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Renovating paspalum pastures by direct drilling ryegrass – is it worthwhile?

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Abstract

A 5-year experiment at Ruakura Agricultural Centre measured the effects of blanket application of glyphosate herbicide and direct drilling of perennial ryegrass and white clover on seasonal pasture composition and production. Plots were sprayed in autumn 1985 with 6, 4, 2 and 0 l/ha of glyphosate before direct drilling with a mixture of 'Ellett' ryegrass and 'Grasslands Kopu' white clover. These treatments were compared with plots of the original paspalum pasture which was not sprayed or drilled. Plots were arranged at random in 6 replicate blocks that were rotationally grazed by dairy cows. Applying high rates (4-6 l/ha) of glyphosate completely eliminated paspalum from the pasture and subsequently, treatment differences between the 6 and 4 l/ha treatments for most variables were small. Differences in winter/spring herbage accumulation between the 4 l/ha treatment and the control plots were highest in the first year and declined with time, representing 1.9, 0.8, 0.8, 0.6 and 0.4 t DM/ha, respectively, over the S years of the trial. The declining growth response was paralleled by an increasing level of paspalum in the previously sprayed plots, which exceeded 30% of DM by the fourth summer. Over the same period, their summer ryegrass contents had declined by more than half (46-20% of DM). These results suggest that for this site further renovation using glyphosate (at 4 l/ha) would be beneficial after 4 years to recapture the immediate superior growth responses, and since the costs of renovation could be met within 2 years.

Keywords Paspalum dilitatum, Lolium perenne, seasonal herbage accumulation, renovation methods, glyphosate herbicide, dairy pastures, volunteer paspalum invasion, pasture botanical composition stability

Introduction

In northern New Zealand, volunteer paspalum (*Paspalum dilatatum* Poir.) is common in pastures where perennial ryegrass (*Lolium perenne* L.) has lost vigour or plant numbers have been reduced after stress periods like severe grazing during summer drought and pugging in winter.

When summer-growing paspalum constitutes more than 25% of the herbage mass, potential feed production during winter/spring can be reduced (Thorn *et al.* 1987), with the possibility of reduced cow performance.

Perennial ryegrass is commonly undersown (direct drilled) in autumn during pasture renovation. Paspalum, however, is a persistent rhizomatous species which offers severe competition to undersown ryegrass. This competition can be reduced by blanket herbicide application before drilling (spray/drilling).

This paper provides 5 years of data from an experiment which measured the effects of blanket application of glyphosate (Roundup®) herbicide and direct drilling of perennial ryegrass and white clover on seasonal pasture composition and production. Thorn (1988) presented a preliminary report on the first 2 years of this experiment. This experiment provided a unique opportunity to monitor the long-term stability of a ryegrass pasture established on a site previously dominated by volunteer paspalum.

Materials and methods

site

The experiment was conducted at the Ruakura Agricultural Centre on 6 adjacent 0.25 ha paddocks covering well-drained Bruntwood silt loam and imperfectly drained Te Kowhai silt loam soils. Further details of regional climate, fertiliser inputs and pre-study pasture composition are given in Thorn (1988).

Experimental design and treatments

The treatments wereoriginalpasture and blanket spraying with 0, 2, 4 and 6 1 of glyphosate in 200 1 water/ha. Sprayed plots were direct drilled on 21 March 1985 with a mixture of high endophyte 'Ellett' ryegrass (18 kg/ha) and 'Grasslands Kopu' whiteclover (3 kg/ha). Details of the establishment methods are given in Thorn (1988). Treatment plots were arranged in a randomised block design with 6 replications.

The experiment began with the spraying of the plots on 12 March 1985 and concluded in June 1990. During the experiment the plots were grazed by dairy cows on 51 occasions, the first 47 days after drilling. Average stocking densities were 160 cows/ha for 6 hours of grazing. Averagepre- and post-grazing herbage masses were 2.9-3.0 t DM/ha and 1.6-1.7 t DM/ha, respectively.

Sward measurements

Standard methods were used for botanical composition and tiller density measurements (Thorn 1988). Seasonal growth rates and yields were calculated from visual estimates ofherbagemass made ateach grazing. Seasonal yields were obtained by summing growth differences betweenpost-grazingestimatesandthenextpre-grazing estimates for winter/spring (May-October) and summer/ autumn (November-April).

Results

For many variables, treatment differences between the 6 and 4 I/ha treatments were small and non-significant. Comparisons are therefore often presented for only the 4 l/ha (now the label rate for paspalum control with glyphosate), the 2 l/ha, the undersown treatment plots (0 l/ha) and the control plots (original pasture).

