way of making contact during kidding and over the winter. Feeding hay to the kids from weaning quietens them and gains their trust. They never get upset when they are shifted or worked in the yards. They also learn that when they are put into a paddock they are meant to stay there. If they get out to another paddock, they quickly return on sight of their handler.

It is very easy to shift mobs with a quiet dog. If a heading dog is sent out the goats will mob up. Stand and watch to see what is happening. Noise and rough handling should be avoided, as goats respond very well to careful handling.

Control within paddocks, with regular shifting, and an unrestricted diet are the keys to success. We never force our goats to eat what we want eaten. They will do the job in their own time. We look on our goats as weed controllers, rather than weed eliminators.

Goats require space and will not tolerate being locked onto confined areas. They will do a more successful job and be more contented when spread over a larger area.

Kidding

Gestation period is the same as for sheep. We kid the does in mid-September, after lambing when the weather is warmer and we set stock. The doe chooses the birth spot, and in most cases kids between midday and sundown. The doe will stay with the kids for 24 hours, and the kids identify the birth spot, staying there for up to three days. On the second and third days the doe browses around and returns to feed the kids. Usually about the third day the doe will shift her kids to a nursery, which is a place where all the kids are put together. The kids stay there for up to two weeks, with the does returning to feed them. The kids do not follow the doe as a lamb follows a ewe. Generally goats kid very easily with no complications; in five kiddings I have assisted only two does.

We observe newborn kids in the evening through binoculars, to read the doe's tag and record the doe. We leave the kids untouched unless there are problems. The next morning we tag and record the kids, which are usually still at the birth spot with the doe, both by then well bonded.

The does are great milkers and very good mothers. The lowest survival rate to date has been 136%, and in 1984 the survival rate was 186%. Kidding is usually very concentrated — 80% in the first ten days.

Health

Goats are susceptible to lice but not fly strike. Lice are host-specific, and are not transferable to sheep or vice-versa. We dip for lice each year, and have found them difficult to eliminate. Lice affect the goats' condition and fleece.

The does are drenched only once before kidding, with drench plus selenium, and have a pre-tup drench of selenium only. The drenching programme for the kids is the same as the lambs, at pre-weaning, and at three weekly intervals (twice) and monthly (twice) (21, 28, 28) with a final drench in winter. I use ordinary sheep drench, increasing the dose by 50%. We have had no problems with this programme. If fed correctly goats don't produce dags. We make salt blocks available at all times. As goats have a high iodine requirement, we administer a 1 ml injection of Lipiodol at the two tooth stage to give long-term slow release of iodine.

All does are vaccinated with five-in-one to provide protection at kidding time, and the kids are vaccinated at two months (when we castrate the buck kids), and receive the second dose at three months. We have had no problems with sleepy sickness, autumn staggers or milk fever.

Goats' teeth just don't seem to wear. Some of our old ferals had very good teeth, possibly because of browsing habits. Teeth eruption times and number are identical to sheep.

Goats are cloven-hoofed with soft horn tissue. Excessive foot growth and foot deformities appear to be heritable, and this is one factor for which we cull. We have no footrot problems with our sheep and

have had none with the goats. I believe goats are as susceptible to footrot as sheep, but have been told that they are more tolerant than sheep and don't lose condition as sheep do.

Horns are used for bunting and fighting, which takes the form of horn knocking, but nothing vicious. Goats like space, and if they are confined the dominant animals demand and get a far greater proportion of the space available. They also use their horns for breaking up plants, to make access for eating easier. This is most noticeable with thistles and gorse.

Yards

Yards don't need to be elaborate. We found a 1.35 metre high yard contains everything. A short race sufficient to hold ten goats is ideal, otherwise fighting and crushing occurs. If pressured, goats will pile up two or three deep. We use scrim to bring goats forward quietly, and we never use dogs in the yards.

Shearing

Goats shed their fibre in spring when the weather warms up, around the end of August. We aim to shear before the fibre cotts up, and because it suits us timewise we shear in the first few days of August.

The second-cross animals and up to purebreds will grow sufficient length to warrant a second shearing six months later, so we shear again during late February. Milking does, especially first and second cross, do not grow much fibre, however once they are weaned good growth will occur.

We wean in mid January, to work in with sales. I think it is better for the kids to be left with the does until then, by which time

Table 1. Returns from Angora wethers of differing grades.

Animal Grade	Class of fibre	Price per kg	Fleece weight	Return
G 4 1st X	Cashgora B or D	\$20	1 kg	\$20
G 3 2nd X	Cashgora B or B 2nd Doe	\$15	1.8 kg	\$27
G 2 3rd X	Young goat or B 2nd Doe	\$18	2.5 kg	\$45

the does and kids are quite happy to be parted. Our doe kids then average 19 kgs liveweight, the wethers are usually one kg heavier.

Shelter

Shelter is essential at kidding time, and for a period after shearing until the fibre has regrown to at least 12mm. Apart from these times, goats seem to be able to cope with weather conditions as well as sheep.

Fibre

Returns from fibre are greater for each grade or cross higher (Table 1).

Commercial cashmere has four different micron ranges from 15-19 microns, and three colour ranges, giving 12 combinations each with a different price. Payment is for cashmere content only. The example in Table 2 shows the best possible combination: under 15.9 micron, white and the top grade, at \$169/kg. Cashgora has five grades.

Mohair has 12 grades, with a further six for pieces, stains etc.

There is a very real incentive to keep upgrading:

— We find that animals each grade higher are quieter and easier to handle than the previous grade.

— For angora cross sale does, each grade higher has been, and still is, worth approximately double that of its parent doe.

— Each grade higher is much better in fibre quality, with better style and character and less kemp. Seeing the improvement over several grades gives us great satisfaction.

— We have found no difference between grades in ability to withstand weather conditions.

Wethers

In Canterbury wethers sold for between \$30 and \$50 per head, depending on grade, over the 1985 autumn. Unlike does who are subject to milking stress, wethers will grow more fibre in a 12 month period (Table 2). Wethers will return \$20-\$45 per annum (first x \$20, second x \$27, third x \$45).

Table 2: Returns from Cashmere fibre (\$ per kg of down content)

Microns	White	Grey	Brown
15 — 15.9	169	126	92
16 — 16.9	161	112	89
17 — 17.9	146	92	61
18 — 18.9	92	54	35

Example: Total weight shorn x yield of Cashmere x price per kilogram for that grade = return per animal.

15 - 15.9 WHITE

A. 200 grams x 25% = 50 grams x \$169
= \$8.45 per head.

17 - 17.9 BROWN

B. 200 grams x 25% = 50 grams x \$61
= \$3.05 per head.

Total Wgt	Price Per Kg
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Conclusion

We find goat farming very satisfying. Goats are very intelligent and respond well to contact and handling. They are also profitable, very clean, healthy, easily handled and managed, are complementary to sheep and cattle, and are excellent weed controllers.

In my opinion, scope for expansion of goat farming lies in the South Island hill country because:

— it is the right type of country, with the type of feed that goats need, usually with a supply of weeds that goats will enjoy eating;

— hill farmers accustomed to handling sheep and cattle, will find the shift to handling goats very easy;

— most hill farmers, especially fine wool farmers, understand and enjoy working with wool, so handling goat fibre, particularly cashgora and mohair, will be like second nature.

Profitable markets exist for fibre and meat at a time when there are not a lot of options left for improving farm profitability. When next pondering the costs of weed control, think instead of the money to be made from weeds, by diversifying into goats. You will not be disappointed.

Table 3: Cashgora grades and returns

		CASHGORA	
		(Pool 1/85)	
		G4 (1st X)	G3 (2nd X)
Fibre Diameter (microns)	Kid	17-21 μ A or D	20-24 μ B or D
	Adult	20-23 μ B or D	22-26 μ B or B 2nd Doe
Price \$ per kilogram	Kid	A \$87.00 D \$22.00 Ave \$30.00	\$20.00
	Adult	\$22.00	\$15.00
Weight in 12 months	Kid	0.5 kg	0.7 kg
	Adult	1.0 kg	1.5 kg
Return \$ per 12 months	Kid	\$15.00	\$14.00
	Adult	\$22.00	\$22.50

Table 4: Mohair grades and returns

			MOHAIR (Pool 1/85)		
			G1 (4th X)	Purebred Angora	
G2 (3rd X)			24-26 μ	25-28 μ	
22-27 μ			2nd kid or A/B kid	A or B kid	
2nd kid or B 2nd Doe			26-32 μ	26-36 μ	
24-30 μ			Young Goat or B 2nd Doe	Young Goat A or B Doe	
Young Goat or B 2nd Doe					
\$20.00			\$20.00	\$30.00	
\$18.00			\$18.00	\$22.00	
1.2 kg			1.6 kg	2.0 kg	
2.0 kg			2.5 kg	3.0 kg	
\$24.00			\$32.00	\$60.00	
\$36.00			\$45.00	\$66.00	

Gorse Control with Goats

Joan E. Radcliffe*

Gorse (*Ulex europaeus*) remains one of New Zealand's major scrubweeds, covering over 1.2 million ha of land, nearly half of which is too steep to cultivate. Monsanto, in a discussion paper of May 1984, titled 'The estimated costs of weeds to the agricultural sector of the New Zealand economy' made the point that there are no overall New Zealand studies on the cost: benefit of developing gorse infested lands. Nevertheless, from regional studies they have derived a national value of \$850/ha (1982 prices) for clearing gorse from difficult medium to steep land in remote areas, using a programme of spraying, burning and oversowing. Clearing gorse from more easily accessible medium hill country with the same control programme costs \$790/ha. Three years of inflation, and the removal of chemical subsidies have, of course, escalated these prices.

Goats are now being used as a viable, low-cost option for clearing gorse, especially on hill country. Recently, M. Krause, in the Agricultural Economics Department of Lincoln College, showed that goats are an attractive, economic alternative to herbicides such as 2,4,5-T for scrub removal: especially if the goats are bought in and first-cross progeny are sold on the same market.

Increasing interest and demand for cashmere and mohair fibre may make the economics of using goats for both scrub control and fibre production even more attractive. I believe that these two options need not be mutually exclusive.

*M.A.F. Lincoln

In spring 1980 M.A.F. leased 20 ha of land in tall, solid gorse at Loburn, North Canterbury. The land has been intensively stocked with goats and sheep to see if gorse can be controlled or eradicated without use of herbicides. All sheep and goats were dry stock. Separate studies were done on the original dense gorse, called 'unburnt gorse', and on the remainder of gorse which was burnt before stocking.

Unburnt gorse

Three paddocks, each 0.8 ha were electrically fenced. Paddock 1 was set-stocked with 10 goats/ha for one year, resulting in little noticeable difference in gorse. Aerial photographs showed gorse covering about half the paddock. The second year, stocking rate was 31 goats/ha and by the end of winter, gorse had been dramatically reduced to 11% cover. The following summer, gorse was further reduced to about 5% cover.

In paddock 2, gorse started off at 70% cover. Five goats/ha made no visible difference to the gorse, and only when goat numbers were increased to 23 goats/ha did the gorse disappear.

Paddock 3 also started off with 70% gorse cover. This received a blitz treatment of around 42 goats/ha for one year, during which time the gorse virtually disappeared.

By October 1983, the three paddocks contained little gorse, and a common stocking rate of sheep (7.5 sheep/ha) was introduced, with superimposed low (7.5/ha), medium (15/ha) and high (22.5/ha) stocking rate of goats, in order to follow gorse regeneration. So far (March 1985),

gorse remains alive and well in Paddocks 2 and 3, although bushes are only about 30cm tall (150-200cm at start). Paddock 3, which received the blitz goat treatment, has less gorse than Paddock 2. Most gorse has died in Paddock 1, which has had the longest history of goat grazing (10/ha or more).

An important factor contributing to gorse death has been silver-leaf fungus which enters gorse when bark and stem tissue has been damaged by goats.

Burnt Gorse

Most of the trial area (about 7 ha) was burnt in November 1980 after a light crushing by bulldozer. The burn was far from ideal, and there remained a formidable tangle of burnt, and partly burnt tall tangled sticks. After burning this was oversown with perennial ryegrass, white clover, and super-phosphate.

After subdividing with electric fencing into small (0.8 ha) paddocks, a set-stocked grazing system and a 4-paddock rotational grazing system for gorse control was examined. Either goats alone, sheep plus goats together (1 sheep: 2 goats), or sheep alone were used. An extra treatment in this series examined sheep only under a faster 10-paddock rotation.

After a year, it was apparent that goats alone, or a mixture of sheep and goats, were more effective than sheep only. These two treatments were repeated on an adjacent gorse area, to see if similar results could be obtained. This time, the gorse had a pre-burn spray, and was burnt in April 1982, followed by ryegrass, white clover and superphosphate oversowing as before. These repeated grazing treatments began in October 1983.

In all these treatments, giving a total of 11 main paddocks of burnt gorse (five of these subdivided), a very large number of gorse bushes (400 bushes per paddock, once or twice a year) have been measured, and a wealth of detail about how gorse responds to different types of grazing has been accumulated.

Findings

In the first months after burning, sheep are as effective as goats in controlling gorse. However, as time passes, even 200 sheep/ha grazed in a fast rotation cannot contain all gorse plants. Inevitably, some plants grow beyond the reach of sheep, and after 1-2 years, other control measures such as slashing or spraying are necessary.

In the series of treatments following the November 1980 burn, goats, either rotationally grazed or set-stocked, and the sheep/goat mixture rotationally grazed, gave excellent control of coppicing gorse. Three years of grazing with goats reduced gorse to less than 1% ground cover. Seedlings appeared to be a minor problem as good, dense pasture swards developed. The sheep/goat mixture set-stocked was not as successful, probably because goat grazing pressure was not sufficiently high in the critical first summer after burning. Some goats escaped. The gorse was allowed to spread out, and although the paddock has consistently carried a high stocking rate since then (17.5 goats/ha plus 9 sheep/ha), and the gorse has been kept uniformly short (20-30cm), it is still very dense and now covers about 30% of the paddock.

Following the April 1982 burn, all grazing treatments virtually eliminated the gorse after one year. These treatments were goats only rotationally grazed or set-stocked. The success was attributed mainly to the initial high goat stocking rate (32 goats/ha or 16 goats/ha plus 8 sheep/ha), which was maintained throughout the year, with hay fed in winter.

Throughout these experiments, the sheer volume of gorse eaten by goats has been impressive. Flowers, green stems, brown stems and bark are readily eaten, and if goat numbers are sufficiently high, young gorse regenerating on stems or basal shoots may be kept browsed to 1-2 cm. However, although gorse size may be reduced dramatically, numbers of gorse plants per area of ground may appear to increase. This is because a single large bush may contain

several basal coppicing shoots, which develop (or become visible) only when the large bush has been eaten out, and the centre of the bush has opened up, allowing weeds and pasture plants to germinate.

Gorse as a feed resource

On one trial paddock, 18 goats plus nine sheep/ha have kept gorse browsed to about 30 cm for the last four years. The gorse population has remained very stable. About one-third of the paddock is gorse, and the rest is pasture. Animals are set-stocked, and no supplementary feed is given over the winter.

Under these conditions, gorse has produced up to 19.5 t DM/ha averaged over two growing seasons. This is from gorse about 20 cm high under goat grazing allowed to grow up to 60 cm when protected from grazing by cages. About 12-13 t DM/ha of this is green gorse, much more digestible than the brown stems. We estimate that 7-10 t DM/ha of this green gorse has been eaten by goats.

The animals on all trial paddocks have been regularly weighed, and we can say with

confidence that goats will perform as well on gorse as they do on pasture.

Thus, goats and gorse can be integrated into a productive system.

Conclusion

Our work with goats on gorse in North Canterbury has given us confidence that dry goats, intensively managed on gorse areas, will eradicate dense gorse to negligible levels. Burning gorse first, before judicious stocking with goats or goats and sheep, will achieve good results in 2-3 years, under our conditions. **Not** burning the gorse before introducing goats will also achieve good gorse control, but higher goat numbers are needed to cope with the large volume of gorse at the start, and sustained goat grazing is needed thereafter for at least 3 years.

If the objective is to utilize the gorse rather than eradicate it, then goats can be successfully farmed on short gorse/pasture associations. Liveweights are satisfactory, and there is no reason to suppose that fibre yields would be depressed.

Sweet Brier Control with Goats

G. L. Holgate*

Introduction

Shrub weed control with goats is not new. Replying to a question concerning the use of goats for blackberry control, the Fields and Experimental Farms Division of the New Zealand Department of Agriculture, Industry and Commerce said,

"...if the goats are kept on continuously for some time (probably a few years) it will gradually disappear. If you intend to purchase goats it is suggested that you should purchase Angoras, as a return can be obtained from the sale of their hair". (Fields and Experimental Farms Division, 1914)

However, in the last decade renewed interest and research have been focussed on the subject.

Sweet brier (*Rosa rubiginosa*) is a nuisance weed, particularly in the drier parts of Otago, Canterbury and Marlborough. It can restrict sheep and cattle grazing over substantial areas of some properties. Bascand and Jowett (1981) estimated that sweet brier was abundant on more than 100,000 ha of farmable land in the South Island.

Sweet brier is common where there is a reasonably high level of fertility, a well drained soil, minimum competition, and protection from grazing especially at the critical seedling stage (Molloy 1964). Sweet brier was first recorded in New Zealand in 1835 (Molloy 1964). It was classified as a noxious weed in 1900.

Background to trial

Goats have been used specifically for brier control on Merivale Station, the property of Gerald and Mary Goodger at Tarras, since 1978, although the impact of goats

on brier was noted before this. The Department of Lands and Survey has been assessing the impact of goats on brier on one block of Merivale Station since 1980, and in 1981 established a co-operative trial with the Goodgers to study the subject in more detail.

The simple trial was established to compare the relative value of feral goats, Angora goats and Merino sheep for sweet brier control. The three animal types were set stocked separately in 0.5 ha paddocks at rates designed to equate the food energy requirements of animals within each paddock. This was done by equating metabolic bodyweights (liveweight^{0.73})** The relative stocking rates were:

1 Angora 1.4 ferals 1.2 Merinos
for average animal liveweights of 47.3 kg, 29.7 kg and 39.8 kg respectively. The actual stocking rates which were determined subjectively were:

10 Angoras, 14 ferals and 12 Merinos per ha.

Merinos were young wethers, Angoras mixed-age wethers and the ferals (captured from the wild approximately three years previously) were mixed-age dry females. Independent groups of all three animals were maintained as duplicated treatments in six paddocks. Animal weights were checked periodically and fleece weights from the Merinos and Angoras were recorded at shearing. Paddocks were spelled whenever animal liveweights declined appreciably, or when the sward was reduced to a stubble height <3 cm.

**Metabolic bodyweight has been used to obtain proportional measurements of fasting heat production and should equate food energy requirements (Blaxter 1967, Webster 1979).

*Department of Lands and Survey, Christchurch

Initially each paddock contained scattered sweet brier plants, in a pasture dominated by browntop (*Agrostis capilaris*) and sweet vernal (*Anthoxanthum odoratum*). Living plant cover was measured by point analysis and density of living sweet brier was calculated by the "joint point-distance nearest-neighbour distance technique" (Batcheler, 1973). Height and width of plants encountered using this technique was also recorded, and photographs were taken of marked brier plants in each paddock. A sweet brier plant was defined

as "a cane or group of canes separated by more than 10 cm at ground level from any other cane or group of canes". This overcame the problem of distinguishing separate plants from suckers in the tangle of canes at the base of most bushes.

Results

Within nine months ground cover of living sweet brier was reduced by more than 75 percent in the goat paddocks, and was significantly lower (LSD, $\leq .05$) than that in the sheep paddocks for the rest of the trial (Figure 1).

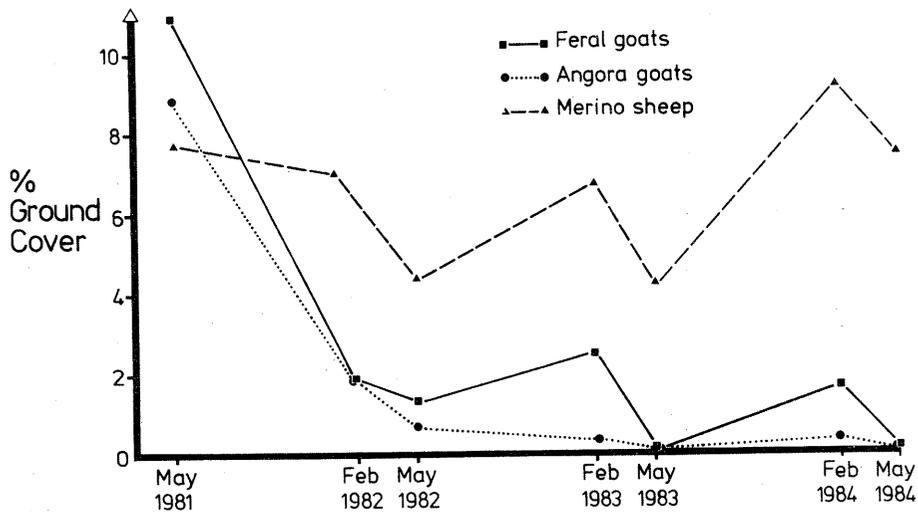


FIGURE 1: Changes in living Sweet Brier ground cover.

Similarly the mean height and width of plants in the goat paddock were reduced

by more than 50 percent within nine months (Figure 2).

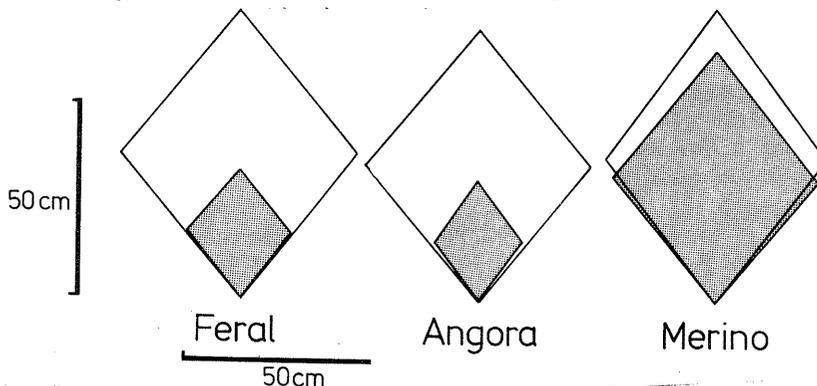


FIGURE 2: Average maximum living dimension of Sweet Brier 'plants' May 1981 and February 1982 (hatched)

By May 1984 the mean height and width of the plants in the goat paddocks had been

reduced by almost 90 percent from the figures recorded in May 1981 (Figure 3).

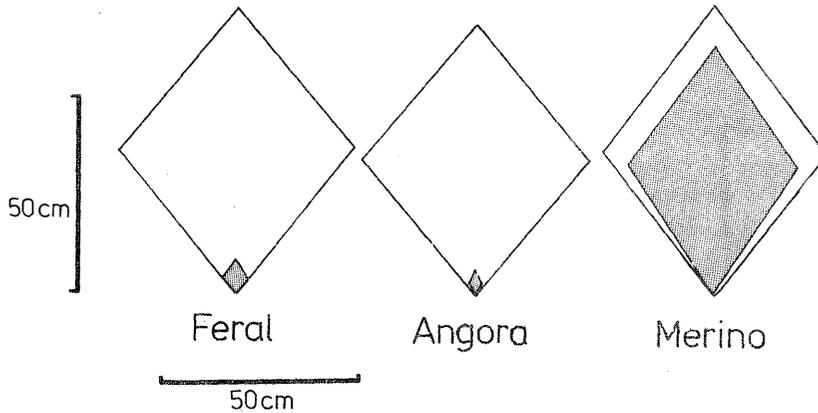


FIGURE 3: Average maximum living dimension of Sweet Brier 'plants', May 1981 and May 1984 (hatched).

The goats also reduced the number of living canes per sweet brier plant. By the end of the trial in May 1984 an average of over 90 percent of the plants in the goat paddocks consisted of only 1-2 living canes. In the sheep paddocks, and initially in the goat paddocks, only 40 percent of the plants consisted of 1-2 living canes. Conversely, at the completion of the trial approximately 1 percent of the plants in the goat paddocks

consisted of 8 or more living canes, whereas initially some 20 percent of the plants consisted of 8 or more living canes.

Not only did the goats reduce the sweet brier cover, the maximum living dimension of the plants and the number of canes per plant, they also reduced the number of living plants. After two years, density of living sweet brier plants under goat treatments was significantly lower (LSD, $\leq .05$) than that under sheep. (Figure 4)

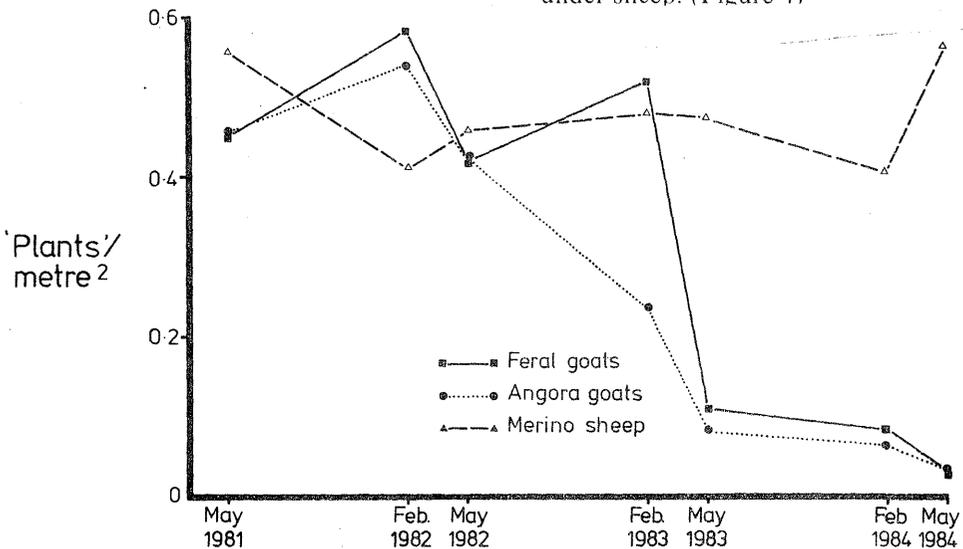


FIGURE 4: Changes in living Sweet Brier 'plant' density.

As well as controlling sweet brier growth, the browsing preference of the goats resulted in an increase in clover cover in the goat treatments, compared with that in

the sheep treatments. (Figure 5). This was particularly so for the Angora treatments which had significantly higher (LSD, $\leq .05$) clover cover than the sheep treatments from February 1983 on.

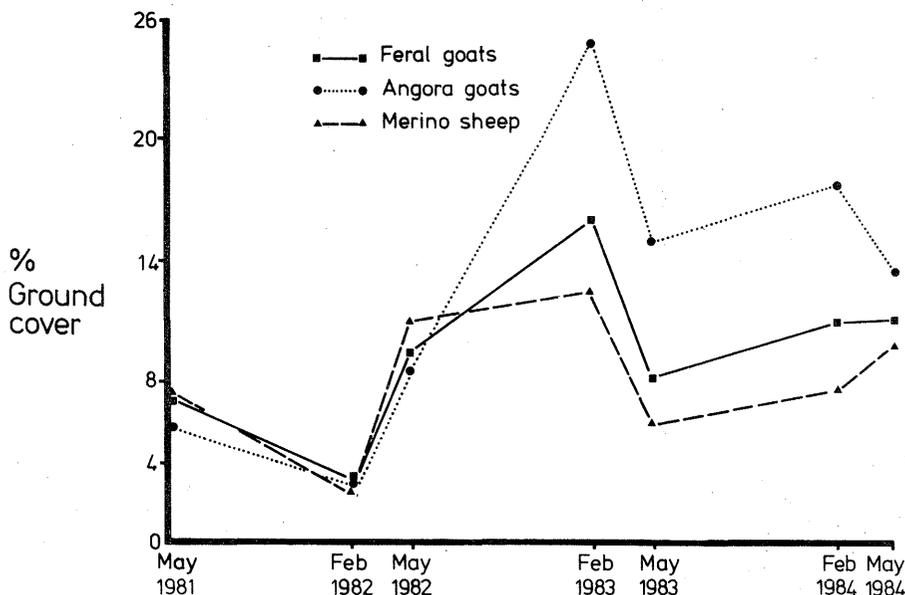


FIGURE 5: Changes in living clover cover.

These are the results of a simple small scale trial, and some people might properly ask how applicable they are to an on-farm situation.

On-farm results

To test the applicability of these small-scale trial results to an on-farm situation, a 50 ha block has been grazed by goats stocked at about 10 per ha for about three months in every nine months. The goats were a mixture of feral and Angora.

