

Comparison of pasture establishment from a conventional disc drill and a prototype strip seeder drill

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Abstract

Establishment of grasses and legumes drilled in spring with a prototype strip seeder drill or a conventional triple disc drill were compared on two sites in the presence and absence of paraquat. On the Eamscleugh site, plant establishment in autumn, as a percentage of viable seed sown, was higher with the prototype drill than with the triple disc drill in the absence of paraquat. The application of paraquat increased establishment with the triple disc drill and differences between the drills were not consistent over species. Paraquat had no discernible effect on the competing vegetation or establishment at Ohau Downs. Establishment of birdsfoot trefoil, cocksfoot and tall fescue, but not alsike clover, was significantly higher in autumn in the prototype drill treatment. Treatment effects on standing herbage mass on both sites followed a similar trend to establishment although paraquat increased herbage mass in the prototype drill treatments on Eamscleugh, in contrast to the non-significant effect on establishment. The present results indicate the potential of the prototype strip seeder drill for cost effective establishment of improved pasture species in difficult environments.

Keywords direct drilling, establishment, strip seeder, lucerne, tall fescue, birdsfoot trefoil, upland brome, alsike clover, cocksfoot, paraquat, herbicide

Introduction

Increasing pasture production on low producing hill and high country soils usually relies on the introduction of improved pasture species adapted to the environmental conditions (Scott *et al.* 1985). This depends on the availability of reliable, cost effective establishment techniques. Aerial oversowing is an option, particularly for legumes, where soil moisture conditions are adequate. In drier environments, direct drilling has considerable potential but in practice results have been variable.

Two major problems with direct drilling are improper seed placement (Campbell *et al.* 1983) and inadequate

control of existing vegetation (Brash 1983). Species vary in their tolerance to sowing depth (Woodman *et al.* 1991) and correct sowing depth can be critical for species with low seedling vigour (Campbell 1985; Chapman *et al.* 1990). Control of depth of seed placement is particularly difficult on areas with rough terrain typical of those in the tussock grasslands. In dry environments, herbicide control of competing vegetation is usually necessary to reduce competition for moisture during the first summer (Douglas 1985). However, the high cost of herbicide application reduces the cost effectiveness of direct drilling and in some instances herbicides can be ineffective in controlling weeds such as sorrel (*Rumex acetosella* L.) in early spring before drilling (Brash 1983). Mechanical control of competing vegetation has been obtained using a rotodril (Dunbar *et al.* 1980). However lack of mechanical reliability, particularly in areas with rocks, has limited the potential of these type of drills.

A prototype strip seeder drill has been developed as a cost effective, robust and mechanically sound single-pass direct drill. Emphasis has been placed on mechanical reduction of competing vegetation and control of depth of sowing even in rough environments. Details of the mechanical specifications and design of the MAF/AEI prototype drill have been given by Horrell *et al.* (1992). Agronomic data on the establishment of grasses and legumes following overdrilling into two sites, representative of depleted, dry tussock grasslands, are presented in this paper.

Materials and Methods

The experiment compared the establishment of 4 pasture species (2 legumes and 2 grasses) after drilling with a conventional triple disc or the MAF/AEI prototype strip seeder in the presence and absence of herbicide application. A split plot trial design was used with 2 (drill) x 4 (species) main plots and 2 (herbicide) subplots and 4 replicate blocks.

Trials were laid down in Central Otago and the Mackenzie Country. The Central Otago site was on Eamscleugh Station on a Conroy sandy loam (BGE) at an altitude of 600 m with a mean annual rainfall of

approximately 340 mm and pH 5.9. The area had previously been **oversown** and topdressed but a combination of lack of maintenance fertiliser, and high rabbit populations had resulted in a very depleted vegetative cover of **scabweed** (*Raoulia* spp.), hairgrass (*Vulpia bromoides* L.), fescue tussock (*Festuca novae-zelandiae* L.), and broadleaf weeds. The Mackenzie site was on Ohau Downs Station on an Ohau silt loam (YBE) at an altitude of 550 m with a mean annual rainfall of approximately 510 mm and pH 5.7. The site was undeveloped and had been subject to an extensive grazing regime. The dominant vegetative cover consisted of fescue tussock, **hawkweed** (*Hieracium pilosella* L.), sorrel, **browntop** (*Agrostis capillaris* L.), and a native plant understorey.

