

FIELD SCREENING OF COVERCROP SPECIES  
FOR ESTABLISHMENT ON FOREST CUTOVERS

by

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# Field screening of covercrop species for establishment on forest cutovers

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## Abstract

Oversowing cutovers is a new concept in site management that takes an innovative approach to improving soil nitrogen and controlling weeds.

Trials were established in Whakawerawera forest and the FRI Long Mile area to test a range of commercially available pastoral species for forest oversowing. Results from these trials have identified several candidate species for further testing on a wider range of sites.

Cocksfoot and Yorkshire fog have shown to be two outstanding species for sowing in spring or autumn. For autumn sowing only, annual rye grasses and Koha serradella have proved to give good ground cover for one year. Fertiliser on sites similar to the site tested (Whakawerawera) is likely to give an improvement in ground cover of 10-20%.

Results from these trials indicate that the establishment of a covercrop is best assessed 8 months or 1 growing season after sowing.

## Introduction

The increase in weed problems in New Zealand forests and the expanding area of cutover to be managed, has indicated it is timely to begin to investigate the potential of alternative methods of weed control. The current increase in environmental awareness has emphasised the need to find solutions that are environmentally acceptable. Overseas trends have indicated that the future use of herbicides for weed control will be restricted. Although the use of herbicides has given adequate weed control to establish trees the effectiveness of herbicides is short term with weeds returning to establish where bare soil remains.

One alternative is to control weeds by grazing livestock (West and Dean, 1990). While this has been successful on some forests, it has not been widely adopted. Another alternative involves oversowing a covercrop. The objective with oversowing is to occupy the site with an easily managed covercrop that may provide nitrogen for tree growth but will not be a hindrance during silvicultural operations (West and Dean, 1992). While lupin (*Lupinus arboreus*) has been used for decades in coastal sand forests (Gadgil, 1984) the identification of *Lotus uliginosus* cultivar Maku as an outstanding legume for forest conditions (Gadgil, 1986) has indicated there is an opportunity to use legumes on a much wider range of sites.

Large block sowings at Kaniere Forest (Balneaves, 1984) and Omataroa (West and Dean, 1991) demonstrated that some control over vigorous weeds such as shrub hardwoods and pampas could be achieved with lotus. Early trials testing the establishment requirements of Maku lotus (West *et al.*, 1988) indicated similar results.

A suitable covercrop species would need to be: 1) able to establish quickly on cutover when oversown, 2) highly competitive against the expected dominant weeds, 3) commercially available at a reasonable cost.

Research with glasshouse pot trials have shown that some grasses have considerable impact on slowing the growth of pampas plants while lotus Maku was shown to have very little effect (Gadgil, 1990). An initial grass oversowing trial in Mamaku Forest (West *et al.* 1988) indicated that the three high quality grasses sown were not suited to this site. Wild grasses such as sweet vernal, Yorkshire fog and brown top colonised and dominated the trial site.

For the covercrop concept to be successful, suitable species need to be identified that will suit forest sites. Over the last 50 years a large number of grass and legume species have been selected and bred by the agricultural sector for pastoral farming. It is these species that are currently commercially available in sufficient quantity.

Considerable research is needed to determine for each site which species of grass or grass/legume mixture can establish well and how effectively they compete with the local problem weeds. An initial step in this programme of work is to select suitable candidate species from the current literature and establish a series of screening trials to test groups as they are identified.

This report gives the results of two trials established to screen for successful forest covercrop species.

## Trial 1 - Whakawerawera forest

### Location and Site Description

This trial was located in Compartment 9, Whakarewarewa Forest off Red Tank Road. The site was previously an old larch (*Larix decidua*) stand, which was clear felled in January/February 1990. The area received no site preparation (not burnt) and was planted in radiata pine in June/July 1990 at approximately 1000 stems/ha.