Data from this block on the cover of sweet brier and stature of plants are very similar to that from the trial, i.e. there was a dramatic decrease in these parameters within one year. The length of time taken to register a decrease in plant density is the obvious difference between the trial and on-farm situation (Figure 6)

The longer response time, in terms of a decrease in 'plant' density is most likely attributable to the lower stocking rate, and

longer and more frequent spelling periods.

The effect of 'goat pressure' appears to have been similar on the farm block and in the trial. After five years on the farm block approximately 6300 goat grazing days had been accumulated and the brier 'plant' density had been reduced by some 2300 plants per hectare. In the trial the equivalent number of goat browsing days (averaged across the trial) was reached between 20 and 24 months. The average reduction in brier plant density between those periods was some 2150 plants per hectare. This represents a very similar reduction in brier plant density for the same number of goat grazing days, both on the farm block and in the trial.

Discussion

Goats can control sweet brier growth. They readily browse brier and can dramatically reduce the stature of bushes and reduce the number of plants. Given the

ability of brier to sucker and survive (Molloy, 1967), and the arbitrary definition of a 'plant' used in the trial, the recorded decrease in brier plant density may not all be permanent if the goat pressure is removed. (This aspect is currently being examined). Examples of the regrowth

capabilities of brier in terms of increased suckering and replacement cane growth were observed in the trial. For example, approximately 40 cm height of new cane growth was recorded on one plant during a spelling period of 40 days.

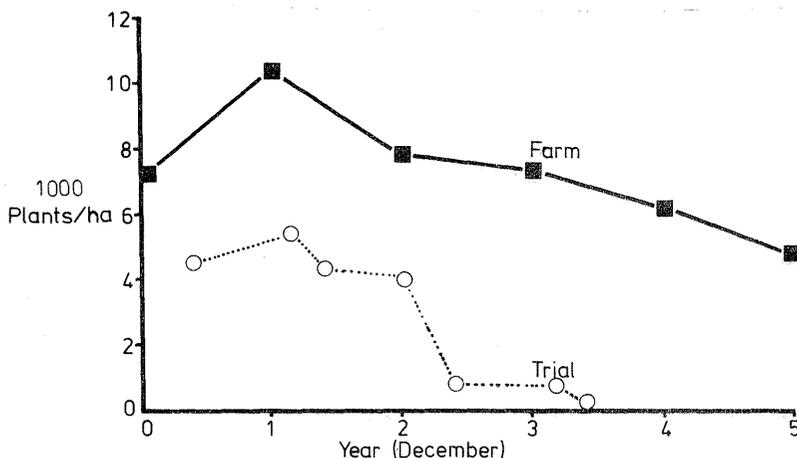


FIGURE 6: Changes in 'plant' density — trial and farm situations.

Control of any shrub weed is aided by intensive farming systems with adequate subdivision and high stocking rate. Control of brier with goats is no exception, and control of the goats is an essential component. Adequate quantity and quality of fencing is essential.

Using the latest Mohair pool prices (e.g. A. Buck \$18/kg), our trial Angoras would have each returned some \$118 over the three year period. At a stocking rate of 10/ha this would represent a gross return of some \$390 per hectare per year, while at the same time helping to remove the need for possible expenditure on weedicide.

A more detailed assessment of the economics of sweet brier control with goats has been completed. Using a feral flock producing only 50gms of Cashmere per year, the assessment indicates a **nett cost**

of brier control over a three year period of some \$47 per hectare (Land, 1985, see Appendix 1). If a Cashmere flock producing even say 100 gms of down per animal per year were used, this \$16 net cost per hectare could be transformed into a profit of \$54 per hectare per year over the three years.

Conclusion

Brier control is not simple, and running goats will not necessarily solve the problem. However, intensively managed goats can control brier, and offer the prospect of providing a financial return at the same time.

Acknowledgements

The trial was a fully co-operative one with Gerald and Mary Goodger of Merivale Station, Tarras. Their financial and managerial contribution, as well as their hospitality, is gratefully acknowledged. The technical

assistance of Carol Jensen, Alice Shanks, David Payton, and David Weir of the Department of Lands and Survey is also acknowledged.

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Appendix 1
 Economics of sweet brier control
 (moderate infestation of 3000-5000 plants/ha)
 (from Land, 1985)

Aerial application of 2,4,5-T/Picloram

Chemical 11 litres/ha at \$34.10/litre	375.00
Application by helicopter	125.00
Resow clover (including application)	16.00
	\$516.00

Root raking

Bulldozing at \$50-60/hr	285.00
Resow clover and grasses	35.00
	\$320.00

Goats

Assumptions:— stocking rate 14 feral wethers/ha

— death rate (5-10%) 1 feral wether/ha/year

— culling rate (15%) 2 feral wethers/ha/yr

— cull-for-age wethers sold for meat

— buy in replacements

— 3 years to get 95% + kill of brier

Costs: — replacements — 3 wethers/year at \$30 each	90.00
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— animal health at 80¢/wether	11.20
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— shearing at 75¢/wether	10.50
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\$111.70

(Note: goat numbers are being maintained so initial cost of purchase could be offset by returns from sale)

Returns: — Meat: 2 wethers at 10 kg x 130¢/kg	26.00
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— Fibre: 14 wethers clip 0.7 kg x \$100/kg	70.00
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\$96.00

Nett cost of brier control over three years

3 years x (111.70-96.00)=\$47.10/ha

(Note: this assessment excludes any costs incurred for additional fencing or altered management)

Goats For Controlling Pasture Weeds

M. G. Lambert*

Introduction

Interest in farming goats as a viable alternative or complement to sheep and cattle has risen since the early 1970s. Predominant uses have been for weed control, milk production or mohair production. More recently, interest in cashmere and meat production has increased.

Feeding behaviour of the goat

Plants have a variety of mechanisms for protection from grazing. Tall stature for foliage borne above grazing height; thorns, spines, and tough leaves as physical deterrents; and biochemical substances which are unpalatable or poisonous deter would-be grazers. Plants with some or all of these characteristics often prosper in pastures, and are known by sheep and cattle farmers as weeds.

In many studies goats have been found to select more browse (weeds) than sheep or cattle, when offered a range of forages. The goat's agility and dexterity allow it to browse to a height of about 2m, and to break branches down in order to reach forage above that height. Goats' narrow muzzle, prehensile tongue, and mobile upper lip, enable selection of nutritious plant parts from among thorns, spines and other low quality plant parts. Also, goats appear to tolerate bitter substances which make forage unpalatable to sheep and cattle (McCammon-Feldman *et al.*, 1981).

Despite the commonly held view, there is doubt about whether goats can, in fact, digest fibrous feeds better than sheep. Goats may have a greater dry matter intake and

rate of passage than sheep (McCammon-Feldman *et al.*, 1981), but their digestive efficiency is most likely less.

For high levels of performance, goats like sheep probably require a high quality diet. However, specific foraging characteristics enable them to select a nutritious diet from forage types normally rejected by sheep and cattle.

Weeds grazed by goats

Research and observation in New Zealand has identified many common weeds grazed by goats. These include: blackberry, sweet brier, gorse, broom, thistles, manuka, kanuka, bracken fern, tauhinu, barberry, ragwort, rushes, sedge and tutu (Wright, 1927, Guthrie-Smith, 1929; Larsen, 1951; Batten, 1979a,b; Crouchley, 1980; Lambert *et al.*, 1981; Rolston *et al.*, 1981; Radcliffe, 1982; Buick, 1984; Atkins, 1984).

Research at Ballantrae

At Ballantrae Research Area, near Palmerston North, we have found that goats graze many of the above species. Our research has been concerned particularly with gorse, thistles, rushes and manuka. From a trial started in April 1979, and stocked at 10 s.u./ha with various ratios of breeding ewes and does (all goats =Goat 100; goats: sheep 67:33 =Goat 67; goats: sheep 33:67 =Goat 33; all sheep =Sheep 100), the following observations have been made. (more detailed results are presented by Lambert *et al.*, 1981; Rolston *et al.*, 1981, 1982, 1983; Clark *et al.*, 1982, 1984).

Gorse

Results with mature gorse have been similar to those described elsewhere in these

*DSIR, Palmerston North

Proceedings by Dr J. E. Radcliffe. In addition, goat grazing of seedling and regrowth gorse after spraying and burning has resulted in plants being kept at a height of 4-13 cm. In the Sheep 100 treatment regrowth gorse was on average 73 cm tall 27 months after the trial started, and represented a serious reversion problem. Whereas goats killed a proportion of large mature gorse plants, this was not so with smaller regrowth and seedling plants, i.e. goats controlled, but did not eradicate gorse.

Thistles

Marsh, Scotch and winged thistles are annuals/biennials, and survive by establishment of seedling plants in the autumn. Wherever goats were present these thistles did not form mature flowerheads. Goats delayed browsing these species until they had bolted to head. They then started at the immature flower, and grazed down into the base. In the Sheep 100 treatment, however, thistles flowered freely.

Californian thistles are perennial, with underground stems (rhizomes). Goat grazing initially increased density of aerial shoots, but after two summers the thistles disappeared — presumably the continual defoliation of new shoots depleted plant reserves to the extent that the plants expired.

Thistles are highly favoured by goats, and even low goat stocking densities should give good thistle control.

Rushes

Rushes were eradicated at the goat stocking rates in the Goat 100 (30/ha) and Goat 67 (20/ha) paddocks. In the goat 33 (10/ha) area only the most palatable species (*Juncus pallidus*) was grazed to any extent, whereas *J. gregiflorus*, *J. sarophorus* and *J. australis* were not. Rushes are not particularly palatable to goats, and were severely grazed only where goat stocking density was high, or pasture availability low.

Manuka

Scattered mature manuka bushes were grazed by goats. After two years 87%, 66% and 10% had been killed in the Goat 100,

67, and 33 treatments respectively. A 10% mortality in Goat 33 treatment increased to 55% after four years. Goats readily grazed fresh growth on manuka bushes. They attacked mature manuka by grazing foliage, breaking down branches and ring-barking trunks.

Pasture

Pastures in the Goat 100, 67 and 33 treatments were evenly grazed, and seed-heads did not accumulate. In contrast, pastures in the Sheep 100 treatment were patch-grazed in summer, with rank pasture and seed-heads occurring between patches.

Goat grazing encouraged white clover growth. This effect was greater as the proportion of goats increased, and the Goat 100 pastures became dominated by large-leaved white clover, ideal quality feed for sheep. Under low grazing pressure from goats alone, pastures became white clover/Yorkshire fog dominant.

A study of dietary preference of goats and sheep showed that the white clover increased because goats did not like to graze it. However, if goats are hungry they will graze white clover-dominant pastures. Where goats are to be used as a tool to develop white clover dominance, they should be grazed at a stocking density such that associated grasses are grazed, but white clover is not. Such conditions should give white clover competitive advantage, giving the additional benefit from goat grazing of increase in pasture suitable to sheep and cattle.

Grazing behaviour

Observation of goats and sheep grazing together on hill sides showed a complementary relationship between goats and sheep, by virtue of their grazing behaviour:

- Goats grazed coarse weeds, whereas sheep did not;
- Sheep grazed white clover, whereas goats preferred not to;
- Goats preferred to graze on steeper sites, whereas sheep spent more time on flatter sites.

Animal Production

We found that sheep grazed with goats

performed better than sheep grazed with sheep. Liveweights and lamb weaning weights were higher. However, goat performance was not improved by the association. Recent work in Australia with mixed sheep and goat stocking (McGregor, 1985) suggested that at high stocking rates, where pasture is the only available forage, sheep will outcompete goats.

Goats grazed with sheep or cattle perform best where a wide range of forages is available, particularly if some of it is unpalatable to sheep or cattle.

How many goats?

The extent of required reduction of sheep or cattle numbers with introduction of goats depends on the type of vegetation being farmed. If grass-dominant pasture on flat land is used, and stocking rate is already high, then inclusion of goats will require removal of other stock on a metabolic liveweight basis (i.e. one 25kg goat would be equivalent of 0.6 50kg sheep). However, on pastures on hill or high country with broken topography, infested with coarse weeds, and lightly stocked, no adjustment is necessary. Adding another 5-10% stock units as goats should result in no decrease and perhaps an increase in sheep and cattle performance.

Farming of weeds

If breeding goats are used, they will perform well where they are allowed to voluntarily graze a range of forages. As weeds are eaten in one block animals should be moved to another block with a higher 'weed availability'. If goat numbers are high relative to the magnitude of the weed problem, then eventually goats will require more and more pasture.

In such a situation goat numbers should be decreased and the weeds grazed in such a way that weed survival and production is ensured. This is contrary to a policy of weed eradication. However, if goat farming is profitable in its own right, and shrubs are a good source of forage for goats, it may not be in the farmer's best interests to completely eradicate them.

I am suggesting that the weed problem on

hill and high country farms may be easily solved by goats being grazed as a proportion of the livestock. "Weeds" would then become a valuable source of forage.

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MAF Research on Alternative Pasture Species, Cultivars and Lines For Southern South Island Hill and High Country.

J.M. Keoghan*

Most pasture cultivars currently used in southern South Island hill and high country pastoral development have been selected primarily for intensive lowland and hill country farming systems.

An increasing awareness of the limitations of relying on broadly adaptable "National" cultivars over a very wide range of environments has led to a gradual increase in programmes to identify germplasm better suited to specific regions, environments and farming systems. The release of "Grasslands (G.) Tahora" white clover is tangible evidence of this approach. "Tahora" has shown greater productivity and persistence than the "National" cultivar "G. Huia" white clover when hard grazed on wet, infertile North Island hill country. Similarly, "G. Maku" *Lotus pedunculatus* is a valid alternative to "Huia" on wet, acid and infertile high country soils.

In this summary, conventional species include the following: White clover (*Trifolium repens*); red clover (*T. pratense*); subterranean clover (*T. subterraneum*); lucerne (*Medicago sativa*); ryegrass (*Lolium* spp.); cocksfoot (*Dactylis glomerata*).

For many hill and high country environments and farming systems, it is not possible to validly describe the range of adaptability and agronomic suitability even

within these conventional or traditional species. Consequently, in some of the trials including them, a broad range of "alternative" cultivars and lines has been included:

1. White clover: Alternatives to the "National" cultivars "G. Huia" and "Pitau" include "G. Tahora", free-seeding types (e.g. "Whatawhata", "S₁ Louisiana" and "Clarence Valley"), tap-rooted types (e.g. "Dusi"), large-leaved, sparsely stoloniferous types (e.g. G. 18, "Tamar" and "Aran") and a range of germplasm from K.H. Widdup's "Southland" breeding programme.

2. Perennial ryegrass: Alternatives to "G. Nui" and "Ruanui" include "dryland" ecotypes and breeders' lines, late-flowering lines and crosses with European material.

3. Red clover: "Alternatives" to "G. Pawera", "Turoa" and "Hamua" include G.21 (2N) and G.22 (4N) (Hamua x Morocco lines), G. low-temperature-germination line, G. low-formononetin line, G. nematode-tolerant selection, "Renova" and "Mont-Calme" (Switzerland) and "Britta" (Sweden).

4. Cocksfoot: "Alternatives" to "G. Apanui" include "G. Wana" and "Kara".

5. Subterranean clover: "Alternatives" to "Mt Barker" and "Tallarook" include "Woogenellup", "Nangeela", "Clare", "Howard", "Seaton Park", "Larissa" and "Trikkala".

* Invermay Agricultural Research Centre, Mosgiel

6. Lucerne: "Grasslands Oranga" and CRD breeders' lines as well as currently recommended cultivars such as WL 318, "CRD Rere" and PR 524.

Since most of the long-term trials reported in this review have been initiated in the last three seasons, any results so far are preliminary ones. Results from recent establishment and management studies on "G. Maku" lotus however, have already been used to formulate clearcut recommendations for this species and short-term trials on condensed tannins in "Maku" and Birdsfoot trefoil (*Lotus corniculatus*) have been reported with brief summaries of the main conclusions reached.

Research Programmes

Establishment and management studies of "Maku" lotus

Observations of blocks oversown with "G. Maku" Lotus in Otago tussock grassland areas, had indicated that potential yields were not being obtained as a result of low seedling establishment and limited spread of established plants. Several studies were initiated in 1982:

M.E. Wedderburn: "The effect of nitrogen and inoculum rate on the establishment of oversown "Maku" Lotus".

M.E. Wedderburn and W.L. Lowther: "Studies on the establishment, management and spread of "Grasslands Maku" Lotus".

Reference: Wedderburn, M.E., and Lowther, W.L. 1985. *Proc. NZ Grassland Assoc.* 46. 97-101.

The above studies showed that slurry inoculation of seed at up to five times the normal manufacturer's rate is an effective method of increasing establishment because it increases nodulation, plant production in the first year and winter survival. The incorporation of 10 per cent (W:V) gum arabic in the slurry improved viability of rhizobia and allowed seed to be stored for up to two weeks with little reduction in rhizobia viability.

When poor establishment has resulted in sparse swards of "Maku", the studies

showed that vegetative spread (rhizomes) is maximised by avoiding grazing in a critical summer/autumn period (January-March). Such management is a remedial measure; if initial cover of "Maku" is satisfactory, swards can be rotationally grazed throughout the growing season. The deleterious effect of summer/autumn grazing on rhizome growth, was shown to be less, if grazing at this time was sufficiently lenient to leave a considerable residual leaf area (i.e. a 10-12 cm stubble)

The studies showed that the technique of natural reseeding to enable spread, has little application to "Maku" in the Otago tussock grasslands because of limited seed production, particularly at higher altitudes and on shady aspects.

Animal performance from "Maku" Lotus

When grown on acid and infertile soils, "Maku" contains sufficiently high levels of condensed tannins (>6%) to expect low animal growth rates, mainly because of reduced voluntary intakes and digestion. Several studies have recently been conducted to determine the implications of this when "Maku" is used as an alternative to clovers:

W.L. Lowther and T.N. Barry: "Comparative performance of sheep grazing oversown "Maku" lotus or a clover mixture.

T.N. Barry, S.J. Duncan and T.R. Manley: "Feeding value of "Maku lotus".

References: Barry, T.N.; Duncan, S.J. 1984. *British Journal of Nutrition* 51:12.

Barry, T.N.; Manley, T.R. 1984. *Ibid* 51: 22.

A major grazing trial on acid and infertile soils on the Waiora Hill Farm showed that daily liveweight gains of weaned lambs could be initially lower on lotus-based than clover-based pastures. However, provided they were preconditioned for at least two weeks on the lotus pastures, their subsequent growth rates were similar to those for clover-based pastures.

A six-week grazing trial also demonstrated that sheep can adapt to the high

condensed tannin content in lotus. Lambs conditioned on lotus for eight weeks prior to the trial, grew 50% faster than unconditioned lambs. An indoor trial indicated that plasma growth hormone is involved.

Condensed tannins in Birdsfoot trefoil

In view of the increasing interest being shown in birdsfoot trefoil (*L. corniculatus*) for low-fertility tussock grasslands, this species was studied to determine if high tannin levels were likely to be a problem under such conditions.

W.L. Lowther, T.R. Manley and T.N. Barry: "Condensed tannin levels in *Lotus corniculatus* cultivars".

The cultivars fell into two distinct groups: Prostrate and semi-prostrate "grazing types" ("Empire", "Leo", "Fargo" and "Winnar") contained lower tannin levels than erect and semi-erect "hay types" ("El Boyero", "Franco", "Ginestrino", "Granger", "Lot", "Maitland" and "Sao Gabriel"), 0.4-1.4% compared with 2.3-3.7%. All such levels, while ensuring that *L. corniculatus* will be non-bloating, can be expected to have little or no effect on voluntary intakes. In contrast, in the same trial, "Maku" lotus had a level sufficiently high (8.3%), to expect a depression in voluntary intake and digestion in unconditioned animals. Agronomic assessments (J.M. Keogh, W.L. Lowther) have indicated only one relatively consistent trend; hay-types as a whole, have been more productive so far than grazing types. However, there are marked site (replicate) variations in yield and highly significant site x cultivar interactions.

Altitudinal sequence studies in the Otago high country: Climatic and edaphic limitations to legume growth.

Pasture production on the extensive East Otago Plateau is limited by soil acidity, low fertility and low temperatures. Trials were started in 1979 at sites ranging from 760 m to 1160 m on the Lammerlaw/Lammermoor ranges, to assess the fertiliser inputs required to develop and maintain improved pasture on tussock grasslands. A sequence

of closely related trials at 730, 870, 1060 and 1190 m altitude was also initiated on the NW slopes of the Remarkables Range, where soils are less acid than at corresponding altitudes on the Lammerlaws/Lammermoors.

M.J.S. Floate, W.H. Risk: "Lotus and clover responses to lime, phosphate and sulphur in an altitudinal sequence".

Reference: Floate, M.J.S.; McIntosh, P.D.; Risk, W.H.; Enright, P.D. and Smith, L.C. 1985. *Proc. NZ Grassland Assoc.* 46. 111-118.

On the Remarkables, mean annual yields for P + S treatments decreased from about 7000 to 3500 kg DM/ha and on the Lammerlaw-Lammermoor sequence, from about 2000 to 200 kg DM/ha. At all Lammerlaw-Lammermoor sites, S-deficiency was so severe that there was little response to P until S was added and in most cases there was little response to S in the absence of P. On the Remarkables, soil test values were more variable and lotus yields were closely related to them. In contrast to clovers, lotus showed little or no response to lime, except at the highest altitude (i.e., lowest pH) on the Lammerlaws.

The lower yields and greater decrease on the Lammerlaws suggest that the climatic limitations there are more severe than at corresponding altitudes on the Remarkables.

The previous series of trials on the Otago Plateau, showed that clovers responded well to a heavy (4 tonne/ha) application of lime but the effectiveness of more economical rates was not measured. A series of three trials (at 465 m 750 m and 1040 m altitude) was therefore established in spring 1983 to investigate the lime requirements of six legume cultivars and the relative yields of these legumes at different altitudes where soil conditions were as similar as possible (pH 4.6-4.7; available P, 6-7 ug/g and phosphate-extractable-SO₄, 6-8 ug/g). The legumes sown were: white clover ("G. Huia" and "Tahora"); red clover ("G. Pawera") '*L. pedunculatus*' ("G. Maku"); birdsfoot trefoil ("Maitland"); *T. hybridum* ("Tetra" alsike).

M.J.S. Floate, J.M. Keohan: "The response of contrasting legume species and cultivars to lime and superphosphate on an altitudinal transect of acid tussock grassland soils".

In the absence of lime and/or superphosphate, yields of all oversown legumes has been very low, although initial seedling establishment and survival of all cultivars except "Maku" was very similar. "Maku" numbers were lower than for the other cultivars.

Acidity has limited production almost as much as a nutrient supply; at the higher sites, legumes other than "Maku" usually failed to respond to superphosphate without lime. "Maku" however, was more tolerant of acidity than the others; it responded to superphosphate in the absence of lime at all sites.

Legumes responded to lime and superphosphate except where the growth of "Maitland" and "Maku" lotus was severely limited by climatic factors at the highest site. In general, the greatest benefits were obtained with 250 kg superphosphate and 1 tonne lime per ha. Higher rates gave little further response.

All species demonstrated the P-sparing effects of lime because a given yield could

be attained with less superphosphate when more lime was applied and significant lime x superphosphate interactions were recorded. Lime not only raised soil pH but also significantly increased Olsen-P and SO₄-S levels at all sites, thus providing an explanation for the significantly enhanced yields when 4 tonne lime per ha was applied without any fertiliser.

Yields of all species declined sharply with altitude and neither lotus variety nor "Pawera" red clover produced any measurable growth in the 1984/85 season at the highest site. Yields of "Pawera" red clover (up to 8 and 4.5 tonnes DM/ha) were higher than any other species at sites 1 and 2 respectively, while "Tetra" alsike clover gave the highest yield (840 kg DM/ha) at the highest site.

Although "Maku" lotus has proved to be very well adapted edaphically to the Otago Plateau, marginal climatic adaptability hampers its use (e.g. considerable susceptibility to herbage damage from summer frosting). Trials closely related to those previously described, were established in spring/summer 1983 on the same three sites, to evaluate the adaptability and agronomic potential of a broad range of legume germplasm (Table 1).

Table 1. Legume germplasm established in altitudinal sequence trials, East Otago Plateau.

Species	Common name	Number of accessions
L. pedunculatus	Big trefoil	55
L. corniculatus	Birdsfoot trefoil	35
L. pedunculatus x	Lotus hybrid	1
L. corniculatus	(G.4712)	
T. repens	White clover	33
T. hybridum	Alsike clover	20
T. pratense	Red clover	10
T. ambiguum	Caucasian clover	3
T. medium	Zigzag clover	1
M. sativa	Lucerne	11

J.M. Keogh, M.J.S. Floate: "The climatic and edaphic adaptability of pasture legumes on acid and infertile tussock grassland soils".

To date, only preliminary data are available. *L. pedunculatus* lines from areas with mild climates (e.g. Chile) or with some Mediterranean parentage (e.g. "Maku") have been more susceptible to summer frosting than North American, mid-European and New Zealand lines lacking Mediterranean parentage (e.g. G. 4701 and 4702).

At the lowest site (Waipori) herbage production from a "Maku" selection has been unexcelled among *L. pedunculatus* lines, but this advantage disappears with increasing altitude (severity of climate); at the highest site (Ailsa Craig), a significant number of lines have shown greater growth and rhizome spread than "Maku" (e.g. G.4701). This result has considerable significance because vegetative spread is the only way that the cover of *L. pedunculatus* can be expected to improve in colder high country areas, following sparse establishment.

"Grasslands Tahora" White clover

In trials, "Grassland Tahora" white clover has shown greater productivity and persistence than "Grasslands Huia" when hard grazed on wet, infertile North Island hill country. However, little is known about its adaptability and agronomic potential relative to "Huia" and "Maku" lotus on southern South Island hill and high country areas with acid and infertile soils. Transplants of "Tahora", "Huia", "Maku" and "Leo" birdsfoot trefoil were established in summer 1983 at three contrasting hill and high country sites: Observation plots of *L. corniculatus* cultivars (c.v. "Maitland", "Franco", "Lot", "El Boyero", "Ginestrino", "Sao Gabriel", "Tana", "Cascade", "Granger", "Winnar", "Empire", "Fargo" and "Mandan"), were also established.

Site 1: Waiora, 450 m altitude. Mahinerangi hill soil; an upland YBE.

Site 2: Howells Hut, 855 m. Teviot high country YBE.

Site 3: McPhees Rock, 1300 m. Teviot high country YBE.

J.M. Keogh: "Grasslands Tahora" white clover: comparisons with "Huia" white clover, "Maku" lotus and "Leo" birdsfoot trefoil, on acid and infertile hill and high country soils".

In the absence of lime, both white clover cultivars were insufficiently well adapted edaphically to survive on the infertile and periodically waterlogged hill soil. "Maku" Lotus is well adapted on this soil and the *L. corniculatus* cultivars, marginally so.

On the free draining, more fertile intermediate site, all cultivars are well adapted. Lower yields of harvestable DM from "Tahora" than "Huia" reflect its more prostrate growth habit: other measurements of plant growth (visual vigour and stolon spread) have indicated that their overall vigour and response pattern to fertiliser are almost identical.

Both clover cultivars showed markedly better low-temperature germination and early seedling development than "Maku"; *L. corniculatus* was intermediate.

Germination of seedlines which had been selected from "Maku" for faster germination at low temperatures by D. Scott, Officer-in-charge, MAF Seed Testing Station, showed no improvement under cool field conditions compared with "unselected" "Maku".

Legume establishment and growth on mine tailings.

Tree growth on mine tailings in the Naseby Forest is hampered by the harsh physical properties of these "soils" and by multiple macro- and micro-nutrient deficiencies. Provided they can be satisfactorily established and show sufficient long-term persistence to act as cover crops and soil stabilisers, adapted legumes should offer a relevant means of reclaiming such mine tailing areas. If successful legume stands can be established and maintained prior to or

in association with trees, the expected improvement in the physico-chemical properties (including N-status) of these droughty, infertile, highly mineral "soils" should lead to improved tree growth rates. Several legume species and cultivars (*L. corniculatus*, "Tana" and "Leo"; *L. pedunculatus*, "Maku"; *T. hybridum*, "Tetra"; *T. pratense*, "Pawera" and *M. sativa*, "WL 318") were sown on three adjacent sites in Wet Gully Road, Naseby Forest, in Spring, 1983.

J.M. Keoghan. "Legume establishment and growth on mine tailings in the Naseby Forest".

The difficulty of establishing "Maku" when it is oversown in physically difficult (bare, exposed) environments was clearly demonstrated; when seedling counts were made four months after sowing, only four per cent of the viable "Maku" seed sown had produced surviving plants in the open, compared with 12-16 per cent for the other cultivars. Establishment of "Maku" was markedly increased (six-fold) in the shelter of Douglas Fir trees.

