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PASTURE RENOVATION BY OVERDRILLING

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Abstract

The Agricultural Machinery Research Centre, Massey University, undertook pasture renovation with a prototype direct drill at several North Island sites. Banded herbicide application was found to provide an effective medium term (two years) means of introducing ryegrass and clover species into browntop dominant pastures being intensively grazed.

Specialist pasture species were introduced into Northland dairy pastures by band spraying and direct drilling. Wana cocksfoot and Pawera red clover were slower to establish than Nui and Ellett ryegrass. All species contributed to greater herbage dry matter production of the sward than the control and appeared to be persisting competitively.

Keywords: Direct drilling, overdrilling, band spraying, winged opener, inverted T slot, pasture renewal, pasture renovation, prototypedirect drill, Northland, Taranaki, Manawatu, no-tillage.

INTRODUCTION

The use of no-tillage or direct drilling as a means of introducing improved pasture species has grown in practice throughout New Zealand in recent years. Control of competition from existing species, particularly in the immediate seedling zone, has long been recognised as essential for successful establishment of new species. Mechanical removal of competition from the seed zone was advocated by early workers (Robinson and Cross 1960, Blackmore 1962) and more recently by Dunbar et al. (1980). However, many modern direct drilling openers create little ground disturbance, and while the seed groove provides a suitable microenvironment for seedling establishment, there is little mechanical effect in reducing competition from the existing sward (Baker 1970, 1971, 1976a, Choudhary and Baker 1980, 1981a,b 1982). The importance of these two interacting factors has led to several studies using banded herbicide application as an alternative means of reducing competition (Blackmore 1962, Collins 1970, Baker et al. 1979c, Ryan et al. 1979, Barr 1981, Baker 1982, Kunelius et al. 1982, Betteridge and Baker 1983).

Banded herbicide application has the advantage of providing short-term competition control for seedlings while maintaining total DM for livestock at reduced cost in comparison with blanket herbicide application. However longer term effectiveness of banded herbicide application is highly dependent on the composition of the resident sward, post-drilling grazing management, and short or long term objectives (Barr 1980).

Pasture renovation, incorporating both blanket and banded herbicide application, had been an integral part of an ongoing direct drilling field-test programme operated by the Agricultural Machinery Research Centre, Massey University. In this programme, areas ranging from plot to commercial field-scale have been drilled in several soil types and resident swards throughout the North Island. In 1984 and 1985 the total area drilled for pasture renovation in autumn was 150 ha on 35 sites, however detailed measurements were taken on only three of these sites.

This paper reports field observations and measurements during the establishment phase, together with short-term production from these three long-term farm trials utilising different management systems in Manawatu, Taranaki and Northland.

METHOD AND EQUIPMENT

Farm trials 1 and 2 reported below did not involve detailed dry matter production cuts. Rather, broad comparisons were made on the basis of stock utilisation and

production ("stock unit grazing days"). This provided the opportunity to modify inputs into the system each year according to the specific management needs of the farmer involved and to identify particular aspects of the system which required more detailed study. A further farm trial (3) was assessed on the basis of dry matter production measured by local MAF advisory officers.

Farm Trial 1

Trial farm 1 was a semi-intensive hill country sheep and beef cattle unit located in the Pohangina Valley, 35km NNE of Palmerston North. Approximately 30% of the farm was tractorable river flats on a silt loam soil. Resident pastures were predominantly browntop *(Agrostis tenuis)* and Yorkshire fog *(Holcus lanatus)* which provided limited feed production in early spring and reflected a low fertility status of the soils.

In March 1983, 2.5 ha of typical resident pasture was overdrilled using a prototype direct drill with "winged" openers (Baker et *al.* 1979b). 'Grasslands Nui' ryegrass *(Lolium perenne)* and 'Grasslands Pitau' white clover *(Trifolium repens)* were drilled together at 18 kg/ha and 2 kg/ha respectively, along with insecticide (Phorate) at 6 kg/ha. Fertiliser (diammonium phosphate 18:20:0:0) was drilled with, but horizontally displaced from, the seed at 100 kg/ha over half of the total area. This was additional to the annual basal fertiliser application for the farm. Banded herbicide application was achieved by dribbling a 1% solution of glyphosphate onto two 2.5cm wide semi-pneumatic press wheels mounted on the drill openers which in turn applied the solution in 2.5cm wide bands either side of the seed groove. In this way 200 I of dilute solution was applied per drilled hectare (equivalent to 600 l per sprayed hectare). Thus only 30% of the resident pasture was physically contacted by the herbicide but up to 70% appeared affected due to translocation of the glyphosate.