Paspalum status

The paspalum content of pastures before herbicide application in March 1985 was similar for all treatment plots, averaging 38% of DM. Paspalum was reduced to a low level in the plots receiving a low rate of herbicide and was completely eliminated where high herbicide rates were applied (4-6 l/ha) (Table 1). Peak paspalum levels occurred in summer/autumn (January-April). Paspalum content of sprayed pastures progressively increased during the experiment and by January 1989 had exceeded 30% of DM, maintaining similar levels until the end of the experiment.

Tiller density data confirm this trend (Figure 1). During the 2 years after spraying, paspalum tiller densities were lower where high rates (4-6 l/ha) of glyphosate wereused, but by February 1987 differences betweenthehighandlow (2 l/ha) herbicide rate treatments had become small and non-significant. During the last 2 years of the trial, paspalum tiller density did not differ among treatments. Tiller density in the 6, 4 and 2 l/ha treatment plots was highest in June 1990, averaging 897 paspalum tillers/m* compared with 787 for undersown and control plots.

Table 1 Changes in the paspalum content (% of DM) of pastures during the experiment.

Date	Treatment				
	4 l/ha	2 l/ha	0 l/ha	Control	LSD[a]
30 April 1985	0	2	13	10	3.9
28 February 1986	4	4	27	44	9.9
12 January 1987	14	22	30	47	9.3
7 January 1988	12	12	20	18	10.0
31 January 1989	35	47	58	34	10.7
3 April 1990	27	31	23	34	14.9

[a] LSD = least significant difference. P<0.05

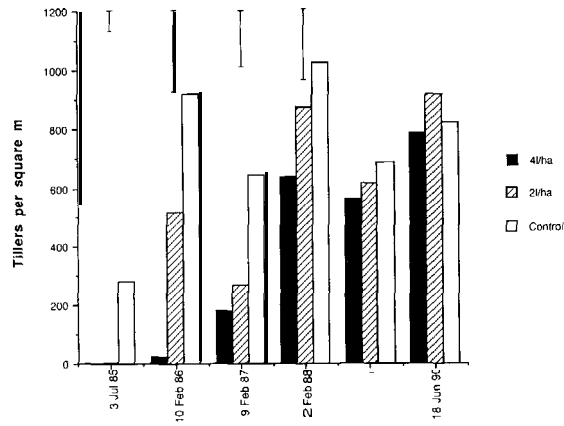

Figure 1 Paspalum tiller density (tillers&*) in pastures over a 5 year period following spraying with glyphosate in March 1985. Vertical lines are LSD (P<0.05) levels.

Ryegrass status

A similar ryegrass content existed in all treatment plots in March 1985 (averaging 29% of DM) before herbicide application. Sprayed plots contained more ryegrass in summer than did control plots in 1986.1987 and 1988, but differences were small and non-significant in the last year (Table 2). During 1989 and 1990, ryegrass content during summer/autumn was less than March 1985 levels (averaging 20% of DM). Ryegrass levels in undersown plots were intermediate between plots receiving 2 l/ha of glyphosate and the control plots.

Table 2 **Changes in the ryegrass content (% of DM) of pastures during the experiment.**

Date	Treatment				
	4 l/ha	2 l/ha	0 l/ha	Control	LSD[a]
30 April 1985	41	38	47	42	14.0
28 February 1986	48	44	29	15	9.8
12 January 1987	37	24	20	15	11.5
7 January 1966	32	33	31	28	9.0
31 January 1989	21	17	14	19	6.7
3 April 1990	23	20	25	20	9.2

[a] LSD = least significant difference, P<0.05

Other pasture components

The white clover content of the pastures were not affected by treatments, apart from immediately after herbicide application (see Thorn 1988). andranged from 18-40% of DM, depending on season. Dead material was the other major component of the pasture which, apart from the effects of herbicide application in autumn 1985 (see Thorn 1988), ranged from 20-30% of DM in summer/autumn and 2-12% of DM in winter/spring. Weeds and other grasses were usually less than 10% of DM.

Seasonal yields

Pasture herbage accumulation from drilling until the first grazing (21 March-6 May 1985) was on average lower for the sprayed (-1.1 t DM/ha) than for undersown and control plots (1.0 t DM/ha), reflecting the effects of the herbicide on plant death and loss of dry matter. Accumulationduring winter/spring in sprayed plots was greater than in unsprayed plots from 1985 until 1988 (Table 3), but treatment differencesbccameprogressively smaller as the pasture aged (Figure 2). Undersowing produced much smaller but consistent advantages over the control, than did the plots sprayed before drilling.