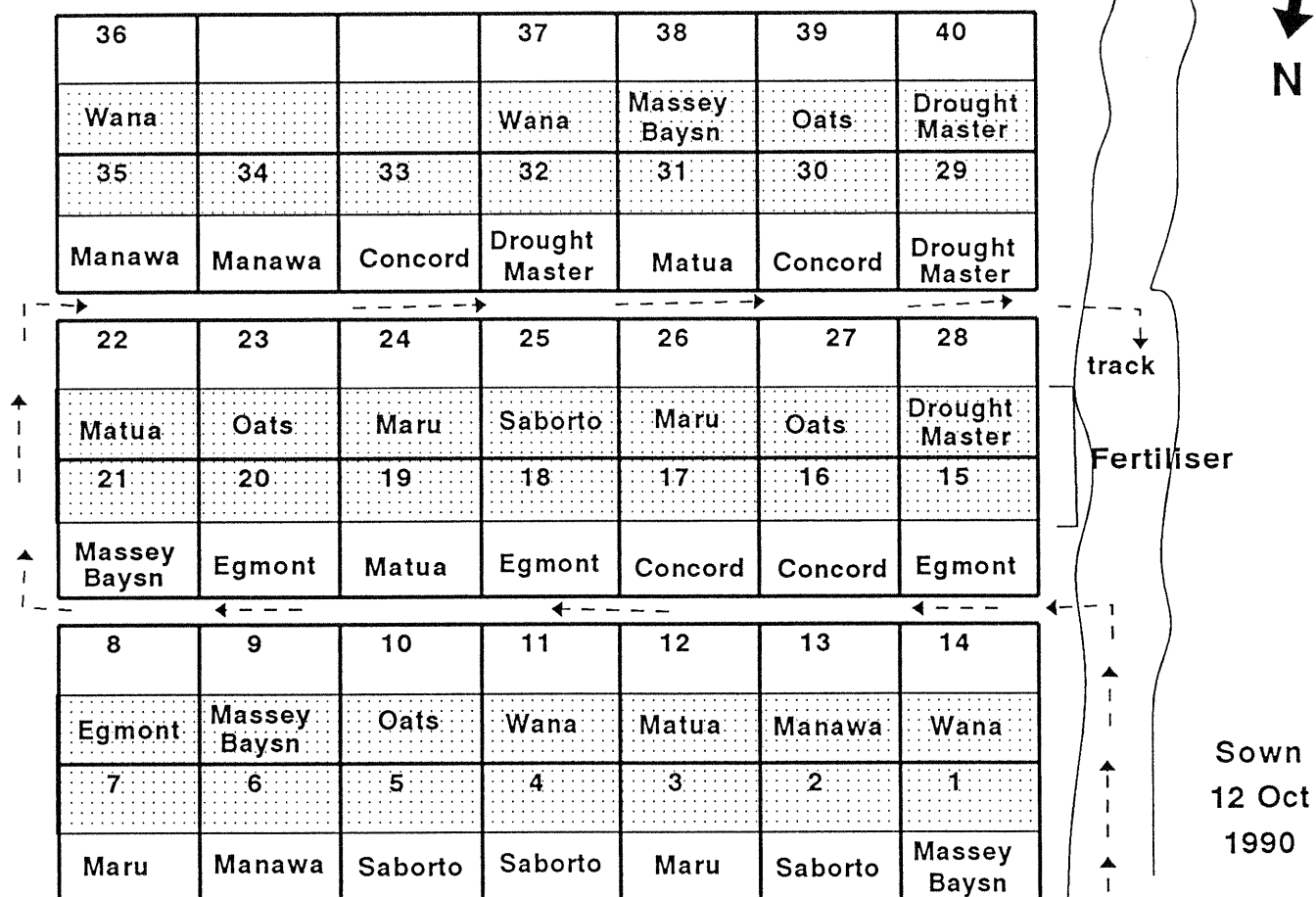
### Methods

#### Plot establishment

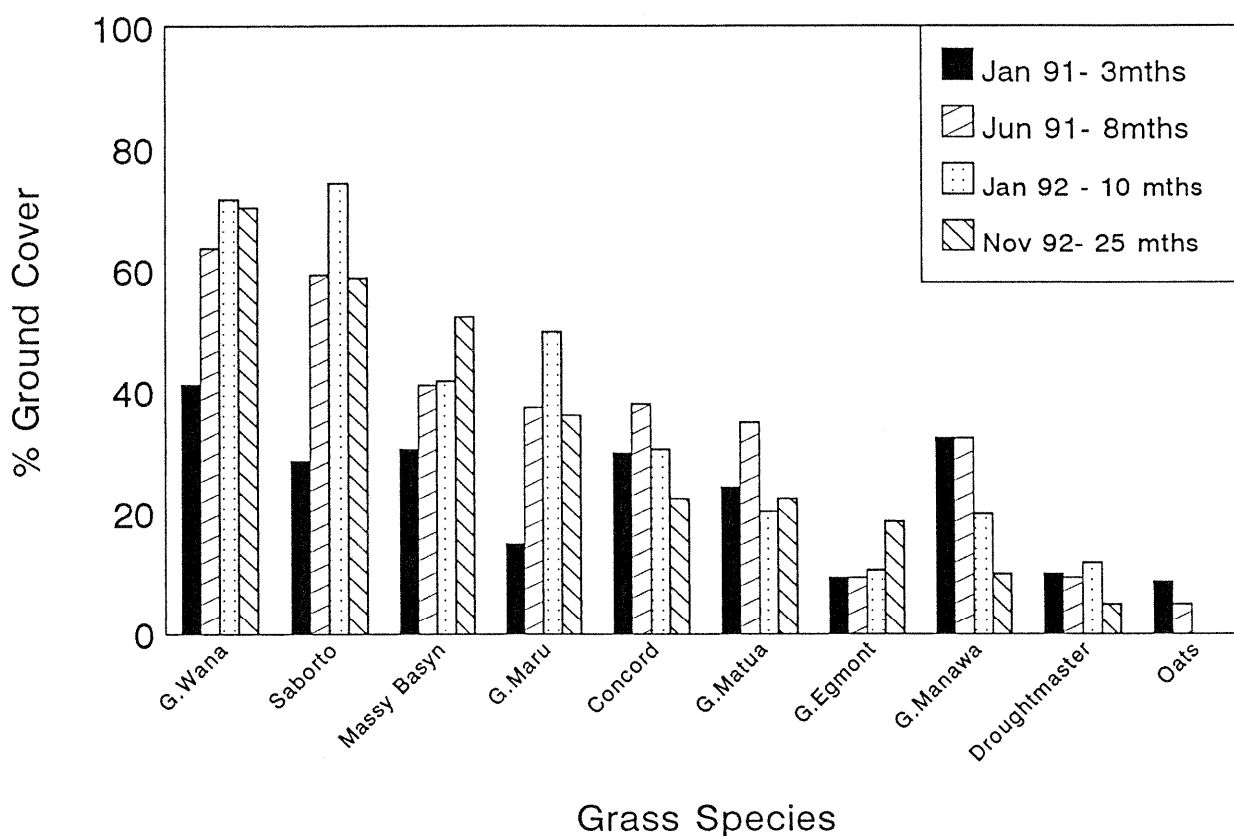
To remove some wild grasses, flat weeds, and seedling blackberry the trial site was first sprayed with Round Up using knapsacks. To facilitate access some of the larger pieces of slash were removed from the site by hand, however no cultivation was given to the site. Forty plots (5m x 5m) were established to test 10 species with 4 replicates. Table 1 gives the species selected for this trial and the sowing rate. Seed was sown by hand in October (spring) 1990. Each plot was split into two halves to test for the effects of with and without fertiliser. 150kg/ha of general purpose fertiliser (Nitrophoska 12:10:10) was applied by hand to one half of each plot (see map - figure 1).

The trial design is a randomised block, split plot design. Prior to the allocation of treatments each plot was assessed for the percentage of ground covered by slash and debris. From this assessment plots were categorised in one of four levels of slash, from

**Figure 1: Grass species establishment trial**  
**FR 139 Whakarewarewa Forest**



**Figure 2: Whaka trial - Performance of Grass species by time since sowing**  
 Unfertilised plots only



low to very high. Slash level was therefore used to stratify the blocking of the trial, ie each species was sown into plots with low, medium, high, and very high levels of slash.

TABLE 1 - Grass species for oversowing

Common name	Botanical name	Breed/Cultivar	Sowing rate(kg/ha)
1. Cocksfoot	<i>Dactylis glomerata</i>	G. Wana	10
2. Cocksfoot	<i>Dactylis glomerata</i>	Saborto	10
3. Ryegrass	<i>Lolium multiflorum</i>	Concord	20
4. Ryegrass	<i>Lolium x hybridum</i>	G. Manawa	20
5. Ryegrass	<i>Lolium perenne</i>	Droughtmaster	20
6. Yorkshire fog	<i>Holcus lanatus</i>	Massey Basyn	10
7. Brown Top	<i>Agrostis capillaris</i>	G. Egmont	10
8. Phalaris	<i>Phalaris aquatica</i>	G. Maru	10
9. Oats	<i>Avena sativa</i>		20
10. Prairie grass	<i>Bromus willdenowii</i>	G. Matua	20

G = Grasslands

#### Ground cover assessments

Plots were visually assessed on four occasions by two independent operators. All plots were assessed by both operators except for the final assessment when half the replicates were assessed by one operator and half assessed by the other. Ground cover percentage was recorded for the species oversown, for major weeds, and for broad weed groups. The percentage of bare ground and ground covered in slash was also noted. For the later assessments the height of vegetation of each species or group was also recorded.