Only "Maku" lotus and "Tana" birdsfoot trefoil had failed to produce satisfactory stands by the end of the first season, when sown in the open. Establishment growth showed little response to phosphate except in WL 318 lucerne where the addition of 40 kg/ha of P doubled DM production compared with rates of 20 kg/ha or less. "Pawera" showed outstanding establishment growth and cover in the first season.

In the 1984/85 season, "Maku" yields were nearly four times higher in the shelter of the trees than in the open (1960 v 540 kg DM/ha).

Highest seasonal yields were produced by "Tana" birdsfoot trefoil growing in the shelter of the trees (2950 kg DM/ha). Highest seasonal yields in the open were harvested from "Leo" and "Tana" birdsfoot trefoil and "Pawera" red clover (1930, 1800 and 1950 kg DM/ha respectively) and lowest, from "Maku" (540 kg DM/ha).

Sheep's burnet

Sheep's burnet is perceived by some

farmers as having a role in the low rainfall zone of Central Otago (<600 mm annually). in supplying high quality standing feed at low cost for the critical late winter-early spring period. Its use is being strongly promoted commercially in spite of an almost complete absence of quantitative data on its performance. A trial has been initiated to collect agronomic data on the performance of sheep's burnet.

D.W. Brash. "Dry matter yields, forage quality and response to nitrogen, sulphur and phosphate fertiliser of sheep's burnet (*Sanguisorba minor*) at four sites in Central Otago".

Legumes for outwash soils in the Upper Waitaki

There are an estimated 260,000 ha of tussock grassland below 900 m in the Upper Waitaki, a high proportion of which are droughty, infertile and weakly structured outwash soils. Currently used cultivars of conventional clovers are insufficiently drought tolerant to persist on these outwash soils, while currently used lucerne cultivars are often poorly adapted edaphically to them, showing poor root penetration, probably because of aluminium toxicity. Consequently, they are no more productive during droughts than the clovers.

A wide range of conventional and alternative legume species were established on a droughty, eroded Mackenzie Soil (sub-hygrous high country YBE), near Omarama, during Summer, 1983 (Table 2).

J.M. Keoghan, M.H. Douglas. "The adaptability and agronomic potential of pasture legumes on droughty, infertile, outwash soils of the inter-montane basins of the Upper Waitaki".

The emphasis on birdsfoot trefoil reflects its potential as an alternative to lucerne and clovers in marginal lucerne areas in the high country, as a "poorer land grazing lucerne". The trial is closely linked to the Grasslands Division *L. corniculatus* breeding/selection programme (K. H. Widdup).

Birdsfoot trefoil cultivars and lines have shown a wide range of vigour and pattern

of production. Some have been more productive than the six cultivars on the approved herbage cultivars list. Those from continental areas with severe winters are, on the whole, more dormant during autumn than those from areas with mild winters. Cultivars and lines ranked highest for drought productivity in 1984/85 were: "Vega II" (USA); S1516 (Australia); S1860 (Netherlands); S1843 (Sweden); S1039 (Portugal); S1070 ("Taborsky"); S1510 (France); S1870 (Chile); and S2078 (North Island selection). Elite plants are being noted.

Pasture species for lower sunny faces in the high country

Currently used cultivars of conventional species are either very difficult to establish when oversown on lower sunny faces in the

high country (e.g Lucerne and grasses) and or lack sufficient survival, persistence and spread to enable this important landscape class to be fully developed for late autumn, winter and early spring grazing. A wide range of conventional and alternative legume, grass and forb species, cultivars and lines is being established within a lower sunny paddock on the Tara Hills High Country Research Station (Table 3). This trial represents an on-the-farm approach to evaluation, with introductions being integrated with the resident species and subjected to the same management as the paddock as a whole.

J.M. Keogh, M.H. Douglas. "Pasture species, cultivars and lines for high country grazing systems. 1. Adaptability, productivity and persistence on lower sunny faces".

Table 2. Legume germplasm established on the Red Flat, Omarama

Species	Common name	Number of accessions
<i>L. corniculatus</i>	Birdsfoot trefoil	87
<i>L. tenuis</i>	Narrow-leaf trefoil	2
<i>L. pedunculatus</i>	Big trefoil	5
<i>L. corniculatus</i> x <i>L. pedunculatus</i>	Lotus hybrid (G.4712)	1
<i>T. repens</i>	White clover	7
<i>T. pratense</i>	Red clover	10
<i>T. hybridum</i>	Alsike clover	7
<i>T. ambiguum</i>	Caucasian clover	1
<i>T. medium</i>	Zigzag clover	1
<i>T. balansae</i>	Balansa clover	1
<i>T. subterraneum</i>	Subterranean clover	8
<i>M. sativa</i>	Lucerne	13
<i>Ornithopus</i> spp.	Serradellas	3
<i>Onobrychis viciifolia</i>	Sainfoin	1
<i>Coronilla varia</i>	Crown vetch	1
<i>Dorycnium pentaphyllum</i>	Prostrate canary clover	1
<i>D. hirsutum</i>	Hairy canary clover	1

Table 3. Legumes, grasses and forbs established on a lower sunny face, Tara Hills.

Species	Common Name	Number of Accessions
A. Legumes		
<i>T. repens</i>	White clover	18
<i>T. subterraneum</i>	Subterranean clover	9
<i>T. pratense</i>	Red clover	5
<i>T. hybridum</i>	Alsike clover	7
<i>T. ambiguum</i>	Caucasian clover	2
<i>T. balansae</i>	Balansa clover	3
<i>L. corniculatus</i>	Birdsfoot trefoil	8
<i>L. corniculatus x</i> <i>L. pedunculatus</i>	Lotus hybrid (G. 4712)	1
<i>M. sativa</i>	Lucerne	5
<i>M. arborea</i>	Tree medick	1
<i>Ornithopus spp.</i>	Serradella	3
<i>Onobrychis viciifolia</i>	Sainfoin	1
<i>Astragalus cicer</i>	Milk vetch	1
<i>C. varia</i>	Crown vetch	1
<i>D. pentaphyllum</i>	Prostrate canary clover	1
<i>D. hirsutum</i>	Hairy canary clover	1
<i>Lupinus polyphyllus</i>	Russell lupin	1
<i>L. arboreus</i>	Tree lupin	1
<i>Chamaecytisus palmensis</i>	Tagasaste (tree lucerne)	1
<i>Hedysarum coronarium</i>	Sulla	1
B. Grasses		
<i>Lolium perenne</i>	Perennial ryegrass	15
<i>L. multiflorum</i>	Italian ryegrass	2
<i>D. glomerata</i>	Cocksfoot	5
<i>D. woronowii</i>	—	1
<i>Bromus willdenowii</i>	Prairie grass	2
<i>B. inermis</i>	Smooth brome ("G. Tiki")	1
<i>B. marginatus</i>	Mountain brome ("G. Hakari")	1
<i>B. scoparius</i>	—	1
<i>B. carinatus</i>	c.v. "Deborah"	1
<i>Agrostis castellana</i>	Dryland browntop	1
<i>Festuca arundinacea</i>	Tall fescue	4
<i>F. rubra</i>	Creeping red fescue	2
<i>Cynosurus cristatus</i>	Crested Dogstail	1
<i>Elytrigia intermedia</i>	Pubescent wheatgrass	1
<i>Holcus lanatus</i>	Yorkshire fog	2
<i>Phalaris aquatica</i>	Canary grass ("G. Maru")	1
<i>Secale dalmaticum</i>	Mountain Rye	1
<i>Poa pratensis</i>	Kentucky bluegrass	1
<i>Arrhenatherum elatius</i>	Tall oatgrass	1
C. Forbs		
<i>Sanguisorba minor</i>	Sheep's Burnet	1
<i>Cichorium intybus</i>	Chicory	1
<i>Achillea millifolium</i>	Yarrow	1
<i>Echium vulgare</i>	Vipers bugloss	1

Table 4. Legumes, grasses and forbs established on a mid-altitude grazing trial, Tara Hills.

Species	Common Name	Number of Accessions
Legumes		
<i>T. repens</i>	White clover	12
<i>T. pratense</i>	Red clover	1
<i>T. hybridum</i>	Alsike clover	7
<i>T. ambiguum</i>	Caucasian clover	1
<i>L. corniculatus</i>	Birdsfoot trefoil	4
<i>L. corniculatus</i> x	Lotus hybrid (G. 4712)	1
<i>L. pedunculatus</i>		
Grasses		
<i>L. perenne</i>	Perennial ryegrass	15
<i>D. glomerata</i>	Cocksfoot	3
<i>B. inermis</i>	Smooth brome ("G. Tiki")	1
<i>B. marginatus</i>	Mountain brome ("G. Hakari")	1
<i>B. willdenowii</i>	Prairie grass ("G. Matua")	1
<i>F. arundinacea</i>	Tall fescue	3
<i>Holcus lanatus</i>	Yorkshire fog ("Massey Basyn")	1
<i>Secale dalmaticum</i>	Mountain rye	1
Forbs		
<i>S. minor</i>	Sheeps Burnet	1

Pasture species for mid-altitude shady areas of the high country

A major trial at Tara Hills (B.E. Allan) to determine the effects of stocking rate and grazing method on pasture and animal production from oversown mid-altitude tussock grassland, has indicated that the scope for improvement with intensified management is restricted by limitations shown by the cultivars of the traditional species oversown.

A wide range of conventional and alternative species is being established within the nine grazing treatments of this trial, to determine the effects of stocking rate and grazing method on their survival, spread and growth (Table 4.)

J.M. Keoghan, B.E. Allan: "Pasture species, cultivars and lines for high country grazing systems. 2. Adaptability productivity and persistence on shady faces".

Browse species for the high country

Some tree and shrub species introduced by MWD Plant Material Centre, Aokoutere, have shown considerable potential for revegetation and soil and water conservation on depleted areas of the South Island high country. Trials by the Alexandra Centre (B.J. Wills) have shown that some of these multi-purpose species have considerable value for forage as well. An observation trial of multi-purpose shrubs has been established on a lower sunny face at Tara Hills. Species: *Cercocarpus montanus* ("Mountain mahogany"); *Kochia prostrata* ("Bluebush"); *Atriplex halimus* ("Saltbush"); *Coeanothus* spp.; *Chamaecytisus palmensis* ("Tagasaste").

J.M. Keoghan, M.H. Douglas: "Observation trial of multi-purpose shrubs with forage potential".

Introduction of grasses into tussock grasslands

Introduction of grasses into tussock grasslands was highlighted as being the number one problem in Southland and Otago at the Farmer Advisory Research Meeting held at Invermay in 1980. Past research has shown that establishment rates of 1% or less are not uncommon.

I.R. Hall. "Trials on the introduction of grasses into tussock grasslands".

Sites: Waioara; Waipori and Tara Hills.

Grasses: "Nui" ryegrass; "Apanui" cocksfoot; S170 tall fescue; Crested dogstail and Massey Basyn Yorkshire fog.

In a trial at Tara Hills, excellent establishment rates were obtained when mob stocking was used to damage the existing vegetation and then tread the seed into the soil. ("Nui" and "Apanui", 9%; "Massey Basyn", 12%).

However, unless there is adequate nitrogen being transferred from legumes to the grasses, oversowing grasses will be a waste of time and money because any grasses which do establish will be N deficient and will contribute little to pasture quality and production. Consequently, either sufficient S and P must be present in the soil to ensure that the legumes are fixing adequate amounts of N or alternatively, fertiliser nitrogen applied. Furthermore, runholders will also be wasting their time and money oversowing grasses if there is already an appreciable exotic grass component in the areas being oversown.

Pasture Species Most Suited to Non-Arable Hill and High Country: A New Look at Traditional Species

B.E. Allan*

Introduction

Oversowing with clover and grass dominates pastoral improvement of South Island hill and high country. Numerous varieties and cultivars have been tested and screened over the past 30 years for suitability to this environment, yet only a handful are currently used. Grassland's cultivars of white and red clovers, cocksfoot and ryegrass, along with alsike clover have proved most successful despite the fact that most of these cultivars have been specifically bred for intensive grazing on cultivated lowlands.

There are a number of reasons why traditional lowland cultivars are used extensively in the hill and high country.

(a) Seed for many of the new varieties is not commercially available, or is expensive.

(b) Suitable species may be difficult to establish — for example, lucerne in preference to white clover in semi-arid areas; tall fescue in preference to ryegrass for frosting tolerance (Vartha and Clifford, 1973; Clifford, 1975; Musgrave, 1980).

(c) Many alternatives are suited only to specific areas according to their moisture, temperature and fertility and management requirements (Scott, 1979; Scott *et al.*, 1985). Conversely at Tara Hills for example, Grassland Huia and Nui are sown on the intensively grazed irrigated flats, but also

recommended for inclusion in oversowing mixtures for the dry hill country.

(d) There is not enough information on the use and management of many of the promising alternatives.

A newly tested species should not be recommended for hill and high country merely because it grows well in that environment. To be successful it must persist in a system that efficiently produces saleable animal products.

Existing native and adventive species (eg browntop, sweet vernal) have contributed greatly to sustained production from the hill and high country. It seems logical to fit promising new pasture species into management systems that are in harmony with existing species. Much of the past evaluation of plant material has been primarily concerned with establishment and has largely overlooked management requirements.

This paper first outlines the management principles necessary for improved but sustained animal production from oversown tussock country, and then examines how white clover, cocksfoot and ryegrass performed under such management.

The Tara Hills Grazing Trial

In 1978 a long-term grazing management trial was set up on oversown tussock country at Tara Hills (Allan, 1985). The trial investigates effects of various combinations

*Tara Hills High Country Research Station, Omarama.

of stocking rate and management practice. The objective is to improve pasture utilisation and animal performance on oversown country, in a 500 mm (20") rainfall zone.

What we have learnt

It is clear that increased stock numbers is the key to improved utilisation. (Figure 1). More intensive subdivision and associated rotational grazing does not improve overall utilisation, but it does improve the evenness of utilisation within a block. This is necessary for good animal performance at high stocking rates.

Optimal liveweight gain/ha was achieved from a simple form of alternating grazing; with stock shifts every two-three weeks at a medium stocking rate that utilised approximately 70% of the inter-tussock pasture at each grazing (Figure 2). Wool growth was not greatly affected by either stocking rate or grazing practice, so maximum production/hectare was achieved at the high stocking rate.

The greater liveweight gains from alternating grazing at the medium stocking rate were achieved mainly during the summer months when dry conditions limited pasture

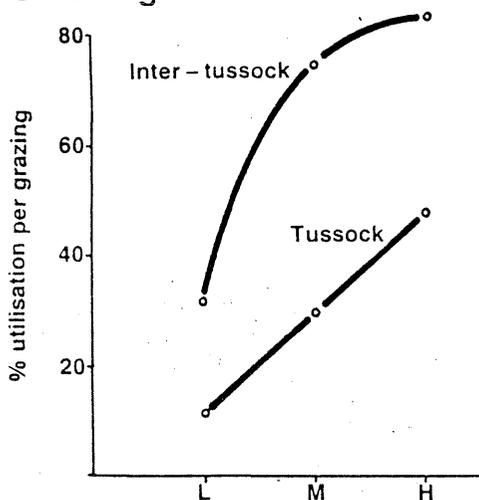
growth. In these conditions the growth rate and quality of inter-tussock pasture was somewhat enhanced by alternating grazing, but the main reason for the greater liveweight gain was the greater bank of pasture than existed under continuous stocking (Table 1).

These results clearly highlight the need for adequate stock numbers to encourage non-selective utilisation, and the need for subdivision to maintain control and allow a bank of feed to develop ahead of stock requirements. The application of these principles in planning run development and management has been discussed in more detail elsewhere (Allan, Lowther and Walton, 1985).

The performance of traditional species

The amount of clover in the oversown pasture was influenced more by environment than by management (Figure 3). White clover persisted better than red and alsike, but none of the grazing treatments kept the large increases in the cover of this species that occurred during climatically favourable seasons. The suitability of white clover is clearly marginal in the more open, tufted-

Stocking rate



Grazing practice

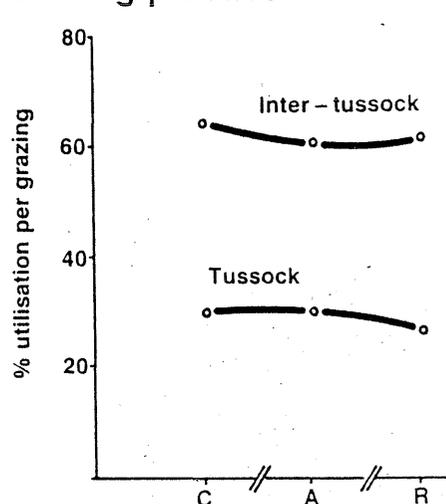


Figure 1: The effect of grazing management on pasture utilisation (mean value per grazing over three years) L low, M medium, H high stocking rate. C continuous, A alternating, R rotational grazing.

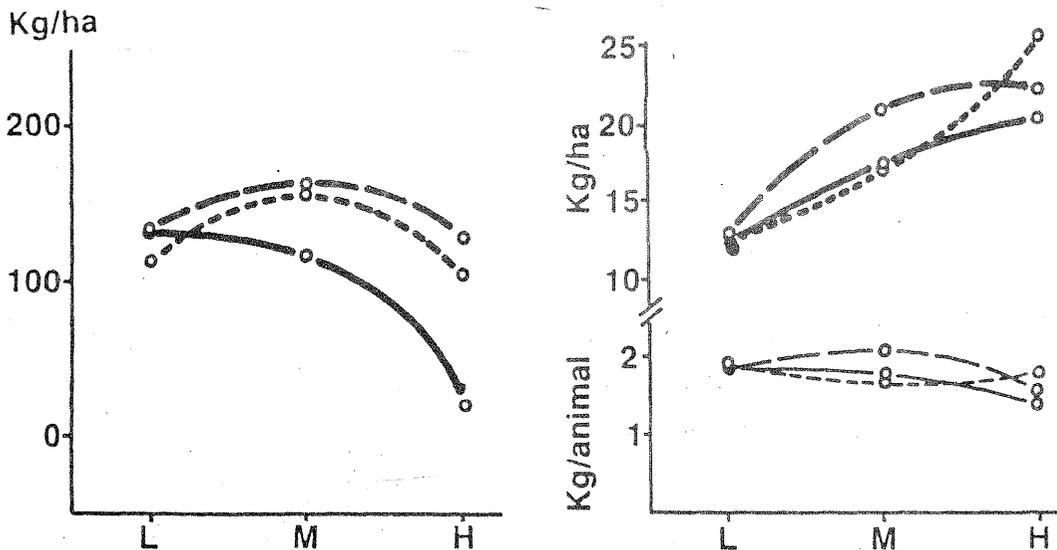


Figure 2: The response in Merino hogget liveweight gain (kg/ha) and clean wool growth (kg/animal and kg/ha) to stocking rate for different management practices on oversown tussock country. L low, M medium, H high stocking. — continuous, - - - alternating, rotational grazing

type pastures typical of oversown YGE and dry YBE soils. Because the contribution from red clover was insignificant at levels that gave best liveweight gain/ha, this plant should be valued as a special purpose species, rather than included in general oversowing seed mixtures.

Grazing management can considerably influence the amount of cocksfoot and ryegrass in the oversown pasture (Figure 4). Increased utilisation decreases cocksfoot cover, especially if there is inadequate subdivision to periodically spell the pasture. Conversely, the amount of ryegrass increases as utilisation is improved. This grass is clearly more tolerant of continuous stocking than cocksfoot. However, New Zealand-bred ryegrasses are not particularly cold tolerant, and this may limit their suitability in some high country areas, particularly for shady faces above 750 m (Allan, 1985).

Further evaluation of specific plant material

The grazing trial at Tara Hills has shown

that considerable gains in animal productivity can be achieved through improved management of pastures oversown with white clover, cocksfoot and ryegrass. But all these species have revealed limitations.

Work is now underway to examine the performance of a wide range of traditional and alternative plant material within the various treatments of this grazing trial. This work concentrates on the long-term ability of specific plant material to persist and spread, rather than the more traditional approach of ability to establish in small, fenced-off plots. To achieve this, individual seedlings were well established in a glasshouse and then, after a period of climatic hardening in early spring, manually planted on a relocatable grid basis into each treatment of the grazing trial. A further six weeks of establishment was allowed before the grazing treatments were started.

Twelve white clovers including Grasslands' Huia, Tahora, Pitau, and G18 are being assessed. Other legumes include Pawera red clover, seven alsike clovers and

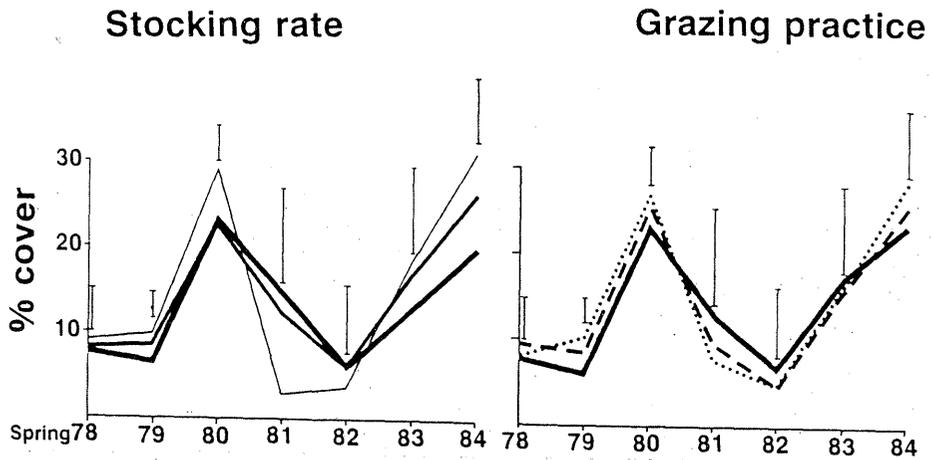


Figure 3: Grazing management and seasonal effects on the white clover cover of oversown tussock country. _____ low, _____ medium, _____ high stocking rate. _____ Continuous, _____ alternating, _____ rotational grazing

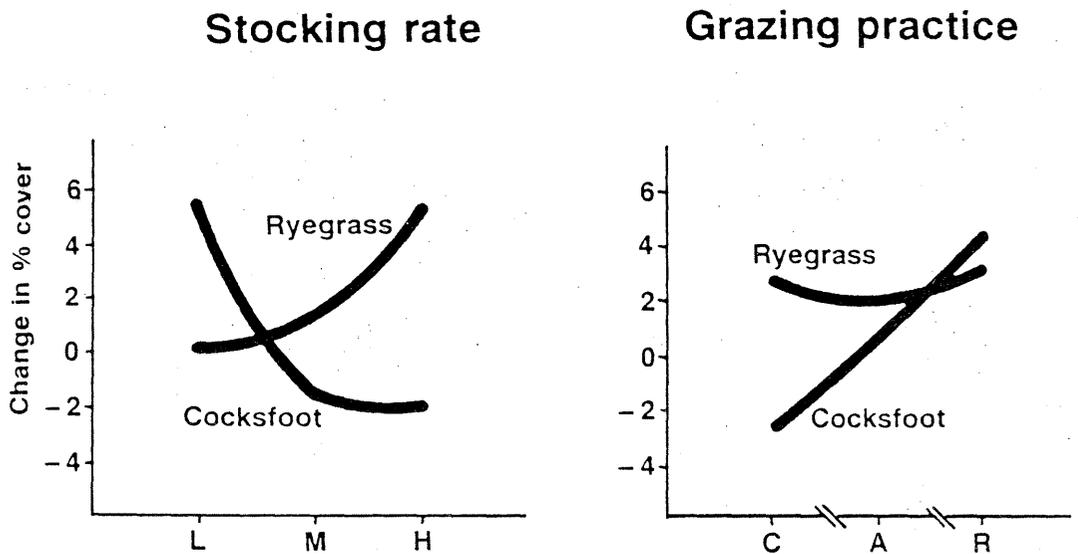


Figure 4: Changes induced by grazing management in cocksfoot and ryegrass cover of oversown tussock country (from Allan, 1985) L low, M medium, H high stocking rate. C continuous, A alternating, R rotational grazing.

12 Lotus varieties. Thirteen ryegrasses, including local ecotypes considered drought and cold tolerant, are being compared with Nui and Ruanui. Wana cocksfoot is included with Apanui and a local ecotype. Three tall fescues, three brome species including Matua, and sheeps burnett are also under examination. A complete list of the plant material is presented elsewhere in these proceedings (Keoghan, 1985).

Performance of this material will be monitored over the next few years and we are confident that results will indicate material suited not only to oversown tussock country in general, but also to specific management systems farmers may prefer or be compelled to use.

Table 1. Effects of grazing practice on the inter-tussock component of an oversown pasture grazed at a stocking rate achieving approximately 70% utilisation per grazing (mean of three years).

	Spring	Summer
Pasture growth (kg/ha/day)		
continuous	20	6
alternating	20	9
Pasture quality (%DOM) [†]		
continuous	75	67
alternating	79	72
Pasture bank (kg/ha)		
continuous	550	70
alternating	570	310

[†] *in vitro* digestibility during 1981/82 (mean for white clover and cocksfoot).

Conclusions

Better utilisation of oversown tussock country is achieved through increased stock numbers. To improve animal production, both rotational grazing and increased subdivision at high stocking rates is needed to provide a sufficient bank of feed ahead of stock.

Although clovers, cocksfoot and ryegrass show some limitations on well grazed oversown tussock country, they still appear best for general purpose oversowing. Grassland's Huia white clover, Nui ryegrass as well as Wana cocksfoot and alsike clover are the cultivars presently recommended. We are now testing material, mainly from within these species, that may be more suited to intensified grazing on oversown hill and high country.

Other species will certainly be more suited to special purpose areas (e.g. Grassland's Maku lotus on very acid soils, lucerne on very dry faces, and sheeps burnett for winter feed). The place for, establishment and use of such species is examined elsewhere in these proceedings.

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Lucerne Establishment on High Country Soils

M.H. Douglas*

In the South Island lucerne is mainly grown on free draining soils of low water-holding capacity in the 300-800 mm rain zone. On these soils lucerne has an average annual productive advantage above pasture of 43% (Douglas 1986).

Successful establishment of lucerne may not necessarily lead to high productivity if subsoil conditions prevent root growth. Under these conditions lucerne loses its productive advantage over other legumes, and on yellow-brown earth soils, which typically have acid subsoils, red clover may be more productive than lucerne (Douglas 1986).

In the past observers considered lucerne should be established on the plains throughout the Mackenzie Basin (Tussock Grassland Investigations unpublished report), but to the contrary, farmer experience was that lucerne failed to persist on high country yellow-brown earths (Scott *et al.* 1974). There were lucerne crops in the Mackenzie Basin which were well established but poor producing. In order to find the reasons for the lack of vigour and persistence the majority of the lucerne crops in the Mackenzie were sampled for soil analysis, and foliage nutrient status.

We have determined by analysing the soil profiles of 86 lucerne stands throughout the Mackenzie Basin that lucerne vigour and rooting depth are badly affected by the soluble aluminium level in the soil. We sampled each profile at 75 mm intervals down to 300 mm, and these were analysed for pH and aluminium soluble in a 0.01

M Ca Cl₂ solution. We have further determined that where lucerne is its most successful, soluble aluminium is negligible.

When the soil profile soluble aluminium levels are below 5 the lucerne produces well and the plants are strongly tap rooted. If the soluble aluminium levels rise above 10 the root system becomes stunted, forked and often with horizontal rooting, and above 15, lucerne roots are generally absent. When the soluble aluminium level was above 10 the lucerne was invaded by weeds such as sorrel and lacked vigour and productivity, and drought tolerance.

Soluble aluminium levels are a function of acidity and levels can increase sharply below pH 5.6 (Grigg 1981) (Fig 1), but this may not always happen. The interesting result we found were vigorous and productive lucerne stands, competitive against

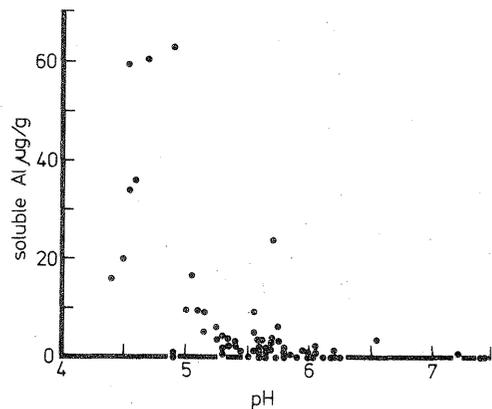


Figure 1. Al soluble in 0.01M Ca Cl₂ V PH (from Grigg 1981)

*Tara Hills High Country Research Station, Omarama.

weed invasion and taprooted when soil pH levels were down to pH 4.9. These paddocks had soluble aluminium levels close to or below the test level of 5. (Table 1).