There was a tendency for unsprayed plots to accumulate more dry matter over summer/autumn than did sprayed plots, but differences were usually small and non-significant. Summer/autumnherbage accumulations ranged from 8-13.6 t DM/ha over the trial period.

Table 3 Herbage yields (t DM/ha) over consecutive cool seasons.

Period	Treatment				
	4 l/ha	2 l/ha	0 l/ha	Control	LSD[a]
8.5.85 - 7.10.85	6.2	5.7	4.8	4.3	0.75
29.5.86 - 28.10.86	4.2	4.1	3.6	3.4	0.48
30.4.87 - 8.10.87	4.1	4.0	3.7	3.3	0.54
22.4.88 - 5.10.88	4.2	4.2	3.8	3.6	0.52
26.5.89 - 9.10.89	3.9	3.6	3.6	3.5	0.27

[a] LSD = least significant difference, P<0.05

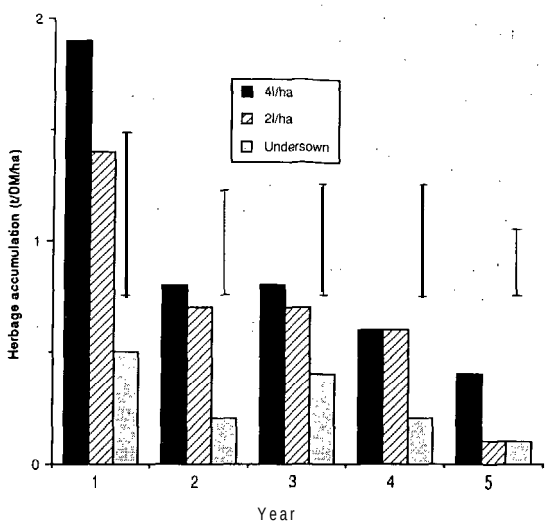

Figure2 Extraherbageaccumulation during winter/spring (t DM/ha) on treatment plots compared to the controls (original pasture) over a S-year period. Vertical lines are LSD (P<0.05) levels.

Cost-benefit analysis

A simple cost-benefit analysis was used to estimate the value of the extra dry matter produced in winter/spring for pastures sprayed before drilling and undersown pastures, when compared with the original pasture (control) (Table 4).

Table 4 Cost-benefit analysis for renovation of paspalum pastures.

	Sprayed (41 /ha)	Undersown
Total extra dry matter produced over 5 years (kg DM/ha)	4500	1400
Assume 85% utilisation (kg DM/ha)	3825	1190
Assume 20 kg DM produces 1 kg milkfat (kg of milkfat)	191	59
Assume 1 kg milkfat Is worth $4 ($)	764	236
Costs ($)	525[a]	100[b]
Net return ($)	239	136
For a 60 ha dairy farm renovating 15% or 9 ha of pasture: Net return ($/farm)	2151	1224

[a] Includes direct costs (seed, herbicide, contract rates for drilling and herbicide application) and indirect cost of loss of autumn grazing equivalent to 2100 kg DM/ha.

[b] Includes direct costs (seed, contract rates for drilling) and assumes indirect costs are small.

Discussion

This trial was designed to demonstrate the extent that major changes in pasture botanical composition brought

about by renovation can persist. The results show that the positive yield effects of herbicide application before drilling were large during the first year but had disappeared by the fourth year, as paspalum once again became the major pasture component exceeding the level of 25% of DM suggested by Thorn *et* al. (1987), when reduced winter/spring growth potential is possible. Visual examination of the pastures after spraying with high rates of glyphosate (4-6 l/ha) suggested complete kill of the resident paspalum. Regeneration from volunteer seed was likely since paspalum contributed about 40% of the pasture dry matter production before spraying.

Dollar returns from spray/drilling are likely to be higher because of the large initial growth response of the new ryegrass plants sown into a relatively competition-free environment compared to when undersown into established plants. This experiment allowed the overall benefits in terms of extra herbage production to be assessed and indicates that at least for this site, renovation every 4 years is appropriate.

Conclusions

Renovation of paspalum pastures is considered worthwhile since the costs of renovation using glyphosate herbicide can be repaid in 2 years, and the costs of undersowing in 1 year. Another renovation of the trial site could have been considered 4 years from drilling in order to recapture the superior gains in winter/spring herbage accumulation that occurred immediately post-drilling.

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