The first grazing occurred after seven weeks after sowing. Subsequent grazings were aimed at promoting dominance of the introduced species over the remaining resident species. A further 4 ha and 4.5 ha were drilled in autumn 1984 and 1985 respectively, using essentially the same methods except that fertiliser application was delayed until immediately after the first grazing to reduce early stimulation of the resident sward observed in year 1.

Production from the 1983 overdrilled paddock and an adjacent control undrilled paddock was monitored in terms of "stock unit grazing days" per hectare. Estimates relating to "SUGD" are given in Table A.

Farm Trial 2

Trial farm 2 was an 84 ha seasonal supply dairy unit situated 10km south of Opunake in Taranaki on essentially flat topography. The soil type was Egmont silt loam and average rainfall was 1000mm with generally even distribution. Resident pasture was dominated by dogstail (Cynosurus cristatus), Yorkshire fog, sweet vernal *(Anthoxanthum oderatum),* and browntop, resulting in early spring feed shortages.

The aim of the farmer involved was to increase production from 450kg BF/ha to 700kg BF/ha in 7-8 years. Taking paddocks out of production for renewal could not be justified, hence the pasture renewal system had to provide a repeatable technique which allowed the benefits of improved pasture species to become cumulative.

On 15 December 1984, 5.5 ha of resident pasture was direct drilled with greenfeed maize in rows 300mm apart using the prototype direct drill previously described. The area had been previously sprayed with a mixture containing herbicide (glyphosate at 4 l/ha) and insecticide (chlopyripos 1.5 l/ha). Compound fertiliser ("Complisal" 12:10:10:1) was drilled alongside the seed at 100 kg/ha and a further 84 kg/ha of urea was broadcast on the surface between the seed rows at drilling. Molluscide (metaldehyde) was broadcast on the surface at the time of drilling at 12 kg/ha. A maize plant population of 200,000 plants/ha was successfully established.

Twenty three days after the maize crop had been removed at the end of March the area was direct drilled with Ellett ryegrass (5.5 kg/ha), Nui ryegrass (5.5 kg/ha), Pitau white clover (1.6 kg/ha), 'Grasslands Pawera' red clover (0.8 kg/ha) and 'Grasslands Moata' annual ryegrass (1.6 kg/ha), with fertiliser ("Ammophos" 12:10:10:1) at 100 kg/ha drilled alongside the seed.

The extra dry matter produced by the maize crop allowed an additional 11 ha of old pasture to be blanket sprayed (glyphosate 3 l/ha) and direct drilled at the same time as the maize stubble, using the same method and seed mix. Fertiliser (100kg DAP/ha) and insecticide (phorate 5 kg/ha) was drilled alongside this seed.

Farm Trial 3

Trial farm 3 was also a seasonal supply dairy unit situated 5km east of Warkworth on flat to rolling topography. The production objectives and limitations were similar to those of trial farm 2, given the regional differences in climate. The main objectives of pasture renovation were to improve summer pasture production, increase drought, tolerance and overcome the dominance of tall fescue. Banded herbicide application was used to introduce several new species with minimal loss of short-term production.

A field-trial/demonstration area with two reps was drilled with the prototype direct drill previously described, on 19 April 1984 with separate areas of either 'Grasslands Roa' tall fescue (5 kg/ha), 'Grasslands Wana' cocksfoot (5 kg/ha), Nui ryegrass (13 kg/ha), Ellett ryegrass (13 kg/ha) all with 2 kg/ha Pitau white clover, and Pawera red clover (3 kg/ha) without Pitau. The control was the resident pasture sward.

Glyphosate herbicide was band-applied with the press wheels at 600 I of 1% solution per sprayed ha. Insecticide (methiocarb) was broadcast on all plots at drilling at the rate of 6 kg/ha. Superphosphate (0:10:0:11) at 375 kg/ha was broadcast on all plots five days after sowing.

Monthly production measurements were taken by MAF advisory staff in order to assess the establishment of the introduced species and their persistance and contribution to total production in the long term.

RESULTS AND DISCUSSION

Farm Trial 1

Production comparison (which was based solely on grazing, Table 1) for the first seven months from drilling showed 48% increase in stock unit grazing days per hectare.

Hay making (year 2) on the overdrilled paddock and silage harvesting (year 1) and hay feeding (year 2) on the control paddock made the estimation of relative stock grazing days on the two areas too vague for accurate comparison. However, the initial increase in estimated production on the overdrilled area appeared to have been at least maintained. After two years the assessment of the farmer was that the overdrilled area was producing approximately twice as much feed as the control area. If so, this suggests either that the relative contribution from the introduced species had increased, or stock utilisation of the same had improved, or both. At that stage, ryegrass appeared to be competing successfully with, and perhaps even dominating, browntop. Similar initial results were observed on the areas overdrilled in 1984 and 1985.