#### **Results**

Figure 2 gives the results of each assessment for the unfertilised plots. Species have been ranked by their level of ground cover in the final assessment. Clearly the two cocksfoot species have proved to be the best species on this site, closely followed by the Massey Basyn and Grasslands Maru.

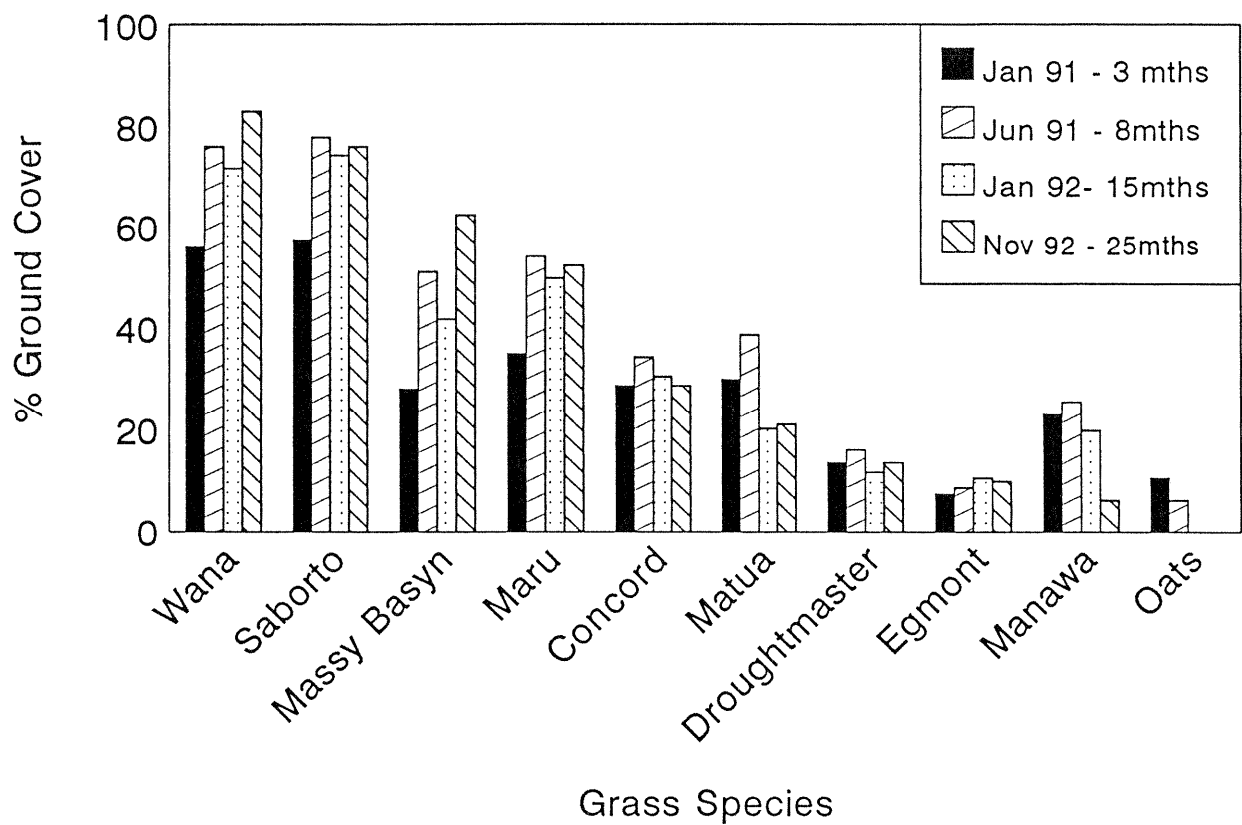
It is evident from these results that the assessment taken 3 months after sowing did not give a very good indication of the final result. However the assessment after 8 months (1 growing season) correlate well with the final result except for the ryegrass species which are either annuals (Concord) or annual/perennial hybrids (Manawa).

Figure 3 gives the results from the fertilised plots. The ranking of the species is not changed by the fertiliser although clearly the level of ground cover is improved.

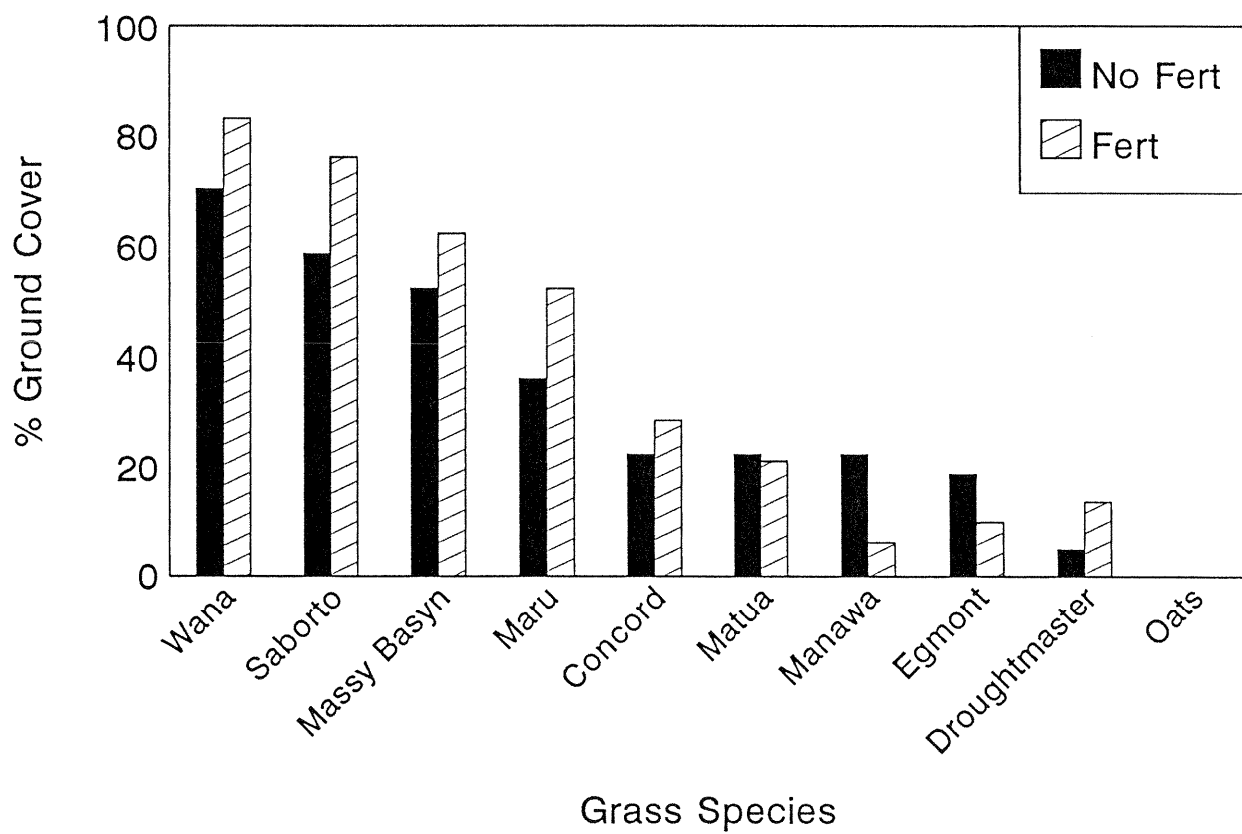
Figure 4 compares the ground cover achieved with and without fertiliser. 25 months after oversowing, fertiliser generally gave a 10-20% improvement in ground cover for the more successful species tested.