Thus pH alone does not provide a good diagnostic method to determine if lucerne will have a productive advantage over other legumes. The soluble aluminium test in conjunction with the pH test provides a sound basis to determine if lucerne will perform well on a particular soil. It should be emphasised that subsoil profile sampling is necessary to obtain soluble aluminium levels, as it can be noted in profile B (Table 1) that this profile was very antagonistic to lucerne between 225 and 300 mm, but the top 0-150 mm was reasonably favourable for lucerne. The lucerne roots will move horizontally in this top zone. The lucerne in this paddock was generally shallow and fork rooted to 225 mm depth.

Although it is possible to manipulate the topsoil acidity with lime, there appears little point in doing so, when there is an antagonistic subsoil. Although Davis (1981) and Black and Cameron (1984), have shown it beneficial to improve subsoil conditions in pot experiments, the logistics of this in the field are largely untested. The rates of lime required may be considerable (Grigg 1981), thus cost will influence any decision to grow lucerne.

Thus, for the Mackenzie Basin, we can identify soils by a soluble aluminium test to determine if lucerne will be vigorous and productive. The soils on the old outwash

plains, and above the 700 mm rainfall isohyets are generally unsuitable for lucerne. The soils on which lucerne can readily establish and be productive are the young outwash soils of the fans, recent river terraces, or hill sides below 600 mm average annual rainfall, or where the soluble aluminium test is below 5. Soils with pH > 5.8 will not have a soluble aluminium problem.

Other legume species are more tolerant of low pH and high soluble aluminium levels and red clover, alsike, white clover and *lotus corniculatus* are options.

Lucerne overdrilling

Although the requirements for lucerne establishment are well known (Musgrave 1982; Douglas 1986) and the overdrilling of lucerne investigated previously (Dunbar *et al.* 1980; Brash 1983), there was a lack of understanding of what was happening to the seedling population during the establishment year. Lucerne overdrilling establishment experiments had already demonstrated the advantages of herbicide in controlling competition and retaining soil moisture at a higher level (Brash, Daly and Horrell 1983).

In conjunction with the N.Z. Agricultural Engineering Institute, we investigated four different drills to establish lucerne by overdrilling.

The lucerne seed was sown in the first week of September at a rate of 18 kg/ha of pelleted seed (9 kg/ha bare seed) and with 400 kg/ha of dicalcic phos a lime

TABLE 1. Soil profile analysis for pH and soluble Aluminium from two paddocks of poor shallow rooted lucerne and two paddocks of high producing lucerne.

Profile	POOR				GOOD			
	A		B		C		D	
Soil Depth mm	pH	Al	pH	Al	pH	Al	pH	Al
0-75	4.8	8.0	5.4	3.8	4.9	4.6	5.3	2.8
75-150	5.0	13.8	5.2	6.0	5.1	4.5	5.2	3.6
150-225	5.0	13.8	5.2	6.0	5.1	4.5	5.2	3.6
225-300	5.2	22.0	5.0	18.5	5.3	5.1	5.3	3.1

superphosphate mixture which also included molybdenum.

Insecticide was also drilled to counteract grass grub. Four drills were tested — two rotodrills, one disc seeder and one spring-tynd seeder. The experiment was divided into untreated and herbicide treated (glyphosate @ 2 l/ha) plots, with the herbicide applied 10 days prior to drilling. The vegetation was a dense prostrate grass sward, with scattered briar, haresfoot trefoil, and occasional hard tussock. The site was on an outwash fan with a soil pH of 6.2, and soluble aluminium level close to 1.

Results

In the spring seeds are sown into soil which will diminish in moisture level. Herbicide control of the resident vegetation shows an advantage as it maintains soil moisture at a much higher level throughout the spring months (Fig. 2), and this effect is translated into the number of seedlings established and their growth (Figs. 3 and 3a). Of interest is the second germination

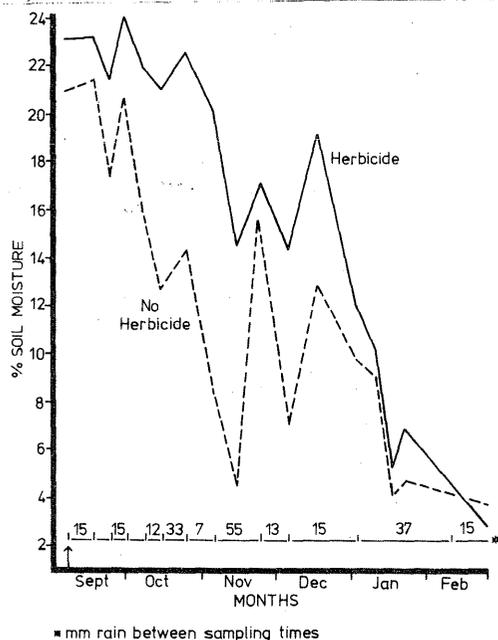


Figure 2. The % soil moisture (gravimetric) - Mean for soil profile 0 - 22.5 cm.

which occurred after heavy rain in November.

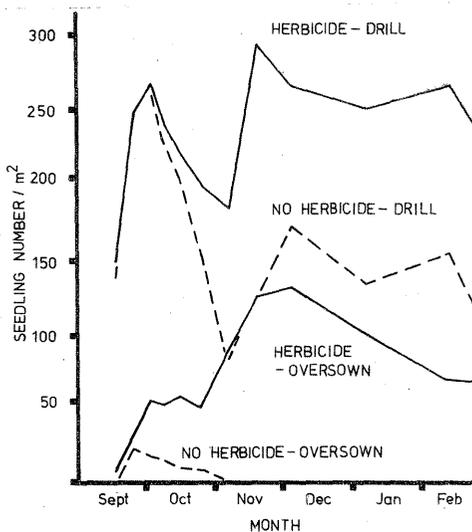


Figure 3a. The number of lucerne seedlings/m² on herbicide treated and untreated native pasture established by overdrilling or oversowing.

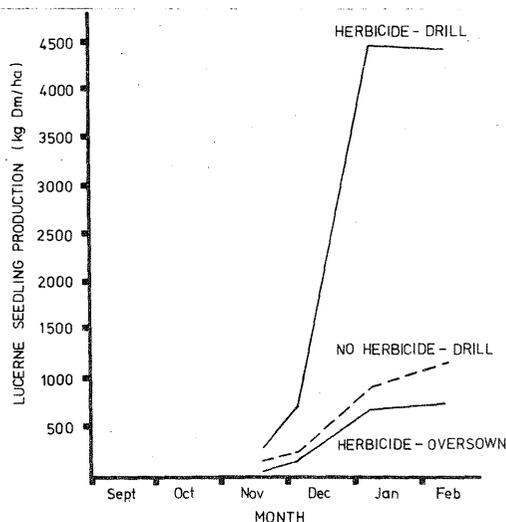


Figure 3. The production of lucerne seedlings (kg Dm/ha) on herbicide treated and untreated native pasture established by overdrilling or oversowing.

Without herbicide the oversown seed failed to establish. On this site haresfoot trefoil provided vigorous competition after fertiliser application, and there was no sign of further germination following the November rain. Herbicide assisted the oversown seed, but seedling numbers were below those in the drilled plots. Seedling dry matter production increased threefold when seeds were drilled in the herbicide treatments (4500 kg DM/ha c.f. 600-1000kg DM/ha produced without herbicide or when oversown with herbicide). (Figs. 3 and 3a).

Although there is little difference between drills when herbicide is used, there are large differences between drills when herbicide is not applied. The rotodrills effectively reduce competition by covering the inter-drill area with soil. Thus with the roto drill there is little difference in establishment between herbicide and non herbicide (Fig. 4).

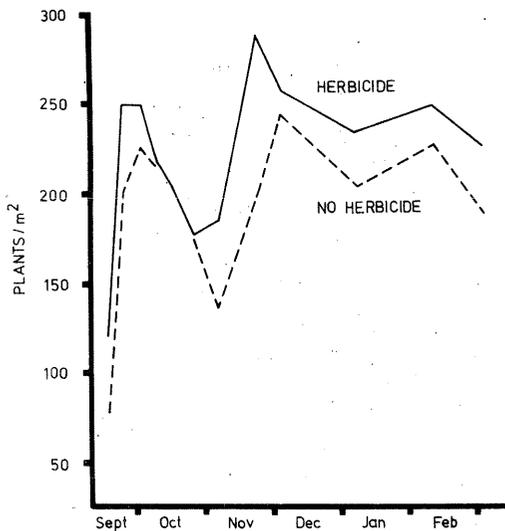


Figure 4. The effect of the rotodrill on the establishment of lucerne into herbicide treated and untreated native pasture.

Conversely the triple disc shows poor establishment without herbicide where the seedling suffers from adverse competition from the vigorous growth of haresfoot trefoil. (Fig 5).

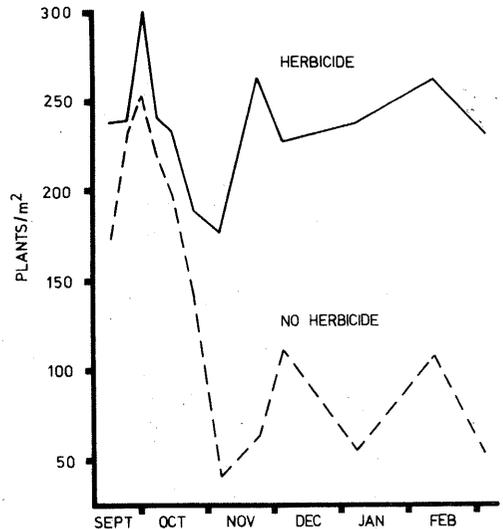


Figure 5. The effect of the triple disc on the establishment of lucerne into herbicide treated and untreated native pasture.

Although there are marked differences between the herbicide and non herbicide treatments, the seedling numbers are well above 30 plants/m², the number sufficient to maximise production (Palmer and Wynn-Williams 1976). Following the advice of Palmer and Wynn-Williams at least halving the seedling rates with the herbicide treatment, appears a positive way to reduce overdrilling costs.

Our results show herbicide can dramatically improve establishment, and our experience is that the type of drill used to subsequently drill the seed is unimportant.

A general establishment recommendation for lucerne in a dry tussock grassland environment is:

- Determine if the soil profile is suitable for lucerne with pH tests at various levels; if the pH is below 5.8, undertake a soluble aluminium test, particularly of the subsoil.
- Pre-spray the area with glyphosate.
- Drill with inoculated and pelleted seed, and lime reverted superphosphate plus molybdenum, in the late winter/early spring.
- Use an insecticide to control grass grub.

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Fitting Pasture Species and Cultivars into High Country Landscapes and Grazing Systems

J.M. Keoghan*

In contrast to other regions of New Zealand, the high country is mainly unimproved grassland. Some of this region is too cold and/or dry to support extensive forest and scrub associations, and grassland has become an induced climax for the remainder because of pre- and post-European burning and post-European grazing. Furthermore, sources of seed to enable reversion to scrub and forest associations have usually long since disappeared. Consequently, as well as a wide range of pasture improvement options, much of the high country can still be farmed in its "natural" low fertility state without major reversion to scrub, as occurs in some other areas of New Zealand.

Thus, more species and cultivars have a role in high country grazing systems than elsewhere in New Zealand. The range includes resident species, which reflect differences in soil fertility, climate and past and present management practices such as seeding mixtures, burning and grazing. It also includes a very wide choice of introductions in terms of drought tolerance and soil fertility requirements. Most of these options are available for any one runholder to use within the farm. The opportunity exists to selectively develop and utilise the property, by using different suites of species and cultivars. Such development strategies

will be strongly influenced by the landscape classes of the property; classes determined by different combinations of slope, aspect and altitude (and therefore climate), soil type and fertility, vegetation type and cover, and location relative to stock management. Selective development also means selective fertiliser application from zero through to high, reflecting the diversity of landscape classes and the role that is decided for each to meet seasonal feed requirements in the most cost-effective way.

In the past decade, a much broader range of pasture species and cultivars has become available to the high country farmer, giving more options for pasture improvement programmes. Examples of these are: "Grasslands Wana" cocksfoot as a superior alternative to Grasslands Apanui; "Grasslands Pawera" red clover as a superior alternative to "Grasslands Turoa"; "Grasslands Maku" *Lotus pedunculatus* as a valid alternative to "Grasslands Huia" white clover for wet, acid and infertile high country soils (e.g. on the Otago Plateau); "Grasslands Roa" tall fescue as an alternative to perennial ryegrass for better drought and pest tolerance.

The most recent development has been the release of two grasses specifically for high country pastures, namely "Grasslands Hakari" *Bromus marginatus* and "Grass-

*Invermay Agricultural Research Centre, Mosgiel

lands Tiki" *B. inermis*. In the future a New Zealand cultivar specifically selected for high country environments is likely to become available for each of the following legume species: Alsike (*Trifolium hybridum*), Birdsfoot trefoil (*L. corniculatus*), Crown vetch (*Coronilla varia*), Caucasian clover (*T. ambiguum*) and Zig Zag clover (*T. medium*). Such imminent releases result from 20 years of trial work conducted by Grasslands Division High Country group led by Dr D. Scott, and reflect an increasing awareness of the value of releasing pasture cultivars for specific regions, environments and farming systems.

To better understand the roles that different pasture species can play in high country development some appreciation of their climatic and edaphic (soil) adaptability and their agronomic characteristics is required. See Table 1 for a summary of some of these aspects.

Given this information we can "fit" species and cultivars to individual seasonal feed requirements and landscape classes with more confidence (Table 2).

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TABLE 1. Environmental suitability/adaptation of pasture species for South Island hill and high country. (adapted from Scott *et al* 1985)

1. Temperature	
1. Cool temperature, high altitudes, south aspects.	
2. Moderate temperature and altitudes.	
3. Warm temperatures, low altitudes, sunny faces.	
2. Moisture	
(a) Tolerance to moisture stress	(b) Suitability for sites with prolonged moisture stress
1. Low	1. Low
2. Moderate	2. Moderate
3. High	3. High
(c) Suitability for intensive irrigated pastures	(d) Sites where species is of greatest value in livestock feeding system systems relative to other species
1. Low	1. Low moisture stress
2. Moderate	2. Moderate moisture stress
3. High	3. High moisture stress
3. Soil fertility	
(a) Adaptation to low fertility	b) Sites where species is of greatest value relative to other species.
1. Low adaptation to low soil fertility	1. Low fertility
2. Moderate adaptation to low soil fertility	2. Moderate fertility
3. High adaptation to low soil fertility	3. High fertility
(c) Adaptation to wet, acid and infertile soils	
1. Low	
2. Moderate	
3. High	
4. Grazing tolerance	5. Stock acceptability
1. Tolerates close or set stocking	1. Low
2. Intermediate	2. Moderate
3. Requires lax or long regrowth periods as in hay production.	3. High
	6. Seeding rate (kg/ha) (Inoculated and coated in the case of legume species)
	7. Seed availability (1985)
	1. Would not be sown
	2. Only available in experimental quantities
	3. Limited quantities available
	4. Freely available.

Species	1	2				3			4	5	6	7
	Temp- erature	a	b	c	d	a	b	c	Grazing Accept- tolerance ability	Seed rate	Seed avail- ability (1985)	
Legumes												
Alsike clover	1-2	2	2	2-3	2	2	2-3	2	2	2	2-4	4
White clover	2-3	1-2	1-2	3	1-2	1	2-3	2	1	3	2-4	4
Red clover	1-2	1-2	1-2	3	1-2	1	2-3	1-2	3	3	2-4	4
Lucerne	2-3	3	3	3	3	1	3	1	3	3	4-10	4
Maku												
Lotus	1-2	1-2	1	1	1-2	2	1-2	3	2	3	4-6	4
Birdsfoot trefoil	2-3	2-3	3	2	2-3	2	1-2	2	3	2	4-10	3
Suckling clover	1	1	1	1	1-2	3	1	3	1	2	½-1	1
Haresfoot clover	2	3	2	1	3	3	1	1	1	1	0	1
Zig Zag clover	2	2	2	1	1-2	3	1-2	2	1	2	1-2	2
Caucasian clover	1-2	2	2	1	2	3	1-2	2	1	3	1-2	2
Crown vetch	2-3	3	3	1	3	3	1-2	1	1	2	1-2	2
Yellow sweet clover	1-2	2	2	1	2	2	1-2	2	2	2	2-5	2
Subterranean clover	3	2-3	3	1	2-3	1	3	1	2	3	5-10	
Greenfeed lupin	2	2	2	1	2	1	3	2	3	3	5-10	3
	1			2			3		4	5	6	7

Species	Temperature	Moisture				fertility			Grazing Acceptability		Seed rate	Seed availability (1985)
		a	b	c	d	a	b	c	tolerance	ability		
Grasses												
Cocksfoot	1	2-3	2-3	2	2-3	2	1-2	2	2	3	5-15	4
Tall fescue	1	2	2	3	1-2	1-2	2-3	1	1-2	3	5-15	4
Perennial Ryegrass	2-3	1-2	1-2	3	1-2	1-2	2-3	1	1	3	10-15	4
Hybrid Ryegrass	2-3	1-2	1-2	3	1-2	1-2	2-3	1	2	3	10-15	4
Annual Ryegrass	2	2	1	3	1-2	1	3	1	2	3	15-25	4
Timothy	2	1	1	3	1	1-2	3	2	3	3	2-5	4
Phalaris	2-3	2	1-2	1-2	1-2	3	1	2	3	1-3	3	3
Prairie grass	3	2	2	3	2-3	1	3	1	3	3	20-30	4
Smooth brome	2	2	3	1-2	1-2	2	2	1	1	3	5-15	2
Mountain brome	2	2	2	1-2	1-2	1-2	3	1	3	3	20-30	2
Browntop	1-2	2	2-3	1	2-3	2-3	1	3	1	2	¼-2	4
Yorkshire fog	2	1-2	2	1	2	2	1	3	2	3	2-5	3
Crested dogtail	3	2	1	2	2	1-2	2	1	1	2	5	4
Tall oat grass	2	3	3	1	2-3	3	1	1	3	2	1-3	2
Pubescent Wheat grass	3	3	3	1	2	3	1	1	2	2	1-3	2
Fescue or hard tussock	1	2	3	—	3	3	1	2	2	1	0	1
Blue tussock	1	2	3	—	2	3	1	2	2	2	0	1

Species	Temp erature	Moisture				Fertility			Grazing Accept- tolerance ability	Seed rate	Seed avail- ability (1985)	
		a	b	c	d	a	b	c				
Silver tussock	1	2	2	—	2	2	2	2	2	1	0	1
Snow tussock	1	2	2	—	1-2	3	1	3	2	1	0	1
(c) OTHERS												
Sheeps sorrel	1	2	3	—	3	3	1	3	1	1	0	1
Yarrow	2	3	2	—	3	2	2	2	2	2	2-10	2
Sheeps burnet	2	2-3	3	—	3	2	1	1	2	2	10-15	3
Tagasaste or tree lucerne	3	2	1	?	2-3	1-2	2	1	3	2	2-5	3
Tree Medick	3	3	1	?	3	2	1	1	3	2	5	2

TABLE 2 The most suitable role(s) for species and cultivars in the seasonal feed supply. Species arranged in *approximate* order of preference within each category. (Adapted from Scott *et al.*, 1985).

Autumn-saved standing winter feed

(a) Low-moderate soil fertility

Grasses on the whole better than legumes.
Cocksfoot; browntop; sweet vernal; tall oat grass.

Alsike; crown vetch; red clover; "Maku" lotus.

(b) Moderate - high soil fertility

Grasses on the whole are better than legumes.

Tall fescue ("Roa" and S170 equal); Cocksfoot ("Kara" and "Wana" the best); perennial ryegrass; "Matua" prairie grass; "Maru" phalaris

Red clover ("Pawera" best); alsike; "Maku" lotus.

Special-purpose winter crops.

(a) Moderate soil fertility

Ryecorn ("Rapaki") and oats ("Omihī" and "Saia")

(b) High soil fertility

Annual ryegrasses ("Tama" best); barley ("Claremont").

Turnips; swedes; kale; green feed lupins.

Late winter/early spring special purpose feed

(a) Low-moderate fertility

Sheeps burnet

(b) Moderate-high fertility

Ryecorn and annual ryegrasses

Lucerne (for high fertility areas, but follow this early use with a long spell to allow stands to recover)

Subterranean clover (use only on lowest altitude, sunny country.

"Mt Barker" seed available; "Woogenellup" seed, unavailable).

Special purpose lamb fattening feed (high fertility required)

Red clover ("Pawera" best); white clover ("Huia" best).

"Grasslands Hakari" Mountain brome;

"Matua" prairie grass; hybrid ryegrasses ("Manawa" or "Ariki")

Spring-early summer feed

(a) Low soil fertility

Haresfoot clover (dry areas), suckling clover (moderate-moist areas); red clover; "Monaro" Caucasian clover; zig zag clover; "Maku" lotus; Crown vetch.

Browntop, sweet vernal; chewings fescue; blue tussock; Yorkshire fog; native tussock and Danthonia; pubescent wheatgrass; sheep sorrel.

(b) Moderate soil fertility

Alsike clover; sweet clover (short term, "Yukon" best); Birdsfoot trefoil ("Maitland", "Granger" or "Cascade"); "Maku" lotus (moderate -moist areas); Crown vetch; subterranean clover (lowest altitude, sunny country).

Cocksfoot ("Wana" best); "Grasslands Tiki", Smooth brome; Yorkshire fog ("Massey Basyn"); crested dogstail, silver tussock.

(c) High soil fertility

Alsike; lucerne (WL 318 best); white clover ("Huia" best); red clover ("Pawera" best).

Cocksfoot ("Wana" best); perennial ryegrass ("Nui", "Ellets" and "Ruanui" about equal); tall fescue ("Roa" or S170); "Maru" Phalaris; hybrid ryegrasses ("Ariki" best); "Hakari" mountain brome; "Matua" prairie grass.

Late summer/autumn feed

(a) Low soil fertility

Suckling clover

Chewings fescue; blue tussock; native tussocks; danthonia; sheep sorrel; yarrow.

(b) Moderate soil fertility

Red clover ("Pawera" best); birdsfoot trefoil ("Maitland", "Granger" or "Cascade"); "Maku" Lotus; alsike clover.

Cocksfoot ("Wana" best); perennial ryegrass; "Tiki" Smooth brome; crested dogstail; sweet vernal.

(c) High soil fertility

Lucerne; red clover; white clover ("Huia" best).

Tall fescue ("Roa" or S170); perennial ryegrass; "Hakari" mountain brome; "Matua" prairie grass.

Hay or silage

(at least moderate soil fertility required)

Lucerne; red clover ("Pawera" best); alsike; Birdsfoot trefoil. "Kahu" Timothy; cocksfoot ("Kara" best); tall fescue ("Roa" or S170); "Maru" Phalaris.

Shrubs for reserve feed ("feed banks", browse)

Largely untried in on-the-farm feeding trials in the high country. Possibilities for future systems: tagasaste (tree lucerne), tree medick, mountain mahogany; salt bush; blue bush.

Species for the Moist Zone

C. Bridgeman*

Introduction

Eskhead Station is 15,909 hectares, situated in North Canterbury on the Lake Sumner road, approximately 130 km from Christchurch.

I purchased the property in June 1981, when it was carrying 3000 breeding ewes, 3600 other sheep and 560 cattle — 8700 stock units. In 1985 the Station carried 13,500 sheep and 880 cattle.

The property had previously been run by resident managers, there had been no development or topdressing, there was one stock proof fence on the property and two holding paddocks at the homestead. Access was virtually non-existent, with one rough track out to an area 10 km from the homestead.

The winter climate is harsh, with winter dormancy from April to October. Rainfall varies from approximately 1000mm at the homestead, 1500mm at the mid section of the property to more than 2500mm at the extreme end of the property. Rainfall is reliable in most seasons, and there are usually good north-west rains in the summer.

Development

When planning the development of Eskhead I considered rainfall to be one of the key factors for achieving successful oversowing or cultivation. I selected the mid section of the property with two prime areas; the 'hogget block' and 'Island Hills' areas for development. These areas lie in the moist zone with the rainfall in excess of 1250mm per year. Both areas are subject to good winter sunshine hours, but are exposed to the north-west winds. The

*Eskhead Station, Hawarden

problems associated with these areas were lack of access, fences and airstrip.

The Rural Bank approved a land development encouragement loan for developing these two main areas, using oversowing and topdressing. The hogget block, at an altitude of about 650m rising to 800m, was flat and arable, with an extremely tight cover of browntop, hawkweed, scattered tussock and some native clover. Estimated carrying capacity was one sheep to two hectares. It was 800 hectares, with one ring fence, and no access.

As Eskhead has only limited holding paddocks and no arable land at the homestead, I considered it was necessary to quickly obtain some high producing species and good pasture for feeding young stock. The hogget block had been recommended for oversowing and topdressing, but because of its tight browntop sward and low fertility levels I considered cultivation would give the quickest, best result. Soil tests revealed a pH of 5.4, low calcium levels, a medium range of phosphate at the 10 level and low sulphur levels. The phosphate retention is reasonable. The soil type is Tekoa hill series, which when developed with adequate phosphate and lime is reasonably highly productive.

Development commenced with a contractor giant discing all the easy arable areas on half the block. Approximately 160 hectares were discd in May and June of 1982. It was a particularly harsh winter, and by the end of June the ground had frozen solid, and the discs could not penetrate.

With cultivation the area came up very turfy and the break down was extremely

slow because of its low fertility. The area had no consolidation and cultivation was difficult. It was decided to sow the area in turnips to obtain some cash flow from the initial outlay.

The following year the whole area was re-cultivated, using a goliath chisel plough, which had the effect of breaking up the pan, and the area was seeded out to new grass. The grassland mixture was used, because of the low fertility, low pH and virtual nil nitrogen status.

Clovers were going to be important for the fixation of nitrogen and good establishment of a ryegrass sward. But browntop reversion was going to be a major problem with the pH level and low calcium level. Prior to sowing, the area had received 600 kg/ha of molybdc sulphur super, but no lime. I considered that with this input the ryegrass could be established, and selected the following mixture:

7 kg Nui ryegrass
3½ kg alsike clover
1½ kg white clover

All clover seeds were inoculated and pelleted. This extra cost I considered necessary for maximum establishment of the clovers in the autumn to prevent frost lift. I chose alsike clover because I did not want the total smothering effect that white clover can give in initial years, and the subsequent associated dramatic drop in production. I found alsike, although slightly slower to establish, formed a better ratio between ryegrass and clover in these initial development years.

The exercise was successful, and I attribute the success to the area being left ungrazed until July, then heavily mob stocked with over 9000 sheep stock units, destocked for two months and then rotationally grazed by cattle and 2000 ewe hoggets. The heavy stock pressure applied for a short time in the winter/early spring consolidated the sward and maximised ryegrass tillering. The ryegrass has now established and there is a good balance of

clovers in the sward. Spring summer stocking rate is now over 20 stock units per hectare.

The second phase of development was oversowing and direct drilling. The Island Hills block, an unfenced area of about 2000 hectares, contained 600 ha of warm sunny country. This warmer country was selected for development because I needed an area for flushing and tugging ewes, and, if possible, to provide a better class of improved winter feed. The altitude ranged from 450-1200 metres, with a considered economic development zone lying below the 850 metre level. Cover was predominantly browntop with sweet vernal and some native clover. In some areas silver tussock was very strong. The soil type is, again, Tekoa hill series. Soil tests revealed pH levels of 5.1, phosphate levels between 12 and 16, sulphur levels 6-7 and phosphate retention around 50.

The development plan for this block was to establish fences before over-sowing. A 20 kilometre subdivision fence separating the sunny from the shady country was receted in 1982. In 1983 the subdivision fencing followed with one key fence established on the 500 m contour line. This meant that approximately one third of the block to be developed was on the lower altitude level. The area was then burnt and seeded in the spring of 1983. An airstrip was hurriedly established so that superphosphate could be applied as soon as possible. The airstrip was operational by January 1984, and an application of 500 kg of molybdc extra sulphur super was made then. The species sown were:

4 kg perennial ryegrass;
4 kg alsike clover;
1½ kg white clover; and,
1 kg cocksfoot.

The mixture is nothing adventurous, and the main emphasis is on alsike clover. From my experience, where a ryegrass, white clover, cocksfoot mixture has been applied to unimproved hill country, an uncontrol-

lable white clover explosion occurs in the first two years after development, resulting in high levels of trash building up, and reduced legume and grass plants in the following years. Alsike does not have the same explosive tendency, it has a lower phosphate requirement, and so far has persisted well.

