Birdsfoot trefoil and black mountain rye: On-farm trials in the South Island hill and high country

B.E. Allan, J.M. Keoghan[1], H.M. Chapman, W.J. Fraser[1], R.J. Doney and K.D. Trainor[2]

MAF Technology, Tara Hills High Country Research Station, Omarama
[1] MAF Technology, Invermay Agricultural Centre, Mosgiel
[2] MAF Technology, Redbank Research Centre, Clyde

Abstract

An on-farm approach combining research, development and technology transfer (investigative development) is proving to be a relevant method for improving the adoption rate and understanding of alternative pasture species and cultivars in the South Island hill and high country. Several such trials which result from partnerships between scientists, consultants and key farmers are now underway in contrasting geographic/environmental zones. The design of one trial is described. The trials have highlighted the value of birdsfoot trefoil (*Lotus corniculatus*) and black mountain Rye (*Secale montanum*).

Birdsfoot trefoil is proving more persistent than conventional legumes such as lucerne and red clover on droughty infertile outwash soils. In all on-farm comparisons two New Zealand experimental cultivars of birdsfoot trefoil, G32 and 'Dryland', have performed at least as well or better than overseas cultivars.

Black mountain rye is out-producing other drought tolerant grasses and in particular providing excellent special purpose greenfeed in early spring and autumn. The background and development of this grass is detailed.

The trials are proving excellent focal points for farmers, consultants and commercial representatives in the search for and use of more sustainable, ecologically sound pastoral systems.

Additional key words: *Investigative development, alternative species and cultivars,* Lotus corniculatus, Secale montanum, *technology transfer.*

Introduction

Farmer interest in the search for and use of more sustainable and ecologically sound pastoral systems for the predominantly drought prone soils of the South Island hill and high country has never been higher. Demand for such systems is growing as problems such as recurring droughts and hieracium loom as a threat to survival for many farmers. Seed supply is also improving, thanks to a change in plant breeding attitudes in New Zealand over the last 10 years. Plant species are now being identified and developed to suit specific regions, environments and farming systems (Corkill *et al.*, 1981). We are on the threshold of a new era.

The concept of on-farm investigative development was first used by MAF Technology South in 1987 (Keoghan *et al.*, 1989) as a means to test and demonstrate to farmers the suitability of new and alternative pasture species for specific pasture systems. The approach is a compromise between large scale credible commercial demonstrations and small replicated research plot trials. The specific purpose is to help bridge the gap between breeder, agronomist, consultant and farmer.

There are now six major on-farm trials established in the southern half of the South Island in a range of locations from Middlemarch (520 mm annual rainfall, 200 m above sea level) to the Upper Clutha (550, 270) and from the Waitaki Basin (500, 500) to the Hakataramea Valley (450, 250).

Methods

The recently established trial on John McKenzie's Belfield property in the Hakataramea Valley is a good example of the on-farm investigative development concept. This trial is looking at the persistence of various legume and grass combinations and their ability to provide winter grazing on fertile but drought

prone arable soils. The 9.6 ha trial was drilled into a 17.5 ha paddock in February 1990, and within this there are four replicates, one of which is shown in Figure 1. Species under examination are tall fescue, cocksfoot, 3 brome grasses, wheat grass, phalaris, black mountain rye, perennial ryegrass, birdsfoot trefoil, lucerne, alsike and red clovers. Grasses and legumes were cross-drilled to give plots up to 980 m^2 of various legume/grass combinations.

The trial has no internal sub-division fencing and is mob grazed as necessary as part of John McKenzie's management system. Establishment, dry matter, production, persistence and acceptability of the various pasture species to sheep are being assessed. The trial will continue for at least four years.

Results and Discussion

Results are presented from the point of view of species rather than specific trials. Birdsfoot trefoil and black mountain rye have, in particular, shown promise in a number of on-farm trials. Results will concentrate on these two species.

Birdsfoot trefoil

Birdsfoot trefoil has a potential as a productive and persistent legume for moderately fertile hill and high country, particularly where soil acidity limits the success of lucerne (Scott and Charlton, 1983). Because of the considerable variability within birdsfoot trefoil, a joint project between DSIR Grasslands and MAF Technology was launched in 1983 to evaluate and select genotypes for a suitable high country 'Dryland' cultivar (Chapman *et al.*, 1990a). The selection of this cultivar is now near completion, but there are still questions relating to the place for, establishment and management of birdsfoot trefoil. Farmer uptake of birdsfoot trefoil has generally been limited (Chapman *et al.*, 1990b).