Figure 5 gives the composition of ground cover at the final assessment for the unfertilised plots. If the plots sown in Oats (which only achieved 5-10% ground cover in the first year) are taken as controls (not sown) it is clearly indicated that the trial site would normally have major weed regrowth. Blackberry and bracken are the dominant

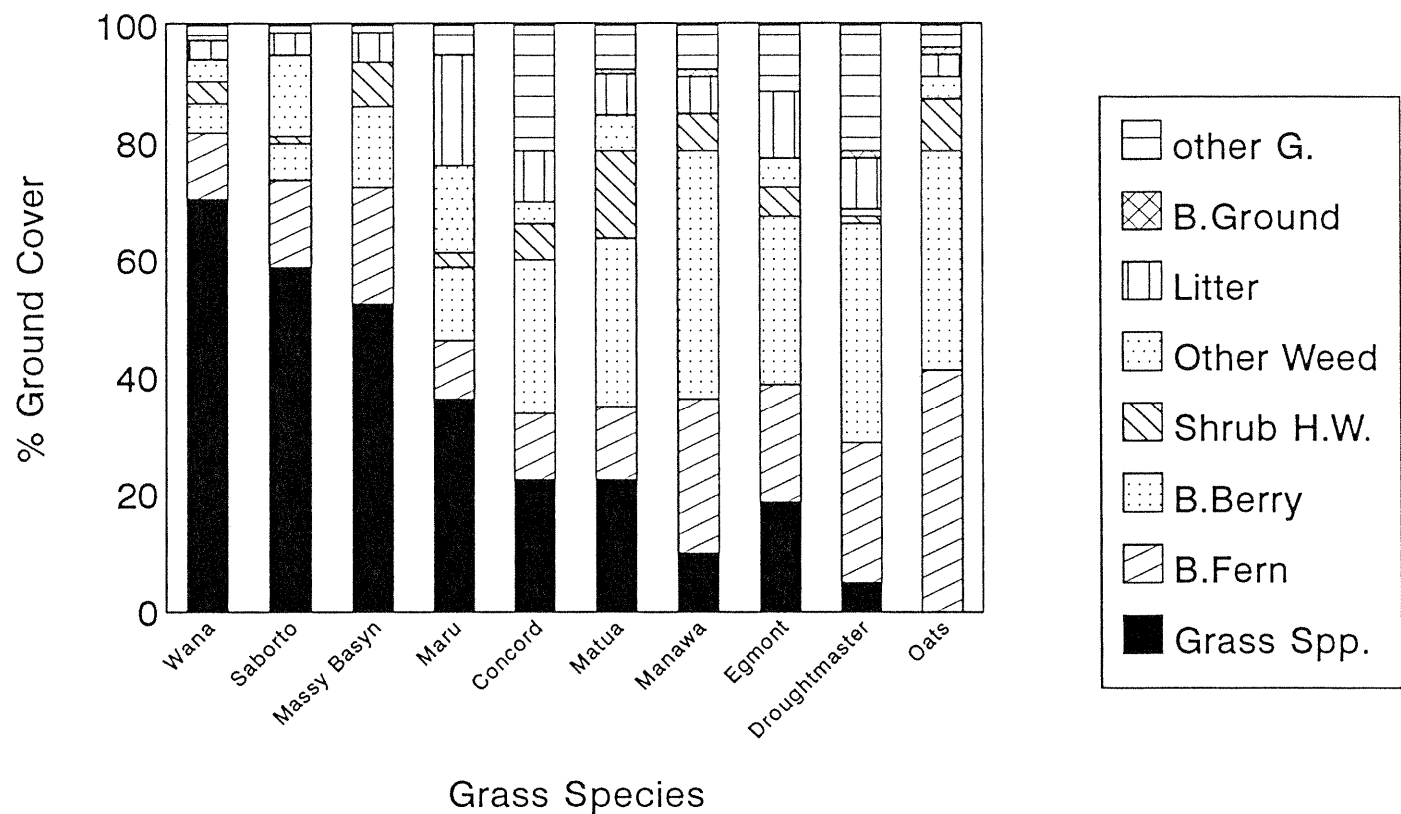
**Figure 3: Whaka trial Performance of grass species by time since sowing**  
Fertilised plots only