Even though ryegrass may not show up initially, it must be introduced in the first stage. Given time and stock fertility, the ryegrass will show up. A heavy application of phosphate has sweetened the native species. Browntop, hitherto ungrazeable, is now providing some marginal feed. Overdrilling trials (in conjunction with Agricultural Engineering Institute, Lincoln College) were established in the autumn of 1984, evaluating four different types of drills. Unfortunately the trial was conducted late, but from the information obtained from tiller counts, the Lincoln College roto drill gave the best plant establishment. In the tight sward and strong browntop competition, the roto drill with its rotary hoe action, formed a seed bed and provided a good mulch for the establishment and protection of the introduced species. An area was roto drill overdrilled in the spring of 1984 with phenomenal results. Phosphate was applied at 375 kg/ha and the same

mixture of ryegrass, alsike and white clover and cocksfoot was used. Plant establishment was very good, and even with the October seeding, clovers flowered and set seed in March 1985. Had they been oversown the clover seeding would not have occurred until the second year.

Alsike withstands frost and cold better than white clover, particularly at establishment. It can also be used as a standing crop for autumn and early winter use.

Summary

I consider that alsike clover, with a lower phosphate requirement than white clover, is ideally suited to the 1000mm plus rainfall zone.

Where legumes and grasses can be introduced by either direct drilling or cultivation, results are considerably better due to the removal of the competition from resident species, especially in the higher rainfall zones.

Bee pollination is critical in the first year's flowering, especially for alsike.

Innoculation and pelleting is critical for maximum establishment of legumes.

The biggest problem facing any recent developer is the future cost of phosphate. Plants demanding lower P inputs must be given priority.

Species for Intensive Use

E. W. Vartha*

D. Scott, L. A. Maunsell**

The species available for use in hill and high country are generally the same as those used in the rest of New Zealand. The situation is however changing with current breeding projects and recent releases providing some materials to be used specifically for hill and high country e.g. alsike clover, *Lotus corniculatus*, 'Tahora' white clover, mountain brome and smooth brome.

This paper reviews research on special purpose species for the more favoured fertile areas of the high country, these areas being limited, usually of low relief, possibly irrigated and used primarily for winter feeding. Much of the information is from (Grasslands Division, DSIR,) research in the Mackenzie Basin of the high country. There is a dearth of information on hill country reflecting the lack of research venture into South Island hill country in general.

Early research (Clifford & Vartha 1966, 1967) was into the possibility of overdrilling cereals and annual ryegrasses rather than using full cultivation practice to grow them for winter feeding. Only ryecorn was successful, but through having to use a considerable amount of nitrogen fertiliser (50 kg N/h) and with either herbicide or partial cultivation, the method is considered impractical. Alsike clover was included with ryecorn and even in overdrilled treatments without any cultivation, alsike could be successfully established. An experiment done at Simons Hill Station over 3 years showed how this legume could contribute to winter feeding practice, but in an indirect role because it had to be fed off before

winter frost destroyed it. Winter feeding of half-bred ewes was compared on similar tussock grassland blocks, one of which had 20% of the area overdrilled with alsike the previous autumn. The alsike was spelled from grazing from late summer to be fed from May to mid June, so maintaining or slightly increasing ewe liveweight in early winter. (Fig. I.) Ewes on the unimproved block were reduced in liveweight over this period. Subsequently it was possible (on the clover-improved block) to feed ewes with only half the hay ration fed on the unimproved block, resulting in both groups reaching the same liveweight at the end of winter. Besides the benefit to winter feeding, the clover area subsequently had marked effect on ewe and lamb nutrition in spring and summer.

Overdrilling alsike clover in this way for winter feed at least in the Mackenzie Country seems to have had little impact on practice, and cultivation would be the more favoured means of growing species for winter feed.

A recent reappraisal of cereals and annual ryegrass on cultivated ground in the dry zone at Haldon Station showed yields of green feed were only moderate, dry autumn conditions restricting early development so that most of the yield was from spring rather than cool season growth. Ryecorn was the highest yielding of the green feed cereals (Table 1). It has the ability to regrow after early winter grazings whereas other cereals don't.

The major change in the Mackenzie Country from the late 1960s, when winter feed research was initiated by DSIR, has

*MAF Lincoln

**DSIR Lincoln

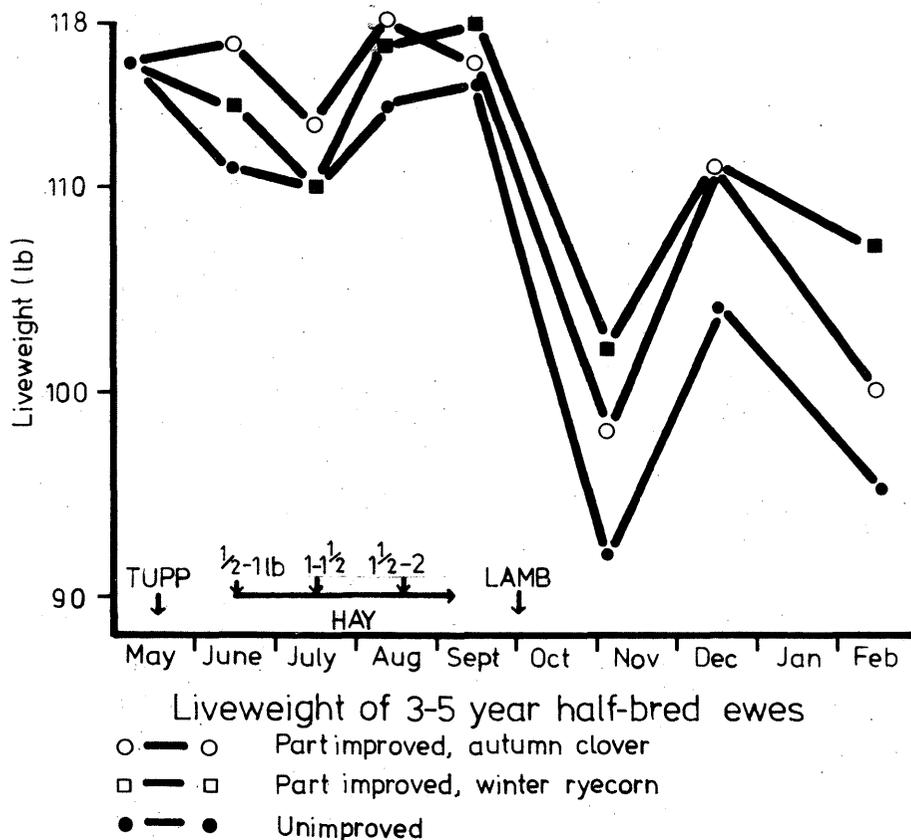


Fig. 1. Liveweight change of half-bred ewes during winter under three feeding regimes (from Vartha & Clifford 1971).

been the development of irrigation on some stations, thus removing a major limitation to providing winter feed.

Hay has been the traditional supplementary winter feed and lucerne would be the desired species where it can be grown. Data from pure species stands at Haldon Station shows the pre-eminence of lucerne when grown under irrigation (Table 2). Of the other legume species, Pawera red clover gave a small margin of yield over Huia white clover, and alsike was considerably lower yielding. Pure sown grasses, with nitrogen fertiliser at a rate of 115 kg N/ha, gave yields that were less than 50% of those for the legumes. Where a high rate of nitrogen was applied (345 kg/ha) grass yields more closely approached yields of the legumes

other than lucerne (Table 2).

For hay production, grass-legume mixtures will generally be used. Two experiments were done on border-dyke irrigated soils at Maryburn and Haldon Stations with about 90 legume/grass mixtures, under high superphosphate fertiliser and with two hay cuts per year (Scott & Maunsell 1985). Over three years measurements (2nd, 3rd and 4th year of stands) lucerne mixtures were the highest yielding at 9.6 t/ha. The next highest yielding mixtures were with red clovers (8.9 t/ha) followed by those with alsike clover (8.2 t/ha) and those with white clover (6.9 t/ha). The swards were generally legume dominant throughout, with red clover mixtures being the most productive in the second year (Pawera > Hamua > Turoa) and

Table 1: Comparative yields of some green feed cereals from March to October (from Scott *et al.* 1984).

Species	Range in yields (t DM/ha)
Ryecorn	.8 - 2.3
Wheat	1.2 - 1.4
Triticale	1.0 - 1.4
Barley	1.2 - 1.8
Oat	0.7 - 1.4
Annual ryegrass	.7 - .8

lucerne mixtures in the third and fourth years (Saranac > Wairau). Over the second to fourth years, proportion of grasses in the mixtures averaged from 26% for Yorkshire fog to 47% for cocksfoot.

On dryland at Tara Hills lucerne was pre-eminent for hay but cocksfoot made little contribution in a mixture with lucerne. Yields of Wairau lucerne from 3 cuts per year were 2.79, 6.72, 7.09 and 11.39 t DM/ha in the four years from sowing, not differing from Rere lucerne and being generally 50% higher than the yield from *Lotus corniculatus* cv France. Mixtures of cocksfoot (4 kg/ha) with Wairau lucerne (11 kg/ha), did not give higher yield than Wairau lucerne alone and as the annual yield of lucerne increased, so cocksfoot was decreased, yielding only 1 tonne of the total 11.45 t in the fourth year (Daly 1984).

Table 2: Annual yield (tonne DM/ha) of pure species stands at Haldon Station under two fertiliser regimes (from Scott & Maunsell 1981)

Species	Irrigated	Dryland		
	Fertiliser - Moderate ¹	High ²	Moderate	High
Lucerne	17.3	18.8	4.3	5.0
Pawera red clover	11.0	11.3	4.3	4.3
Huia white clover	10.7	11.0	4.0	3.9
Alsike	7.1	8.6	2.9	3.3
Apanui cocksfoot	5.1	11.2	2.7	4.3
Roa tall fescue	4.3	11.7	3.3	7.0
Ruanui ryegrass	4.0	9.7	2.3	6.2
Matua prairie grass	3.4	11.5	1.8	5.1

1. 250 kg/ha/yr superphosphate = 115 kg N/ha/yr for grasses.

2. 800 kg/ha/yr superphosphate = 345 kg N/ha/yr for grasses.

Besides hay production, autumn regrowth can be used for *in-situ* winter feeding. The emphasis is on the grass component because of the generally much greater frost tolerance of grass relative to legume herbage. The key element is the amount of green grass taken into the winter. Research at Haldon Station was done on dryland with pure grass stands to which 300 kg/ N/ha was applied during the growing season, the aftermath from a hay cut in January being accumulated for winter use. The low herbage yields reflect the dry

conditions for growth (Table 3). The percentage of living tissue and its *in-vitro* digestibility in mid winter were higher for ryegrass and tall fescue than for cocksfoot.

Daly & Allan (1984) report winter feeding of an irrigated Nui ryegrass (70%) Huia white clover sward that (in different years) had accumulated, 1.5 - 3.5 tonnes of herbage from spelling in February. The mean loss in herbage mass from mid May to early September was 24% of the initial amount and *in vitro* digestibility changed from 77% to 68%. Liveweight of mated Merino ewes

Table 3: Some winter feed characteristics of autumn saved dryland pastures (from Scott & Maunsell 1985)

Species and Cultivar	Yield Jan. — May (t DM/ha)	July	
		% living tissue	% digestibility of living tissue
Ryecorn	1.7	94	83
Cocksfoot 'Kara'	1.3	64	71
'Wana'	1.1	68	67
'Apanui'	1.1	64	73
Phalaris 'Maru'	.9	69	71
Ryegrass 'Nui'	1.4	76	79
'Ariki'	1.1	76	79
Tall fescue 'Syn II'	.8	87	77
'Roa'	1.0	75	77
Prairie grass	.6	76	79
Mountain brome	.9	65	80
Smooth brome	.5	41	82

fed on the pasture at 1.2 kg DM/head/day from June to September, was about 2 kg lighter at the end of that period. Irrigated grass could thus be substantially used for wintering.

Prospect is now held for use of tall fescue for winter grass production with irrigation. This approach is currently being tried at The Wolds Station where nitrogen fertilised tall fescue is being taken as a hay crop the aftermath to be used for winter grazing in combination with the hay. This practice is derived from that used in mid-Western United States of America for winter feeding of cattle.

The difficulty in providing winter feed from special purpose pastures in the high country will always be the limited areas of sufficiently fertile soils, particularly with irrigation, to provide either for hay production or for *in situ* grazing practices, rather than a lack of suitable species for use on such areas. The legume species now available can give high yields of hay particularly with irrigation. The practice of *in-situ* grazing will probably be restricted to cultivated sowings rather than from oversowings which tend to lack suitable grasses. For the larger area that could be overdrilled, more widespread use could be made of alsike clover, which being more frost-resistant than white clover, could be grazed before heavy frosting occurs.

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Species for Special Purpose High Country Pastures

A commentary

J. Tavendale & R. Evans*

More intensive use of the hill and high country land resource has increased in the last fifteen years. Availability of Government scheme finance stimulated this development in the late seventies and early eighties. Development has traditionally involved oversowing with clovers and cocksfoot, application of superphosphate and subdivision of lowland tussock, and the cultivation of suitable lower lands for greenfeed and fodder crops followed by the establishment of permanent pastures.

Recent dramatic changes in the economics of farming and lower demand for some farm products, may result in much smaller areas being developed, and a greater emphasis on intensive use of areas already developed.

Intensive land use and growth of special purpose pastures will involve species well known to the farmer today, and species presently used in only a very limited manner, if at all, in South Island hill and high country.

The subject of pasture species should be looked at in the broad context of changing livestock production systems. Aspects important in management are:

1. Increased demands for wintering young store cattle.
2. Feed demands of breeding cows, particularly in intensive sheep grazing systems.
3. Fattening increased numbers of lambs without adequate return from store stock sales.
4. Wintering increased numbers of replacement sheep.

OVERSOWN IMPROVED HILLS

Improved hill blocks can provide feed of a specialist nature. Choice of species for the improvement of hill blocks should take into account how the development is to fit into the overall farm management programme.

Legumes

Variations in frost tolerance of clovers should be considered when oversowing hill country. For blocks likely to be spelled and stored for late winter/early spring use, red clover and alsike are the varieties. When there is to be no *in situ* grazing though, choice of species should relate more to the yield, persistence and likely oestrogenic effects. Farmers and consultants are cautious about the long term effects of oestrogen in red clover and the plants' persistence. The most persistent variety, Pawera, has the greatest oestrogenic effect, so alsike and white clover have been the preferred species.

Amongst the recently released varieties, Tahora white clover is expected to be more persistent than Huia, and should help overcome the almost 90 percent loss of white clover plants that has been observed.

Maku lotus is outstanding on very low pH soils. It also has a specialist role because of its ability to survive without fertilizer. Maku lotus is the preferred legume species where the economics of continued fertilizer application is questionable.

Grasses

In the writers' view, cocksfoot remains the only species worth including in seed mixtures for oversowing tussock country. Wana is a new release which farmers should consider using on drier warmer country.

*Farm management consultants, Ashburton.

Our experience with ryegrasses used in seed mixtures has been disappointing. However, low prices make it an inexpensive component of the seed mixture, and time could yet prove that sowing it is justified.

CULTIVATED PASTURES

Intensive use of plant species in the hill and high country mainly involves the use of pastures established after cultivation.

Legumes

Red clovers provide high summer/autumn production where there is adequate rainfall, and are more frost tolerant than other legumes for autumn saved pasture. Hamua and Turoa varieties were traditionally regarded as short term components (2-3 years) of most permanent pastures. However, the tetraploid cultivar Pawera will last up to five years, and when overdrilled has been recorded as producing 35 percent of total summer dry matter yield after four years.

Whilst Red clover's high productivity in the initial years of establishment provides quality lamb fattening feed, it can suppress ryegrass production in the subsequent year, and encourage pasture pests, particularly porina.

Huia white clover remains the most popular clover for pastures in the hill and high country area because of its persistence under varying management regimes. It has ability to maintain highly productive, high quality pastures, giving similar total dry matter production to Pawera.

Intensive use of lucerne for grazing has been limited to the autumn, after hay production. Several unsuccessful attempts have been made to use lucerne with companion grass species, as a pasture for intensive use, and this cannot be recommended.

Grasses

Nui ryegrass is the dominant grass species recommended for sowing in the high country. Nui gives high cool season production relative to other species. When stored for mid-winter use, Nui becomes even more superior to the other species, yielding

68 percent more digestible living tissue per hectare than the next best species.

Apanui cocksfoot is the second most popular grass. It gives satisfactory production, but the percentage of living tissue is lower than Nui, giving lower yields of digestible dry matter.

The more recently released variety Roa tall fescue has produced well, and retained a high percentage of living tissue digestibility. This species also had the highest total yield under a dryland moderate fertilizer treatment. We have no experience with this species in the high country, but report that in lowland areas establishment difficulties were experienced where the species was grown for seed. Compared with ryegrass, its frost resistant characteristics and productivity in areas prone to drought indicate that it is a variety which should be more often considered. Pure stands with clovers would be preferable because it is slow to establish.

Matua prairie grass has high production in autumn and winter. It is a specialist grass requiring specialist management for high productivity. Because it will not withstand set stock grazing, its application is limited on many high country properties. As a perennial it may have a role as a specialist pasture of "permanent greenfeed". In high fertility situations this species, too, should be considered more often when planning pasture sowings.

FODDER CROPS

Fodder crops fall into three basic classes--

1. Cereal greenfeeds
2. Annual grasses; and
3. Brassicas.

Cereals

Cereal greenfeeds have guaranteed establishment and early spring growth, they perform well in low fertility situations, and compared with brassicas can be sown late and still achieve high production. In our experience ryecorn is the preferred cereal greenfeed. It has been used very successfully as an intermediate crop between tussock

and brassica crops, providing quality feed in both autumn and spring. Other cereals have much lower recovery rates from initial grazing. Yields observed suggest that apart from ryecorn, oats is superior to wheat and barley, though we have no results for triticale in a field situation.

In moderate fertility situations the lower fertility demanding annual grasses Paroa and Manawa have been combined successfully with ryecorn.

Annual grasses

Paroa (Italian) and Manawa (HI) generally perform as well as Moata and Tama in the moderate fertility regimes present in much of the hill and high country. To date, experience with Moata is limited, but in high fertility paddocks with nitrogen applications higher yields may justify its use. In our experience, Tama has been the poorest performer in these areas.

Brassicas

Brassicas can provide reliable and high yields in the hill and high country. Fertility and moisture requirements increase with the change from turnips to swedes and kale. Kale should be grown only in high fertility situations.

Winter yields of brassicas can exceed those of cereal greenfeed by up to 400 percent. They have lower costs of establishment, but, unlike cereal greenfeeds and annual grasses, have no spring production potential.

Hay and silage

Lucerne is the dominant specialist species for hay production. To achieve consistently high yields it requires high inputs of management, fertilizer and chemicals. In higher rainfall zones red and alsike clover based pastures provide more reliable yields at lower costs.

Farmers should ensure that they make use of new pest and disease resistant lucerne cultivars when establishing new stands.

Silage provides an opportunity to harvest pastures for conserved feed without an adverse effect on autumn production. For quality silage white clover based pastures are preferable to red clover. Oats can be used for both hay and silage production, yields are high, but compared with silage made from pasture, palatability tends to be low.

Summary

There is a dearth of knowledge on the use of specialist cultivars in the high country. While this may not have been critical in the past, changing economies, and the scale of development mean that in the future farmers will have to be more discerning about which species to use.

Hill and high country farmers are probably more able to use specialist species and pastures than their plainsland counterparts. There is an urgent need to encourage farmers to use the new species available, and for scientists to measure the results obtained.

Pasture Management in the Dry Zone.

J. Perriam*

Introduction

To the average tourist travelling from Tarras to Cromwell, with the Clutha River flowing down the side of the road and the rocky manuka-covered hills of the lower Dunstan Range on the other, the sight of a healthy mob of merino sheep being brought off the rocks and up the highway always seems to bring a look of utter amazement and the inevitable question — “God damn ya — what do those woolly criters live on?” Little do they know the complexity of the farming operations that have been built up over the last decade throughout the high country of New Zealand; along with all the economic, social and political pressures that go with being caretaker of one of New Zealand’s greatest resources.

The tourist pays thousands of dollars to come and look at the mountains and hills that make up the panorama of the South Island countryside and probably gives little thought to the individual properties they pass; many identifiable only by a mailbox and a dusty road up into the hills. All of these Runs or Stations have their own potentials and limitations, according to climate and location but all offer a challenge and way of life that, if ever experienced, is never given up easily.

Bendigo Station is one such place. The main limitation being a very low rainfall — approximately 400mm at the homestead.

Prior to purchasing the property six years ago the only information we could find out was “it’s good warm country”. This was a phrase the previous owner seemed to repeat

*Bendigo Station, Cromwell.

a lot when pointing out the merits of the place, which didn’t actually tell us if much grew on it! But, he seemed reluctant to sell and was asking what seemed a lot of money for it so we assumed it must be a good place.

History

Bendigo is located on the north-west slopes of the Dunstan mountains to the east of the Tarras-Cromwell highway. It consists of two adjacent Runs but is run as one unit of 11200 hectares.

The pastoral scene started along with most other local runs when the huge area of Morven Hills (480,000 acres) was subdivided in 1910.

In the following years burning and over grazing severely depleted the tussock cover. This was followed by the rabbit plague which was to last until the introduction of 1080 in 1957. During this period the rabbit completely devastated the vegetation, ringbarking trees planted by the miners, and digging terrace soils up to be blown away. At this time the Upper Clutha Valley was known as the “dust bowl of Otago”.

The previous owner R.F. Lucas was the first runholder to undertake a Conservation Farm Plan with the Otago Catchment Board in 1959. At that time 5500 stock units were carried — 2,500 ewes and dry stock.

At the commencement of the programme the Station was sub-divided into only four hill blocks. By the end of this programme the hill had been split into 14 blocks, recognizing the various classifications of land and providing the first real opportunity to allow native vegetation to regenerate.

Over the next twenty years cover was substantially improved with increased

control of stock movement through fencing, oversowing and topdressing of what were considered the more responsive areas.

Stock

Over the past six years a concentrated effort has been made to extend oversown areas, further subdivide existing blocks, establish a safe, convenient roading pattern and upgrade wool handling facilities. Today the Station is split into 34 hill blocks and is carrying 15,500 stock units — 10,000 merino ewes, 5,000 dry stock and 350 cattle. This is probably a conservative stocking rate but the dependence of the property on limited rainfall and rabbit control and our aim to produce high performances per stock unit determined this policy. This is having excellent results from a financial and conservation point of view and will hopefully allow the property flexibility ahead and retain the vegetation cover now established.

Cattle are a management tool to keep gully and scrub country open for merino sheep grazing. Likewise, a flock of Border Cross ewes are used as roughage clearers mainly in the foothills and paddocks.

A fine wool wether flock is being built up and any further sheep increases will be with wethers to give flexibility in stock management and numbers. They will also be used as follow-up grazers to ewes and hoggets rather than the traditional back block grazer.

Moisture zones

The Station has three very distinctive moisture zones and soil classifications:-

1. sunny front faces-Class VII 200m — 700m altitude with a rainfall around 500mm.
2. mid-altitude Class VI mainly rolling country with outcrops of rock and broken by deep gorges to the south, 700m - 1200m with a rainfall of 500mm - 600mm.
3. high altitude Class VII-VIII flat rolling country, altitude 1200m - 1700m with rainfall of 700 — 800mm.

Vegetation

The dry sunny lower slopes and terraces

have an extremely high evaporation rate with faces lying directly to the north-west and prevailing winds.

Vegetation consists mainly of native trefoils and grasses with scabweed on very exposed areas. A large portion of this area is covered with kanuka, with brier becoming prevalent in the lower gullies. While to the passer-by this land would appear useless, it in fact, holds a vital key to the potential and operation of the Station as a whole.

Grazing management

Stock movement allows native grasses to reseed in the period November - February when the bulk of hill native country is not stocked. Depending on the season some areas are used to winter hoggets, and providing stock ratios are not concentrated, young stock winter extremely well. If young stock are left during the native growing season at limited stocking rates on this country, I would contend that their rate of growth is equal to if not greater than, stock on improved pasture.

This zone is also ideal country for the production of fine and super fine merino wools, which are at present bringing great premiums on the world market.

Stock health problems are almost non-existent and selenium is the only deficiency of sheep grazing this native country. We are fortunate we have not experienced any feet problems with the flock and this could well relate to the utilisation of this zone for periods of the year.

Shelter

Shelter is one of this area's greatest assets. Within five minutes of the shearing shed late August-shorn sheep are spread through the kanuka and rocks and although we have experienced bad storms we have never lost a sheep. We have an extensive shelter tree planting programme on the flats and although this will greatly aid conservation it will be no substitute for the rocks and kanuka for post-shearing shelter.

Green feed

We have come to look on this area as our green feed blocks. The value of grazing this native country for a very short time

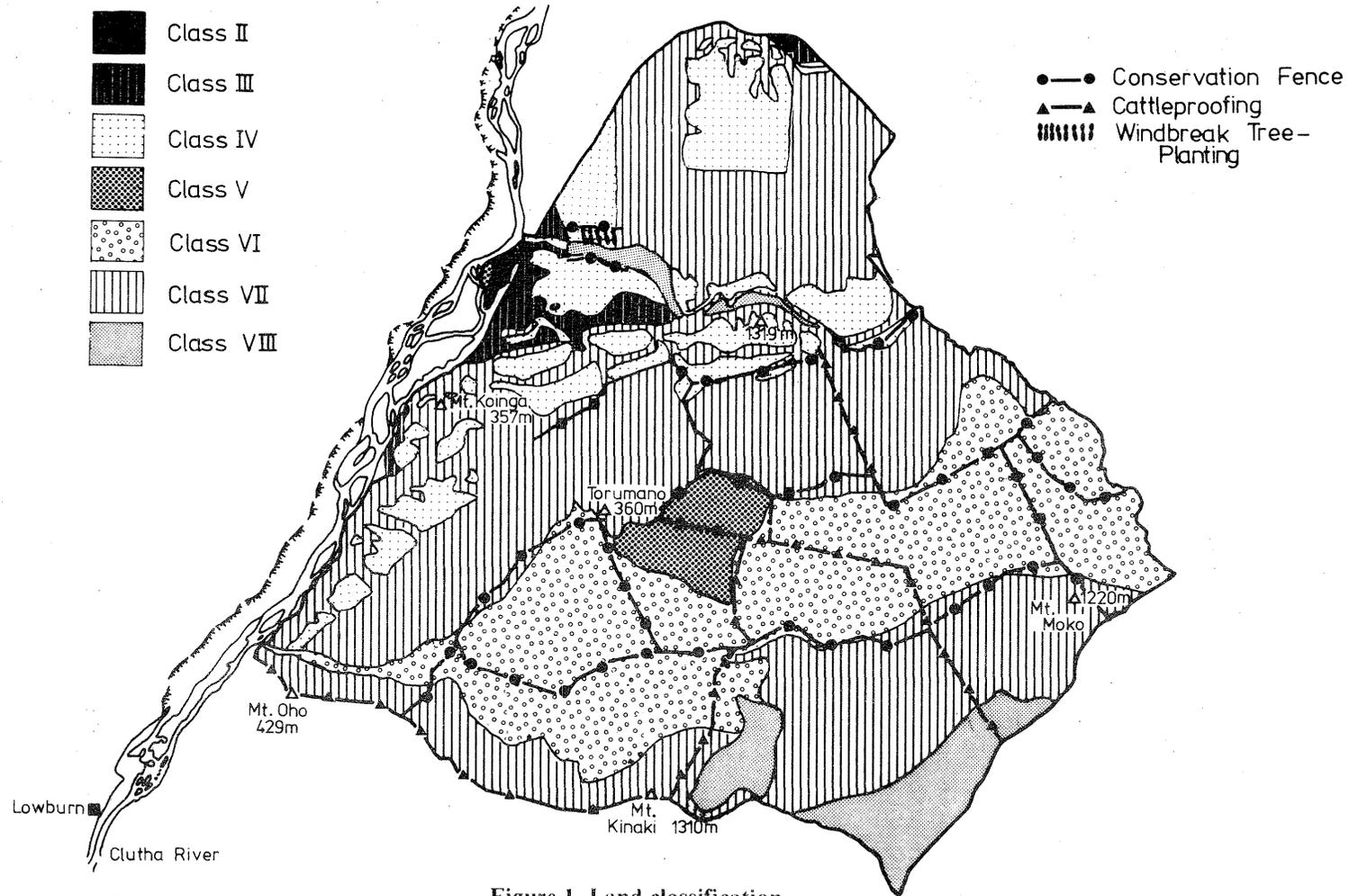


Figure 1. Land classification

for this purpose against the costs of growing additional areas of conventional green feed are becoming more and more obvious. A new development that will further increase the potential of this system is the introduction of plants such as sheeps burnet, successfully growing on the MWD's trial plots on Bendigo. Sheeps burnet, established on the flat terraced areas with the native grasses of the gullies and kanuka for shelter, will increase the importance of this country.

Terraces

Terraces to the north have been subdivided off foothills and brier has been cleared with flats oversown in lucerne for summer grazing. Terrace country, closer to the woolshed will be sown with sheeps burnet because its foliage suffers little from frost and is a permanent deep rooted, drought-resistant plant that will hold through the winter giving a very low cost annual supplement to our green feed system.

