
RESPONSE OF SOME RYEGRASS CULTIVARS TO OVERDRILLING IN SOUTHLAND

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Abstract

A series of experiments investigating the response of several pasture grasses direct drilled into existing swards is reported. The technique has relevance to pasture renovation, improvement of winter forage production, and more rapid introduction into farming of improved pasture cultivars. Improvements in coulter design and use of pasture desiccants were coupled with direct drilling to assist plant establishment. It appeared that aggressive cultivars such as Nui and Tama ryegrasses were best suited to establishment by these techniques, and that lower seeding rates than those normally recommended were very successful. Methods of improving winter herbage production by using winter-active ryegrass cultivars without the need to resow to pasture in the following spring are discussed.

INTRODUCTION

ALTHOUGH the low-cost system of all-grass farming is making considerable impact in Southland (Halford, 1972), concern has been expressed that opportunity to introduce newly bred, agronomically superior pasture species has been severely restricted on farms using the technique. Even under the system where 8 to 10 years of pasture is followed by 1 to 2 years of brassica, it would take considerable time before an improved cultivar was a component of a large proportion of a pasture.

With direct drilling, new pasture cultivars can be introduced with only a fraction of the grazing time lost that occurs 'with cultivation. Direct drilling is successful in Southland's soils and climate (Hay and Ryan, 1977a, b). This is supported by the fact that in the 10 years to 1977-8 the area direct drilled to pastures and winter crops has risen from nil to 10,000 ha. The technique is thought to be particularly effective where direct drilling is within a rotational grazing sequence, as the introduced plants can be allowed time to establish without adversely affecting the remainder of the farm.

A series of trials was laid down to investigate the establishment and subsequent performance of a range of improved pasture

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species introduced by direct drilling. In addition, factors with potential to move the environmental parameters in favour of the establishing seedling such as band spraying with selective herbicides, and improved coulter design, were examined.

It is not the purpose of this paper to discuss the advantages and disadvantages of direct drilling, but to give a preliminary report of our findings on some of the plant responses to methods and techniques of overdrilling grasses into existing swards.

EXPERIMENTAL AND RESULTS

A series of experiments was carried out on the Grasslands Division regional station at Gore. This is sited on Waimumu silt loam, a B-gleyed yellow-grey earth (J. G. Bruce, pers. comm.) , with an average rainfall of 825 mm per annum. Unless otherwise stated, the drill used was a 16-coulter Duncan "730 Multiseeder" equipped with triple-disc coulters. Germination and establishment data were obtained by counting live plants per metre row at 10 positions chosen at random within each plot. Dry matter (DM) production measurements were taken immediately before grazing by cutting four 0.24 m² quadrats per plot with hand shears at the height to which it was to be grazed.

GRASS CULTIVAR AND COULTER TYPE

This trial was designed to demonstrate the relevance of direct drilling to renovation of pasture in a highly stocked farming system. A secondary aim was to evaluate a newly developed chisel-tipped coulter by comparing plant establishment from seed introduced by it with that introduced by disc coulters.

To achieve these objectives, four paddocks within two self-contained farmlet systems described by Harris and Hickey (1977) were treated with paraquat and overdrilled. These paddocks had been used as winter hay feeding platforms for hoggets throughout most of the winter. The pastures had been hard grazed and were heavily trodden. They contained high populations of *Poa annua*, browntop and broad-leaf weeds, and large areas of bare ground, but had a good clover base.

Immediately after treatment with paraquat at 1.5 l/ha, the paddocks were direct drilled on 17 September 1973 with 'Grasslands Ruanui' or 'Grasslands Nui' perennial ryegrasses (*Lolium perenne* L.) . Each of these cultivars was sown at rates to give the same number of viable seeds as contained in 8 and 15 kg/ha Ruanui. Each plot was one drill width and ran the 40-m length of each paddock. An unsprayed area in each paddock was not

overdrilled, giving a resident pasture control. Six adjacent coulters of the 16 were removed from the drill and replaced with experimental chisel coulters which had torpedo-shaped tips. These were forerunners of the "Baker tip" described by Baker (1976a, b). Plots were not fenced from each other at grazing. After an initial establishment period of 6 weeks, overdrilled paddocks were grazed and then took their place in the rotation on each unit.

Plant numbers and DM production data are presented from this experiment. As seeding rate differences were not significant, only main effects of coulters type and grass cultivar, and the coulters \times cultivar interaction, are presented in Table 1.