It must be noted that while additional fertiliser was applied to the overdrilled paddock each year, this was necessary to replace nutrients removed by the additional growth and to assist clover establishment on this relatively low fertility soil. Costs were more than offset by the additional production.

The benefits noted by the farmer from overdrilling using banded herbicide application, compared with his previous experience with conventional cultivation were reduced cost, reduced time for the establishment operation, reduced delay until first and subsequent grazings, improved stock trafficability during the first year, and less

thistle infestation (which may have been partly an indirect function of the more intensive grazing management).

TABLE 1: Assessment of Pasture Production on the Basis of Stock Unit Grazing Days per Hectare.

Number of stock	Stock class	S.U. equiv.[1]	Grazing days	S.U.G.D./ha
Control (4.5/ha)				
1350	m/a ewes	1.0	2 (May)	600
1350	m/a ewes	1.0	2 (July)	300
68	Ewes + lambs	2.5	57 (Aug-Oct)	2153
			Total	3053
Overdrilled (2.5 ha)				
86	Store lambs	0.7	38 (May-June)	915
450	m/a ewes	1.0	2 (June)	360
1250	m/a ewes	1.0	5 (August)	2500
6	Cows & Calves	7.0	13 (September)	218
43	m/a ewes	1.0	12 (October)	516
			Total	4209

[1] Source: C.W. Holmes, Depart. An. Sc., Massey University.

Farm Trial 2

The Taranaki maize crop yielded 20,800 kg DM/ha, of which approximately 50% was greenfed off-site during the autumn and the balance was ensiled and fed in early spring at a total cost of 1.5 c/kg DM in the field and 3.0 c/kg DM ensiled or green-fed (compared with 6.5 c/kg DM for hay). Grass re-establishment in both the maize stubble and the sprayed pasture was successful, although somewhat slow due to dry autumn conditions. The beneficial microenvironment provided by the inverted T seed slot was clearly illustrated as when the volcanic soil became extremely dry during the drought in autumn 1985, little if any observable seed or seedling mortality occurred. After the drought was broken, insect damage was observed in the maize stubble in areas of heavy stova accumulation from incomplete harvesting.

All new grass paddocks were grazed with milking cows followed by heifers during late July and early August (16- 18 weeks from drilling). Growth rate of the new species after grazing was observed to be substantially greater than control paddocks particularly the winter and early spring growth of Moata ryegrass.

Little quantitative data are available at this early stage but monitoring of the performance of individual paddocks on a basis of butterfat production and perhaps dry matter yield will be ongoing, as the results have so far exceeded farmer expectation and he has elected to continue the system for several years or until his farm has been completely renovated.

Farm Trial 3

All species, with the exception of Roa tall fescue, were successfully established (Table 2).

Ryegrass established rapidly in these plots in the first winter and early spring period. However, once established, Wana cocksfoot and Pawera red clover performed better than the other species over the first year. Performance analyses continue with the object of assessing the relative contributions and persistance of each species in the longer term.

TABLE 2: Dry Matter Production for First Year from Drilling.

Species	Dry matter (kg/ha)	Index
Control	12912	100
Wana Cocksfoot	13808	107
Nui Ryegrass	13310	103
Pawera Red Clover	14157	110
Ellet Ryegrass	13331	103
Roa Tall Fescue	12980	100

CONCLUSIONS

From the results of these three selected farm trials, together with observations from other situations encountered in the field drilling programme, the following conclusions and observations seem appropriate:

1. With banded herbicide application there is greater dependancy on intensive and controlled grazing management for successful establishment of the new species, than with blanket herbicide applications.
2. Banded herbicide application in highly competitive swards, e.g. kikuyu, and perhaps browntop, if fertility levels are not simultaneously improved, is likely to be ineffective.
3. High producing crops, such as maize, can be successfully grown using direct drilling. Such crops can be used as a means of off-setting a temporary loss in pasture production in the autumn during pasture renewal where blanket herbicide application is appropriate.
4. Consistency of depth of seed placement, particularly in heavy soil types, is important for the successful establishment of clovers, and to a lesser extent, grasses; and should be in the range of 10-20mm.
5. Attention to the shape of the drilled slot is essential, particularly in drying soil conditions, with an inverted T shape showing consistently greater tolerance to climatic and soil changes than any other shapes so far encountered.
6. Seeding rates, in the use of ryegrass/clover mixes, should seldom need to exceed a total of 15 kg/ha providing that seed viability and the seed microenvironment as affected by the drilling technique are of high standards.

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