Mid altitude Class VI

The mid altitude block is mainly moderate to easy rolling country with outcrops of rock and steep gorges to the south. The majority is well covered with silver tussock. Most of this country has been oversown and topdressed with excellent results and has also benefitted greatly from the Land Development Encouragement Loan Scheme. A programme of applying 250 kilogrammes per hectare of sulphur super every third year is proving adequate to maintain this development.

Soil testing has shown dark sides to have a higher phosphate requirement than sunny sides, and the sunny sides require more sulphur. As each block may have many small dark and sunny faces the correct application of super is very difficult in this type of country.

The advent of the turbo charged Cresco aircraft has aided application and reduced costs.

Some initial oversowing has "burnt out" and it is our aim to keep a good cover of tussock especially on sunny faces to protect the oversown grasses through dry spells.

One interesting point is the lack of brier and noxious weeds, especially to the south where wild goats have been present in significant numbers over recent years. Hundreds have been shot but the programme is currently under review as captured nannies sold for over \$200 each last spring.

Grazing

During the summer months (September to February) most mid altitude blocks are stocked with ewes allowing a percentage of blocks to spell and reseed depending on the season.

Winter months are managed under a rotation system with sheep being moved every one to two weeks depending on the size of the block. Set-stocked sheep do noticeably better and stay clean when there is a balance of native and improved pasture available.

Fencing of this country into smaller blocks and subdividing larger sunny from dark faces has greatly increased our ability to better utilize this improved country and increase stocking rates.

Although fencing and super are essential ingredients for successful development some people overlook the value and importance of the experienced shepherd with good dogs that can anticipate stock behaviour and needs.

Class VII W and VIII

This is flat to rolling high altitude country with some deep gorges. Ground cover is mainly blue tussock.

The area is grazed by ewes in March and April after weaning and allows the spelling of oversown blocks for autumn mating. This limited grazing is essential to the balance of the Station's grazing pattern and allows tussock cover at lower altitudes to be maintained under higher stocking rates through droughts.

Our problem plant in this zone is the Spaniard in the lower portion of this country at about 1200m — 1300m. The annual grazing of the small plants appears the only way to check the spread of this weed. Lack of grazing pressure in areas has

aided the spread of the plant.

Paddocks and flats

Paddocks have been under automatic irrigation and are basically used as holding blocks for weaned and sorted stock off the hill. They allow versatility of stock sales, especially with larger lines of store sheep and lambs.

Although large amounts of hay have been made in the past off flats we intend to limit the operation because of rising costs and instead utilize lucerne areas to grow out more young stock for sale in favourable seasons.

Extremes

Extremes of temperature in these zones are something we live with and farm for.

Summer temperatures reach 60° C+ in the foothills and sub-zero temperatures occur through the mid altitude country.

After sitting in freezing fog for hours trying to get a muster started or pushing a mob of sheep through snow, against the contrast of droving stock in a cloud of dust and heat in late February, you learn to work with the extremes of climate and not against them.

Heat

As the majority of stock sorting has been done at 230m altitude, heat during the summer months is our major limiting factor with both moving and working stock. Temperatures can reach 40° C along sunny faces by midday and sheep and dogs pretty soon come to a mutual understanding that the shade of a kanuka bush is the best place for the rest of the day. A network of yards have been built throughout the property and linked with roading through gullies. This has greatly reduced droving stress and time spent moving stock.

Fog

Fog is the most depressing weather element and can be most severe on stock. A layer of fog can hang in the valley for up to two weeks or more turning the Class VI zone into a sheet of ice and hoar frost. Sheep stay in the corners of the blocks looking for sun and apart from hunting them around, if you can find them, there

is very little you can do. Fog is probably our greatest limitation to rotational all winter stocking as its incidence varies dramatically from year to year.

Rabbits

Rabbits, which inhibit the full utilization of this dry country and the establishment of new cultivars, are the greatest threat to our programme.

Last year 60 hectares of well established green feed were wiped out. It is very disappointing to see carefully managed vegetation devastated back to the state of the rabbit plague years ago. Biological control of rabbits is necessary if this country is to be fully utilized.

Reserves

Four hundred acres (160ha) of Bendigo are designated Historic Park. We are quite agreeable to this for both historic preservation and public safety.

But there is now talk of the kanuka covered area being made an ecological reserve. As this kanuka covers a large area of the Station and is an integral part of our farming system, we are very concerned about this possibility.

Although field staff have been very good to deal with, often the powers-that-be overlook the cost of maintenance and other consequences of public use of reserved land. An example of this on Bendigo is, that due to the greater public use of the Historic Reserve stock tend to keep clear of this area and this has led to a serious noxious weed problem (brier) and fire hazard with ungrazed growth around old buildings. We have now fenced the Reserve in an effort to lessen the fire risk.

Mining

The upsurge of interest in the area from mining companies is also of concern. At present exploration and prospecting licenses cover half of the property and we have mining companies knocking on the door wanting to start work.

We paid a lot of money to farm the land for pastoral uses and since then have spent a lot more to consolidate that use. This

should give us the right to say no to mining operations if they in any way put at risk the pastoral activities and value of the property. I am told that we do not have that right. If we take action to protect the interests of the pastoral land this is surely going to lead to a conflict of interests.

Diversification

We have plans to further utilize areas of the kanuka belt and have applied for a recreation licence to fence off a block and release native animals in the wild for a safari type or trophy shooting operation. The location close to the Historic Reserve and

main tourist centres with the wilderness and rugged scenic appearance of the undeveloped area appears to be an attraction in itself, especially to the urban dweller.

This wildlife concept associated with diversifying into deer farming will widen uses of some areas without limiting present uses.

A tourist high country retail shop has been established on a main highway close to the Station, with ideas and some goods coming from Station. This has proved a successful and popular concept with tourists and we would see the wildlife proposal as

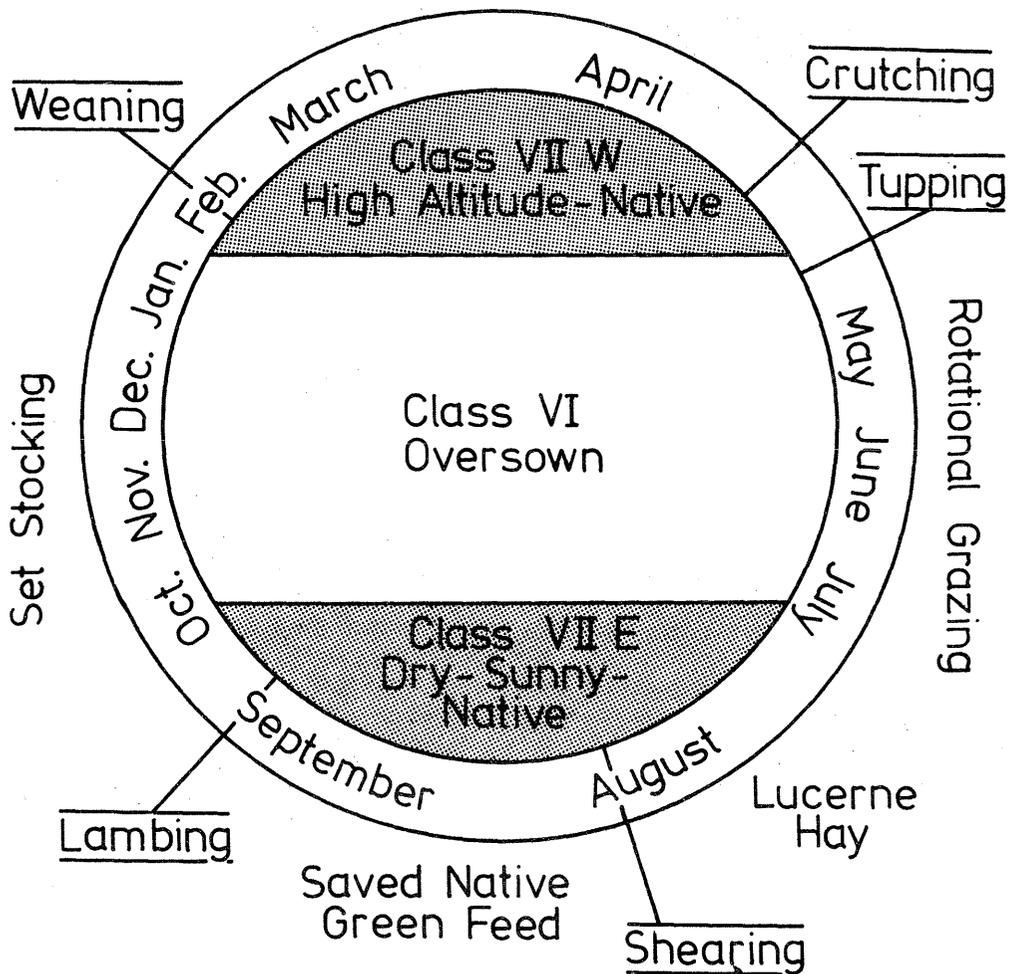


Figure 2. Grazing pattern of zones

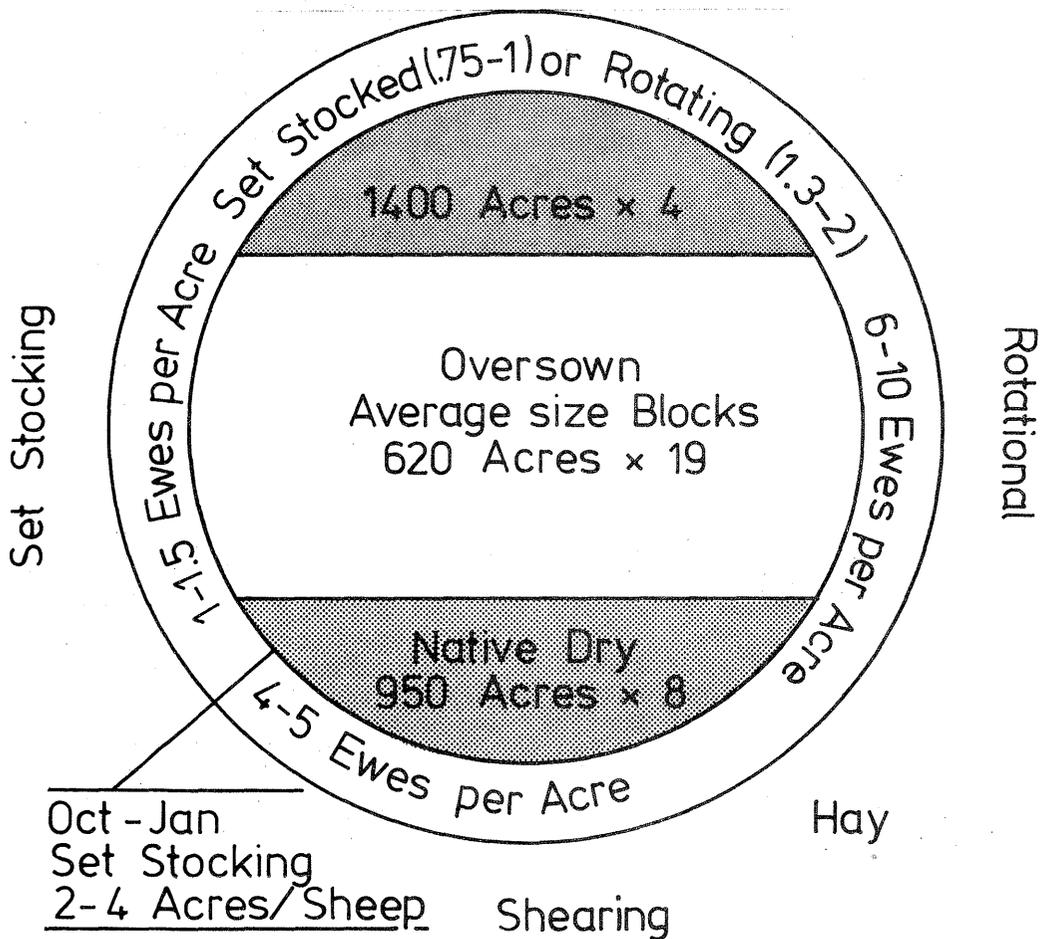


Figure 3. Stocking rates and block sizes

a possible extension.

Irrigation

A large area of the Station's flat country is included in proposals for irrigation from the Clutha development. The potential is enormous with the majority of our flat land ideally suited to the development. This obviously would have wider benefits to supplement the developed hill country. We are considering an alternative private scheme to bring eight cusecs of water across the run from 1150m with storage through

the Class VI belt, to irrigate some lower sunny terraces.

Summary

Over recent years the dryland pastures of Central Otago have been transformed from vast areas of severely depleted soils to sought-after farming country.

1. Conservation plans over dryland soils have had an immense impact and enabled Bendigo to carry greatly increased stocking rates at no detriment to the vegetation.

2. This has allowed close subdivision and the better utilisation of individual classes of land.
3. It has also allowed for a flexible grazing system to take advantage of different moisture zones.
4. Our stocking rate on this class of land has to be either conservative or flexible to allow for unforeseen drought periods.
5. We look on cattle as a management tool only in the low rainfall zones.
6. Each zone has different rainfall and vegetation cover but are interlinked and complementary:

Class VII E

The warm winter country provides the opportunity to grow out larger numbers of young fine woolled sheep. This country is important for shelter and post shearing feed, and has potential for further development.

Class VI

On Class VI land stock grazing allows for the retention of tussock cover to protect oversown plants from burning out through dry spells. Costs of maintaining these oversown pastures must remain viable in years to come.

Class VII — VIII

This class provides essential grazing relief for lower oversown pastures.

Limited grazing appears to benefit this land, slowing Spaniard growth and consolidating depleted soils.

7. An increased network of roading and stock handling facilities has reduced droving and stress on stock.
8. Possible future pressure for land required for Reserves or mining operations is of great concern.
9. Rabbit control costs and lease rentals will have greater effect on profitability and our ability to maintain development in the future.
10. I can foresee further opportunity for diversification through tourism.
11. The further development of dryland plants and economic irrigation systems still offer tremendous potential for the Station.

Conclusion

The future of dryland farming is reliant on political decisions.

The economic control of rabbits and our ability to retain a pastoral priority over ever increasing competing interests will have a great influence on the future of the Station.

Overall I see a good future for dryland hill country farming and the results of development and conservation in the Upper Clutha would have to stand as an example anywhere in the world.

Adding Value to Fine Wool Sheep

A Heath*

R Ward-Smith**

This paper contains our observations on the way we managed our way out of a difficult period of reorganisation without resort to the use of anything unconventional or magic.

Introduction

Ruataniwha Station is situated in the Mackenzie Basin on the northern side of the Ohau River, adjacent to the town of Twizel. The property was subdivided off the Ben Ohau run in 1920, and leased as a small grazing run. It was purchased by the New Zealand Electricity Department in 1965, for the establishment of Twizel as a base for the Upper Waitaki Power Development Scheme. The land not required for hydro development works or town site has since been farmed by the Department of Lands and Survey, on a profit sharing basis.

Description

When purchased, the property consisted of 5440 hectares. However, power development works has left only 3650 hectares, within which two areas totalling 1430 ha are not grazed. The area actually farmed now is 2100 hectares, just 40% of the original farm.

The property consists of two-thirds flats and terraces, the balance running into a hill block above Lake Ohau. Half the hill is very steep dark faces, which will be in a proposed reserve. The rest is made up of sunny basins rising from lake level at 500 metres up to the top of Ben Ohau at 1520 metres.

*Manager, Ruataniwha Station

**Department of Lands and Survey, Timaru.

Soils comprise 93% yellow-brown earths of the relatively unproductive Acheron, Pukaki, Kaikoura and Cass series, with the remaining 7% yellow-grey earths of the more productive Tasman and Dobson series.

The climate has extremes, with a hot dry summer with strong hot northwest winds, and long cold winters with extended periods of hoar frost. Rainfall is 500mm (20") near the homestead and increases to an estimated 750mm (30") on the hill block, but can vary widely from season to season and year to year. This year only 120mm (5") fell between January and June.

Several falls of snow may be experienced during the winter but these only infrequently cause difficulties.

Development

In 1965 only 40 hectares was improved pasture, but cover now consists of the following:

- 165 ha homestead farm area
- 95 ha recently direct drilled flats
- 1000 ha oversown and topdressed hill and flats
- 1960 ha of native flats and hill
- 430 ha of proposed reserve

3650 ha — Total area available.

The main farmed area is subdivided into thirty main blocks (60-80 ha), and the homestead area is divided into 30 paddocks averaging 5 ha. Extensive shelter belts have been planted, some swamp developed, yards and shearers' quarters erected. The total unadjusted cost of development has been \$225,000.

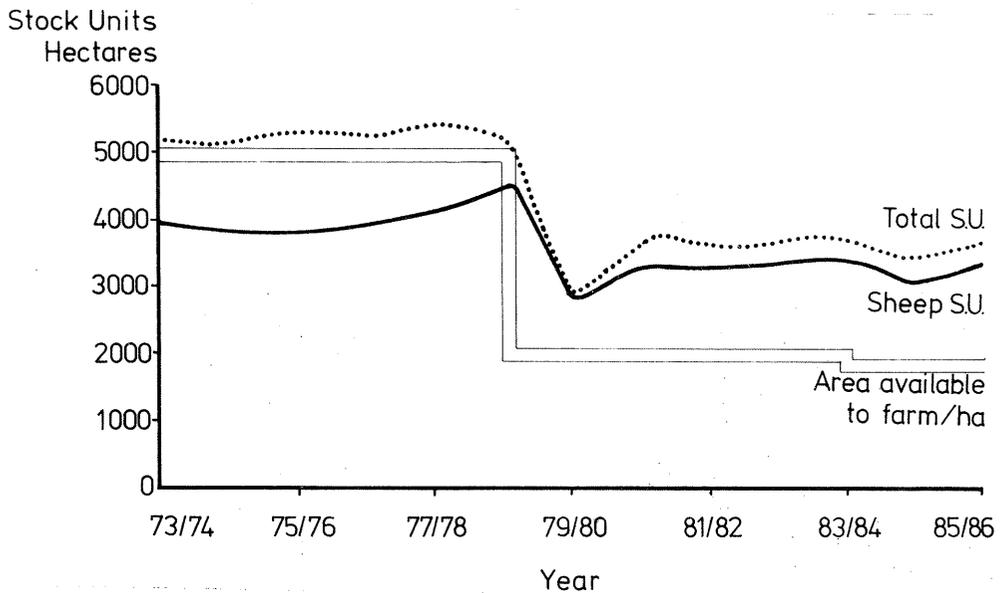


Figure 1. Farmed area and stock carried 1973/74 – 1985/86.

Figure 1 shows the pattern of changing stock and production over recent years. Currently 1000 less sheep are carried than in 1965; however, the productivity of the present stock is much higher, and they are carried on 40% of the original area. The total weight of the wool clip has been maintained with per head production rising by 1 kg to 4.6 kg per head. Lambing percentage has increased by 35% with 1600 more lambs produced annually. (Figure 2).

Management

In June 1979 about half of the effective grazing area had been lost to the Waitaki Power Project. Massive alterations to blocks and difficult access made management extremely difficult. Driving stock through construction zones is an experience to remember!

Before Ruataniwha could be returned to a viable unit, the issue of economic survival had to be addressed. With the knowledge that the district could produce good quality wool, and that the sheep could shift well, we saw establishment of a flock with a good

constitution, high levels of production and providing surplus saleable stock, as the way to survival. Part of our farming philosophy is that stock produced for sale must be sound and of high quality. If we can establish that kind of integrity then we are certain that our produce and stock will command a premium in the market place. It was obvious the first job would be finding some way of lifting ewe bodyweights. If you want Merinos to produce well you have to feed them well.

The initial breakthrough to improved stock performance lies not in costly development programmes, but in more efficient use of available resources. With this approach the stock come first, before the additional development. The success of this method at Ruataniwha drew us to the following conclusions:

- If Merinos have bodyweights of a reasonable level (55kg and over) they have the ability to withstand the most extraordinary changes in diet, provided the quantity and quality is sufficient for their immediate needs.

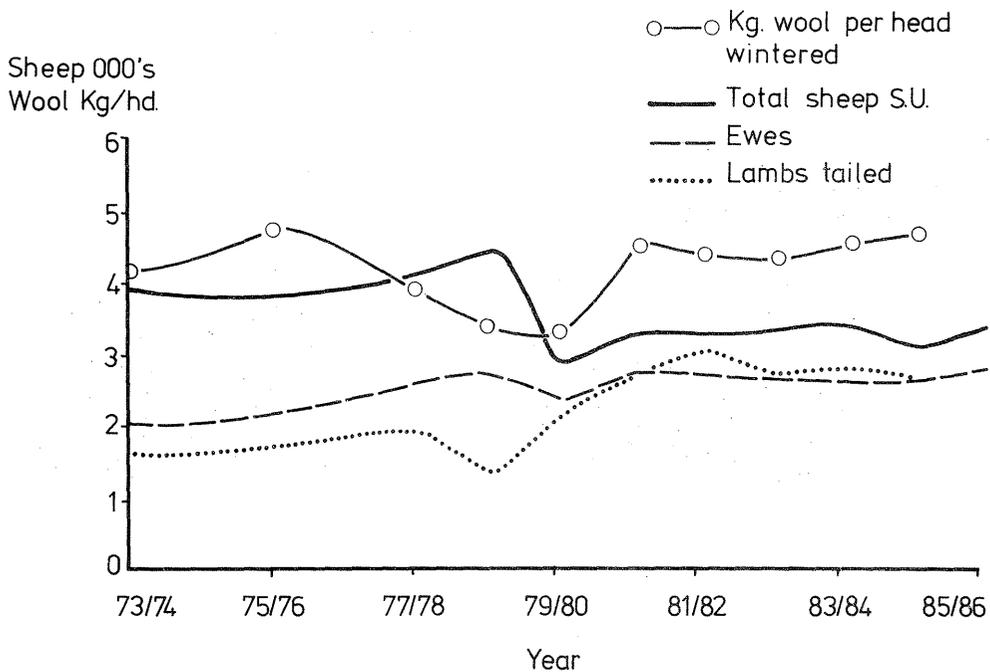


Figure 2. Wool and lamb production

— Merinos can adapt to major change in management style, provided consideration is given to their highly strung natures. It is very important to allow them time to settle into new management systems, as is consideration for their preference for frequent shifts to fresh grazing. Their desire for frequent fresh grazing appears to be paramount, irrespective of quality.

— Given Ruataniwha's environment it is important that the pursuit of optimum bodyweights is an active continual process which takes precedence over other management aims and plans. There is no time of the year that we will willingly let sheep lose weight. On Ruataniwha, there are only brief periods of the year when ewes reach optimum weights.

Improvement in the tussock cover on the blocks and improvement of the paddock pasture quality has been inextricably linked with the rise in sheep performance. All facets of the station management combine to provide the opportunity or environment,

for better stock performance, and concentration on any one facet to the exclusion of the others will not give good results in the long run.

Our approach to feeding stock is liberal, but not wasteful. In our region, pasture not utilized deteriorates very quickly, resulting in loss of immediate production and jeopardising future potential. It is very easy to get trapped into controlled starvation management methods by an obsession with complete utilization. These methods which have been advocated by large advisory organisations and other august centres of learning have, lost sight of the fact that grass is grown to feed the sheep, and sheep are not kept just to eat the grass.

The incorporation of all the preceding ideas and aims into Ruataniwha's day to day programme required a bit of lateral thinking. To accommodate the seasonal feast or famine fluctuations on the different parts of the property we viewed the grazing requirements of the flock strictly within the framework of seasonal stock movements.

Compared with planning on a whole year basis this made working out feed requirements according to season and climate a lot simpler and more flexible. Developing this concept, the year was divided into six segments which correspond to the major events on the sheep calendar (Figure 3).

There were immediate follow-on benefits:

1. It simplifies stock management in the diverse areas.
2. It was more successful in coping with the highs and lows of varying growth patterns.
3. All classes of stock have priority on the small more productive areas at some time of the year.
4. The time stock have to stay on poorer areas is limited, and this also gives the poorer country a better chance to recuperate between grazings.

Gross margins

The production parameters shown in Figure 2 have been used to give gross margins for the following periods:

1. The pre-canal construction period,

when most of the property could be grazed and a mixed wether/ewe flock was run utilizing significant areas of native tussock. During this time average flock size was 4100 s.u.

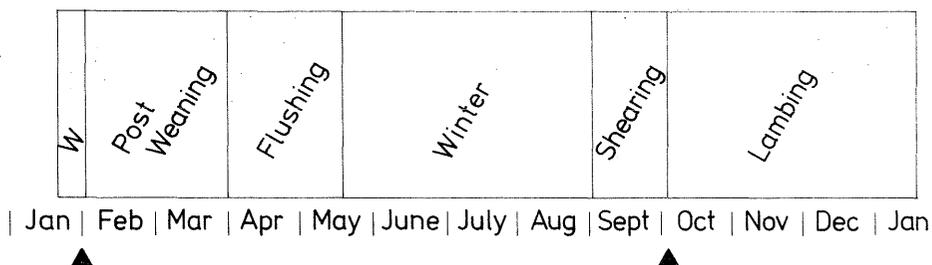
2. The post-canal construction period, when large areas of the native flats were lost, and the wethers sold off. Average flock size has been 3200 s.u.

Only direct costs have been deducted, to give gross margins, and prices relate to last season, relative to equivalent quality. The gross margin has to cover overheads and fixed costs such as fertilizer, hay, wages and interest charges.

(1) Pre-construction (before 1979)

Mixed ewe/wether flock of medium productivity

Gross margin	\$25.23/s.u.
	\$21.15/sheep
4100 s.u.	est. \$103,500



Cattle	Paddocks	Tussock		Paddocks
Lambs	Paddocks	Improved tussock + hay		Paddocks
Ewes	Tussock	Paddocks	Improved tussock + hay	Paddocks Improved tussock

Figure 3. Seasonal grazing pattern.

(2) Post-construction
Ewe flock of high productivity

Gross margin	\$48.11/s.u.
	\$44.07/sheep
3200 s.u.	est. \$154,000

N.B. No additional grazing has been done.

Conclusions

Adding value to fine wool sheep has been important for the survival of Ruataniwha, following the major disruptions caused by the Upper Waitaki Power Development Project. Even though there has been a reduction of 60% in the size of the property, and a reduction of 22% in the number of stock units carried, there has been a 50% increase in the gross income. This transition has confirmed that:

- Merinos must be well fed to produce well;
- Concentration of effort on the better areas has enabled capitalisation of natural advantages, and better use of major resources.
- Maintaining a balance between the separate facets of farm management has resulted in higher stock body weights and higher productivity.
- Feed supplies can be allocated to better advantage and the above points incorporated through a structured management programme arranged around a framework of seasonal stock movements.

Can Traditional Hill Country Agriculture Survive the Market Economy?

(1) A farmer's view

E. Garden*

Last year, pastoral products provided more than half New Zealand's total export receipts. Two thirds of those pastoral earnings came from hill country production. It is, thus, clear that viability of hill country farming is important to the nation as well as to farmers.

I want an agricultural industry in which I, my sons, and our cadet have a good future. However, I don't want farmers to seek or receive short term palliatives which will jeopardise the long term future of the industry. This has happened in the past. The SMP scheme is a prime example. SMPs were compensation to the agricultural exporting sector for a fixed unrealistic exchange rate. Had the New Zealand inflation rate been kept down, farmers would have received a greater income without SMPs.

It is nonsense to say that because British and French lamb producers are subsidised so too must New Zealand lamb producers be subsidised. We have, instead, to look closer to home to see why our pastoral products aren't competing on world markets.

Before looking at this area, though, I'd like to say a word on diversification. I consider I was invited to make this presentation because of my experience diversifying hill country farming. Politicians and

*Avenel Station, Millers Flat

bureaucrats have stated that farmers must diversify and shift emphasis from traditional commodities, to alleviate the financial pressure now being felt by the agricultural sector. To this I say 'rubbish'!

I believe that rather than diversify, farmers have to do better what they do best. They must grow more saleable lamb and freezer ewes, and more wool.

Diversification is very costly. We at Avenel make no secret of the fact that we would make a greater return per stock unit if we didn't divide our energies between forestry, bees, goats, deer and farming politics. We have diversified for reasons other than to ease the short term financial pressures we face.

Our forestry enterprise, for example, is building up a capital resource for the future. Forestry is an efficient land use, and will provide a fund in the future.

Deer, I believe have a significant role to play in the high country. They are an efficient form of land utilisation. During the next decade a lot of money will be made from deer, and a lot of money lost on them, too. It has been said that it isn't economic to borrow at 22 percent to invest in deer. But many are doing it. I would say that once deer lose their scarcity value, and all livestock values are relative to meat values, deer farming will still be an efficient form of land use.