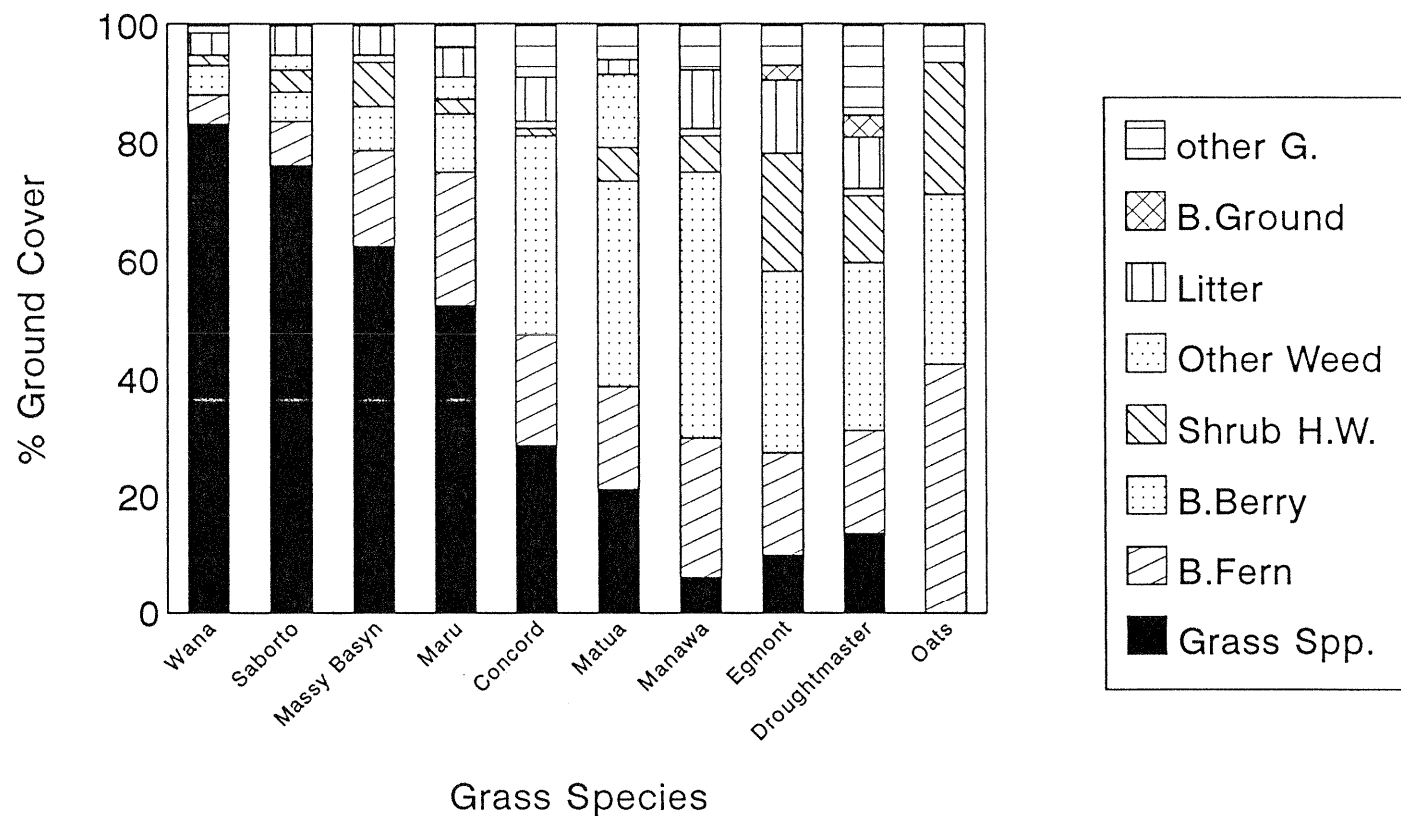
**Figure 4: Whaka trial - Effect of fertiliser on Covercrop establishment**  
assessed Nov 1992 - 25 months after sowing



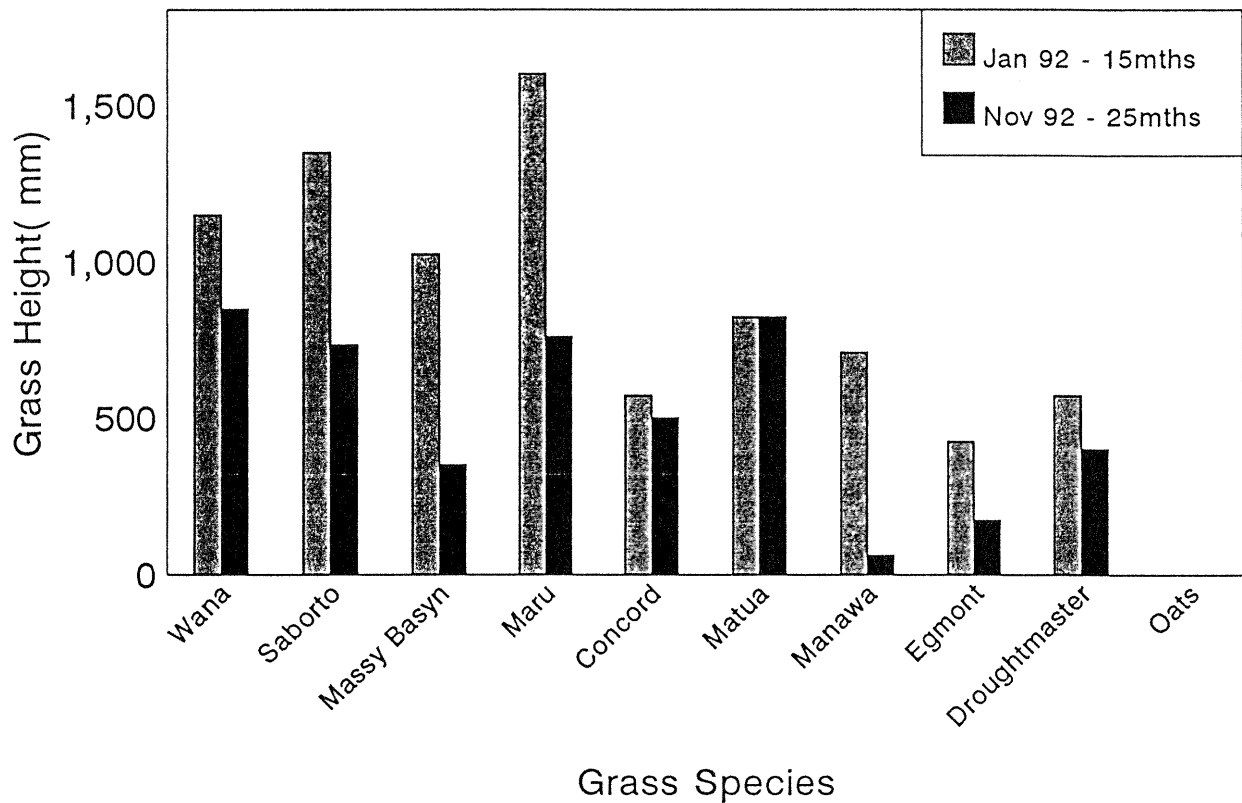
**Figure 5: Whaka trial - All ground cover, unfertilised plots only, 25 months after sowing.**