The on-farm trials provide an opportunity to better define the role of birdsfoot trefoil. For example, a trial at Omarama Station (500 mm rainfall, 500 masl) compares birdsfoot trefoil with conventional legumes on droughty, infertile, outwash soils (Keoghan *et al.*, 1989). This trial of over five hectares is part of a 93 hectare improved area that is mob grazed two or three times a year. Birdsfoot trefoil cultivars were drilled at 4 kg/ha with WL320 lucerne at 8, Pawera red clover at 5 and 'Connie' lupin at 10 kg/ha. Table 1 shows seedling establishment together with plant numbers and vigour two years later. 'Dryland' seedling numbers were significantly greater than any of the birdsfoot trefoils or other legumes, presumably because of higher seedling vigour. After two years 'Dryland' remained the most abundant legume although Pawera red clover was slightly more vigorous in growth. Plant numbers of both 'Dryland' and G32, a recent Grasslands selection, are now considerably superior to the commercial cultivars Empire and Granger.

The advantage of birdsfoot trefoil over conventional legumes on drought prone infertile soils is becoming clearer as this trial progresses. Plant numbers of 'Dryland' and G32 appear to be increasing under a management of summer spell to allow seed set. Permanent transects have been set up to monitor the longevity of established plants and the appearance of new plants. We feel that management of birdsfoot trefoil to allow the build-up of a seed bank is essential to the success of this species on these soil types.

The performance of birdsfoot trefoil on dry but more fertile soils is under study in the on-farm trial at Glenfoyle, Alan Kane's property in the Upper Clutha (550 mm rainfall, 270 masl). This trial, established in spring 1988, compares G32 with 'Dryland' and 'Cascade', with and without companion grasses (Keoghan *et al.*, 1989).

Birdsfoot trefoil established well (123 seedlings/m^2) and, unlike establishment at Omarama Station, numbers did not vary significantly between cultivars. Plant longevity is being monitored, particularly in relation to competition from companion grasses.

Companion grasses for birdsfoot trefoil: The correct choice of companion grass depends on the soil type. For example on the dry infertile soils of the Omarama Station trial, the grass should be chosen for its ability merely to persist rather than compete. The most promising grasses to date have been Kara cocksfoot and Hakari mountain brome (Table 2). However, on the more fertile soils of Glenfoyle, Hakari mountain brome, while producing significantly more total dry matter than other grasses, reduced the proportion of birdsfoot trefoil in the sward (Table 3). It is too early to determine if Hakari will adversely effect trefoil plant numbers but on these more fertile soils tall fescue, in this case Au Triumph may be a more suitable companion grass. This grass carries well into the winter and so suits the 'seed bank' management suggested for birdsfoot trefoil pastures.

Black mountain rye

Black mountain rye is a perennial grass with similar attributes to ryecorn (*Secale cereale*) in that it has strong seedling vigour and very good cool season

Trial Design (2.4 hectares)

P.G.G. Grazing Brome & Redquin							
WL320 Kara	WL320 Maru	WL320 Tall Oat	WL320 Mandan	WL320 Hakari	WL320 Tiki	WL320 Mt Rye	WL320 Rye / Nil
DRYLAND							
Cascade	Cascade	Cascade	Cascade	Cascade	Cascade	Cascade	Cascade
Tetra	Tetra	Tetra	Tetra	Tetra	Tetra	Tetra	Tetra
Pawera	Pawera	Pawera	Pawera	Pawera	Pawera	Pawera	Pawera
Redquin	Redquin	Redquin	Redquin	Redquin	Redquin	Redquin	Redquin

Sowing Rate (kg/ha)

Local Ecotype Ryegrass	17	Tiki Brome	11	Tetra Alsike	5.5	WL320 Lucerne	6
Hakari Brome	27	Tall Oat (Pelleted) ..	7	Pawera Red	5.5	Cascade L. Cornic ..	5
Mandan Wheat Grass ..	33	Kara Cocksfoot	10	Redquin Red	5.5	Dryland L. Cornic ...	5
Mountain Rye	35	Maru Phalaris	8				

Figure 1: Example of on-farm trial design. One replicate of the trial at Belfield, Hakataramea Valley. The design covers 2.4 ha but is not drawn to scale.

TABLE 1: Legume plant numbers and vigour on droughty infertile outwash soils at Omarama Station - Drilled September 1987

	Nov 1987	April 1989	
	Seedlings per m^2	Plants per m^2	Vigour (0-5)
'Dryland' corniculatus	102	10.2	3.3
G32 corniculatus	69	8.4	2.5
'Granger' corniculatus	34	4.1	1.6
'Empire' corniculatus	60	1.5	1.2
Pawera red clover	39	7.6	3.5
WL318 lucerne	46	3.8	1.3
'Connie' lupin	8	0.2	2.3

TABLE 2: Grass plant numbers and vigour, and effects on 'Dryland' trefoil plant numbers on droughty infertile outwash soils at Omarama Station - Drilled September 1987.