It is said that world markets are not strong enough for a continued farming emphasis on meat and wool. In 1970 it was said that wool was finished, yet now we are selling as much as we can produce. In the case of lamb, I believe there to be real opportunities for selling considerably more than has been sold to date this year. In particular, chilled lamb has a big future especially on the affluent United States market. There has recently been a change of emphasis towards heavier animals, particularly for the speciality cuts trade.

To better consider the financial realities of traditional hill and high country farming in this time of change, Ralph Lattimore of Lincoln College undertook an extensive exercise to produce the data in the appendix. The actual income and expenditure for Avenel's 1984/85 sheep enterprise was taken, and projected to 1985/86 and 1986/87 seasons. All figures are presented on a per-stock-unit basis, so they are relevant to all properties. Income shown is from cross-bred wool, and hence will be lower than for fine wool.

The exercise is relevant to downland farms, I think, because we have reasonable returns from lamb, in spite of the drought.

Let me say that Avenel is not a poor producing farm. The stock are performing, and have some potential yet. The low returns revealed in this analysis are not acceptable. New Zealand's economy is dependent on the pastoral sector, so negative returns cannot be allowed to happen.

Remedies

The two avenues to remedy poor returns are:

1. Increased revenue per stock unit; and
2. Decreased input costs per stock unit.

It is still possible to increase revenue from hill country pastoral farming. To tap this potential, more feed would have to be grown, feed would have to be better utilised, and stock husbandry would have to be improved to a level not before seen. Over

a ten year period, it would be possible to:

Harvest an extra 0.5 kg of wool/s.u.	\$1.80/s.u.
Sell lambs for an extra \$2 (1984/85 \$)	\$1.00/s.u.
Improve lambing by 10%	\$2.40/s.u.
	<hr/>
	\$5.20/s.u.

To achieve this lift in production, a considerably greater physical and financial input is required. I consider a 10% or 50cents/s.u., lift per year possible, beginning in the 1986/87 season.

Sheep meat price stabilisation schemes are not the answer. I am not sad to see SMPs removed. Not only did I get only a small proportion of them, but they also confused signals from the market place.

The orderly removal of assistance to the agricultural sector is acceptable, so long as assistance to other sectors is also removed. Right now, tariffs, import licencing and export incentives are costing farms a great deal. Protection of local industry through licencing and tariffs, prevents consumers from using cheaper imported goods. Of all farm inputs, 85% are purchased from New Zealand manufacturers. The excess costs of this system are calculated by M.A.F. to be around 20% of farm input costs. Interest and on and off-farm expenses, and protection of the manufacturing sector is costing Avenel at least \$3.50/s.u.

It has to be realised that the pastoral industry cannot stand the extra \$3.50/s.u. cost to provide guaranteed subsidies to commercial enterprises which cannot compete on world markets. Neither should the workforce expect agriculture to pay this extra purely to provide extra jobs. The Government is obviously moving slowly on the removal of protection to the manufacturing industry for fear of creating an unacceptable level of unemployment.

Unemployment, however, is a **national** responsibility, yet we in the agricultural sector are paying a disproportionate cost for the luxury of full employment in this country. At the moment agricultural producers are expected to provide a competitive product, without the benefit of competitive input costs.

The other area in which agricultural product costs could be reduced is a reduction in meat processing costs. A reduction of \$3.00 in real terms would increase farm earnings by \$1.56/s.u.

Conclusion

Ralph Lattimore's table sets out where we will be in 12 months from now. A dramatic increase in farm production will yield 50 cents/s.u. extra, and a real \$3.00 reduction in killing charges would yield an extra \$1.56/s.u. Further immediate disassembling of protection to the internal manufacturing sector would reduce farm costs by an estimated \$3.50/s.u.

A combination of these factors would give a real increase in yield of \$5/s.u., to achieve the same return on capital as achieved in 1984/85.

Appendix 1: Forecast of Financial Performance — 1985-87

Financial returns for 1984/85 are projected forward for two years for the farm as if it were a single sheep enterprise under

the following assumptions.

- i) Market returns and input costs are assumed to change over the next two years by a similar proportion with the exception of items listed under (ii) and (iii). This balanced cost/price change may be accompanied by a concomitant exchange rate change.
- ii) On the revenue side, farm gate returns are reduced in accordance with the projections made in MWBES (1984) for SMP withdrawal and meat inspection fees. These forecasts include a drop in lamb prices of 20 per cent (\$5.61 per lamb) and 38 per cent in cull ewe prices. It is important to note that these forecasts of scheduled prices make no allowance for interest or principal repayments on the MISA No 2 account deficit in 1985/86 or 1986/87. Wool prices are forecast to remain at 1984/85 levels.
- iii) The cost of fertiliser, fuel, electricity and cartage is increased in real terms in accordance with MWBES (1984).
- iv) The principal mortgagee is the Rural Bank and interest charges were changed in 1984 to 9.5 per cent. Interest costs have been increased over the next two years in line with the Rural Bank review schedule, MWBES (1985).

Forecasts — financial performance — Sheep Enterprise Basis

	\$ per Stock unit		
	1984/85	1985/86	1986/87
Gross Revenue	29.15	25.62	25.41
Gross Margin	23.84	20.30	20.09
Less Other Variable Farm Costs (including fertiliser)	11.21 (4.32)	11.66 (4.62)	12.31 (4.83)
equals Return to Labour and Capital	12.63	8.64	7.78
less Financing and Management Costs	8.72	8.97	9.36
equals Return to Equity	3.91	-0.33	-1.58
add back Interest Payments	1.89	2.12	2.27
equals Return to Capital	5.80	1.79	0.69
Productive value of Assets (1983/84 = \$173)	132	41	16
% Return on Capital	4.4%	4.4%	4.4%
		held constant	

Factors which will tend to improve outcome:

1. Meat and Wool prices increasing faster than rate of inflation.
2. Capital stock retention by all farmers to stabilise export availability.
3. Reduction in real processing charges.
4. Reduction in real input costs (import liberalisation).
5. Reduce maintenance costs (short term).
6. Reduction in foreign capital inflows.
7. Reduction in Government borrowing and interest rates.
8. Increase productivity (eg, diversification).

Factors which will tend to worsen outcome:

1. General cost inflation faster than meat and wool price increases.
2. Increased slaughter of capital stock.
3. Increase in real processing charges.
4. Higher import protection (tariffs higher than 17%).

References

MWBES (1984), Impact of the 8 November 1984 Budget on N.I. Hard Hill Country Sheep and Beef Farm. *Paper C238/b*, N.Z. Meat and Wool Board Economic Service, Wellington.

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Can Traditional Hill Country Agriculture Survive the Market Economy?

(2) An economist's perspective

G.E. Rutherford and P.G. Bushnell*

The title of this session, 'can traditional hill and high country agriculture survive the market economy?' suggests that the risk to hill and high country farming is believed to be greater under the new set of 'market economy' policies. I will address this topic by:

- considering the term 'market economy';
- discussing the alternative to a policy of neutrality, and examining some of our recent history;
- commenting on the pace of change, and issues of balance in the rate at which assistance is removed;
- looking at the implications of current policies for sheep and beef in the hill and high country; and, finally,
- discussing some aspects of the future prospects for this type of farming.

The market economy

The term 'market economy' does not refer to the middle ground between totally free and totally interventionist systems. There are, in fact, no totally free markets. All markets require some form of government intervention, even if only to establish and maintain the common law system, for the efficient functioning of the market.

A market uses prices as an instrument to summarise and transmit a multitude of

information about the actions of individual producers and consumers. Changes in relative prices signal the need for structural change. The precise nature of that change will depend on individual circumstances.

The set of policies which has been labelled the market economy aims the neutrality between different activities, and, thus, avoids encouraging one activity at the expense of others. The result should be that the amount produced and consumed of each good is guided by the good's true value to the economy.

Policy alternatives

A policy of neutrality means that no activity is favoured, and none disadvantaged. All stand or fall by their value to the nation — exportable products by what someone overseas is willing to pay for them.

In any alternative policy the government would intervene to alter prices so that one commodity would become worth relatively more than the same thing on the world market. In other words, the government chooses the winners and the losers. There are two main reasons why governments are less successful than the market at choosing winners — firstly, governments do not have that multitude of information that individuals within markets have, and, secondly, lack of the profit motive in the bureaucracy greatly reduces the likelihood that govern-

*Economics Division, MAF, Wellington

ments will know more about future market outcomes.

The situation a year ago

In early 1984, there was in place a wage and price freeze which prevented market signals being transmitted through the price system. Prices could not convey demand and supply signals, and relative wage movements could not respond to industry well-being.

An increasing number of regulations were applied, in particular to interest rates. The controlled price of funds suppressed clear signals about supply and demand, and funds had to be rationed. Lenders and borrowers were not free to find mutually acceptable interest rates.

The exchange rate was fixed at an overvalued level, which was sustainable only because of regulations controlling the flows of foreign exchange. Notwithstanding this, a financial outflow occurred as people moved funds overseas as fast as was possible.

The longstanding policy of protection for industries producing import substitutes was continued. Very simply this meant that the economy paid up to three times over the amount the activity contributed to the nation, based on its overseas price.

Partial compensation was made to farmers by way of SMPs, but the products performing the worst overseas got the greatest subsidies, further distorting market conditions. Subsidised loans to farmers were another form of redress, but only one third of lending to farm enterprises benefited. Fertiliser prices and transport were subsidised too. Farmers in the toughest, least economic locations using the bulkiest most costly fertiliser to transport, were encouraged and subsidised the most.

Exporting manufacturers also received compensating subsidies by way of export incentives.

In summary, the system a year ago was one in which market signals were blocked out completely, or seriously twisted. Producers of products in high demand overseas received a reduced reward, but

many producers of products not in demand were paid subsidies to produce more of it.

Clearly, it is pointless having farmers pay tax to subsidise manufacturers, manufacturers pay tax to subsidise farmers, and both pay more tax to subsidise unemployment created by the same economic policies. Better options are available.

The effect of economic policies

Estimating the precise effect of the measures in place a year ago is difficult, but in general their impact has been:

- penalising of import substitutes and exporters by the overvalued exchange rate;

- import protection acted to protect industries with high margins and thereby push up prices of land, labour and capital; it protected industry producers charging higher than true market prices for their goods; sustained a structural rise in the exchange rate, giving low returns from exports;

- agricultural assistance, at close to \$1,000m per annum only partially offset costs imposed by protection;

- agricultural assistance favoured less saleable products, and was selective in application; and,

- high levels of assistance contributed to a large budget deficit, adding to the public debt and resulting partly in high interest rates. This, together with a serious trade imbalance brought about by an overvalued N.Z. dollar and unbalanced assistance has meant disturbingly high levels of overseas debt.

Resulting budget deficit and agricultural transfers were probably not politically sustainable in the medium term. At the same time, the Meat Board has amassed a deficit to September 1984 of some \$495m.

How the situation developed

New Zealand's economy in the 1930s and 40s was pastorally based. A policy of industrialisation followed, in order to save foreign exchange and achieve a more diversified economy less subject to the variability of export market food prices. Also, the (mistaken) belief was held that

industrialisation would provide employment for a larger population. The means to industrialisation chosen was import protection, supported by a fixed exchange rate.

The relatively well-off farmer exporters paid for the new policy with higher input and production prices, and lower product prices. When agricultural investment or output slowed down, incentives were offered, and occasionally the New Zealand currency was devalued.

Gradually it became accepted that import protection and import substitution imposed costs on, and inhibited profitability of and investment in, agriculture. Compensatory assistance was given to maintain reasonable levels of agricultural output.

The resulting complex pattern of cross transfers meant that a large share of national income and expenditure passed through Government's hands, and assistance was unevenly applied. The effect was to produce an investment pattern related not to international market prices, but, rather, to subsidy levels. Investments profitable to individuals were not those profitable to the nation.

Consequently, our national income grew much more slowly than most other countries, and we had to borrow heavily from the savings of other countries to support the slow improvements in incomes that occurred. In effect, we mortgaged our future income.

Changes in policy.

Changes in the last year have been:

- devaluation of the N.Z.\$ by 20%, a level which the market has since judged to be about right;
- removal of regulations controlling lending and borrowing rates;
- removal of exchange controls in preparation for floating the exchange rate;
- removal of the reserve ratio system for monetary control;
- increases in issued import licences, opening at least 10% of the market to imports from 1 January 1985;

- a plan to increase issued import licences by 5 percentage points each subsequent year;

- reductions in assistance to industries whose industry plans are under review;
- announcement of phased reductions in agricultural assistance;
- increasing of government charges on a range of goods and services; and,
- phasing out of export incentives.

The pace of change

Some industry groups have complained about the great pace of change, but it must be recognised that it was essential for most changes to be made concurrently, and that across-the-board changes were necessary if opportunities for productive investments were to be developed.

Agricultural groups are rightly concerned about comparative rates of change in assistance. If assistance was removed more rapidly from agriculture than elsewhere, mobile resources would tend to move out of agriculture, leading to reduced investment until changes have evened up.

So far as agriculture is concerned, the most relevant changes to watch outside the sector are those made to industries of import-substituting and export-manufacturing.

Putting aside SMPs, the total amount of assistance removed from the agricultural sector 1984-1987 is forecast to be about \$220m, or 30% of the original total.

For import substituting manufacturers, the effect of lifting licencing protection will be in the region of 40%. The more heavily assisted industries are subjects of industry plans, and will also have their levels of assistance reduced. The key point is that the effects in these industries are broadly similar to the removal of SMPs for pastoral products, except that sheepmeat SMPs lasted an extra year to September 1985.

The manufacturing exporters Export Performance Taxation Incentive, which cost \$300m in 1984-85, has been reduced by 50 percent, and is to be further reduced and eventually phased out at 1 April 1987. Further, the Export Market Development

Taxation Incentive will probably be replaced by a more selective scheme, which allows the injury test to be regained for our exports to the U.S.A.

While there are some gaps in our knowledge, all available information supports the view that changes in assistance are occurring at broadly the same rate to the different industries.

Effects

Under the more neutral set of current economic policies, we will move to an economy where prices convey market signals, and the relative profitability of investments to individuals will be the same as their relative profitability to the nation. This will make us more responsive to market changes. Adjustment to change will be a continuous process, rather than something bottled up and let go once in a blue moon.

A floating exchange rate protects exporters more against a general decline in profitability. When the general profitability of exporting falls, the exchange rate tends to fall, and in that way restore profitability. At the moment, the exchange rate is being held up by our high interest rates, which are attractive to foreign investors. This is a temporary phenomenon, and part of the cost of weaning ourselves off an enormous budget deficit — it won't change until the budget deficit comes down.

The products and individuals previously most heavily assisted will feel the most pain as assistance is removed. In the agricultural sector that is sheepmeat producers, farmers who have borrowings from Government agencies and those distant from ports. Hill country sheep and beef farming encompasses all those.

Practicalities - the short term perspective

— Drawing on the work of Scott Gretton and Rob Gerard, M.A. F. advisors who have recently investigated profitability of North and South Island hill country sheep and beef farming ...

“After a generally good 1984-85 season, poorer seasonal conditions will lower stock performance for 1985-86. Prices to farmers

for wool and beef are expected to remain about the same as last year, but sheepmeat returns are forecast to decline in response to the reality of market prices.”

An analysis of expenditure shows South Island hill country farmers taking a projected deficit of around \$7,000 even after approximately 15 percent reduction in farm inputs. This compares with a surplus of around \$17,000 estimated for 1984/85.

Economic growth rates in the U.S.A. and Europe, as well as U.S. dollar fluctuations are the major uncertainties in these forecasts. Strong economic growth tends to push up beef and wool prices. While Meat Board pricing policies do not alter market returns, they will be a major factor affecting prices farmers receive for sheepmeat in 1985-86.

The longer term — 1986-87 and beyond.

So far as inputs are concerned, the inflation rate can be expected to moderate, with a 'blip' as GST is applied. Average mortgage interest costs will rise. However, the average interest rate on Rural Bank lending will still be below 11 percent in 1986-87. Termination of the fertiliser price subsidy in 1986-87 and phasing out of the Phosphate Commission's involvement in phosphate rock purchase, will put upward pressure on costs.

Reduction in protection for manufacturing and cheaper rates for seasonal finance will moderate input costs. Efficiency of input use will also affect input costs.

Revenue outcome is more difficult to foresee. It depends on farmers' ability to change output mix, and manage physical and financial aspects of the farm. There is good reason to believe that lower market interest rates will put downward pressure on the exchange rate, pushing up domestic currency returns for exporters. It is difficult to foresee future prices on overseas markets, but as you'll recall, in the late 70s lamb looked the only bright prospect, and there's no reason why a similar change of fortune shouldn't occur again.

But the chances are that farmers who do nothing to adjust to changes will be worse

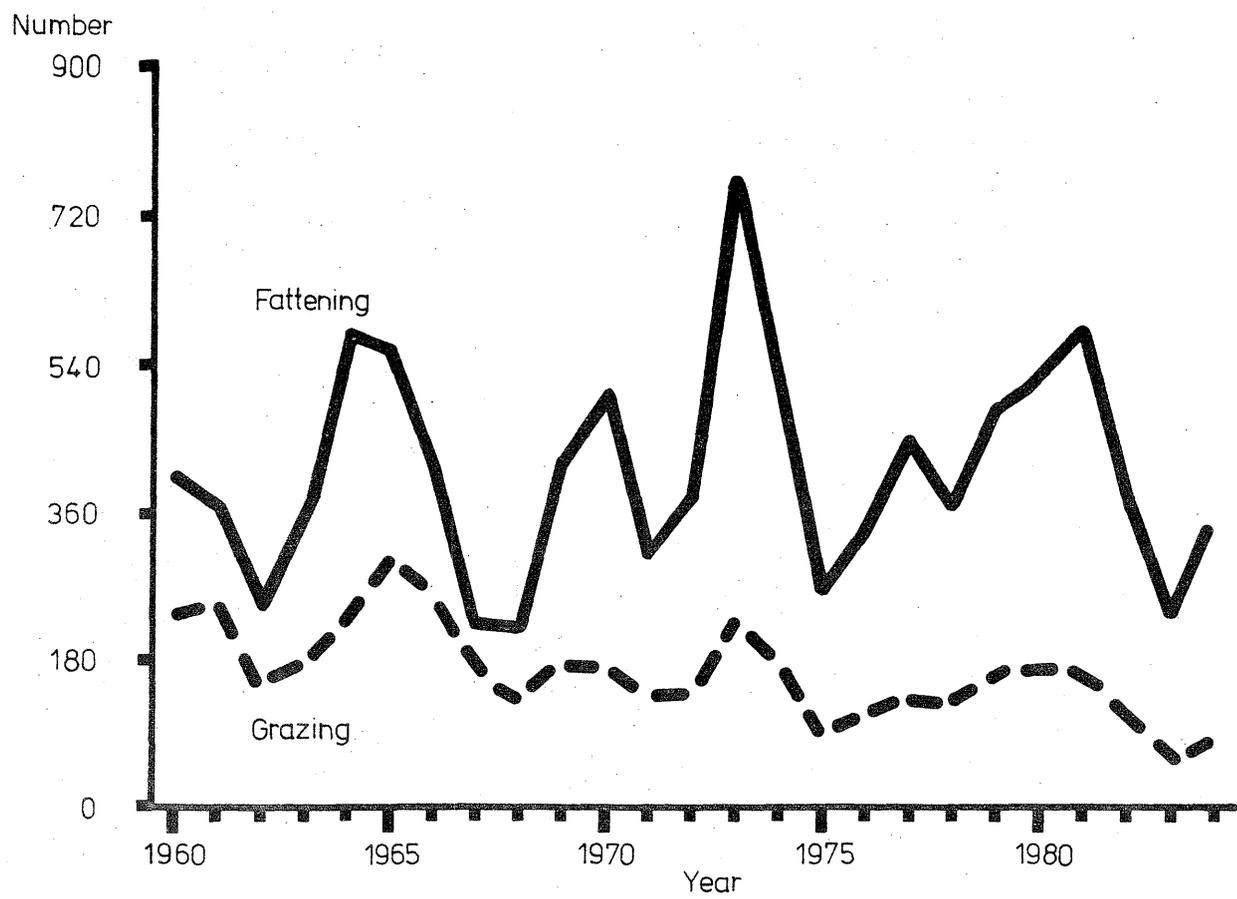


Figure 1. Number of farm sales

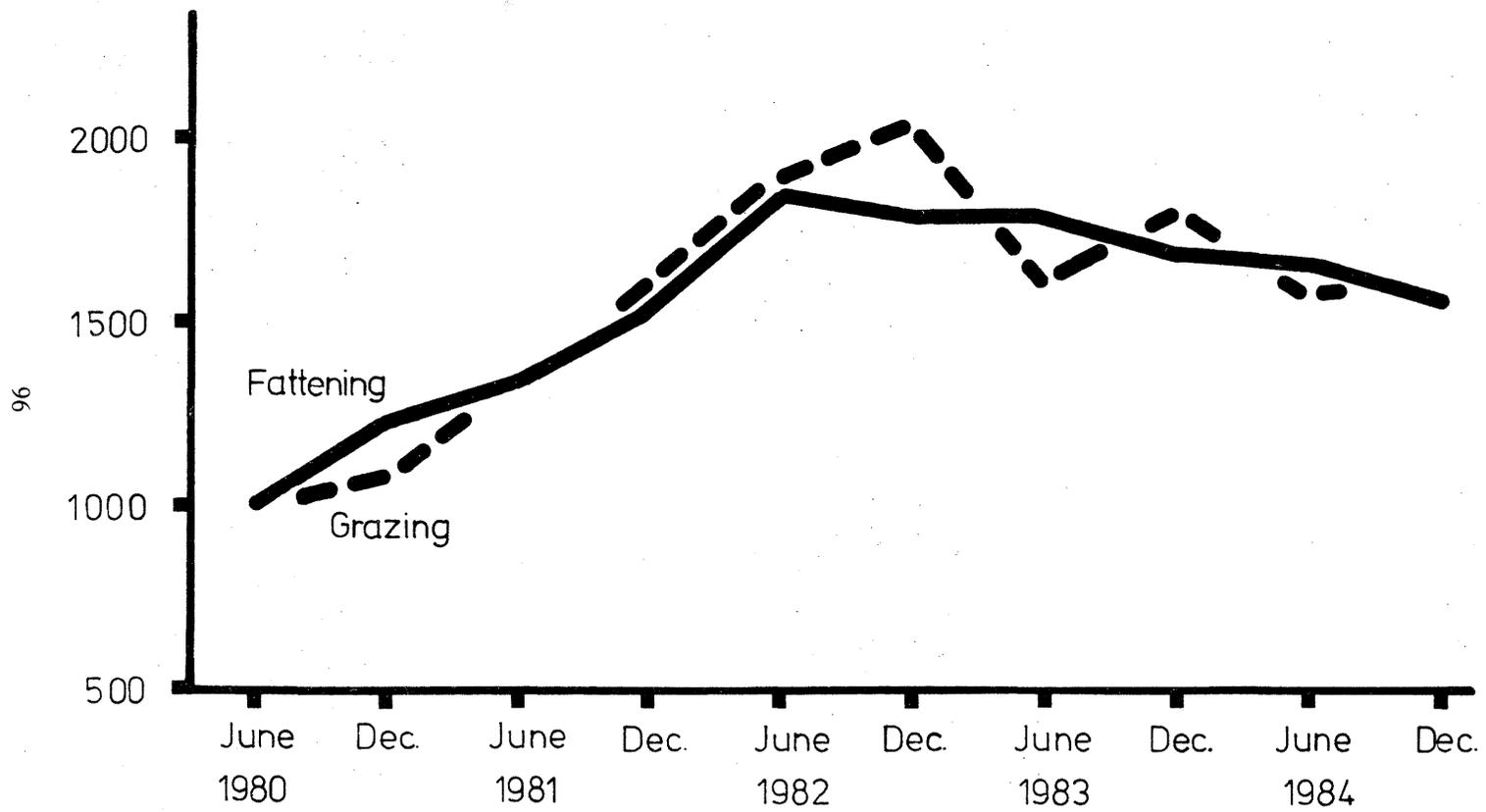


Figure 2. Six-monthly index of farmland sales
 Economic units — price per stock unit (June 1980 = 1000)

off in the future.

There is a limit to adjustments that can be made, and wholesale changes in production patterns are not possible. Newer farming areas are not secure or guaranteed, and time is needed to develop and acquire new skills. However, marginal changes in output can be made with an acceptable level of risk. Shifts in emphasis to beef and wool, to finer wools or higher fecundity stock, and cropping on suitable land, are all realistic avenues for farmers to consider.

Improvement in the quality of financial management is also likely to provide benefits. A once-a-year trip to the accountant with a box of receipts may be cheap in the short-run, but is very costly in the long run. There would be other areas for improvements, too, which mean dollars saved or earned. All must be explored.

A further important area of adjustment for hill country farming is its capital structure and asset values. In general, when the income stream produced by an asset falls, the market price of the asset also falls until a sustainable relationship is resumed.

From the mid 1970s to 1981, prices of grazing land rose extremely rapidly. The rise was not sustainable, and from 1981-82 there has been a sharp turnaround. Since then farm sale prices have declined on a \$/stock unit basis, reflecting the relatively poor profitability of farm assets.

In his analysis based on 1982-83 survey data, Neil Taylor from the Meat and Wool Board's Economic Service showed that the median equity of sheep and beef farmers was 84 percent. Almost 90 percent of sheep and beef farmers had an equity of 65 percent or more. This means that the vast majority of farmers are in a reasonably sound position to weather a downturn in incomes or deterioration of land values and equity in the short term.

However, his analysis showed that a lot of farmers have been maintaining their cash position by mobilising their equity, which rose rapidly through 1976-1981. That kind of policy works only while land values are rising, which they're no longer doing. While

those with good equity positions can use it to carry them through until they reorganise for higher profitability, mining capital can be only a temporary palliative.

Farmers with low equity, however, face the risk of their equity being dissipated by extra borrowing and changes in asset value. They also have the highest debt servicing costs, and are additionally burdened by rising interest rates. For this section of traditional hill farmers, unless performance is high, capital restructuring is necessary. Bankers, creditors and the Government are making and will continue to make every endeavour to see such affected farmers through the difficult adjustment period. However, there will be cases where it is to both creditor and client interest to consider amalgamations, allowing farming to continue at an appropriate asset value, with a sustainable debt servicing structure.

The inescapable fact is that financial performance is the key to longer term survival and prosperity, whether equity is high or low.

Conclusion

I have discussed why it is better for farmers, rather than governments, to pick their own winners. I have looked at the transition path from previous policies towards a neutral approach to different products and processes. Next I looked at the way these policies might work for hill and high country farming, and finished with some indication of future prospects.

Let me conclude by rephrasing the initial question:

"Can traditional hill country farming survive **without** the market economy?"

Can Traditional Hill Country Agriculture Survive the Market Economy?

(3) A commentary

A. Rayner*

My job this afternoon is to act as commentator on the two previous papers. I have, however, only recently moved into the area of agricultural economics, and so my knowledge about the field is still fairly meagre. What I shall be doing therefore is raising questions, rather than giving answers.

I was very interested to hear today's papers. One of the reasons I didn't want to give George Rutherford's paper myself, as had been suggested at one stage, was that while I am in considerable sympathy with the main aims of the Government policy, nevertheless, I am certainly aware that it is potentially painful for certain sectors of the economy. I did not want to put myself into a position of actually trying to work out exactly how much pain the specific sector we are looking at is really going to have to bear. I was therefore very interested to hear what the speakers had to say on the matter. I am not sure we got a very clear answer, for reasons that I will explain in due course.

Can I first make one general comment about overall government policy? As has been mentioned already this afternoon, the Government is taking the view that one should not pick winners. Picking winners is dangerous. We have been given examples

*Lincoln College, Canterbury.

about the dangers of picking winners:— the whole Think Big policy, Marsden Point, SMPs on particular products but not other products — all these are examples of the dangers involved. But I would also like to point out to you the corollary that follows from this, and that is that there are also dangers in picking losers. I think we had better bear in mind before we write-off traditional hill country farming, that indeed there are just as many dangers in picking losers as there are in picking winners. We're here speculating about the likely future of hill country farming, but our prognostications may be just as wrong as the prophesies made by the government in times past, when determining on their various kinds of Think Big projects.

Now, to make a few specific comments about the papers. First of all, I was, in general, surprised at the degree of agreement between the two speakers, and this is something I will be re-emphasising as I go through one or two of the points. In the first case, both speakers seemed to be in agreement with the general thrust of the new Government's more market less interference policy. Eion Garden did not say "let us have SMPs back", he did not say "let us have subsidies back, let us have cheap interest rates back", in fact, he said just the opposite, he did not want that to be the

case. He did not want agriculture to be supported by the government in the way it has been in the past. So there was no suggestion, then, that we should return to the kind of interventionist policy that we have had in years gone by. This surprised me, because this is to a large extent not the kind of statement that one is reading in the press. There is the suggestion being put about that in fact agriculture does need support and does need compensation now because of the current difficulties it is facing. Eion Garden was not asking for that.