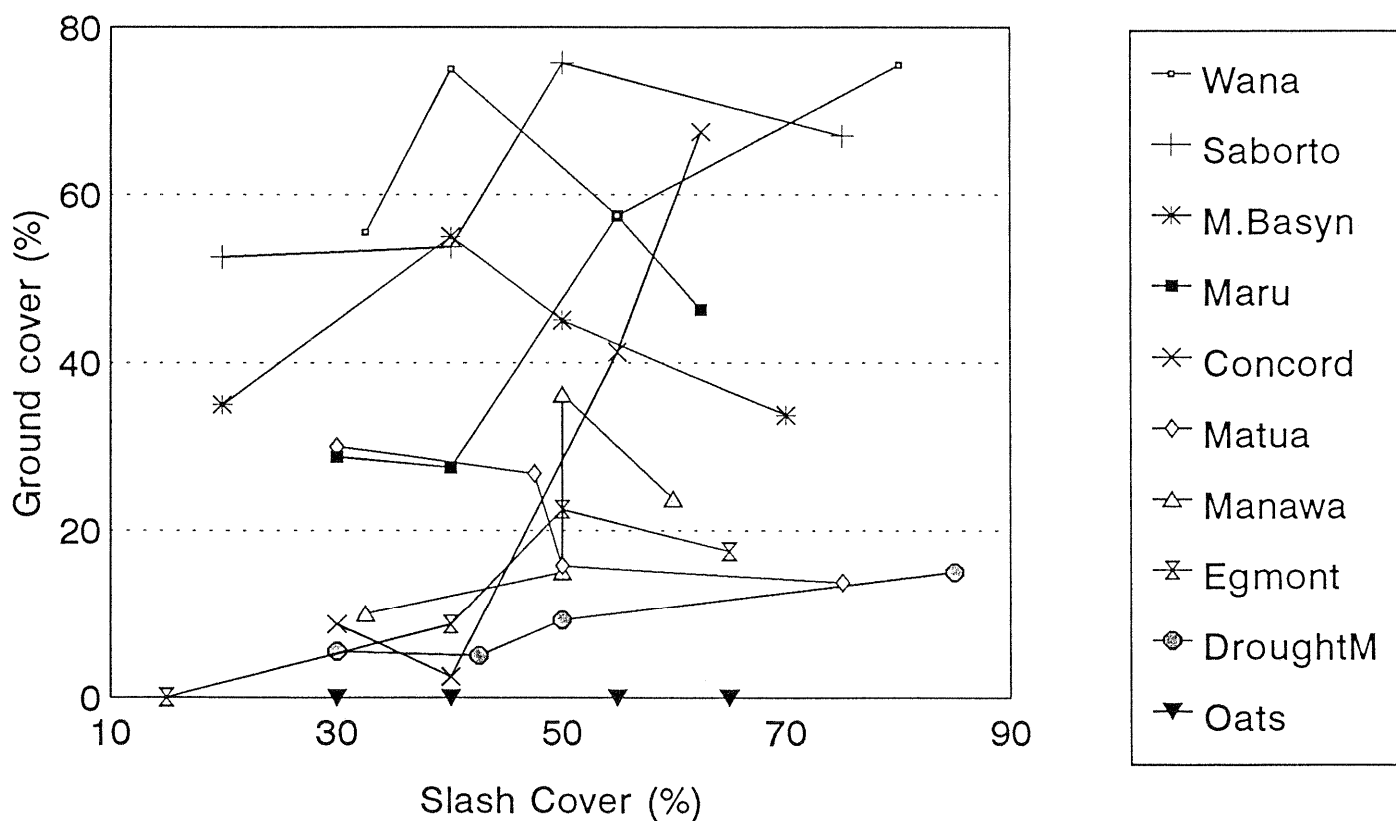
**Figure 6: Whaka trial - All ground cover, fertilised plots only, 25 months after sowing.**



**Figure 7: Whaka trial - height of oversown species**  
Unfertilised plots only



**Figure 8: Effect of Slash on Grass establishment**  
15 months after oversowing





weeds with the shrub hardwoods consisting of buddleia, broome, and gorse. The effectiveness of some of the grass species (particularly cocksfoot and fog) to reduce weed regrowth on this site is very significant. Figure 6 gives similar results for the fertilised plots with an improved level of weed control.

The height of the oversown species was measured in the last two trial assessments. Figure 7 gives the results of height measurements for the unfertilised plots (the fertilised plots were found to be of similar height) and indicate there is considerable difference between species.

From the assessment of initial slash cover it is possible to examine the effect this has on covercrop establishment. Figure 8 gives the relationship between slash cover at the time of sowing and ground cover by the covercrop species 15 months after sowing. No clear trend is evident indicating slash at this site did not influence the covercrop establishment.

## Trial 2 - FRI Long Mile area

### Location and Site Description

This trial was located in an area that had previously been a Corsican pine (*Pinus nigra*) stand in the Long Mile area. The site had been clear felled in 1990 and burnt in February 1991.

### Methods

#### Plot establishment

As this area had been recently burnt, no other site preparation was needed. Plot size was the same as in the Whaka trial (5 x 5m), however no fertiliser treatments were included. The trial is a randomised block design, with blocking done on a geographic basis (see map - figure 9). Table 2 gives the species selected for this trial and their sowing rate. As this trial differed from the Whaka trial by being a burnt site with autumn sowing, 4 of the most promising species tested in Whaka were repeated here. Seed was sown by hand in April (autumn) 1991.

Table 2: Species sown in Long mile trial

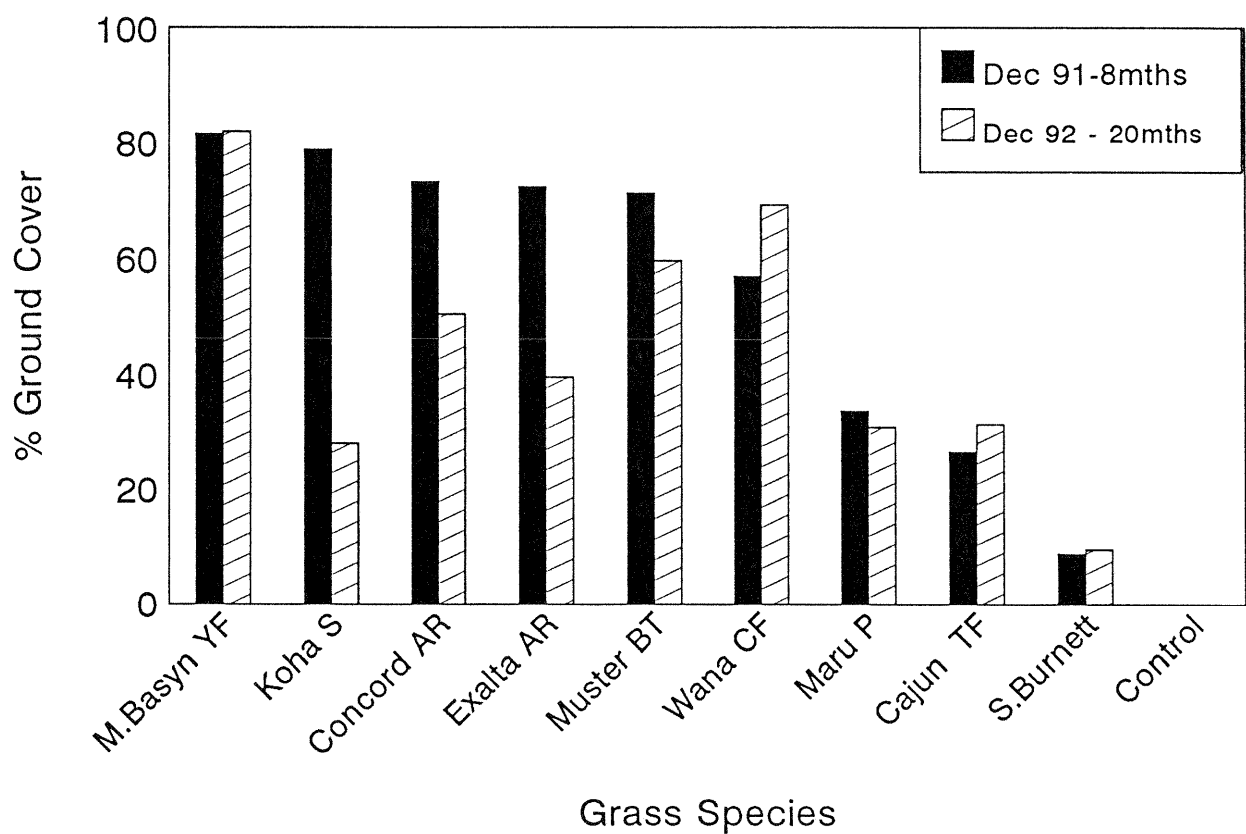
Breed/ cultivar	Common name	Botanical name	Coating system	Sowing rate* (kg/ha)
1. Exalta	Annual ryegrass	<i>Lolium multiflorum</i>	Nutriprill	14
2. Muster	Brown top	<i>Agrostis capillaris</i>	None	7
3. Cajun	Tall fescue	<i>Festuca arundinaceae</i>	Nutriprill	7
4.	Sheeps Burnett	<i>Sanguisorba minor</i>	None	7
5. Concord	Annual ryegrass	<i>Lolium multiflorum</i>	Superstrike	14
6. Wana	Cocksfoot	<i>Dactylis glomerata</i>	Superstrike	7
7. Massey Basyn	Yorkshire fog	<i>Holcus lanatus</i>	Nutriprill	7
8. Maru	Phalaris	<i>Phalaris aquatica</i>	None	7
9. Koha	Pink Serradella	<i>Ornithopus sativus</i>	None	7