TABLE 1: PERCENTAGE ESTABLISHMENT* OF TWO GRASSES INTRODUCED BY TWO METHODS INTO EXISTING SWARDS

	Sampled at							
	21 days				42 days			
	Ruanui	Nui	LSD	5%	Ruanui	Nui	LSD	5%
Coulter type:								
Chisel	37.0	60.3			37.5	56.9		
Disc	37.8	70.8	6.3		40.8	58.8	6.7	
Var. mean	37.4	65.5	7.6		39.1	57.9	4.4	
Coulter mean	Chisel Disc				Chisel Disc			
	48.7	54.3	4.5		47.2	49.2	4.8	

*Plant numbers expressed as a % of viable seeds sown.

Coulter type had no effect on the establishment of Ruanui.

Percentage establishment of Nui after 21 days showed a significant advantage in favour of the disc coulters, but this advantage over the chisel coulters had disappeared at the 42-day sampling. Nui had a significantly higher field germination than Ruanui at each sampling date. Nui had higher field germination at 21 days from disc coulters introduction than from the chisel coulters, but this difference had disappeared at the 42-day sampling because of an apparently greater loss of Nui seedlings from introduction with disc coulters.

Plots overdrilled with Nui produced 10% more annual total DM than Ruanui and the control plots as shown in Table 2. Contribution of the sown ryegrass was 2200 kg higher at the 8 kg/ha sowing rate and 1300 kg higher at the 15 kg/ha sowing rate for Nui compared with Ruanui. The lower seeding rate of Nui gave significantly higher ryegrass yields over both Ruanui rates and control.

TABLE 2: MEAN ANNUAL* AND SOWN GRASS YIELDS OF TWO RYEGRASSES AT TWO SEEDING RATES (kg DM/ha)

Variety	Sowing Rate	Total Herbage	Ryegrass
Control	0	11600	6600
Ruanui	8	11 600	6900
Ruanui	15	11350	7200
Nui	8	12 750	9100
Nui	15	12 650	8500
LSD 5%		1 500	1650

*Two years' results.

UNDERSOWING OF NUI

The aim was to provide increased high quality late-autumn/early-spring feed, and leave the pasture with a perennial species of superior agronomic value than that originally present.

Regrowth, from a previously hard-grazed pasture containing 30% ryegrass, 3% white clover, and 67% of weed grasses such as browntop (*Agrostis tenuis*), crested dogstail (*Cynosurus cristatus*), *Poa annua*, and sweet vernal (*Anthoxanthum odoratum*), was sprayed with paraquat at 2.5 l/ha on 28 February 1974. Areas to be used as control plots were not sprayed. On 1 March 1974, 20 m X 4 m plots within the sprayed area were overdrilled with one of the following: 'Grasslands Tama' Westerwolds ryegrass (*Lolium multiflorum* Lam.), 'Grasslands Paroa' Italian ryegrass (*L. multiflorum* Lam.), Rahu ryecorn (*Secale cereale* L.) and Mapua oats (*Avena sativa* L.). To remove the necessity of re-sowing in spring to perennial pasture after winter annual greenfeeds (Hay and Ryan, 1977b), Nui, which was shown by Harris *et al.* (1977) to be the most productive perennial ryegrass in this environment, was cross-drilled in each plot, including the unsprayed control plot, at 15 kg/ha. Sowing rate of the winter greenfeeds was adjusted to give the equivalent seed number to 20 kg/ha Tama.

The trial contained four replicates and was grazed with a mixed-age wether flock within 48 hours of sampling for herbage yield.

The management system initially was designed to utilize the greenfeeds as soon as possible in the spring and allow the establishing permanent pasture to develop without further competition from the cover crops. The greenfeeds received three winter grazings (20 May, 21 August, and 23 September). After the September grazing when the cereal crops had almost disappeared (< 10 tillers/m² for Rahu ryecorn and Amuri oats), the area was closed

for conservation and on 6 November silage was cut. The regrowth was grazed 2 weeks later, and subsequently when it attained a height of 15 cm.

The results of this experiment are expressed in two stages: (1) Establishment and survival of Nui under various greenfeeds from sowing to the silage cut are shown in Table 3.

TABLE 3: MEAN ESTABLISHMENT YIELD OF NUI SOWN WITH FOUR GREENFEEDS (kg/ha)

	<i>Rahu</i>	<i>Tama</i>	<i>Paroa</i>	<i>Amuri</i>	<i>Overdrilled</i>	<i>LSD 5%</i>
					<i>Pasture</i>	
Nui ryegrass	3440	1840	2270	3370	5850*	990

*Total ryegrass component of the sward including overdrilled Nui and resident ryegrasses.