The pasture species were drilled **with** either a

conventional triple disc drill or prototype strip seeder drill. Mechanical details are given by Horrell *et al.* (1992). The species used (Table 1) were those considered to be suited to the different sites. Due to possible problems with inoculation of birdsfoot trefoil (Chapman *et al.* 1990) all legume seed was inoculated at 5 times the manufacturers stipulated rate with the incorporation of 10% gum arabic in the slurry and sown within 1 day of inoculation. All grass seed was coated by the **Superstrike** process. Each pasture species plot consisted of one 54 m long **drill run** (width 2.25 m) of 15 coulters with the triple disc drill and 10 coulters with the **MAF/AEI** prototype drill. Seeding rates were calculated on a per hectare basis and therefore were sown 50% higher within each **coulters** row with the MAF/AEI prototype drill than with the triple disc drill.

Table 1 Plant species **sown** at each site (kg per ha).

SPECIES		EARNSCLEUGH	OHAU DOWNS
G 32 birdsfoot trefoil	(<i>Lotus corniculatus</i> L.)	6	6
Otaio lucerne	(<i>Medicago sativa</i> L.)	10	nil ¹
Tetra alsike clover	(<i>Trifolium hybridum</i> L.)	nil	6
Wana cocksfoot	(<i>Dactylis glomerata</i> L.)	10	10
Cajun tall fescue	(<i>Festuca arundinacea</i> L.)	18	nil
Hakari upland brome	(<i>Bromus marginatus</i> L.)	nil	25

¹ Not drilled at site.

Table 2 Comparison of a prototype drill and a disc drill on the establishment (as a % of seed **sown**) at the end of Spring (October) and Summer (May).

TIME:		OCTOBER 1990			MAY 1991		
SITE:		Earnsclough		Oha Downs	Earnsclough		Oha Downs
HERBICIDE:		+		±	+		±
SPECIES	DRILL						
Birdsfoot	Prototype	40	50	48	44	55	31
	Disc	18	56	39	3	30	14
Lucerne	Prototype	48	52		52	44	
	Disc	34	43		10	39	
Alsike	Prototype			29			41
	Disc			32			37
Cocksfoot	Prototype	27	31	26	36	35	17
	Disc	13	20	21	7	39	4
Fescue	Prototype	45	40		47	53	
	Disc	21	40		9	32	
Brome	Prototype			60			48
	Disc			63			30
s.e.d. ¹		7.4		4.0	9.0		5.7
s.e.d.		8.5			9.4		
MEAN	Prototype	40	43	41	45	47	34
	Disc	21	40	39	7	35	21
s.e.d. ²		3.7		2.0	4.5		2.9
s.e.d.		4.2			4.7		

¹ Except when comparing means with the same level(s) of SPECIES.DRILL.

² Except when comparing means with the same level(s) of DRILL.

Half of each drill plot was sprayed with paraquat at 0.6 kg ai/ha 3-7 days before sowing.

Fertiliser was applied by drill through a separate box at the rate equivalent to 100 kg/ha maxi-sulphur-superphosphate (50% S, 5% P) at Eamscleugh and 250 kg/ha superphosphate (12% S, 9% P) at Ohau Downs. Molybdenum at 50 g/ha was sprayed on to the plots and Miral 5G insecticide (50 g/kg isazophos) at 40 kg/ha was broadcast after sowing. The Eamscleugh site was drilled on 11 September 1990 and Ohau Downs was drilled on 30 August 1990.

Establishment was recorded by counting seedlings in spring (October) and then in autumn (May) and expressing as percentage of viable seed sown. Herbage mass was assessed by cutting to ground level in January and May (Eamscleugh) and May (Ohau Downs) and expressing as DM sown species per hectare. Presented yield information has been back-transformed after analysis of log data by analysis of variance.

Results

Seedling establishment

At the October assessment on the Eamscleugh site, there was a significant ($p < 0.05$) interaction on seedling establishment between drill type and herbicide treatment (Table 2). Seedling establishment in all species was higher from the prototype strip seeder than from the disc drill in the absence of herbicide. Paraquat application significantly increased seedling establishment with the disc drill, resulting in little difference between drills in the presence of herbicide.

Herbicide application had no apparent effect on the existing vegetation or on establishment on the Ohau Downs site and hence results from the herbicide comparisons have been combined. In October, there was no significant difference in seedling establishment between the two drills.

On Eamscleugh Station, few seedlings survived over summer in the triple disc treatment in the absence of paraquat (Table 2). This contrasts with the survival in the prototype drill treatments in both presence and absence of paraquat. Plant numbers in autumn were higher from the prototype drill than from the disc drill in the absence of paraquat. However, in the presence of paraquat, the difference between drills was apparent only with birdsfoot trefoil and tall fescue. The application of paraquat increased establishment of all species in the triple disc treatment.

At Ohau Downs, birdsfoot trefoil, cocksfoot and upland brome plant numbers in autumn were significantly higher in the prototype drill than in the triple disc drill.