\* on bare seed basis

Figure 9: Longmile Oversowing Trial

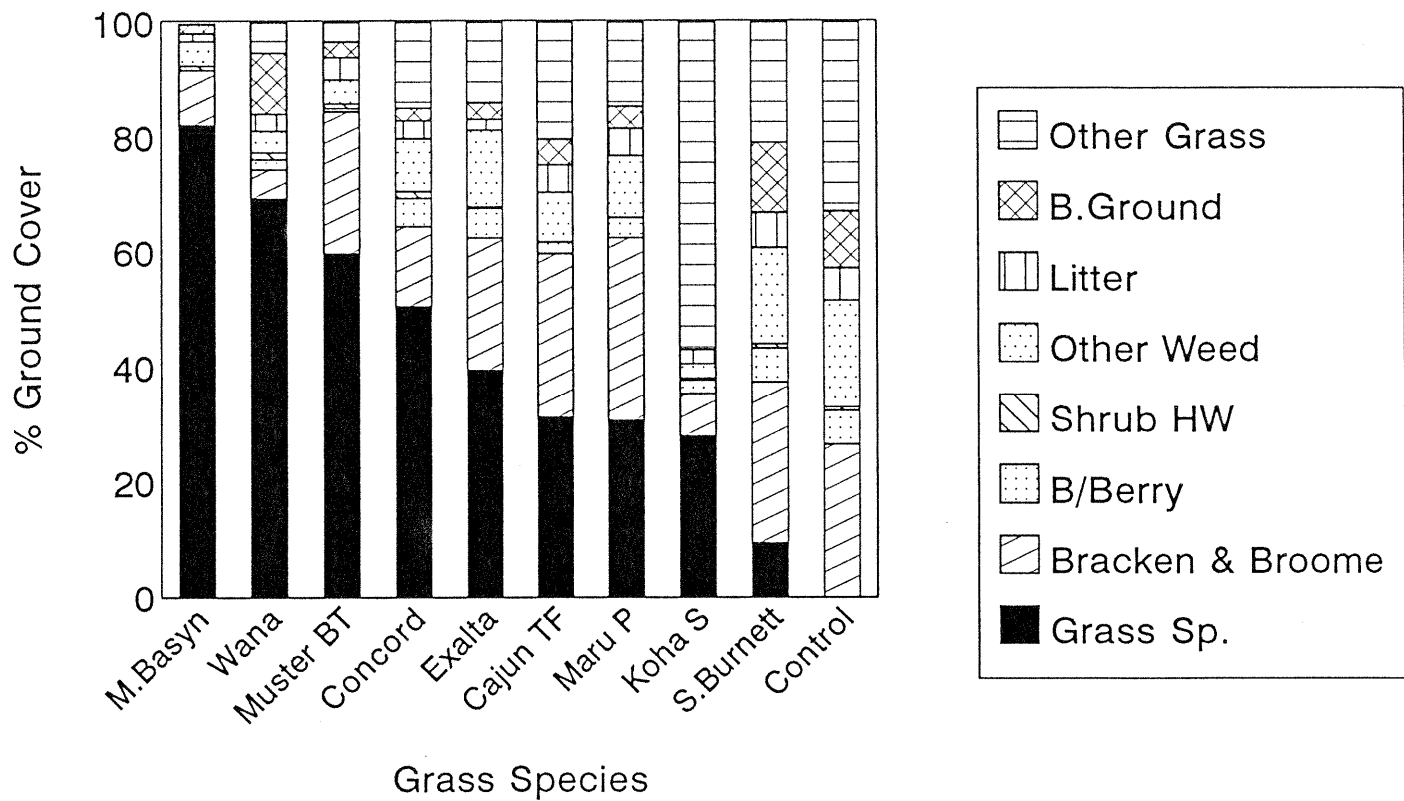
Block D	Muster	40	39	Maru	Plots 5x5m 4 replicates
	Concord	38	37	Wana	
	Koha	36	35	Cajun	
	Exalta	34	33	S. Burnett	
	M. Baysn	32	31	Control	
Block C	Control	30	29	Maru	Sown on 26 APRIL 1991
	Muster	28	27	S. Burnett	
	Wana	26	25	Koha	
	Cajun	24	23	M. Baysn	
	Concord	22	21	Exalta	
Block B	M. Baysn	20	19	Koha	
	Wana	18	17	Cajun	
	Maru	16	15	Exalta	
	Control	14	13	Concord	
	Muster	12	11	S. Burnett	
Block A	Koha	10	9	Maru	
	Muster	8	7	S. Burnett	
	Cajun	6	5	Exalta	
	Concord	4	3	Control	
	M. Baysn	2	1	Wana	