Nui established satisfactorily under the winter-active cover crops, although there was a significant negative correlation between greenfeed yield and Nui yield ($r = 0.79$). Relative yields, based on the ryegrass component of the overdrilled pasture as 100, were: Nui with either *Rahu* or *Amuri*, 59; *Tama*, 31; and *Paroa*, 39. The winter-active ryegrasses, *Tama* and *Paroa*, exerted the greatest suppression ($P < 0.05$) on Nui ryegrass yields.

(2) Development of the Nui swards was measured over two subsequent summer-autumn periods from November to May inclusive, and production is shown in Table 4.

TABLE 4: SUBSEQUENT SUMMER-AUTUMN HERBAGE PRODUCTION OF UNDERSOWN NUI SOWN IN 1974 WITH FOUR GREENFEEDS (kg/ha)

<i>Winter Greenfeeds</i>	<i>1974-5</i>		<i>1975-6</i>	
	<i>Total</i>	<i>Nui</i>	<i>Total</i>	<i>Nui</i>
<i>Rahu</i>	9170	6500	8870	6980
<i>Amuri</i>	8800	6050	8830	6930
<i>Tama</i>	8440	3210	9270	7030
<i>Paroa</i>	8770	3290	8670	3980
Permanent Pasture	8930	6570*	8610	6340*
<i>LSD 5%</i>	790	1020	870	1180

*Total ryegrass component of the overdrilled swards including Nui and resident ryegrasses.

There were no significant differences in total summer-autumn yield in either year from the undersown Nui compared with the overdrilled permanent pasture. Effects of *Tama* and *Paroa* carried over into the first summer-autumn period and still suppressed Nui,

which contributed 37% of the total, whereas Nui under-sown with the cereals contributed 70% of the total. In the second year Tama had disappeared and allowed Nui to produce yields comparable with those from the Amuri and Rahu swards. Nui contribution to the total yield under Tama was 76%, and under either Rahu or Amuri, 78%. However, the effect of Paroa on Nui was still evident in the second year, when Nui contributed 45% and Paroa 35% of the total yield.

BAND SPRAY TECHNIQUE

A further trial was established with winter greenfeeds. It investigated band spraying with drilling. Spray nozzles were mounted directly in front of the coulters and paraquat at 2.5 l/ha was applied to kill a 4 to 5 cm strip of pasture into which the seed was drilled. The technique was designed to obviate the need for killing all resident pasture and to leave a sward in spring when the winter annual had disappeared. This trial was drilled on 16 February 1977 with a 12-coulter drill fitted with "Baker chisel tips". Three winter-active ryegrasses were used: Tama, Paroa, and 'Grasslands 4709' tetraploid Italian ryegrass (*L. multiflorum* Lam.). Measurements were taken under grazing and the experiment was replicated four times.

Table 5 gives establishment data at 14 days for the three winter-active ryegrass species introduced after blanket spraying, band spraying, or direct drilling without herbicide.

TABLE 5: PLANT COUNTS OF THREE RYEGRASSES 14 DAYS AFTER DRILLING WITH THREE METHODS OF HERBICIDE APPLICATION. (Main effects; No. plants/metre row)

<i>Cultivar</i>		<i>Technique</i>	
Tama	56.8	Blanket spray	42.7
Paroa	33.1	Band spray	40.8
4709	31.0	No spray	37.2
LSD 5%	5.1	LSD 5%	n.s.

Larger plant populations of the cultivars tended to be established with blanket spraying than from either band or no spraying. Tama had significantly higher numbers of plants/treatment than either Paroa or 4709. Large apparent differences in DM yield at the first grazing 5 weeks after drilling are shown in Table 6.

The winter-active ryegrasses formed pure swards in the blanket-sprayed treatments, but, as they were starting from seed, did not at this stage yield as highly as the resident pasture from the band

TABLE 6: TOTAL HERBAGE YIELDS FOR THREE RYEGRASSES, FIVE WEEKS AFTER HERBICIDE APPLICATION (DM kg/ha)

Cultivars	Drilling Technique		
	Blanket Spray	Band Spray	No Spray
Tama	257 (100)*	1314 (5)	1305 (5)
Paroa	67 (100)	1272 (3)	1416 (3)
4709	108 (100)	1246 (2)	1492 (3)
LSD 5%		n.s.	
Technique mean	144	1225	1405
LSD 5%		135	

*Percentage sown species in parentheses.

and unsprayed treatments. There was a small depression in total yield where the pasture was band sprayed compared with unsprayed plots. Sown species represented then a very small proportion of total yield in both the band and unsprayed treatments. However, at subsequent grazings this changed, and at a sampling on 3 August sown species were contributing substantially to the total yield (Table 7) in the band-sprayed plots and to a lesser degree in the unsprayed plots.