Growth

Standing herbage mass of sown species at Eamscleugh Station was higher from the prototype drill than the disc drill in both the absence and presence of herbicide (Table 3). However, paraquat application increased yield with both drills.

On the Ohau Downs site, there was insufficient grass growth to harvest. The standing herbage mass of birdsfoot trefoil was significantly higher in the prototype drill than in triple disc drill treatment.

Table 3 Comparison of a prototype drill and a disc drill on standing herbage mass of sown species (kg DM/ha), means are given with 95% confidence intervals bracketed beneath.

TIME:	JANUARY 1990 + MAY 1991		MAY 1991	
SITE:	Eamscleugh		Ohau Downs	
HERBICIDE	•	+		
SPECIES:			Birdsfoot	Alsike
Prototype	417 (260-668)	860 (536-1380)	162 (86-307)	247 (131-467)
Disc	33 (20-53)	307 (191-493)	48 (25-91)	334 (177-631)

Discussion

Results presented by Horrell *et al.* (1992) indicate clearly that the prototype drill effectively removed a furrow of existing vegetation. The results from Eamscleugh confirm that this mechanical removal of vegetation effectively reduced competition for moisture for the establishing plants. This reduction in competition was evident on both early seedling establishment and plant survival in autumn. The response in herbage mass in the prototype drill plots to the paraquat treatment is not unexpected as the prototype removed only a 10 cm wide slot of turf. Plants growing in the row can have been expected to experience competition for moisture from the roots of the vegetation growing between the rows. However, the most important feature of the prototype drill was that similar numbers of plants survived in the presence and absence of herbicide.

One of the stated aims of the development project was to improve seedling germination by precision depth control of seeding, a factor implicated in poor seedling establishment from conventional disc drills (Campbell *et al.* 1983). Problems were encountered in controlling seed depth in this prototype and in general all species were sown below the optimum depth (Horrell *et al.* 1992). Further development of the prototype drill is underway to improve seed placement depth.

At Eamscleugh there was an interaction between drill type and herbicide. However, at Ohau Downs there was no apparent effect from herbicide on establishment or growth from either drill. This is attributed to a lack of effect of herbicide on the existing vegetation. Paraquat was used rather than glyphosate because it was expected to be more effective on the short vegetation present in early spring. Brash (1983) commented on the lack of effect of glyphosate applied in spring, particularly in controlling sorrel, and recommended further research into defining the most appropriate herbicide material, rate and timing in these environments. In contrast, paraquat was effective on Eamscleugh where perennials such as sorrel and *Hieracium* were virtually absent from the vegetation cover.

The present results confirm the potential of the MAF/AEI prototype strip seeder for establishing legumes and grasses in low producing tussock grassland environments. Figures calculated by Horrell *et al.* (1992) indicate savings of between \$53 and \$88 per hectare are achievable by sowing pasture with a strip seeder rather than a disc drill with herbicide. These savings are important in attempting to develop cost effective development strategies for the low producing semi-arid grasslands of the hill and high country of the South Island.

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REFERENCES

- Brash, D.W. 1983. Dryland lucerne establishment by overdrilling in Central Otago. *Proceedings of the NZ Grassland Association 44*: 164-169.
- Campbell, B.D. 1985. Winged coulters depth effects on overdrilled red clover seedling emergence. *NZ journal of agricultural research 28*: 7-17.
- Campbell, B.D.; Cosgrove, G.P.; Harris, W. 1983. Why overdrilling red clover in Manawatu lowland failed. *Proceedings of the NZ Grassland Association 44*: 156-163.
- Chapman, H.M.; Lowther, W.L.; Trainor, K.D. 1990. Some factors limiting the success of *Lotus corniculatus* in hill and high country. *Proceedings of the NZ Grassland Association 51*:147-150.
- Dunbar, G.A.; Horrell, R.F.; Costello, E.J. 1980. Overdrilling of dry hill country. *Proceedings of the Lincoln College Farmers Conference 29*: 372-383.
- Horrell, R.F.; Lowther, W.L.; Keoghlan, J.M. 1992. Development of low cost overdrilling technology for pasture establishment. *Proceedings of the NZ Grassland Association 53*: 5 1-54.
- Scott, D.; Keoghlan, J.M.; Cossens, G.G.; Maunsell, L.A.; Floate, M.J.S.; Wills, B.J.; Douglas, G. 1985. Limitations to pasture production and choice of species. In Burgess, R.E.; Brock, J.L. (Eds.). Using herbage cultivars. *Grasslands Research and Practice Series No. 3 NZ Grassland Association* : 9-15.
- Woodman, R.F.; Doney, R.J.; Allan, B.E. 1990. Effects of drilling depth on seedling growth of seven dryland pasture species. *Proceedings of the NZ Grassland Association 52*: 167-170.