	Nov 1987	April 1989		
	Grass seedlings per m^2	Grass plants per m^2	Grass vigour (0-5)	Trefoil plants per m^2
Hakari mountain brome	61	20.3	3.4	9.5
Kara cocksfoot	99	27.2	4.4	9.6
Tiki smooth brome	57	10.6	2.0	13.0
Matua prairie grass	18	1.6	1.2	7.3
Tall oat grass	38	12.0	2.1	10.0
Roa tall fescue	44	5.5	2.4	12.8
Maru phalaris	68	5.3	2.2	9.8

growth. The grass has flat dark green leaves, a paler sheath with fine hairs and purple colouring, a membranous (1 mm+) ligule, and long clasping and often purple auricles. It is adapted to areas with cold dry winters, is drought tolerant by New Zealand standards, and is tolerant of high levels of soil aluminium.

The grass was selected from Yugoslavia in 1957 by Division of Plant Industry, CSIRO in Australia. In a breeding programme at black mountain it was crossed with ryecorn and then backcrossed twice to the parent line in an attempt to improve both seed yield and tillering ability (Oram 1987).

TABLE 3: Total sward production, amount and percentage legume contribution from birdsfoot trefoil ± companion grasses grown on moderately fertile drought-prone soils at Glenfoyle Station - Drilled September 1988.

	Total 1989/90 season	Contribution from birdsfoot trefoil	
Grass treatment	(kg DM/ha)	(kg DM/ha)	(%)
Nil	3110	2960	95
Au Triumph tall fescue	3710	2710	73
Tiki smooth brome	3680	3050	83
Hakari mountain brome	4240	2670	63
SED	380		3

Development at Tara Hills: One hectare was sown at Tara Hills in 1986 and a further two hectares was drilled with lucerne the following spring on fertile, well drained fan soils. Dry matter production was monitored for two years under dryland conditions and black mountain rye/lucerne outproduced both Matua prairie grass/lucerne and tall fescue/lucerne. The cool season activity of black mountain rye, particularly early spring growth, was most encouraging. For the last two seasons this area has been managed for seed production. In autumn 1989 a further 3.3 ha was drilled near Duntroon for seed production in collaboration with farmers Bill Simpson and Robert Duff. Despite the dry conditions this area produced 680 kg of dressed seed per hectare last season, substantially better than recorded yields in Australia.

Establishment and production: Black mountain rye has been included in three of our on-farm trials aimed at providing specialist winter/early spring grazing. On John Davis' property at Longacre near Tarras (500 mm rainfall, 350 masl), the grass is being compared with three tall fescues on moderately fertile dryland soils.

Black mountain rye produced twice as much dry matter as any of the tall fescues (Table 4). All grasses established well but plant numbers for black mountain rye when sown at 18 kg/ha were low despite a good seed germination count. From this and other related experience, a sowing rate of 30 kg/ha is recommended.

Grazing management: Black mountain rye should be regarded as a special purpose greenfeed and ideally

TABLE 4: Dry matter production (kg DM/ha) for the 1989/90 season following autumn 1989 drilling - Davis Bros., Longacre.

	Aug	Oct	Nov	Jan	Apr	Total
Au Triumph tall fescue	327	802	735	559	0	2423
S 170 tall fescue	217	1007	914	545	0	2683
Roa tall fescue	326	642	742	412	0	2121
Black Mountain rye	951	1210	1266	1266	583	5276
SED	79	190	237	217	-	-

should be mob grazed and then spelled. The grass is readily palatable to sheep in the vegetative form, but tends to run to seed easily, becoming rank and unpalatable. It is probably best to sow it on its own rather than mix it with other grasses. Red clover appears to be the most compatible companion legume. Trials are underway to further investigate management under grazing, as well as companion species and its longevity as a perennial.

Rabbits: The Longacre trial was adversely affected by rabbits during the 1989/90 season. It was noted that tall fescue was grazed more by rabbits than black mountain rye. The observation that black mountain rye is palatable to sheep but less so to rabbits could be of major significance and warrants further investigation.

Conclusions

The on-farm trials established to date are helping to clarify the place for, establishment and management of alternative pasture species in the South Island hill and high country. Two such species have been highlighted in this paper. While results from on-farm trials are often more difficult to extract than those from discrete and specifically designed research trials, they are, however, sound and practical. Furthermore, the on-farm trials provide excellent focal points for farmers, consultants and commercial representatives to meet, discuss and monitor progress. This approach is clearly increasing interest and understanding in the use of alternative pasture species and cultivars. The keen interest in black mountain rye, for example, can be mostly attributed to its performance in both the Belfield and Longacre trials. Farmers can see and evaluate for themselves the successes and failures of various species and cultivars in various situations. Many are taking up the on-farm concept and experimenting in a similar way on their own properties. The outcome is greater awareness, acceptance and understanding of the role alternative species can play in today's farming systems.

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