TABLE 7: TOTAL HERBAGE YIELDS AND % CONTRIBUTION OF SOWN RYEGRASSES TO THE TOTAL YIELD AT SAMPLING ON 3 AUGUST (DM kg/ha)

Cultivar	Drilling Technique		
	Blanket Spray	Band Spray	No Spray
Tama	1528 (95)*	950 (62)	1021 (37)
Paroa	1328 (86)	1015 (43)	930 (25)
4709	1381 (94)	826 (45)	766 (26)
LSD 5%		n.s.	
Technique mean	1413	930	906
LSD- 5%		159	

*Percentage sown species in parentheses.

DISCUSSION

Results from these experiments show that Nui, which gave greater pasture yields than original or drilled Ruanui swards, can be successfully introduced by drilling following use of the appropriate herbicide. The technique of band spraying to introduce the winter-active ryegrasses Tama, Italian, and 4709 proved to be successful. Chisel-tipped coulters appear to offer greater assistance to plant establishment than triple-disc coulters.

It appears that relatively low seeding rates of perennial ryegrasses can be successfully employed when direct drilling. Ruanui

and Nui were drilled at 8 and 15 kg/ha. A higher percentage of viable seeds established at the lower seeding rate, which suggests that at the higher sowing rates there was a higher establishment mortality which may be attributed to competition within the rows. Yields obtained from each cultivar indicate that there is no advantage from increasing the seeding rate above 8 kg/ha. Establishment data from the experiment on direct-drilling Ruanui or Nui into existing swards indicate that Ruanui was not as suited to this method of introduction as the more vigorous Nui. Nui suffered a large seedling mortality with the triple-disc coulters but still had greater plant numbers than Ruanui.

The obvious savings which can be made by sowing permanent pasture with a nutritious greenfeed, and the benefits of increased autumn and winter production, have led many researchers to investigate the effect of cover crops on pasture establishment. Brougham (1955) has demonstrated the detrimental effect of barley (*Hordeum sativum*) as a cover crop on pasture establishment from autumn sowing, and points to the effect on ryegrass as being most severe. In this environment Harris *et al.* (1973) have shown detrimental effects of rape on pasture establishment when spring sown, with the effect increasing with seeding rate of the cover crop and being most marked on ryegrass because of its dominance in the establishing sward. Our work has demonstrated that Nui ryegrass is severely affected when sown under the biennial ryegrass Paroa, less so under Tama, and most successful with Rahu ryecorn and Amuri oats. It is thought that this is due to the cereals "disappearing" quickly in the spring under grazing. Our data (not published here) show that a reasonable proportion of white clover is retained from this technique of treating with paraquat and direct drilling.

Three winter-active ryegrasses established similarly under the technique of band spraying and blanket spraying, with the obvious advantage of autumn growth from the resident pastures being retained in the band-sprayed treatments. This technique would enable farmers to use their better pastures rather than deteriorated swards to introduce special purpose cultivars while retaining the original components of the existing pastures.

The mode of action and the shape of the groove from the triple-disc and chisel coulters had a large effect on the numbers of plants established. The triple-disc coulters left a V-shaped groove, compacted at the bottom. Introduced seeds had little soil cover, and exposure to weather was probably responsible for desiccation early in the life of the seedlings. The groove from the experimental

hollow chisel coulter was roughly the inverse of that from the disc coulters.

The most recent chisel coulter has small horizontal sub-surface wings, and these coulters have given a reasonable establishment even in unsprayed treatments. This has never been achieved by using triple-disc coulters and is thought to be due to the root-pruning effect of the tip in the zone of the establishing seedlings removing competition from resident pasture. Coupled with band spraying, this coulter would greatly enhance plant establishment in existing swards by direct drilling. It would enable farmers to manipulate pasture production by introducing superior growing species to increase winter and summer production which would allow an increase in stock carrying capacity and improve the quality of conserved feed.

The experiments reported have covered a wide field, and although they have demonstrated that overdrilling is a valuable technique, further investigations into cheap and efficient methods of establishing improved pasture and winter greenfeed species are needed, as well as detailed evaluations of the plant response to the establishment methods.

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