I would like to add a comment to something else he was saying — he emphasised the importance of the agricultural sector in New Zealand. I would endorse that wholeheartedly and add to it the following point: because agriculture is so important to New Zealand, to the economy, to our exports, it is absolutely vital that we get agriculture right. In other words, it is not a small insignificant sector that we can play around with and that we can make all sorts of mistakes about. It is a sector that we have got to get right. It has got to be efficient, it has got to be producing the commodities that are required. In making this point, can I contrast the situation of agriculture here with that in the Common Market or in the United States. In the Common Market, for example, agriculture is a relatively small, unimportant sector, compared with the manufacturing sector. It is therefore possible to have a totally absurd agricultural economic policy. It is possible to have a situation where vast over-supplies of commodities are being produced that are not and cannot be sold. It is possible to do this because there are economies, or groups of economies, where there are wealthy sectors, industrial manufacturing sectors, that can afford to subsidize agriculture. That is not the situation in New Zealand. We cannot be in a situation where we are producing large quantities of agricultural commodities that cannot be sold. The point I make, then, is that government intervention in agriculture in New Zealand is much more potentially

dangerous than it is in other countries.

A second point where both speakers agree is that once the government achieves Nirvana with the end point of their policy, where the assistance to industry and manufacturing disappears, or is reduced so far it almost disappears, then it is clear that agriculture will be in a better situation. There was total agreement between the two speakers on that.

There was not quite so much agreement on the perceived rate at which the manufacturing sector and the agricultural sector are moving towards this less interfered with ideal situation. Eion's emphasis was, of course, that agriculture was essentially now in a market environment, whereas industry is receiving lots of assistance, which is a real cost to agriculture. George's line, on the other hand, was that in fact there is a reasonable balance in the reduction of assistance to both sectors. I am not in a position to be able to adjudicate on this. Just in passing, I might add that I don't think it too important a question — it raises questions of equity, of course, but I'm not so sure about the economics of it. I would, however, like to make one point with respect to equality of treatment. If in fact the reduction in levels of assistance to manufacturing is going at the same rate as it is in agriculture, I ask the question why we have not been hearing more squeals of anguish from the manufacturing sector? Why is it we are hearing a lot from the agricultural sector, but much less from the manufacturing sector? Is it in fact because the pain is not equal, or is it rather that farmers are a much more vocal group?

Both speakers were agreed on the need for, and expectation of, some re-organisation of farming techniques. In other words, both speakers saw that small changes in farming techniques and financial and farm management would be necessary, and would be seen. That I think is quite clearly the situation. On the other hand, both agreed again that major panic-stricken changes in agriculture would be highly undesirable. Indeed, I would like to endorse

that any large-scale move into deer, goats or forestry, for example, if everybody were to try and do it, is very unlikely to be to the advantage of agriculture. Those who got in there first, and therefore were able to sell off their animals at absurdly high prices, for breeding purposes would gain, but in terms of a longrun proposition, we simply do not have the information available to suggest that a major shift out of beef and sheep into these more with-it up-market kinds of agriculture is desirable. In other words, the change of agricultural technique we are talking about should be of a relatively minor nature, rather than major.

One matter which I thought neither speaker really covered satisfactorily, was the distinction between the longrun and short-run problems. In other words, if we look at the longrun situation, then we can see reasonably clearly where we are going to end up, and the picture doesn't look too bad. If, on the other hand, we look at the situation at the moment, where we are having a considerable readjustment in economic policy, then it's quite clear that agriculture, and indeed the rest of the economy, are having to pay readjustment costs because of the change in policy.

Let me suggest to you why this is the case. In the past few years the economy has had living standards that have been kept artificially high by finance from overseas. We have also had an economy where there has been too little investment, and therefore relatively too much consumption. If we move from that kind of situation to an economy where we do not finance so much by borrowing from overseas and at the same time increase investment expenditure relative to consumption expenditure, both these things inevitable imply a drop in living standards. And they imply a drop in living standards for everybody. It is quite important that agriculture does realise this — in fact, everybody is suffering a drop in living standards.

There is an additional problem faced by agriculture, and that is that not only are living standards going down, but there has

been already a reasonably substantial drop in land values as well. This can be partly attributed to the change in economic policy. So the change in policy has caused everybody's living standards to go down in the shortrun, or almost everybody's, but at the same time, in agriculture it has caused capital values to go down. Who should pay for that? Should the taxpayer pay for it, should there be compensation to farmers because their land value has gone down from the levels that were unsustainably high before? Or, and I put it to you as a provocative suggestion, perhaps the compensation should not come from the general taxpayer, but from the people who gained. In other words, the farmers who sold out when the prices were indeed absurdly high and made a capital gain. They were the people who were gaining from the past economic policy. Should it be they therefore who should be compensating those who are now losing because of the change in policy? I mention this in passing — I don't suppose it'll be taken up by the industry, but it is a thought for you.

Both speakers suggested that the future may not be as bleak as has been put about by some. I want to reinforce that. Wool does indeed look reasonable now. Meat, given better marketing, should improve as well. Most important of all though, I want to emphasise, is the question of the exchange rate. This, to my mind, is central to the whole position of agriculture in terms of its future. There was a suggestion that the 20 percent devaluation was great for agriculture. Unfortunately, it has changed quite substantially since the float. The exchange rate with Australia has now risen by something of the order of 30 percent since the beginning of this year. Also, I would point out, that we have had considerable inflation since the devaluation, compared with our trading partners. So even were the exchange rate to have been an equilibrium exchange rate last year, I doubt very much whether that rate would be one now. With a floating regime, when the miracle occurs and our interest rates

come down, then the exchange rate will move to a position so that we have a balance of trade. The value of exports and imports will then be more or less equal. What exchange rate will achieve this? That is a very good question. One thing I'm quite sure about, though, is that it will have to be lower than it is now. In other words, the level of exchange rate we have now is not sufficient to reduce imports enough. It is not sufficient to stimulate exports enough. So I am sure that once the exchange rate loses the artificial support of the high interest rates, it will go down to the advantage of the export sector.

Let me conclude with some observations of my own. As I said earlier, it is very important in this whole policy discussion to distinguish between long and short run problems. Since we are considering the survival of hill country agriculture, we must examine mainly the longrun situation; the question of longrun survival. The current shortrun problems that we are seeing are, to my mind, very much adjustment problems. That doesn't make them any less painful. Obviously, those who borrowed heavily and bought in when the price of land was very high are feeling considerable pain at the moment. There is no question of that. But this is really an adjustment problem, caused by the change in policy. However, if we are looking at the viability of hill country sheep and beef farming, then I think we must be considering the longrun situation. So let me make a few points of my own about the longrun situation.

First, provided the government does go through in full with its reform of the economy in the industrial as well as the agricultural sector, then we will achieve a situation where the agricultural sector can start buying its inputs at world prices. In this case we will have moved away from the present excess cost to the farmer, explained by Eion, caused by the protection of the manufacturing sector. Once this has been achieved, then, I would presume that very few people would say that there should be continuing support for agriculture, or

any other sector of the economy. In this kind of efficient environment, we would presumably all believe that each sector has to stand on its own economic feet. We cannot keep pouring support from the government to any sector that should be dying away.

How will hill country farming fare in this kind of non-interventionist longrun situation? When the exchange rate falls to a trade balancing level it will give most help to the export sector, as I explained earlier. The main export sector is, of course, agricultural. So the longrun change in the exchange rate should mean that the revenue being received by hill country farmers will rise significantly relative to their costs.

Secondly, land prices have been referred to several times. It is quite clear, I think, to everybody, that the price of agricultural land over previous years has been artificially high. We cannot expect these high land prices to continue in this longrun future that we are looking at, without continued government interference, and without artificially low interest rates. So land prices will fall, and therefore as a result investment in hill country farming will become more profitable for the new people moving in. In other words, part of the adjustment process to make hill country farming profitable is to move the land price down to a level where the returns being generated become reasonable relative to the value of the land itself. I'm sure that this is not a palatable thing to be told for those who own the land, but it is an implication of the past over-valuation. If we want a brighter longrun prospect for hill country farming, one of the costs must be that the land price will have to come down to a realistic level.

Thirdly, with respect to the actual form of farming itself, it is probable that there will be small changes rather than large. It has been suggested that one of the things that may result from the drop in the price of land is increased amalgamations into larger units, and therefore less intensive farming. That is something that is indeed

a realistic possibility.

Economists are very fond of talking about the way people respond to price changes. Let me just give one example to you of the way this has happened in recent history. Take your mind back to the first oil shock, when the price of oil went up by a very substantial amount. At that time there were a large number of people who bewailed this and said that it was the beginning of the end of the industrialized economies, since they could not sustain the high energy price. However, what then happened was that the price of oil went higher still. What was the result? There were minor adjustments in economies. Cars got somewhat smaller, factories were rather more careful about the

use of energy, there were certain minor changes made, and yet with those minor changes the economies were in fact able to absorb this very substantial shortrun change in the price of oil. The point I want to make is that if we are looking at the situation of hill country farming, then rather than expecting the kinds of price changes we have been observing to lead to the end of hill country farming as we know it, the chances are, rather than that, there will be relatively minor adjustments. There will certainly be difficulties in the shortrun, as there were after the oil shocks. But in the longrun I believe that hill country farming won't look that much different from the way it is today.

Matagouri Control

(i) Chemicals

B.A. Patterson*

Not long after an extensive development programme was implemented on Manahune Station in 1973, a matagouri problem began to manifest itself on the north-west faces of the developed area. I was concerned about the spread and growth of matagouri particularly in relation to possible further development work. So after building a properly calibrated spray machine, I began trial spraying in 1977-78.

The first trial, with gorse and matagouri, began in mid November 1977, with a break of several weeks in the middle of the operation. It became obvious very quickly that the first spraying in mid November had yielded significantly better results than the later spray.

The following year (1978), I observed the matagouri to be in full flower and leaf during the second week of November, at which time a helicopter sprayed 8.1 hectares on either side of a hill track that was becoming increasingly difficult to use because of a matagouri infestation. The top side of the track was sprayed with 22 litres of Tordon Brush Killer (at the old chemical rate) with 200 litres of water. The bottom side was sprayed at a rate of 11 litres with 200 litres of water, with a double pass. The outer edge was sprayed with one pass of 5 litres with 100 litres of water.

A 95% kill was achieved with the first two application rates (22l:200l and 11l:200l, double pass), and a 45%-50% kill was achieved with the lower rate.

The first detrimental result was the death of clover that had been established. But all

broadleaf grasses — timothy, cocksfoot, rye and dogstail — grew far stronger. The growth of these grasses is a secondary benefit from spraying, and contributes to the viability of control by spraying.

After spraying, matagouri becomes very brittle, and during spring and summer stock are reluctant to graze sprayed areas. By winter time, the matagouri begins to rot at ground level and break down. In 1979, I put cows to winter on the trial sprayed area, to speed up the breaking down of the matagouri. This proved to be too hard on the cows.

I resisted the temptation to respray the matagouri that was still standing. Instead, in late autumn 1979 the whole block was closed, in order to winter graze with three hundred 18-month and two-year cattle. Their feed was supplemented with meadow hay. This system has several advantages:

- the cattle fed in a larger tighter mob, thereby trampling the standing matagouri.
- mob feeding opened up the area, letting hay seeds regenerate; and,
- use of young cattle made heifer selection much easier as the tighter grazing made those unable to compete easier to cull.

For comparison, I carried out trials on undeveloped country at the same time. It became obvious that matagouri that had not been fertilised was hard to kill. In its native state, matagouri bark is moss-covered. After two or three years fertilising, a lot of this mossy coat is lost, and new growth is more soft and green — allowing easier chemical penetration.

*Manahune, Albury.

My conclusions from these trials are as follows:

- i) Fertiliser must be applied 2-3 years prior to spraying;
- ii) Heavy stocking the winter before, and right up to spraying is important, to expose the matagouri plants;
- iii) Plants must be in full flower at spraying time, and;
- iv) spraying is best done in overcast conditions, or early morning/late afternoon.

TABLE 1. Cost of control

Application rate	5 l/ha	10 l/ha
Two passes 220 l/ha	\$247	\$420
One pass 80 l/ha	\$209	\$382

***Based on chemical cost of \$34.65/litre
Based on helicopter cost of \$30.60/ha**

TABLE 2. Stock unit returns from chemical control

	s.u.	\$	Gross/ha
Before control	3.25 @	\$30	\$97.50
After control	5.00 @	\$38	\$190.00

The costs are high, too high you may say. But, before chemical spraying matagouri cover on my hill blocks was 50%. I have no doubt that if left uncontrolled matagouri will take over, eventually reducing income per hectare to the point where control is not economically viable.

Financial outlay on chemicals is essential to obtain maximum returns of previous development costs. Unlike broom and gorse, matagouri requires only one chemical treatment for permanent control. The rate of application determines percentage kill. A rate of 1 litre of brushkiller per hectare applied with a handgun can give a 50%-60% kill. Chemical 50D is a cheaper alternative that gives good results if used correctly.

My experience is that a total kill isn't necessary, or even desirable. Matagouri cover can protect the land from adverse climatic conditions.

Compared with most other control measures, brushkill chemicals can give matagouri control an acceptable cost.

Matagouri Control

(ii) The burning option

P. Grigg*

Introduction

Matagouri has recently assumed dominance and weed proportion in much tussock grassland, and has become a problem for management and development. It has seriously reduced pastoral production in many areas, and is continuing to do so. Its prominence is related to topdressing, and sometimes, land improvement schemes.

Burning used to be practised more frequently, and it achieved a measure of control. Now, however, conditions have changed. Burning is more difficult, matagouri is recovering more strongly and there is a prejudice against burning.

Contrary to popular belief, burning is not cheap or easy. It would, I believe, be less controversial if its very effect on different types of country was better recognised.

Fire can do damage at higher altitudes where snow tussock may not recover and where raw litter is burned soil may be exposed to frost heave and wind blow.

On the other hand, burning of improved country at lower altitudes is quite different. Where vegetation has been strengthened by topdressing achieving a total ground cover, burning is beneficial. It redresses the balance of competition and prevents dominance of unpalatable woody plants.

The escape of fire to higher altitude country is a real risk of burning low altitude country.

Increase of matagouri is gradual, and it can be masked by grazing. Burning may be chosen as a method of matagouri control because of stock access difficulties to a site,

*Surrey Hills, Mt. Somers.

or when production and profitability have been severely eroded.

Regulations

Burning may be carried out only under Catchment Board permit. Permits are issued subject to conditions such as area, altitude, time, boundaries, manpower available, notification and post-burn treatment. Each area is inspected before being recommended for Board approval, and there is a requirement to notify when the burn will be carried out.

The aim of Catchment Boards is to ensure that burning is necessary only once. The problem is knowing how to achieve this objective. Summer burning is being advocated as the method sure to kill matagouri, but this has not been generally accepted or proven. Summer burning would seem to be dangerous — both at the time of the burn and later when the fire may revive.

In 1985 the South Canterbury Catchment Board approved twenty permits to burn 2,240 hectares, of which three-quarters were for matagouri control.

Conducting a burn

Where a block is to be burned it should be spelled for most of a growing season. The more fuel the better the burn, and the easier it is to burn. A lot of country now has matagouri at a stage of maturity where there is insufficient fuel to achieve a good burn.

Burning is generally carried out in the spring, and time when conditions are favourable is limited. Suitable conditions are when a drying wind has followed a succession of heavy frosts. The best conditions for burning are anticyclonic

weather, still, and with no general wind. There is, however, usually a wind of local influence — westerly early and easterly later in the day. The success of a burn can depend on correctly judging the time the wind will change.

Block burning is better than burning part of a fenced area. Where only a part is burned, grazing becomes concentrated to the detriment of land and stock.

Bulldozed firebreaks are in general use, but are safe only for a backburn away from the wind. They will not contain a front fire. Breaks are prepared by making as shallow a cut as possible to reduce subsequent scouring. Making a cut too deep or too shallow can present problems. In the latter case, tussocks may wash or blow clear of what has covered them, making an incomplete break, allowing fire to trickle across under cover of smoke.

Back burning a strip along a break is more effective. This back burn is often beaten out because if left to burn away, it can, even with slight wind shift burn sideways, then make an assault on the break further along. If a break back burn is left to run, those lighting have to hurry to complete the job, at the same time watching for any creep across the break.

Natural boundaries such as creeks, sparse ridge tops and rocky areas are good breaks. Where it is too steep to bulldoze, breaks are burned by lighting downhill or upwind, allowing a strip to burn back, which is then beaten out with sacks. Where heavy vegetation is burned a solid, safe break is made.

Cotton plant or *celemesia* may have to be grubbed out to make a break. Fires can restart after a burn from smouldering cotton plant.

A snow cap can seldom be used as boundary because shady faces hold snow much longer. It can be a safeguard to higher country, but does not often work on a local scale.

Bulldozers and helicopters are used successfully to contain fire. Where fought without machinery, a fire can be beaten

from the base until the wind changes and the front is eventually contained.

Post-burning management

After burning, high intensity grazing should be continuous to prevent survival of matagouri shoots which sprout from the crown. Where grazed for at least one growing season, young shoots will, hopefully, be eaten before they harden and become unpalatable.

A hot burn which removes sticks and allows stock access for grazing the regrowth is most effective. Cattle can be useful for knocking down and breaking up stick. Goats could be expected to control regrowth, but to be effective, goat browsing would need to follow burning.

It has been argued that a hot burn gives better control of regrowth, or that it can even kill the plant. A slow down-hill burn of heavy vegetation ought to give better control, but in my observation has not been any different in effect to lighter burns. A burn which simply skims the tops of the plants is of little use.

A second burn to destroy young regrowth has been suggested, but it seems the practice is not followed.

Oversowing and topdressing is required as follow-up for initial burns, but for later burns, seeding is not always needed or of much advantage where clover and hard seed is present. Results seem to come more from the grasses already present, such as danthonia, sweet vernal and browntop.

Effectiveness

Burning has been successful and unsuccessful on different parts of our property.

On Surrey Hills, matagouri has been removed from a number of blocks, mainly the easier, damper areas. But the same methods have failed on the steeper, drier, warmer country. On this country it is difficult to get enough fuel for a good burn, even when it is spelled for a year or more. Green growth present on this warmer improved country will not carry fire.

Spraying trials were started four years ago, with chemicals donated by Ivon Watkins-Dow. To reduce costs lower rates

have been tried. We are prepared to accept a less than total kill. Lower rates of water and single pass flying have been tested, as have half recommended rates.

On Barrosa we are in the unsatisfactory situation of repeated burning. Repeat burns are required every five to eight years on the lower rainfall area blocks. Our concern is that if not burned, the matagouri will pass the stage at which it can be controlled in this way. This has already happened on one block.

Better control has been obtained on smaller blocks, but even there, there has been regrowth.

Other options

Matagouri can be valuable for shelter, shade, to break up snow, and even to allow some grass to grow underneath. But there will be plenty around without consciously keeping it for these purposes.

The do-nothing approach has some merits because matagouri can be lived with where it has not been topdressed. It is better that country with matagouri should not be topdressed. Unfortunately, though, doing nothing is not practical where the only defence against hawkweed is topdressing.

Conclusion

Control of matagouri by burning has problems. Matagouri will be checked, not killed, where it has been strengthened by topdressing. Burning has to be repeated, and spelling results in loss of production. Country that has reverted too far to matagouri cannot be burned.

Burning is not an entirely satisfactory method of control, but so long as spraying costs are uneconomic there is no other viable option for keeping tussock country in production.

Matagouri Control

(iii) The do-nothing approach

H. Pawsey*

The 'Do-nothing policy' on matagouri control is to take no active steps to control the plant. In the short term, this policy encourages matagouri to grow and prosper, to maximise long term benefits to the hill country farmer of a stable grassland of clover, grass, tussock and matagouri.

Property Description

Situated on the Virginia Road about 20 kilometres west of Hawarden, Double Tops occupies 2705 ha, of which 400 ha are rolling cultivatable downs, 1100 ha improved tussock and the remaining land, native. Average rainfall is around 750mm at the homestead and 800mm at the western side of the property. The downs are about 500m a.s.l., the highest point is 1000m a.s.l. The hill soils are a mixture of the Hurunui and Haldon series.

We carry 5500 Corriedale ewes, 1300 hoggets, 200 breeding cows and replacements - a total of 8500 stock units. The lambing percentage in 1984 was 98% survival to sale and calving 90%. We clip 3.8 kg wool per sheep wintered.

In the past, the downs have been cultivated, but more recently development has been concentrated on the hill subdivision, using electric fencing and oversowing of clover, grasses and superphosphate. Good clover establishment has been achieved as well as some solid growth from matagouri.

I do not know if Double Tops had a matagouri problem in the past, or whether the current infestation is due to burning practised in the past. Today a large part of the hill, developed and native areas, carry a good cover of matagouri.

*Double Tops, Hawarden

Matagouri

Matagouri is a low fertility colonising nitrogen-fixing shrub unpalatable to stock. Generally superphosphate applications on low fertility land will increase its growth. Matagouri is able to dominate because it is deep rooted, able to withstand moisture stress, and appears to be more tolerant of low soil pH than clover.

Matagouri does not like a vigorous sward of grass and clover growing hard up against its stump nor heavy concentrations of dung and urine. It responds by growing more upright, reducing the spread of ground runners, eventually becoming less vigorous.

The only long term solution to the problem of matagouri spread is to manage it in such a way that it is less able to dominate, and is eventually choked out. Until sufficient increase in fertility has occurred for this to happen, we have to live with matagouri.

The problem is that fertility build-up is very slow, and may not occur because of low rainfall, low pH and lack of development money. There may be a strong case to leave some sites alone, and accept low productivity from them.

Is matagouri a problem?

A walk through matagouri-infested tussock will soon convince most observers (apart from perhaps the pure conservationist) that matagouri is a problem. Scratched legs testify to its menace. But apart from the nuisance value the question still remains, do the disadvantages of this plant outweigh its advantages? If matagouri is a problem will the control measures taken to contain the plant be effective or economically

viable?

Disadvantages

1. Reduces land for grazing. Dense, scrubby matagouri hinders stock mobility. Animals are reluctant to graze around it, leading to rank growth which in time become impenetrable. This usually occurs as a result of an ambitious development programme, when the area of land top-dressed exceeds available grazing control.

2. Mustering difficulties. Matagouri bushes provide cover for straggling sheep, making the musterers job more difficult and time consuming.

3. Reduced wool returns. Sheep grazed on matagouri country prior to summer shearing can get considerable matagouri debris caught in the fleece, which may lead to a reduced wool price. At Double Tops sheep that have been on the hill prior to shearing in February have a tested vegetable matter content of up to 1.5%, compared with sheep in the paddocks which have 0.2%. Hill sheep wool prices can be discounted by up to 15 cents per kilogram.

Matagouri also seems to be an effective wool harvester. Plucked wool may not be a significant percentage of the total wool clip of summer-shorn sheep, but may be more significant in late winter with pre-lamb shorn ewes that have suffered stress and developed a wool break, so belly and flank wool is easily plucked by matagouri.

4. Scabby mouth. Lambs of ewes from matagouri infested country can have a high incidence of scabby mouth. In severe cases scabby mouth reduces lamb growth, but more importantly the freezing works will not accept stock for slaughter when scabby sheep are present. A three-week delay can occur while scabs heal.

Advantages

1. Microclimate. Matagouri, like tussock, can provide a microclimate suitable for developing pasture plants. Tall matagouri provides considerable shelter from the nor'west wind.

2. Lambing and calving shelter. Matagouri provides excellent shelter for stock giving birth. At Double Tops similar

lambing percentages have been achieved by stock left on their own on the hill and those on intensively lambed paddocks. Tall matagouri can provide newborn animals with considerable shelter from strong north-west wind and rain. Also, compared with well covered hill blocks of the same aspect, blocks bared by fire yield depressed final tailing percentages.

3. Snow recovery. Fortunately, Double Tops is not troubled by snow. On the higher country we receive about three or four falls a year of up to 30 cm deep, that can lie around for a week or two. The first grazing available to stock caught in heavy snow is that uncovered by matagouri springing up from under the snow mantle.

Matagouri can also provide useful footing for cattle walking round snow-covered or wet and greasy slopes.

4. Soil stability. On steep rubbly or scree slopes the top batter of a new track takes years to consolidate, usually only after the matagouri has re-established a new root system. I often wonder what would happen to the scree gulleys if matagouri was not there to stabilize the surface with its deep root system.

5. Feed reserve. Unless stock are forced onto matagouri most do not graze too close to matagouri. This can result in a feed reserve building up under the matagouri umbrella during spring, which can be harvested later by hungry animals, should a drought occur.

Comparison

It is difficult to quantify the advantages and disadvantages of matagouri. The obvious financial cost to sheep farmers is that of a reduced return from wool because of moit and wool 'harvested' by the plants. Because we shear in February, wool loss is negligible, though wool from hill ewes can be discounted by up to 15 cents per kilogram. The financial cost to us from this could be as much as \$1560 per year (3000 ewes @ 52 cents discount).

In my view matagouri does not present sufficient menace to warrant eradication. Furthermore, I consider that matagouri has

enough overall advantages for its presence to be beneficial.

In my experience chemical control of matagouri is too expensive. Burning seems to give only a respite and exacerbate the long term problem. I have burned matagouri and obtained a temporary clearance, but have ended up with a worse problem. I have also burned shady faces before oversowing, but again, the matagouri has returned.

When land is denuded, ground cover that is best suited to the environment re-establishes itself. In some situations, such as on a north-west face, desirable grasses may be too exposed to thrive, so such plants as matagouri and thistles might become the colonising plants. In such conditions, it may be preferable to hoof and tooth, rather than burn, establish clover and grass, then spot burn areas of rank growth, the aim being to establish a natural harmonious balance between introduced and native species.

Management

My approach to the problem of matagouri infestation and hill development is to fence according to aspect and soil type. Each block of land should be individually assessed for the best land use. The best cover for grazing is sparse tall matagouri, tussock, clover and grasses. Should it appear that topdressing will result in dense matagouri growth, consider whether the matagouri will grow up and allow the stock to graze underneath. If the conclusion is that topdressing will result in dense low form matagouri, then that block of land is best left as it is or planted in trees.

Subdivision

The usual complaint about matagouri is that hill blocks become overgrown, preventing sheep from grazing the entire block. Set stocked sheep in large blocks favour certain areas and neglect the shady aspects, which become rank.

We have found that 4500 ewes mob grazing 80ha blocks fenced according to aspect will graze most of the block, criss-crossing the areas of tagg, forming tracks. The next time round these tracks become

more numerous and wider and verged with shorter more palatable grass and clover. The matagouri then becomes confined to the tagg and grows more upright.

Cattle, when held on small blocks, will graze hard into matagouri tagg, particularly in the autumn and early winter.

Considerable progress can be made in controlling tagg when stock are mobstocked all year round. However, forcing pregnant stock into tagg does not achieve satisfactory production. Mobstocking is possible only after weaning for a short period (so that ewes do not lose liveweight prior to tupping) and in winter. Cattle are very useful for keeping tussockland open over the spring.

Matagouri control is highly dependent on the level of subdivision. The more fencing, the better the control.

Fertiliser

Matagouri shows a good response to superphosphate. In the past I have made the mistake of stopping topdressing of matagouri-infested faces, thinking I was throwing money away growing more prickles. Normal topdressing of improved blocks should continue irrespective of matagouri infestation. Fertiliser encourages matagouri to grow tall, thereby letting stock in to the sheltered pasture beneath. In time, improved fertility results in choking out of weaker matagouri, leaving a nutritious sheltered grazing block.

Avoid burning

I have yet to see a burn that has killed matagouri. In my observation, burning converts matagouri from an upright plant to a prostrate shrub, and delays the long term establishment of a balanced pasture interspersed with tall matagouri.

The only justification for burning is to clear the mustering off points from hill blocks.

Conclusion

To summarise, I consider that matagouri has advantages to the hill country farmer. Matagouri is a low fertility colonising shrub that responds to superphosphate and is better able to withstand climatic adversity than exotic legumes. In development,

provided that hill country is adequately subdivided according to aspect, matagouri can be encouraged to grow tall and provide a microclimate for desirable plants and shelter for stock.

Matagouri can get out of control, usually in a man-made situation, where land has been topdressed without sufficient follow-up grazing control. Given good grazing technique and regular topdressing, soil fertility will rise, leading to a reduction in matagouri density. On sites where it appears difficult to improve soil fertility, the best land use may well be either a low input, a low stocking rate grazing system or forestry.

My final message is to put up with the nuisance of matagouri in the short term, keep fencing and topdressing and in the long term matagouri will be your friend.