Figure 10: Longmile trial - Performance of covercrop species over time  
Sown April 1991

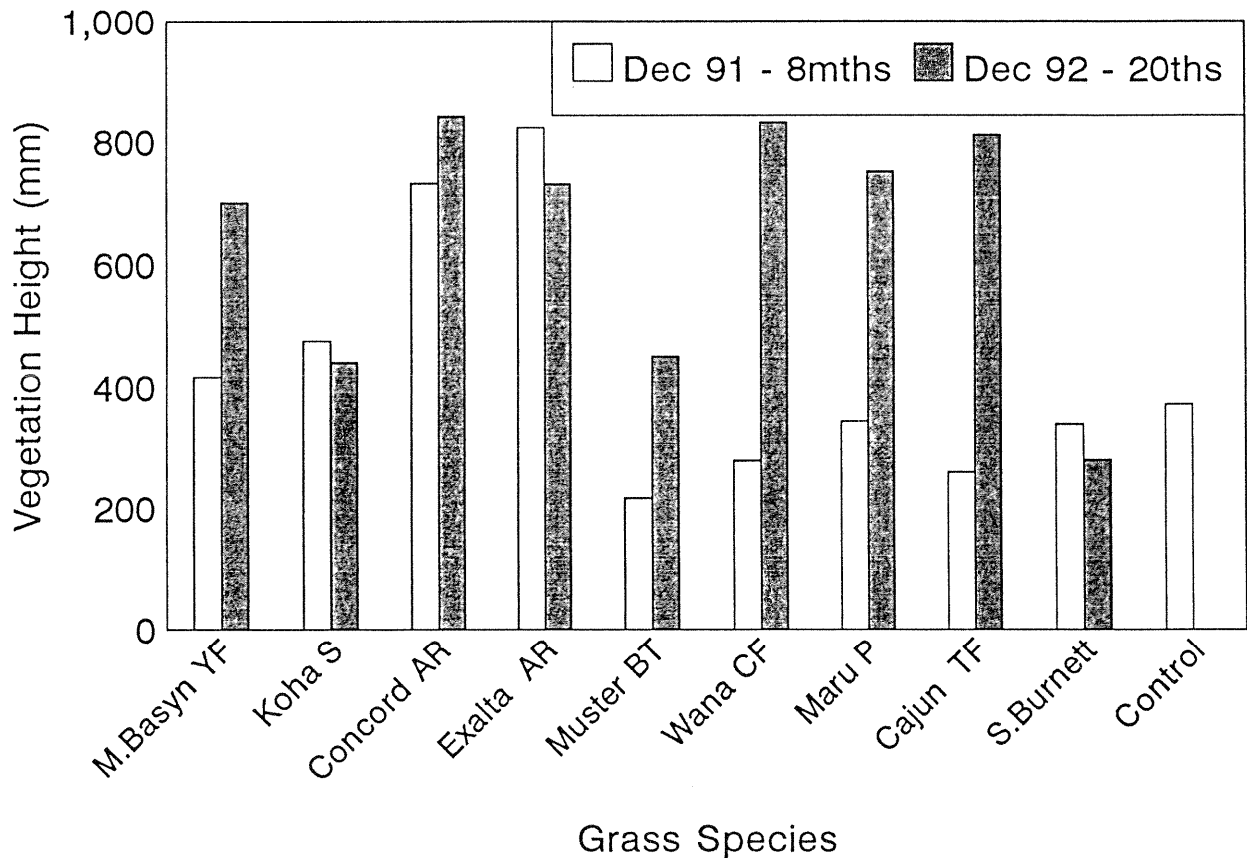


**Figure 11: Longmile trial - all ground cover**

assessed Dec 1992- 20 months after sowing



**Figure 12: Longmile Trial- height of species oversown**



### Ground cover assessments

Plots were visually assessed on two occasions by two independent operators. Ground cover percentage was recorded for the species oversown, for major weeds, and for broad weed groups. The percentage of bare ground and ground covered in slash was also assessed. For each assessment the height of vegetation of each species or group was also recorded.

### **Results**

Figure 10 gives the results of the ground cover achieved for both assessments. Species have been ranked by their performance. Yorkshire fog, Wana cocksfoot, and Muster brown top are clearly successful candidates from this trial. Annuals such as Koha, Concord, and Exalta performed equally well in the first year but did not persist or regenerate well in the second year.

Figure 11 gives the composition of the ground cover at the final assessment. From the control it is indicated that this site has only moderate weed regrowth, mainly bracken and broome, wild grasses, and other minor weeds. However the effectiveness of the best of the oversown species is very significant, especially as there was no fertiliser used.

Figure 12 gives the height of the oversown species at each assessment.

### **Discussion**

Results from this type of field trial can obviously be influenced by the site characteristics, the site history, the climatic conditions after sowing, and the weeds endemic to the area. However valid comparisons can be made of the relative performance of the oversown species within the trial site. Appendix 1 gives the chemical analysis results for pH, N, and P for samples taken at the time of trial establishment. These results can be used to make comparisons with local soil types. A result from Kaingaroa is included to indicate the sites at Whaka and Long Mile are similar to Kaingaroa for these parameters.

As these trials have tested candidates as single species sowings, it raises the question of what may occur with mixtures. Clearly it is desirable to include a legume in the mixture and to possibly have a succession of species. On some sites where perennial species establish slowly, a mixture that includes rapidly establishing annual species may be more successful. Ideally once weeds have been controlled by a covercrop, the legume component should become dominant to provide nitrogen for tree growth. For slow to establish legumes such as Maku lotus the major fertiliser response is likely to come from phosphorus, hence a general purpose NPK fertiliser as tested in this study may not be the most economic way of achieving better legume establishment.

### **Conclusions**

Results from these trials indicate that the establishment of a covercrop is best assessed 8 months or 1 growing season after sowing. These trials have identified several candidate species for sowing in operational trials. Cocksfoot and Yorkshire fog have shown to be two outstanding species for sowing in spring or autumn. For autumn sowing only, annual rye grasses and Koha serradella have proved to give good ground cover for one year. Koha may be more persistent on sites that are dry in summer.

Fertiliser on sites similar to the site tested (Whaka ) is likely to give an improvement in ground cover of 10-20%. Oversown grass can grow to a considerable height, this must be considered when spot spraying around trees.

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## Appendix 1: Soil analysis results

Location	pH	%N	Bray P (ppm) 1	Bray P (ppm) 2	Bray P (ppm) 3
Whaka	5.71	0.262	28.9	21.4	10.9
Long Mile	4.59	0.255	63.5	28.0	10.2
Kaingaroa	5.48	0.178	23.0	15.7	9.1